

HawkEye™ for Windows™



USER'S MANUAL

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Due to application upgrades the details contained in this manual are subject to change without notice. Performance Drilling Technology does not assume any responsibility for discrepancies in this manual.

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HawkEye™ for Windows Support Information

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I. GETTING STARTED

1. Purpose of HawkEye™

The idea for HawkEye™ started in 2006 as the 3rd-generation of the successful directional drilling application WinSURV3D™. It is intended to provide directional drilling information to people involved in the workflow of directional drilling within a rich and powerful 3D environment. That workgroup includes directional drilling companies, directional drillers, engineers, geologists and operators.

A DIRECTIONAL DRILLING TOOL

When a workgroup is out drilling a well, HawkEye™ provides a set of powerful tools to meet a variety of goals related to a project. Proper use of the 3D space will allow them to clearly present how they are doing and how far away they are from other wells in a clear and intuitive way. HawkEye's 3D environment expands a person's spatial visualization of a project.

A TOOL FOR EVERYONE: A directional drilling company will often be charged with planning the geometry of the well and HawkEye™ provides powerful tools to allow them to do that very easily.

Drilling engineers use HawkEye™ to keep up with what is going on, to keep track passively and rest assured of the drilling operation without having to spend a lot of time tracking numbers and visualize things off of list.

Geologists can incorporate their seismic and geologic graphic representation as overlays and visually see where the well is in reference to where their targets are.

Generally there is a gap between what geologists understand about certain drilling engineering restraints and what a driller understands about certain offset data. The friction between the two groups is alleviated with HawkEye™ by creating a common visual workspace in which all data is compiled and easily seen. When a geologist's data is compiled alongside the driller's information, the two groups can forge an optimal and efficient drilling operation.

A WELL PLANNING TOOL

HawkEye™ is a first class well planning tool, allowing for the well planning development of a single well or an entire platform or pad. Virtually all types of wells can be planned with HawkEye™, ranging from simple slant wells to complex 3D wells. The well planning version of HawkEye™ supports the direct generation of wall plots, invoking InkScape™ as the primary graphics editor for the file that HawkEye™ generates. InkScape™ is a widely supported vector graphics editor which specializes in support of the SVG (Scaled Vector Graphics) file standard.

HawkEye™ well planning is template driven. Customized planning templates can be easily created, as can customized plot templates. Once created, these templates can be used to greatly increase productivity.

Included with the Well Planning version of HawkEye™ is a Torque and Drag module. This module allows one to predict the torque and drag characteristics of a given well profile as a function of the variables affect torque and drag. It is easy to use.

THE TWO VERSIONS OF HAWKEYE™

AVAILABLE FUNCTIONS	FIELD	PLANNING
3d Rendered Graphics	✓	✓
Command Line Interface	✓	✓
Advanced 3d Projection Tools	✓	✓
Advanced Geodetics/Magnetics	✓	✓
Integrated Lease/Hard Lines	✓	✓
Lithology Display/Editing	✓	✓
Casing - Lithology Integration	✓	✓
Advanced Proximity	✓	✓
ISCWSA Error Modeling	✓	✓
Winsurv2 Daily/BHA Reporting	✓	✓
Winsurv2 Hydraulics	✓	✓
Excel Survey Reports	✓	✓
Command Line Well Planning	✓	✓
Excel 2010 Scratch Pad*	✓	✓
Large Plot Generation	A3/Ledger	✓
Torque and Drag Program	Optional	✓
Spreadsheet Well Planning		✓
Platform Manager		✓

2. Recommended System Specs

The most important first step in utilizing HawkEye™ is the having the proper equipment. Even the most robust system with maxed out hardware comes to less than half the cost of one copy of HawkEye™. So it makes a lot of sense to get the right equipment.

a. 3D Navigation with Mouse

Certain core aspects of the HawkEye™ interface were designed for optimum 3D navigation with a certain kind of mouse. Although these devices were once “specialty” mice, they can now be acquired at a very reasonable price.

Since the predominant workspace in HawkEye™ is the 3D space, the users find themselves doing a lot of *moving along a curve* in addition to the *zooming* in the plotting modules. It turns out that the art of *zooming* has been perfected in the computer interface world. High-speed scrolling is best done with Logitech’s Hyper-Fast Scrolling or HyperScroll™. This is basically a scroll wheel that is weighted and perfectly balanced so that when you flick it, it will spin continuously for some time. But since its weight is calibrated just right, you can stop the spinning very suddenly with just a touch.

The program in the 3D space requires a frequent number of mouse wheel clicks up and down, and since the standard mouse wheel will actually click at each interval, it becomes an arduous task to navigate up and down a curve if the wheel does not move continuously.

At least with all of the Logitech™ HyperScroll™ models, the wheel itself can be switched between smooth motion and click motion, so the user is not forced to always use continuous motion scrolling. This may prove useful when trying to conduct a fine-tune zoom or for small iteration movement.



HARDWARE SPEC at a GLANCE

Minimum requirements:

- Windows 7 or later
NOTE: **HawkEye™ runs on both 64-bit and 64-bit Windows, but WinServe™ only on 32-bit Windows. So if you want to use WinSERVE™ on the same machine as HawkEye™ then stick to the 32-bit versions of Windows.**
- 4 GB RAM
- 1366 horizontal resolution
- 1.8 GHz processor
- 80 GB hard drive
- Logitech™ mouse with HyperScroll™ wheel

Recommended specs:

- Windows 8 or Windows 10 any edition
- 8+ GB RAM
- Any quad-core processor
- **1920x1080 resolution**
- 120+ GB hard drive
- **Logitech™ mouse with HyperScroll™ wheel**
- Dedicated video card

Logitech's HyperScroll™ mouse wheel is recommended for navigating the 3D space in HawkEye™. These models are referred to as Anywhere™, MX™ or VX™ models.

b. Keyboard Hotkeys

Hotkey guide

Hotkeys work when cursor is over 3D space...

General	Opening Modules	Look-at Point Navigation
<p>Z Mode Switch</p> <p>Space Toggle Sight on/off</p> <p>, Toggle Directional Compass</p> <p>Tab Recalculate parameter (in number field)</p> <p>Enter Input survey data (in Survey Editor)</p> <p>Del Delete selected data</p> <p>Pg Up Up one survey station</p> <p>Pg Dn Down one survey station</p>	<p>Ins Open Survey Editor</p> <p>Q Open QuickPlot</p> <p>R Open Report Generator</p> <p>J Open Job Info</p> <p>T Open Target List</p> <p>K Open Lease/hardline editor</p> <p>L Open Lithology editor</p> <p>Ctrl+C Toggle Casing</p> <p>Ctrl+N Open Sight editor</p>	<p>G Reset driller's view</p> <p>W/↑ Move towards surface</p> <p>S/↓ Move <u>downhole</u></p> <p>A/← Viewpoint zoom in</p> <p>D/→ Viewpoint zoom out</p> <p>[Increase step</p> <p>] Decrease step</p> <p>Ctrl+ W/↑ Camera up</p> <p>Ctrl+ S/↓ Camera down</p> <p>Ctrl+ A/← Camera left</p> <p>Ctrl+ D/→ Camera right</p>
System/Create	Uncertainty Display	Advanced Uncertainty Display
<p>Alt+S Saves survey data to database</p> <p>Shift+T Create target at selected survey</p>	<p>F2 Turn off Uncertainty Display</p> <p>F3 Toggle ellipsoid</p> <p>F4 Ellipsoid w/ wire</p> <p>F5 Wire cylinder</p> <p>F6 Ellipsoid w/ solid cylinder</p> <p>F7 Ellipsoid w/ wire and solid cylinder</p> <p>F8 All solid cylinders</p> <p>F9 Recalculate error models</p>	<p>Alt+E Toggle ellipse plane</p> <p>Alt+O Toggle offset ellipsoid</p> <p>Alt+P Toggle pedal curve</p> <p>Alt+H Toggle <u>highside</u>-lateral ellipse</p> <p>Alt+X Toggle ellipse axes</p> <p>Alt+V Toggle least distance plane</p> <p>Alt+N Toggle North-East Ellipse</p> <p>Alt+M Toggle ellipsoid</p>

c. Screen Resolution

HawkEye™ requires a certain amount of space on the screen. Dimensions are simply the pixel count across and down a screen. The pixel dimensions of computer monitors and laptops vary widely, from the sparse pixel count of a cheap netbook screen at 1280x768, to the massive 3840x2160 “4k” display. **Although great advances have been made in available quality and pixel counts for computer displays, companies still sell plenty of low-res screens because it is a way to keep their costs down.**

NOTE: Although 1366x768 is billed as “HD,” it is only barely adequate for HawkEye™.



At a minimum to run HawkEye™ without interface crowding issues, the monitor should be at least 1366 pixels across (1366x768).

However, **the recommended horizontal count is 1920 (the resolution is 1920x1080).**

A 1920x1080 screen will greatly enhance all aspects of your work productivity and overall happiness.

Code	Name	Aspect ratio	Width	Height
VGA	Video Graphics Array	4:3	640	480
SVGA	Super Video Graphics Array	4:3	800	600
XGA	eXtended Graphics Array	4:3	1024	768
XGA+	eXtended Graphics Array Plus	4:3	1152	864
WXGA	Widescreen eXtended Graphics Array	5:3	1280	768
WXGA	Widescreen eXtended Graphics Array	8:5 (16:10)	1280	800
SXGA	Super eXtended Graphics Array	4:3	1280	960
SXGA	Super eXtended Graphics Array	5:4	1280	1024
HD	High Definition (Basic)	16:9	1366	768
WSXGA	Widescreen Super eXtended Graphics Array	8:5 (16:10)	1440	900
HD+	High Definition (Plus)	16:9	1600	900
UXGA	Ultra eXtended Graphics Array	4:3	1600	1200
WSXGA+	Widescreen Super eXtended Graphics Array Plus	8:5 (16:10)	1680	1050
HD-1080	Full High Definition	16:9	1920	1080
WUXGA	Widescreen Ultra eXtended Graphics Array	8:5 (16:10)	1920	1200

Refer to this chart to figure out where you stand on screen res.

Set to Maximum Resolution

Regardless of the physical dimensions of your monitor, it is nice to have at least a 1600 pixel horizontal to run HawkEye™.

Checking resolution in Windows XP:

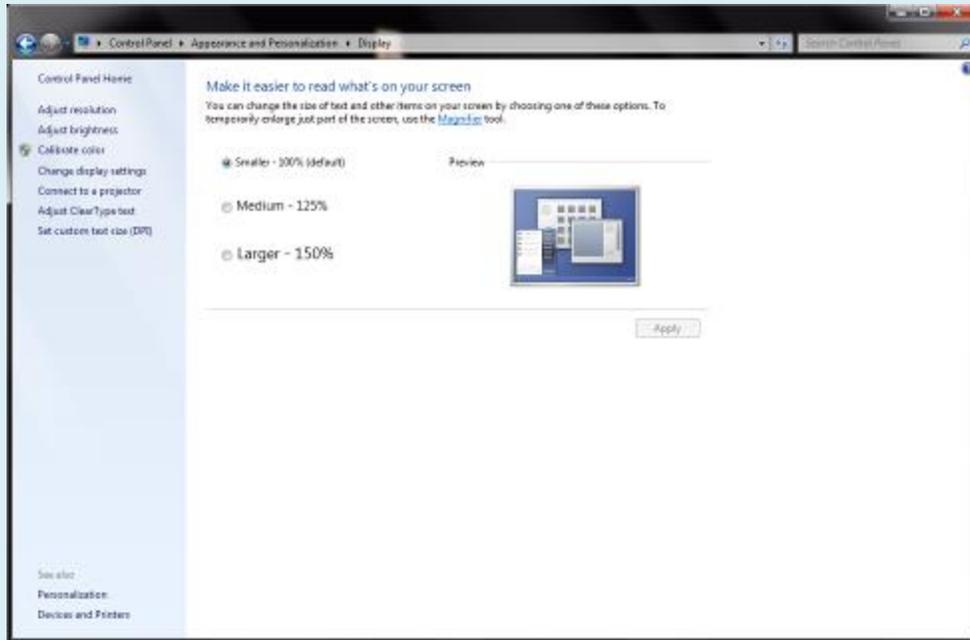
1. Right –click on the desktop.
2. Select “Change Settings”
3. Click on “Display Settings”
4. Move the slider to the maximum resolution.

Checking your resolution in Windows 7/8:

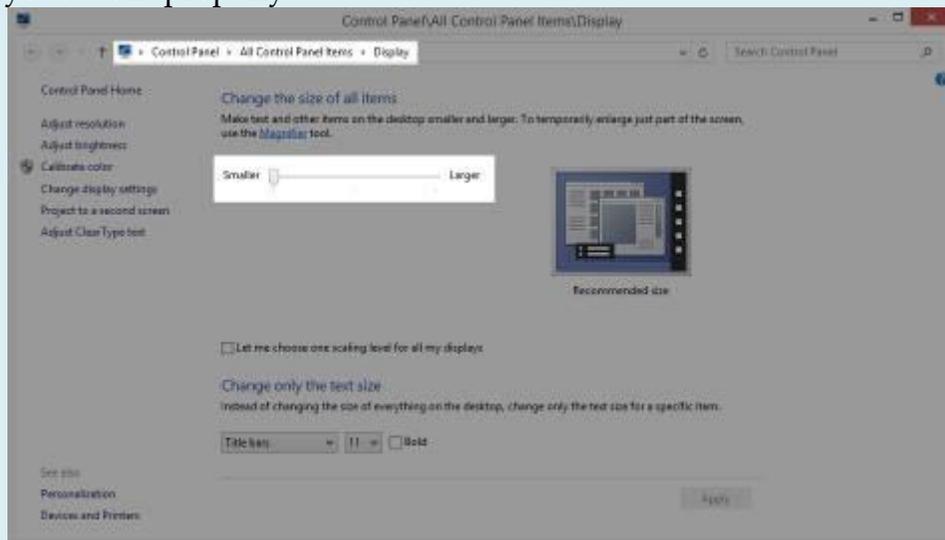
1. Right-click on the desktop.
2. Select “Screen resolution.”
3. Use the Resolution drop-down menu to get to highest res.

Set the Display to “Smaller” or 100%

It is vitally important in Windows 7/8 to set the screen magnification to “Smaller.” To get to that setting, search for “Display” in the Start Menu search bar. (In Windows 8, search for “Display” under “Settings.”) Open up the panel and select “100%.” If it is not already at 100%, you will need to log out and back into Windows.



In late 2014 Microsoft changed the Windows display magnification interface to look like the following. Set the magnification to “Smallest” in order to get HawkEye to work properly.



d. Operating System

Windows Version	Runs WinServe™	Runs WinSURV2™	Runs HawkEye™
XP			
Vista 32-bit			
Vista 64-bit			
7 32-bit			
7 64-bit			
8 32-bit			
8 64-bit			
10 32-bit			
10 64-bit			

e. System and Video Memory

PROCESSOR: Recommended is a quad core processor, but dual core processors are sufficient.

VIDEO CARD: Most important is the dedicated graphics (video) memory. Users don't want to just rely on an integrated graphics board (integrated in the motherboard). This will only be sufficient in higher-end PCs, where the onboard video memory is substantial. The major manufacturers of quality video cards are ATI and Nvidia.

RAM: 8GB of system RAM is highly recommended.

At a Minimum: HawkEye™ will run on a 1.8GHz dual core machine with 4GB RAM, which essentially a mediocre modern notebook. It is preferable to have a screen with at least 1600 horizontal resolution.

3. Installing and Updating HawkEye™

Installation of HawkEye™ is a mostly automated process. There are two ways to install, either by DVD on the local machine or through an internet connection.

Using default installation folder (c:/Hawkeye) is immensely helpful when troubleshooting and keeping track of files upon reinstallation and using HawkEye™ on multiple machines.

INSTALLATION BY DVD

1. Make sure the HASP key is plugged into a USB port.
2. Place the DVD into the DVD drive.
3. Follow all the directions. Install all components as prompted.
4. Several small applications will install. Click through and accept the default settings where applicable:
 - i. Ssrc SVG - This provides support for the Graphics Designer. (This component is not necessary in Windows 8).
 - ii. Inkscape – This is a free Vector graphics program used to edit the Presentation Plots.
 - iii. CUTEPDF Writer – This is a free PDF printer. It is installed so that the user has access to all pages sizes when designing plots.

INSTALLATION VIA INTERNET

1. Make Sure the HASP key is plugged into a USB port.
2. Connect computer to the Internet.
 - a. NOTE: Don't disconnect throughout this installation process. If the connection is severed at any point, you should uninstall the HawkEye™ program completely and start over.
3. With any browser, navigate to hawkeye3d.com and click on "Support." Then click on the Download/Update button.
4. Several small applications will install. Click through and accept the default settings where applicable:
 - a. Ssrc SVG - This provides support for the Graphics Designer. (This component is not necessary in Windows 8).
 - b. Inkscape – This is a free Vector graphics program used to edit the Presentation Plots.
 - c. CUTEPDF Writer – This is a free PDF printer. It is installed so that the user has access to all pages sizes when designing plots.

COMPLETING THE INSTALLATION (DVD and INTERNET¹ INSTALL)

5. Once HawkEye™ is done loading the initial battery of program files, double-click on the desktop shortcut or go Start>HawkEye™. You can also right-click on the HawkEye™ shortcut wherever you find it and select “Pin to Start Menu” to place a shortcut in your Start menu.
6. The program will start up and create a new .hawkeye.mdb file (yes, it’s a double extension) if you are not opening up an existing one. It is placed in the HawkEye folder (default: c:\HawkEye).
7. Close the program. Only at this juncture will HawkEye™ complete its installation process by downloading the remainder of the support files, including GEOGRAPHICAL DATA essential. THIS TAKES A WHILE WITH THE INTERNET CONNECTION.
8. Upon completion of the final volley of downloads, HawkEye™ will be ready for use.

¹ If transfer errors occur at any point in the installation process, the HawkEye™ program will need to be completely uninstalled and the process started from the beginning. This is far less likely to happen with a local DVD installation.

4. See Latest Version Changes, Video Tutorials and User's Manual



Navigate to the Help tab at the top to do the following:

- **Manually checks for updates.** The program automatically checks for updates when launched from the .exe or .exe shortcut. It does NOT automatically check for updates when the program is launched from a .hawkeye.mdb database.
- **Download U.S. Shape Files and Flags Folder:** these are large files and do not automatically install when installing from the server.
- **Show Hotkey Map:** all the keyboard shortcuts in PDF format.
- **Quickstart Guide:** A short summary of all key functions in the program.
- **User's Manual:** Download the latest User's Manual from the HawkEye site.
- **Tutorial Videos:** View tutorial videos posted on YouTube. Internet required
- **About HawkEye™:** Copyright information.



b. Main Screen View Modes

In the top left section of the screen you can find the various viewing options which control the presentation mode for most of the screen. These screens will maximize either of the 2D views, the 3D view, or the default split view.

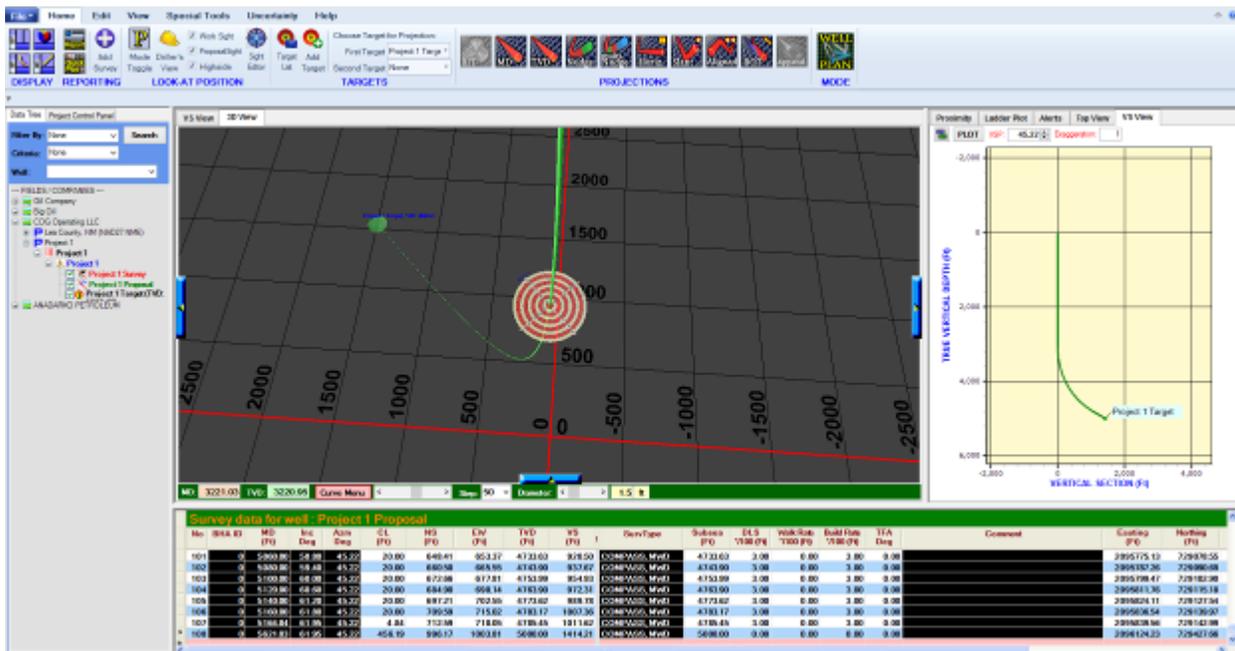
The View Mode buttons on the top left of the main screen will change the view mode to emphasize different data displays: Split, 3D, VS and Top.

1. Split View

The default Split View allows users to have two different views up at the same time, side by side, as well as the Data Tree/Project Control Panel and the Surveys below.

Within the two main windows in the Split View, the user can choose between VS or 3D on the left, and Proximity, Ladder Plot, Alerts, Top or VS View on the right.

In the screen below, the 3D view is selected for the lefthand split panel and the Proximity is selected for the right. This combination is useful in a driller's environment where proximity to other wells needs to be visualized and quantified.



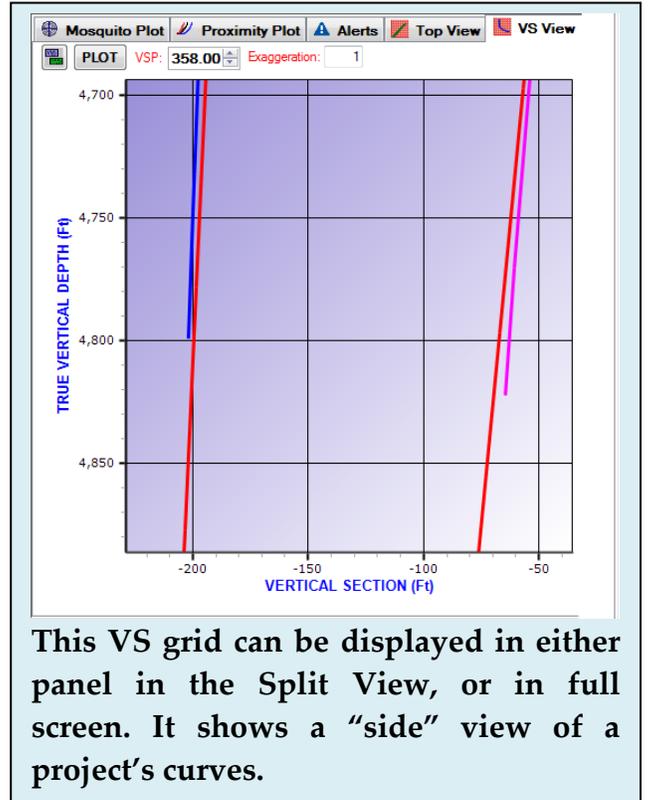
2. 2D View: Vertical Section (VS) View

This is the view that one would have of a well from the side. The view plane is by default 90 degrees from the proposed bottom hole location. The direction which is used to set the Vertical Section Plane (VSP) is the closure direction between the surface location and the end of the well.

Exaggeration decreases the Y-axis interval, which is useful for horizontal wells when trying to better fit the entire well in the graph. The exaggeration is by ratio, so if "1" is 100ft/division, then "2" would be 50ft/division, and "3" would be 33 ft/division.

The icon on the top left  will open the Graphics Properties panel.

The Presentation Plot icon next to it  will open the Presentation Plot module of HawkEye™, with the current Vertical Section view at front and center.



PAN: Holding down the RIGHT mouse button on the 2D window and dragging the cursor around will move the orientation of the grid, allowing the user to navigate along a curve or otherwise change a view perspective along the graph's plane.

ZOOM: Holding down the left mouse button to draw a box onto the graph will zoom the graph into that area. Hold down the right mouse button and scroll the mouse wheel up and down to zoom.

MAXIMIZE VIEW: Double-click on this chart to maximize it to full screen. Then double-click again to return to previous view.

3. 2D View: Top View

Also referred to as a horizontal view, the Top View is as if looking at the well from above, with north oriented to the top.

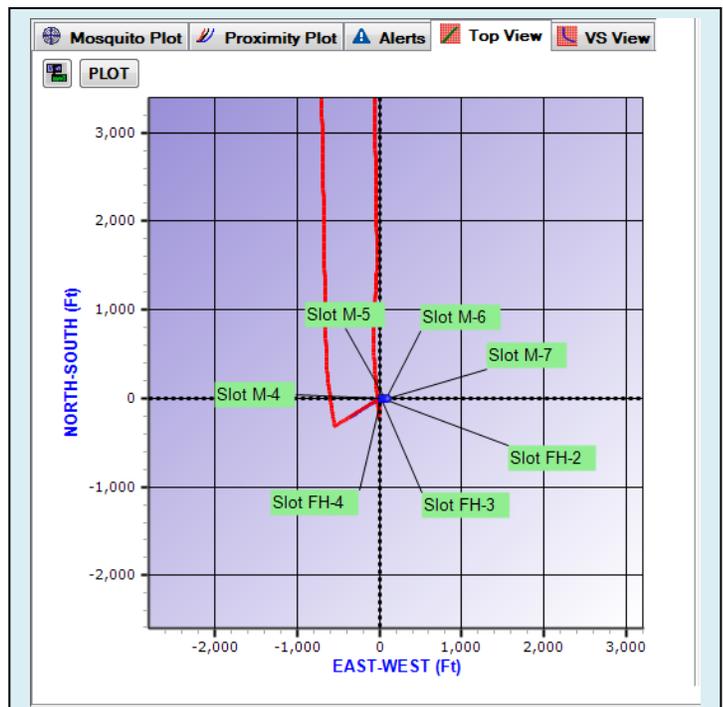
The icon on the top left  will open the Graphics Properties panel.

The Presentation Plot icon next to it  will open the Presentation Plot module of HawkEye™, with the current top view at front and center.

PAN: Holding down the RIGHT mouse button on the 2D window and dragging the cursor around will move the orientation of the grid, allowing the user to navigate along a curve or otherwise change a view perspective along the graph's plane.

ZOOM: Holding down the left mouse button to draw a box onto the graph will zoom the graph into that area. Hold down the right mouse button and scroll the mouse wheel up and down to zoom.

MAXIMIZE VIEW: Double-click on this chart to maximize it to full screen. Then double-click again to return to previous view.



The "Top View" tab available on the right panel in Split View will present a "horizontal view" or bird's-eye view of the well, with north oriented to the top.

4. Proximity

Please see the major subheading on Proximity for the full breakdown, approximately five pages down.

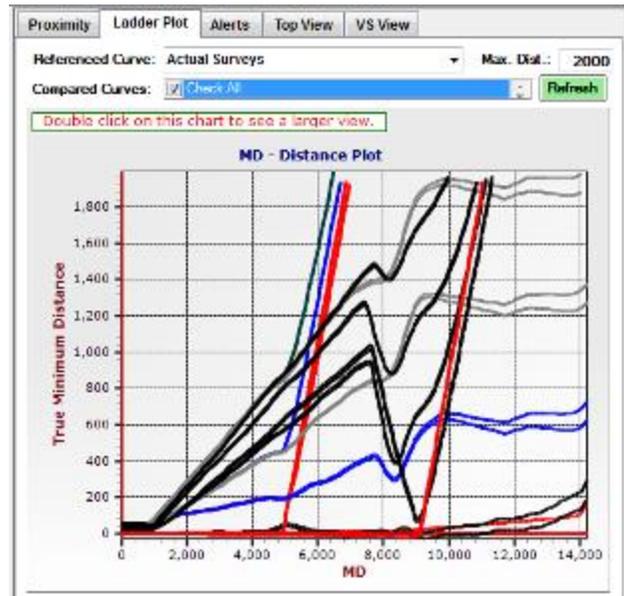
5. Ladder Plot

The Ladder Plot is another way of visualizing the distances between curves. This type of plot is also referred to as an 'MD vs Distance' plot.

The distance of each curve is plotted in the vertical scale as a function of the MD (measured depth).

If the two lines overlap one another that should be interpreted as a potential collision problem.

The advantage of this type of plot is that one can instantly spot problem areas by noting the points at which the curves dip down near the baseline.



REFERENCED CURVE: Select the curve to be the baseline reference with this drop-down menu. The dropdown menu contains all curves in a project.

MAX DISTANCE: This is the observed radius from the reference curve, the distance at which HawkEye™ will stop plotting a curve.

COMPARED CURVES: This drop-down will allow the user to check off each or all the curves to be compared.

REFRESH: Hit this button to recalculate any changes made to the Ladder Plot parameters.

DOUBLE-CLICK TO FULL SCREEN: Double-click on this chart to maximize it and get the color legend that identifies each curve by color.

DOTTED LINES: The dotted lines in a chart represent the outer boundary of uncertainty for a given curve.

6. Alerts

The Alerts tab in the bottom right of the main screen provides a criticality number between 1 and 5, with 5 being the most dangerous, according to certain rulesets that are defined by different companies, in reference to proximity. Center-to-center distance between wells, and ellipses of uncertainty (calculated by ISCWSA error model) are used to calculate proximities.

SAFETY RULESETS are chosen at the start of making a project and can be edited at any time by **RIGHT-CLICKING** on a project in the Data Tree on the left, then selecting “Edit Project” and choosing from the drop-down menu labeled “Safety Ruleset.”

Directional Drillers and drilling engineers should play close attention to Alerts when drilling in a crowded area.



Choose a reference curve under the Alerts tab and get a list of surveys which contain criticalities signifying dangerous proximity to other wells. The criticality figure ranges from 1-5, with the high end representing the most dangerous proximity.

CRITICALITY LEVELS:

Criticality	Comment
1	Nothing to worry about, proceed drilling.
2	Monitor separation factor as drilling proceeds.
3	Caution, continuously monitor Distance both onshore and offshore. Review the action plan for the possibility that the separation factor falls below 1.5.
4	Drilling operations should take swift, positive action to change drilling direction, increase survey accuracy or other actions to increase the separation factor.
5	Stop drilling. You are in a very high risk situation.

The safety ruleset is simply a translation of the separation factor into a number of 1 through 5 in order to simply SF and make it easier to analyze at a glance. There are several different translation tables depending on which company is using the software, but the default safety ruleset covers many project scenarios.

Default Safety Ruleset:

Separation Factor	Criticality
>4	1
<4 to >2.5	2
<2.5 to >1.5	3
<1.5 to >1	4
<1	5

SDI Safety Ruleset:

Separation Factor	Criticality
>2.5	1
>1.5 to <2.5	2
<1.5 to >1.25	3
<1.25 to >1	4
<1	5

ConocoPhillips Safety Ruleset:

Separation Factor	Criticality
>4	1
<4 to >2.5	2
<2.5 or >1.5	3

<1.5 and >1	4
<1	5

Marathon Safety Ruleset:

Separation Factor	Criticality
>1.5 to CC >5	1
>1.5 to CC <5	2
<1.5 to >1.5	3
<1.25 to >1	4
<1	5

Baker Hughes Safety Ruleset:

Separation Factor	Criticality
>1.5	1
<1.5 to >1	4
<1	5

Sperry-Sun Safety Ruleset:

Separation Factor	Criticality
>1.5	1
<1.5 to >1.25	3

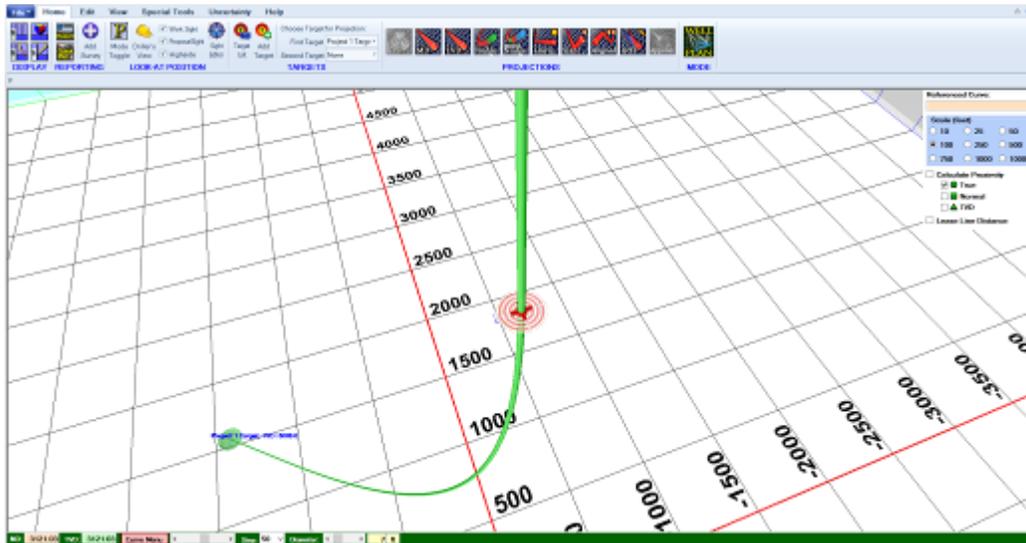
<1.25 to >1	4
<1	5

Schlumberger Safety Ruleset:

Separation Factor	Criticality
>5	1
<5 to >1.5	3
<1.5 to >1	4
<1	5

7. 3D View

This view in HawkEye™ expands the 3D space to occupy most of the lateral real estate of the screen. This is helpful for getting a better overall view a field. You will notice a spatial distortion of the background the further you zoom out, but the curves as represented are not distorted.



Navigation tools in the 3D space are many and powerful, and they are discussed in detail in the next section. But here are a few key mouse-based tools to remember:

FUNCTION	MOUSE CONTROL
Zoom in and out	Hold right button and scroll wheel up and down
Pan	Hold left button and move mouse around
Move slider	Move scroll wheel up and down
Access context menu	Right-click on the object (curve, target, plane or background)

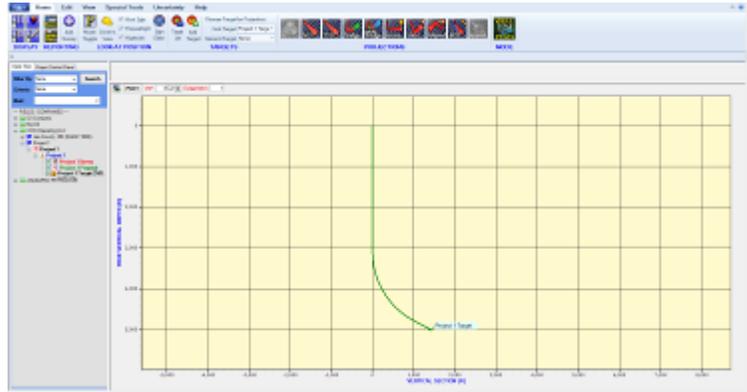
Also don't forget the keyboard hotkeys. See page 11 for the list.

RETURN TO SPLIT VIEW: You can always DOUBLE-CLICK on the 3D space in the Split view to expand the window to full-size.

8. VS View

Clicking on the “VS” icon at the top of the main screen will pull up the Side or “Vertical Section” view onto the main screen, replacing the 3D space and two 2D windows on the right.

This view is normally displayed in the default Split View. It is the view that one would have of a well from the side. The view plane is by default 90 degrees from the proposed bottom hole location. The direction which is used to set the Vertical Section Plane (VSP) is the closure direction between the surface location and the end of the well.



EXAGGERATION decreases the Y-axis interval, which is useful for horizontal wells when trying to better fit the entire well in the graph. The exaggeration is by ratio, so if “1” is 100ft/division, then “2” would be 50ft/division, and “3” would be 33 ft/division.

The icon on the top left  will open the Graphics Properties panel.

The Presentation Plot icon next to it  will open the Presentation Plot module of HawkEye™, with the current side view at front and center.

PAN: Holding down the RIGHT mouse button on the 2D window and dragging the cursor around will move the orientation of the grid, allowing the user to navigate along a curve or otherwise change a view perspective along the graph’s plane.

ZOOM: Holding down the left mouse button to draw a box onto the graph will zoom the graph into that area.

MAXIMIZE VIEW: Double-click on this chart to return to the Split View. Then double-click again to return to previous view.

9. Top View

This mode is an expanded view of the 2D “horizontal view” that is normally seen in the bottom right window when the “Top View” tab is selected. It is a view as if looking from the top down on the well, with north oriented to the top.



The icon on the top left  will open the Graphics Properties panel.

The Presentation Plot icon next to it (“PLOT”) will open the Presentation Plot module of HawkEye™, with the current top view at front and center.

PAN: Holding down the RIGHT mouse button on the 2D window and dragging the cursor around will move the orientation of the grid, allowing the user to navigate along a curve or otherwise change a view perspective along the graph’s plane.

ZOOM: Holding down the left mouse button to draw a box onto the graph will zoom the graph into that area.

MAXIMIZE VIEW: Double-click on this chart to return to the Split View. Then double-click again to return to previous view.

c. Proximity



This plot shows the distance from the reference well (oriented in the center) to the other wells.

CALCULATE PROXIMITY BOX: In order to “turn on” this plot, you have to check the “Calculate Proximity” box. This will activate the relatively resource-consuming calculations. This can also be done by clicking on the blank circle plot itself.

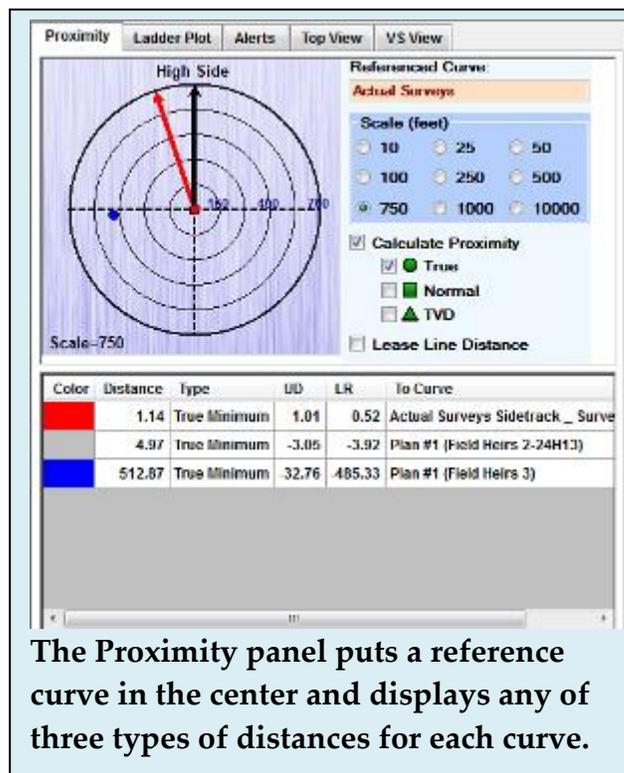
REFERENCED CURVE: This is a display-only box that indicates which curve is the referenced curve that is shown as the center point of the plot. Change the reference curve by changing the current curve selected for the 3D space.

SCALE: Set the radius within which distances between curves is analyzed.

THREE TYPES OF DISTANCES:

TRUE: The closest distance (closest approach) from the reference point to any other well, regardless of what plane it is in. Some references regard this as the “closest spherical distance.” It is important to have this distance type turned on when you are approaching a well, as it is the only tool that can pick up a head on collision with another well.

NORMAL: The plane that the distance is measured on is the plane which is perpendicular to the direction vector where you are currently aimed (current MD, Inc and Azm). This distance is often the most useful when directional drilling; knowing how much to the left or right, or up and down one is determined with this tool. **NOTE: This is the distance type used when adding a UD and RL column to a survey report.**



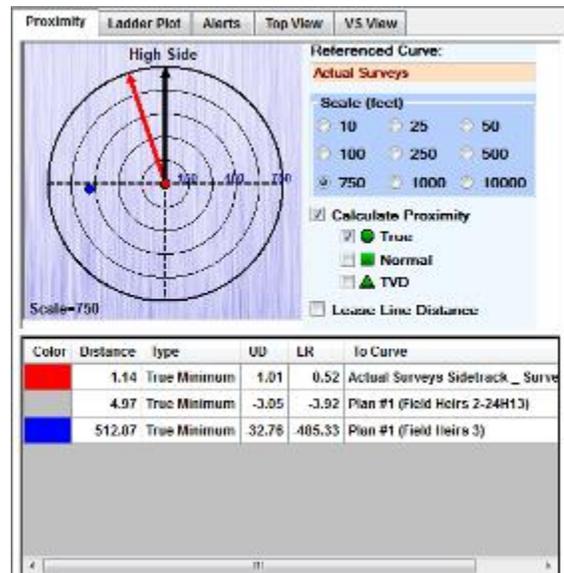
▲ TVD: The distance measured along the horizontal plane at the TVD of the current reference well location. In vertical wells this tool is most useful.

LEASE LINE DISTANCE: Turning this on will measure the distance to any active lease or hard lines. It will display any user-set offset distance to the lease line, as well as the boundary line distance. **The proximity information generated here is displayed in the 3D info field in the upper left corner of the 3D space.** These distances displayed will have an 'O' and a 'B' appended to the end. The 'O' represents the offset boundary from the lease line and the 'B' represents the actual boundary itself. Only the closest boundary point data is displayed.

You can see a thin line in the 3D space connecting the current point with the boundary lines. (To turn on 3D Info, just open the Graphics Properties panel and select the "3D Options" tab, and click the "Show 3d Info" box).

NOTE- North Arrow v. High Side Arrow:

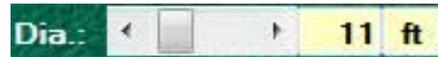
When following along the reference curve, the Proximity plot will stay oriented to north (as indicated by the red arrow pointing up labeled "North"), but when the look-at point reaches an inclination greater than 1.5 degrees, a black highside arrow will appear to indicate the orientation of the plot, and the red north arrow will remain.



NS/EW and UD/LR: If the look-at point along the curve is somewhere under the inclination threshold (set in the Sight Editor on the bottom right of the form), then distances to the curves will be expressed in terms of **North/South** or **East/West** of that curve. When the look-at point reaches an inclination higher than the threshold, then distances are displayed as **Up/Down** and **East/West** of the curve.

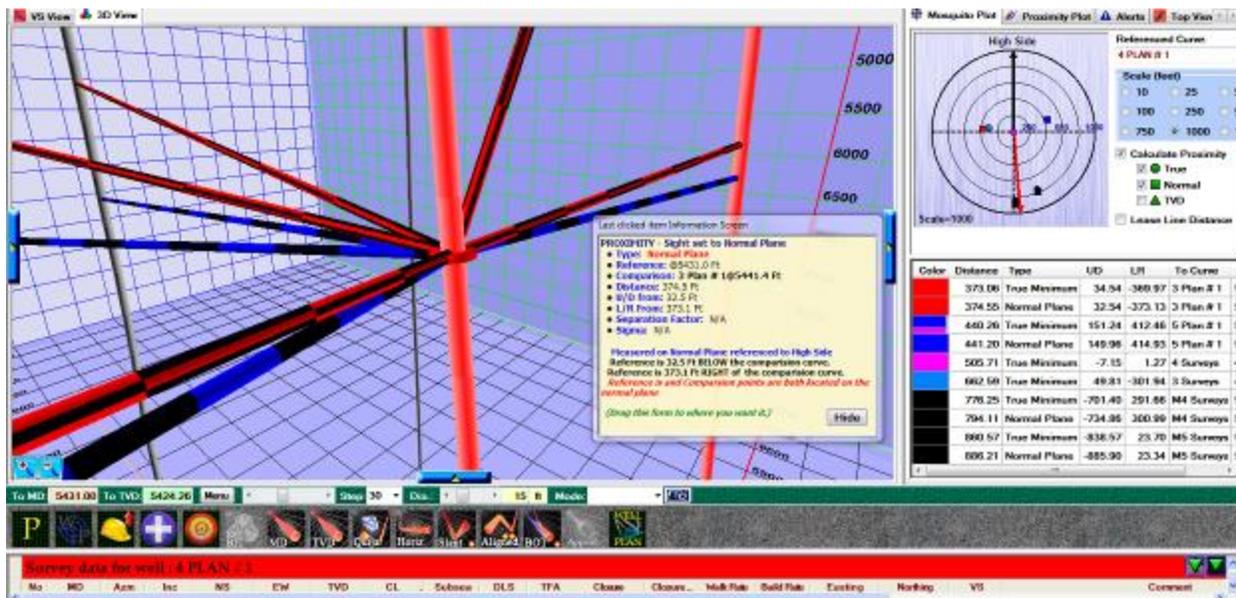
Distance Lines: When "Calculate Proximity" is turned on, distance lines will appear in the 3D space to illustrate the distances calculated in the plot. They are color coded red and black for true distance, Blue and Black for normal distance, and Cyan and Black for TVD distance.

The distance lines will scale to the thickness of the well diameter, which can be set in the little control bar just below the 3D space.



TIP: To get to a specific look-at point for particular proximity analysis, just type in the MD or TVD into the forms then press Tab in the bottom left just below the 3D window.

PROXIMITY INFOCARD: By left-clicking on any of the Distance Lines, an Infocard appears containing all the relevant information of that particular distance calculation from that particular point to the other well.

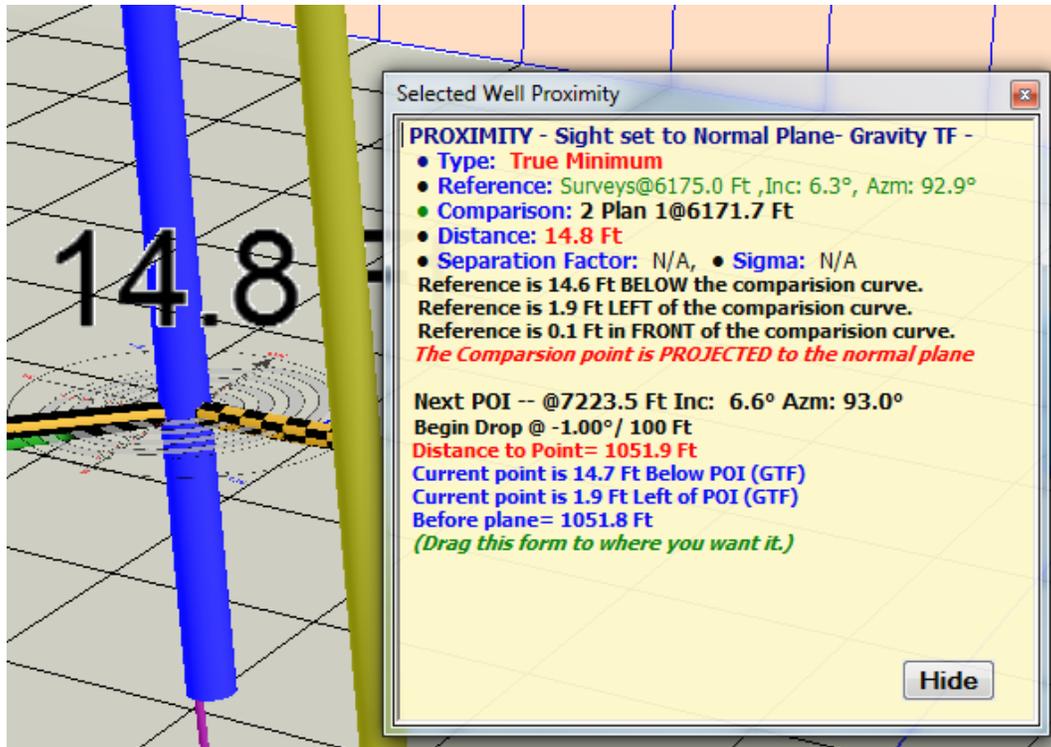


IN-DEPTH ON THE PROXIMITY LINES:

The directional driller has two references for orienting his drilling motor; the one he uses depends upon the last measured inclination. If the inclination is above a certain low value, normally 2 - 5 degrees inclination, then he orients his motor to high side. (The most intuitive way to think of high side is that it is the way you like airplanes to be flown, right side up – that's high side in oil field jargon).

Otherwise he orients his motor to the magnetic direction that he wants to move towards. The MWD tool will control the switchover, so when the DD sees an inclination above the Magnetic-Gravity Tool face value he knows that all the tool faces being sent are gravity tool face. The fact is that this is one piece of operational information that must be monitored carefully when sliding at low angles.

In the snapshot of the Proximity Infocard shown below there are two types of proximity described. The following is a description of how to interpret this card. The first proximity type is the proximity to a well and the second proximity type is Next POI (short for Point of Interest).



PROXIMITY – Sight set to [Normal Plane\TVD Plane] or [Gravity TF\Magnetic TF]

This can represent the proximity between the reference well and any other well in the project, depending on which Proximity Line you clicked on.

Type: [True Minimum\Normal Plane\TVD]

This represents the type of proximity values being displayed. The True Minimum values are illustrated by the yellow and black checkered connection bars in the 3D space. The Normal Plane is illustrated by the green and black striped connection bars, and the TVD plane connectors are represented by the Blue and Black lines. The user selects one or all types of proximity under the Proximity tab. It is best to use True Minimum, but the other two are useful under different circumstances.

Reference: Reference well name @ X MD, Inc: X, Azm: X

This is the name of the reference well and the current point.

Comparison: Name of comparison well and MD point of comparison

Distance: Straight line distance for type of distance X

Separation Factor: N/A Sigma: N/A

If separation factor is being calculated the current value and the current Sigma will be displayed here.

For Gravity Tool Face the distances are described:

Reference is X Above or Below the comparison curve

Reference is X Left or Right of the comparison curve

Reference is X is in Front of or Behind the comparison curve

For Magnetic Tool Face the distances are described:

Reference is X North or South of the comparison curve

Reference is X East or West of the comparison curve

Reference is X in Front of or Behind the comparison curve

When vertical or near vertical (when magnetic tool face is used), it is easiest to explain relative positions in terms of normal geographic terms such of North-South and East-West. At higher angles, when gravity tool face is used, the geographic terms become less useful for orientation and steering, so the plane perpendicular to the direction being drilled (the normal plane) is used as the steering guide. The easiest way to describe orientation relative to this plane is by describing it in local human terms, Above-Below, Left Right, in Front and Behind. The normal plane proximity will always lie on the normal plane, the TVD plane proximity will always lie on the TVD plane and the True Minimum proximity will be off those planes almost always. The local descriptions of the true minimum are projected to the normal plane.

NEXT POI: Points of Interest are defined by the comments that are included on the Proposal curve. A POI can be a kick off point or the top of a formation or any other survey that has a comment. **The only time this proximity is displayed is when the current curve is the work curve and there is a plan curve and the plan curve has comments.** Hawkeye will automatically search for the next point of interest and display how far away it is from the normal plane defined by the inclination and azimuth at the point of interest.

The primary purpose of this is to allow for the users to have a heads-up about what is next in line, be that a formation top, casing point, or a critical point in the plan.

d. File Menu

At the top left of the main screen in HawkEye™ is the File Menu. It allows for a number of core file management options.

HawkEye™ has a flexible method of maintaining projects in database files. It is important to understand the distinction between a “project” and an entire “database file.”

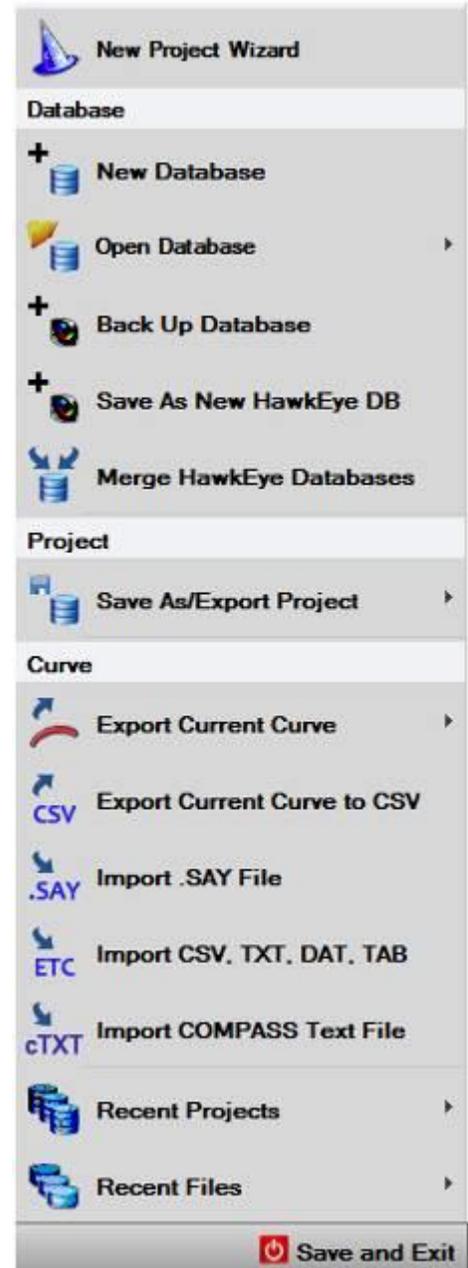
- A *database file* contains a collection of projects.
- Whereas a *project* is a collection of platforms and wellpaths that are related to one another on an operational basis.



NEW DATABASE PROJECT: Select this option to start a new project. The first thing HawkEye™ will ask is for the project file to be named and located. Choose a file location and name the project- it will have a “.HawkEye™” extension. A database consists of a single .MDB (MS Access) file. The file has been assigned a “.HawkEye™” extension so that it can be automatically opened by HawkEye™ when the file is double clicked in Windows, and also to distinguish what kind of .MDB file it is.

A database file can consists of many hundreds of projects. It is not recommended that hundreds of projects are stored in a database file, however; the reason being that opening and maintaining a large database file consumes more machine time and also putting all your eggs in one basket could lead to some extreme frustration should the “.HawkEye” file be corrupted by destructive forces such as a power surge, a virus, or just bad luck.

NOTE: The best strategy is to have an assigned folder (i.e. “c:/HawkEye/Data” or your Desktop) in which all of your HawkEye™ database files are stored. Make routine backups of this directory.



A good plan is to keep a group of related projects for a given customer within a single database; if your customer wants to have direct access to your data it is an easy matter to simply send them the file without being concerned over whether or not some other company's information is divulged.



OPEN DATABASE:

1. **HAWKEYE FILE:** This will invoke the open project dialogue but will only open files with the “.HawkEye” extension.
2. **WINSERVE FILE:** This launches a special dialogue in which the user may either create a new HawkEye™ file, or import WinServe™ files to an existing HawkEye™ project file.

BACK UP DATABASE: This option will save the current database to its current folder (both of which are displayed at the top of the main screen). The backup file will be named after the original file, plus a date and time so that they cannot get mixed up with each other.



SAVE AS NEW HAWKEYE™ DB: Any currently displayed and existing project data can be saved over into a new, separate HawkEye™ file. This is useful for, among other things, backing up and preserving projects as they are before venturing into project deviations. When a project is saved as a new file, the project will still be open under the old name. Thus future changes will be saved to the old project while the new one remains untouched.



MERGE DATA: This tool allows for the merging of separate “.HawkEye” databases. This can be useful in circumstances under which different users are working together on a general group of projects. To use this tool simply use the explorer to point the “.HawkEye” file you want to merge with the current database already opened within HawkEye™.



SAVE AS/EXPORT PROJECT:

1. **SAVE CURRENT PROJECT FILE:** This will launch the “Save as New HawkEye™ file” dialogue.

2. **EXPORT TO WINSERVE™ FILE:** This will allow the user to save certain project data to a WinServe™ (.svy) file. Not all project data is saved to a .svy file from a HawkEye™ project. Before the .svy file can be saved, it must already exist, HawkEye™ does not create the file, it just writes to it. This is because a WinServe™ .svy file has all kinds of data in it that HawkEye™ can't possibly know, like how the plots in WinServe™ should look. All HawkEye™ does is fill in the curve and target data. **NOTE:** If the HawkEye™ project has more than 20 curves, then only the first 20 will be exported to the WinServe™ file. That is because WinServe™ .svy files have a 20 curve limit.



EXPORT CURRENT CURVE: Allows the user to export the “Current Curve” (the one centered in the 3D space) to several different file formats: LAS (Log ASCII Standard), DIMMS (Drilling Information Management System), MMS (Minerals Management Services) and .SAY (WinServe™).



EXPORT CURRENT CURVE TO CSV: Allows the user to export the “Current Curve” (the one centered in the 3D space) to a .CSV (Comma Separated Values) file.



IMPORT .SAY: Brings in a curve from a .SAY (WinSERVE™) file.



IMPORT CSV, TXT, DAT, TAB: Imports a curve from one of these file formats.



RECENT PROJECTS: This list displays all recently opened project files. This is convenient for quick navigation between several projects at once without having to re-launch HawkEye™ from Windows Explorer.



RECENT FILES: This list displays all recently opened non-project files. This is convenient for getting to often-used files without having to open them conventionally.



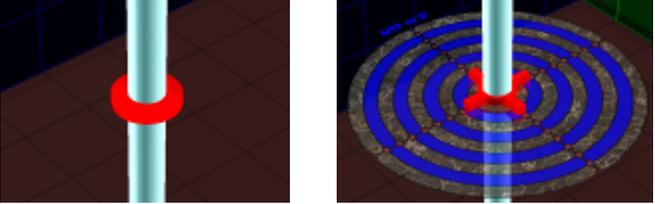
Save and Exit: This will close HawkEye™. The program will always automatically save current data to the currently open HawkEye™ project file. In order to preserve a project prior to changes made before closing out, make sure to save the project as a new HawkEye™ project.

e. Main Screen Navigation Tools

All of the most essential tools for getting between view modes and edit modes are found in two rows just below the 3D space.

It is important to get acquainted with each of these tools, but often the quickest way is to experiment with them in HawkEye™. Switching between work and proposal curve is utterly essential, as is the zooming tool, but learning the different grid and ellipsis modes will also greatly enhance the user's abilities to visualize the space around the well.



	<p>Look-at Point Depth (MD): In the 3D space, the Look-at Point (POV) is only ever at one point on a curve that can be slid up and down with the wheel.</p>  <p>This is where the Look-at Point is located wherever it is on a curve, defined by current MD. The user can type in the MD, then hit TAB to update.</p>
	<p>Look-at Point Depth (TVD): The depth of the Look-at Point, displayed by TVD here.</p> <p>NOTE: These depths are also displayed in the top left of the 3D space (Graphics Properties>3D Options> Show 3D Info). AND always in the info bar just above the survey window at the bottom of the main HawkEye™ screen. The user can type in the TVD they want to be it.</p>

	<p>Curve Menu: Left-clicking this button is the manual version of RIGHT-CLICKING on a curve in the 3D space or Data Tree. It will bring up the contextual menu for whichever is the current curve. This is useful when the MD or TVD specified is exactly what is desired.</p>
	<p>Step Slider: This is a way to move the sight up and down the curve aside from the scroll button on the mouse, or W,S or UP, DOWN keys. This slider become more sensitive as the curve gets longer because the ends of the slider are always the top and bottom of the curve. Click either end to skip to the very beginning or end of the curve.</p>
	<p>Step Interval: This sets the distance of each mouse wheel “click” when gliding up and down the curve. Even with the hyperscroll mouse, it takes a lot of spinning traverse the length of a curve at 1 ft per iteration. But sometimes that’s what is needed for precision navigation. Choose from the step speeds: 1, 2, 5, 10, 20, 30, 50, 100.</p>
	<p>Curve diameter control: This slider controls how thick the curve is displayed in the 3D space. Slide left for thinner, and right for thicker display. The range is 0.5 feet to 100 feet. This will also control the size of the red Crosshairs. Hotkeys: Quickly change the diameter with: Alt+ ↑ and Alt+ ↓</p>
	<p>Opacity: This controls the opacity of all the wells in the 3D space. When the value is decreased, the wells become more see-through.</p>

f. Home Ribbon Menu



The Home ribbon menu contains a series of tools used most often. The following is a brief explanation of the tools:

1. **Display Modes:** Choose from four Display Modes: Split, 3D, Vertical Section or Top View. Also choose a Display mode by double-clicking on the background of the view window itself.
2. **Report:** Opens the Report Generator
3. **QuickPlot:** Opens the QuickPlot module
4. **Add Survey:** Opens the Survey Editor, where surveys are primarily added.
5. **Work Mode/ Proposal Mode Toggle:** Left-click this button to switch between Work Mode or Proposal Mode. NOTE: There can be only one "Current" work curve and one "Current" proposal curve to follow at a time. To set a new "current" curve, just right-click on the curve and select "Set as Current Work/Proposal Curve."
6. **Driller's View:** Left-click to reset to "Driller's View," which is: 1) in the Current Work Curve, at the end of the curve (last survey), highside up.
7. **Highside Up:** To turn on or off the Highside Up view mode independently of the Driller's View, RIGHT-CLICK on this button. The red arrow will indicate if the Highside Up view mode is activated.
8. **Work Sight/Proposal Sight:** Check or uncheck to display the Sight for either the Work curve or the Proposal curve.
9. **Sight Editor:** Left-click to open the Sight Editor, where radius, colors and textures can be chosen for both Sights. Also where the Directional Compass can be toggled.
10. **Target List:** Opens the Target list, which is the best place to add and edit multiple targets all in one form
11. **Add Target:** Quickly adds a single target, and opens that target's Adjuster form.
12. **Choose Targets For Projection:** First Target is used with both Slant and Aligned projections, and the Second Target is used for Aligned projections.
13. **Projections:** All projections are located here. See the section on Projections for more details.
14. **Well Plan Mode:** (Well Plan version only) Toggles the Well Plan module.

6. Project Organization

a. Files and Databases

All data for each Field/Project is saved to a single database file with the extension “.HawkEye.mdb”. The data is organized and presented in a tree structure hierarchy, a concept much like several other well planning software applications, including WinSURV3D.

Briefly, file organization is as follows:

DATABASE FILE (.HawkEye.mdb extension) contains:

Collection of FIELDS/COMPANIES...

Which contain a collection of PROJECTS...

Which contain a collection of PLATFORM/PADS...

Which contain a collection of SLOT/WELLHEADS...

Which contain a collection of WELLPATHS that are either proposed plans or actual surveys.

TARGETS are assigned to either a PLATFORM/PAD or a SLOT/WELLHEADS.

LEASE LINES and HARD LINES are associated with the PLATFORM/PAD.

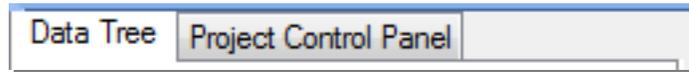
LITHOLOGY is assigned to each WELLPATH, but can be copied to and from a PLATFORM/PAD.

CASING is assigned to each WELLPATH.

JOB INFORMATION is assigned to each WELLPATH.

b. Data Tree

The Data Tree is the basis for navigating through all the immense information that a job contains in HawkEye™. Based on the WinSURV3D™ hierarchy system, it is intuitively organized to allow the user the easiest method of random access to project information. On the top of the left-hand panel of the main screen you will find two tabs.



HEIRARCHY: The data hierarchy here should be familiar to WinSurv3D users with some minor changes. From the top down, data in HawkEye™ is organized into:

Data is organized first by FIELD/COMPANY. This is the root of the tree, and could be conceptualized as either the overall field or as the name of the operator.

Although HawkEye™ could have multiple FIELD/COMPANIES open at a time, it will only have one of these FIELD/COMPANY sub-trees *expanded* and displayed at a time.

The next level is Project, of which also only one can be open at a time. Underneath each of the projects are the one or more platform/pad.

Under platform/pads are the various Slot/Wellheads. From there, Proposal Wellpaths, Workcurves and Targets are all thrown in at the same hierarchical level, grouped by their Slot/Wellhead.

<u>DATA TREE ICONS</u>	
	FIELD/COMPANY
	Project
	Platform/Pad
	Slot/Wellhead
	Proposal Wellpath
	Survey Wellpath (Workcurve)
	First Target
	Second Target
	Target

A Project (P) may be composed of any combination of Platform/Pads (PP) found in a given FIELD/COMPANY (FC). Although the identical tree may appear under each Project, the data for a particular Platform/Pad is only written to the database once, and any modifications to it will be in effect throughout all projects in which that platform/pad appears. However, if you choose to edit a Project by deleting a particular Platform/Pad, only that single Project would be affected: the Platform/Pad data remains in the database, in the Field and any other Projects it is a part of.

A Project is created and exists within an individual Field. The simplest way to understand the hierarchy is to visualize the case of an offshore drilling program. The Field may be a particular reservoir; there may be multiple platform/pads drilling in that same field; each platform/pad has the capacity to drill from a number of slot/wellheads (SW) in the template; and finally, there can be any number of Wellpaths (WP) associated with each slot/wellhead.

USING THE SAME PLATFORM/PAD: One Project may be a single platform/pad; for another you may want to include the next closest platform/pad for anti-collision purposes; a third may include several other platform/pad, and so on. In other words, the *same* platform/pad, or any combination of platform/pad (within a single Field) can be part of any number of different Projects.

COLLAPSING AND EXPANDING: Any level of the tree may be expanded by clicking on the “plus sign” (“+”) to the left of that item. (Conversely, clicking on a “minus sign” (“-”) collapses the tree back up to that level). If there is no plus sign next to the object, that means there isn’t any data below that level associated with that object.

The highest level of data is the **FIELDS/COMPANY**, under which all other dataforms are organized. Any given **FIELD/COMPANY** can contain an **unlimited number of projects, platform/pads, slot/wellheads, curves, etc.**

ASSIGNING TARGETS TO SLOT/WELLHEADS: Targets can be assigned to specific Slot/Wellheads in a Platform/Pad. If they are assigned, you will find them under the slot/wellhead in which they are associated. If a target is not assigned to a slot/wellhead, it will be placed at the bottom of the Data Tree under the last displayed datum in the platform/pad:

The image shows two parts of a software interface. On the left is a data tree under 'FIELDS / PROJECTS ---'. It shows a hierarchy for 'signalhill shcu 23-24 perposal 1'. Underneath, there are several items including 'SIGNALHILL SHCU 23-24 Survey', 'SIGNALHILL SHCU 23-24 Proposal', 'TARGET 2 TLB (Subsea TVD = ...)', and 'TARGET 3 AG (Subsea TVD = 4870.00)'. At the bottom of this branch, 'MY TARGET (Subsea TVD = 3310.00)' is listed. On the right is a 'TARGET ADJUSTER' dialog box. It has a 'Name' field with 'MY TARGET', a 'Shape' dropdown set to 'CYLINDER', and a 'Slot' dropdown set to 'Not Assigned'. A dropdown menu is open from the 'Slot' field, showing a list of wellhead options: 'SIGNALHILL SHCU 23-15 OH', '23-15 OH', '24-4 OH', '23-17 OH', '23-8 RD', '23-8 OH', '23-1 OH', '23-3 OH', '29-7', '23-9 RD1', '23-8 RD2', '23-16 OH', '23-9 OH', and '44-1 OH'. The 'SIGNALHILL SHCU 23-15 OH' option is currently selected.

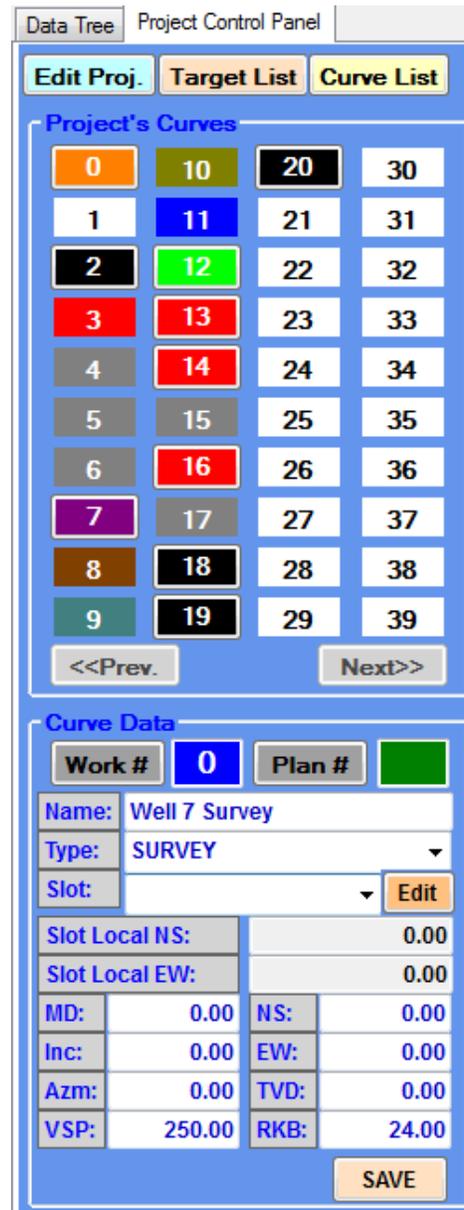
An unassigned Target will be at the bottom of a platform/pad branch (left). To assign it, just right-click, select “Adjust Target Parameters” and select the assignee slot/wellhead from the “Slot” pulldown menu (right).

c. Project Control Panel

The tab next to the Data Tree at the top of the left-hand window is the PROJECT CONTROL PANEL tab. Click on it and you will see an interface resembling the WinServe™ Control Panel. However, **this Project Control Panel is significantly different from the WinServe panel. If you are accustomed to how the WinServe™ control panel works, there are some important differences between how the two control panels operate.**

Each numbered square represents a curve. They are all associated with a particular Project and can be created ad infinitum. There are 40 curves are displayed on the first “page” of the Project Control Panel because most users will not work with more than 40 at any given time. To navigate additional pages of curves in this Panel, simply click the “<<Prev.” and “Next>>” buttons at the bottom of the Project’s Curves panel.

CURVE ASSIGNMENT: CURVE 0 is always designated as the WORK CURVE. CURVE 1 is always designated as the PROPOSAL CURVE. This means that when you assign a curve as a WORK CURVE or a PROPOSED CURVE, the curve is moved to either curve 0 or curve 1. In WinServe™ Curve 0 and Curve 1 were the *suggested* numbers to use, here HawkEye™ forces the issue.



Beyond 1 and 0, all of the curves in this Panel are customizable. By clicking on the numbered square, the associated curve data is displayed on the bottom portion of the Panel. By RIGHT-CLICKING on the square, the user can access the entire contextual menu as if right-clicking on the curve in question in the 3D space. To change the color, for example, just right-click on a numbered box and select “Set Color.”

The EDIT PROJECT button will pull up the small Project Information dialogue. The TARGET LIST button brings up the comprehensive Target List manager, which includes the Target Adjuster dialogue and the tools to add, delete and edit all the targets of the project. The CURVE MANAGER button invokes the small Curve List box that allows for turning on and off curve.

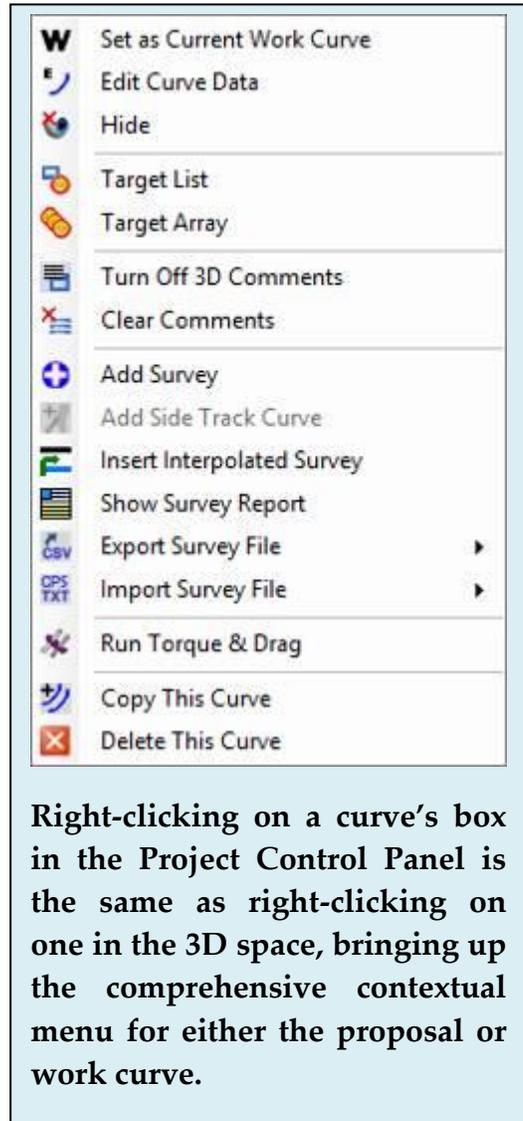
TO ADD A CURVE, just click on a blank numbered box, then go down to the Curve Data window and then:

15. Type in a name for that curve
16. Select the type, either proposal or survey
17. Select the slot/wellhead to be associated
18. Enter location, tie in and direction values
19. Click “ADD.”

The new curve will appear in the first open available square. Any further tweaking of the curve can be done by Right-Clicking on the curve’s numbered box and selecting “Edit Curve” from the curve contextual menu.

SET AS WORK CURVE/SET AS PROPOSAL CURVE: To set a curve as the work curve, or a Proposal curve as the current plan, simply right-click on the numbered box and select the first item on the menu, “Set as Work Curve.” If you make any curve that is not number 0 the work curve, the curve will automatically be the Number 0 curve, otherwise retaining all of its parameters including color.

The former Number 0 curve will be swapped out with the new one such that all other curves keep their number.



Right-clicking on a curve’s box in the Project Control Panel is the same as right-clicking on one in the 3D space, bringing up the comprehensive contextual menu for either the proposal or work curve.

7. Adjusting Graphics Settings

HawkEye™ allows the user to customize the appearance of everything in the 3D space to a very high degree.

a. 2D Charts

These options control the look of the labels and appearance of the 2D charts (VS View and Top View) on the main screen of the program. They do NOT affect the QuickPlot settings. These settings appear on the computer only.



A. Labels:

- a. **Label Manager:** The Labels manager is explained in the next section below. It is the only set of options with its own module.
- b. **Reset Positions:** This will reset all labels and settings in the 2D charts

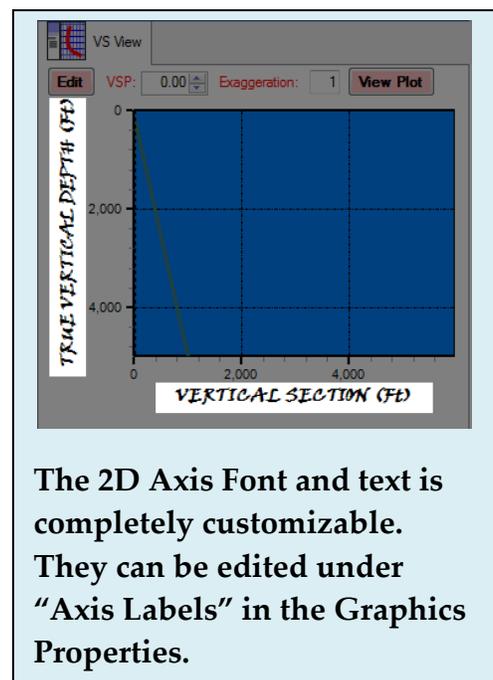
B. Grid: Choose what kind of background grid lines you want for the background of the VS and Top View.

C. Major Line Type: This will affect the style of the major grid lines of the background of the VS and Top View.

D. Minor Line Type: This will affect the style of the minor grid lines of the background of the VS and Top View.

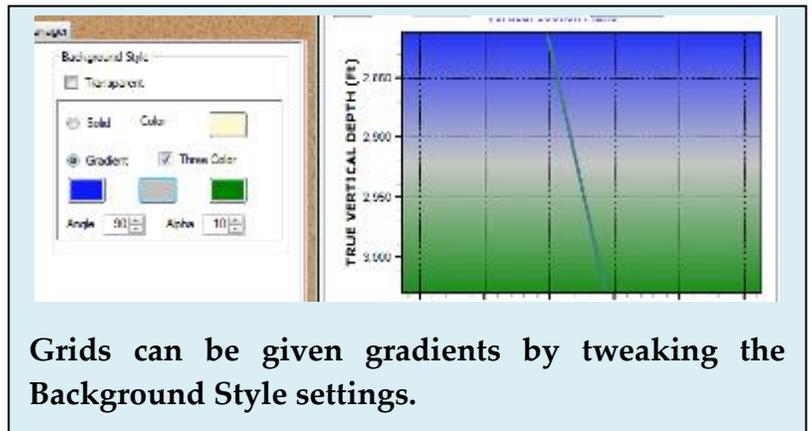
E. Axes Font: This will affect the appearance of the words on the outside left and bottom of the VS and Top View.

F. Top/VS View: Change what the axes labels actually read in the VS and Top View.



G. Background Style: There are essentially three background style modes for the VS and Top Views: one color, two colors or three colors.

The Angle and Alpha determine how multiple colors will bleed into each other.



Grids can be given gradients by tweaking the Background Style settings.

b. Labels Manager

This panel controls all the characteristics of the alpha numeric labels found in the 2D windows as well as the 3D space.

Get to this dialogue by clicking on the icon on the far left under the “2D Charts.”

The screenshot shows the 'Labels Manager' dialog box with the following settings:

- VS View:** MD, Inc, Azm, TVD, VS, DLS are unchecked; Comment is checked.
- Top View:** MD, Inc, Azm, TVD, VS, DLS are unchecked; Comment is checked.
- Auto Label Frequency:** None is selected; Every is set to 5 survey(s).
- Text Properties:** Opaque Background is selected; Show Frames is unchecked; Comment Background Color, Curve Background Color, Target Background Color, and Casing Background Color are visible.
- Scope To Apply:** Selected Curves is checked; Check All is in the dropdown; Current Proposal Curve and Current Work Curve are checked.
- VS View Exaggeration:** TVD / VS is set to 1.
- Both Plots:** Critical Point Lines, Show Links, Name Tags at end of curves, Show Slot Names, Show Casing Labels, and Show Target Labels are checked.

VS and TOP VIEW: Check any of these boxes to toggle the particular label to show up in the 2D VS view and 2D top view.

AUTO LABEL FREQUENCY: This section relates to how often you want to have a label generated in the plot. For now the only option is to select every X number of surveys. However, by MD and by TVD every X number of feet or meters should be available in future versions.

SCOPE TO APPLY: This controls to which curves the labeling schema is to be applied, whether it is to all curves or just the proposal curve and or the current work curve.

TEXT PROPERTIES: This section of the panel controls all of the features of the lettering as they are found in the 3D space. To change the fonts, select the “Axis Labels” tab at the top of the panel and click on the “3D Axis Font...” button.

VS VIEW EXAGGERATION: Exaggeration increases the Y-axis interval, which is useful for horizontal wells when trying to better fit the entire well in the graph. The exaggeration is by ratio, so if “1” is 100ft/division, then “2” would be 50ft/division, and “3” would be 33 ft/division.

BOTH PLOTS: Check any of these boxes to toggle the described features which are applied to both the VS View and Top View graphs.

c. 3D Screen



The “3D Screen” tab contains all parameters that affect the appearance of objects and background in the main 3D window of the program.

A. Curve Comments and Annotations: Select whether you want comments and/or annotations to be displayed for the current slot’s wells, or only for the currently selected well.

B. Target & Casing Comments: These options will determine the appearance of the target and casing labels in the 3D space. Use the checkboxes to turn on and off the comments for these object types.

C. Miscellaneous

- 1. Create Annotation:** This will create an annotation AT THE CURRENT LOOK-AT POINT in the 3D space.
- 2. Show Compass:** This will show the Directional Compass in the 3D. You can also turn this on and off with the (,) comma key while your cursor is hovering over the 3D screen.
- 3. Show Rig:** Toggle the derrick graphic at the top of each currently selected well.
- 4. Show Slidings:** Slide markers are shown if the curve is associated with a job from a WinSurv2 database on the same hard drive. Associate WinSurv2 jobs to a curve by selecting the curve as “Current” work curve, then going to Job Data under the “Edit” tab and selecting “Get from WinSurv2.”
- 5. Survey Markers:** This will generate a green marker at every survey station along the curve.

D. Information Text: This controls the appearance of the “3D Info” in the top left corner of the 3D screen.

It is fairly important to get the settings for this text easy to read because it is referenced frequently. It displays the exact location of your 3D Look-At Point as you move up and down a curve, and interpolates information when there is no official survey at a given MD.



E. AXIS FONT: In the distant 3D background of the 3D space, there are axes, the font and color of which you can change with these options.

F. WALLS AND 3D MAGNIFICATION: Control the color and shade of the 3D background walls and floor.
The Magnification slider will affect the “Zoom Factor,” which is different from the camera zoom done with the right mouse button plus mouse wheel.

d. General



A. Curve Comments: The Auto Comments feature will create a descriptive comment at every critical point on a **plan**. NOTE: If you use this on an as-drilled well, it will generate a comment for virtually every survey station because each station creates a geometrically dynamic shape.

Clear Comments will erase all comments for the current curve. NOTE: There is no “undo” button.

B. Hard/Lease Line: These options determine how a hard line or lease line appears and behaves in the 3D space.

The “Show 3D Objects” option will toggle whether the Line appears as a simple line, or a mass in the 3D space. The “Show 3D Lines” will superimpose simple lines over the mass.

The “Fixed TVD” option will lock the Line at a specific depth. Choose the locked depth in the Lease/Hard Line editor. Get to that editor by finding your Lease/Hard Line in the Data Tree, right clicking on the line and selecting “Edit Lease/Hard Line.” In the Adjuster dialogue that pops up, change the “TVD” of the line to determine its locked depth.

C. Miscellaneous:

1. Include All Structures Within: This option can be used to exclude offset wells that are slowing down the computer.

2. Interval Length For Projections: Change the frequency for surveys in a projection.

3. Autosave Every: Turn this on for the program to save ALL data to the current database at a given interval. For faster computers with adequate RAM (8GB+), it is recommended that this option be turned on.

4. Autoshow Curves with Criticality >1: This will force the program to display curves in the 2D and 3D which have a criticality to the current curve of greater than 1. Criticality is a number of 1 through 5 based on the chosen safety ruleset and the separation factor for any given point.

5. Show tips at Startup: Uncheck this to permanently disable the startup message.

6. Create Projection Comments: This will automatically generate comments for the critical points along an active projection.

D. View Options

1. Display Theme: Choose one of several background color themes for the main program.

2. Remote View: This mode will allow computers that are connected to your machine by remote session to navigate the 3D space without extreme jumpiness in the rendering.

3. Survey Grid: This will launch the Survey Grid Manager, the dialogue where all settings for the survey list on the bottom of the main screen can be changed. You can also get to this dialogue by right-clicking on the colored title header of the Survey List Grid itself, and selecting "Survey Grid Manager."

PROJECT QUICK START WIZARD



The very first option in the File Menu is the Wizard. Clicking on the icon brings up the Project Quick Start, a project Wizard that enables the user to create project with a minimum of information in a short amount of time, all in just a few steps.

The screenshot shows a dialog box titled "Project Quick Start" with a close button (X) in the top right corner. The dialog is divided into four steps:

- STEP 1**: "Field Name:" followed by a drop-down menu.
- STEP 2**: "Project Name:" followed by a text input field. Below it is "Safety Ruleset:" with a drop-down menu set to "Default".
- Unit System**: A section containing:
 - "Linear Unit:" with a drop-down menu set to "US FEET".
 - "DLS = */" with a drop-down menu set to "100" and "Ft" to its right.
 - "Geodetic Unit:" with a drop-down menu set to "US FEET".
 - "Casing Unit:" with a drop-down menu set to "API".
- North Reference**: A section with two radio buttons: "Grid North" (selected) and "True North".
- Vertical Datum**: A section with two text input fields: "Elevation (ft):" set to "0.00" and "RKB (ft):" set to "0.00".
- STEP 3**: A button labeled "Job Information".
- STEP 4**: A button labeled "Geodetics Information".

At the bottom of the dialog are two buttons: "OK" and "Cancel".

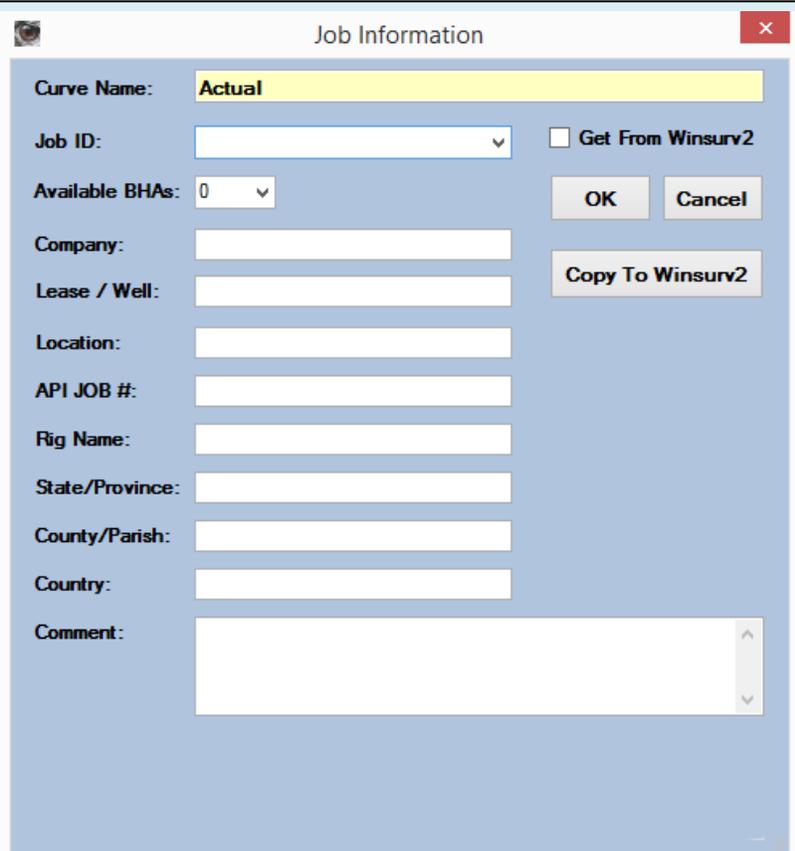
The Project Wizard can kickstart any project with a certain minimum

STEP 1 Enter the Field Name. If it already exists, it will be in the drop-down menu in STEP 1.

STEP 2 Enter the Project Name. Also choose the type of North Reference as well as the units to be used (feet or meters). Choosing the Safety Ruleset for most users will not be necessary (the rulesets are company-specific separation factors for

ellipses of uncertainty). Here the user should also enter the project's elevation and RKB for the platform/pad if known. If this information is not yet known, it can be later entered by right-clicking on the slot/wellhead or platform/pad in the Data Tree and selecting "Edit" in those menus.

STEP 3 Open the Job Information dialogue and enter information. The information in this dialogue is pulled from any available Winsurv2 job information, providing all available JOB IDs to select from. Otherwise, the user will create a new Job Name in this step. Any new Job created here will automatically prompt the user to import the new data over into WinSurv2.

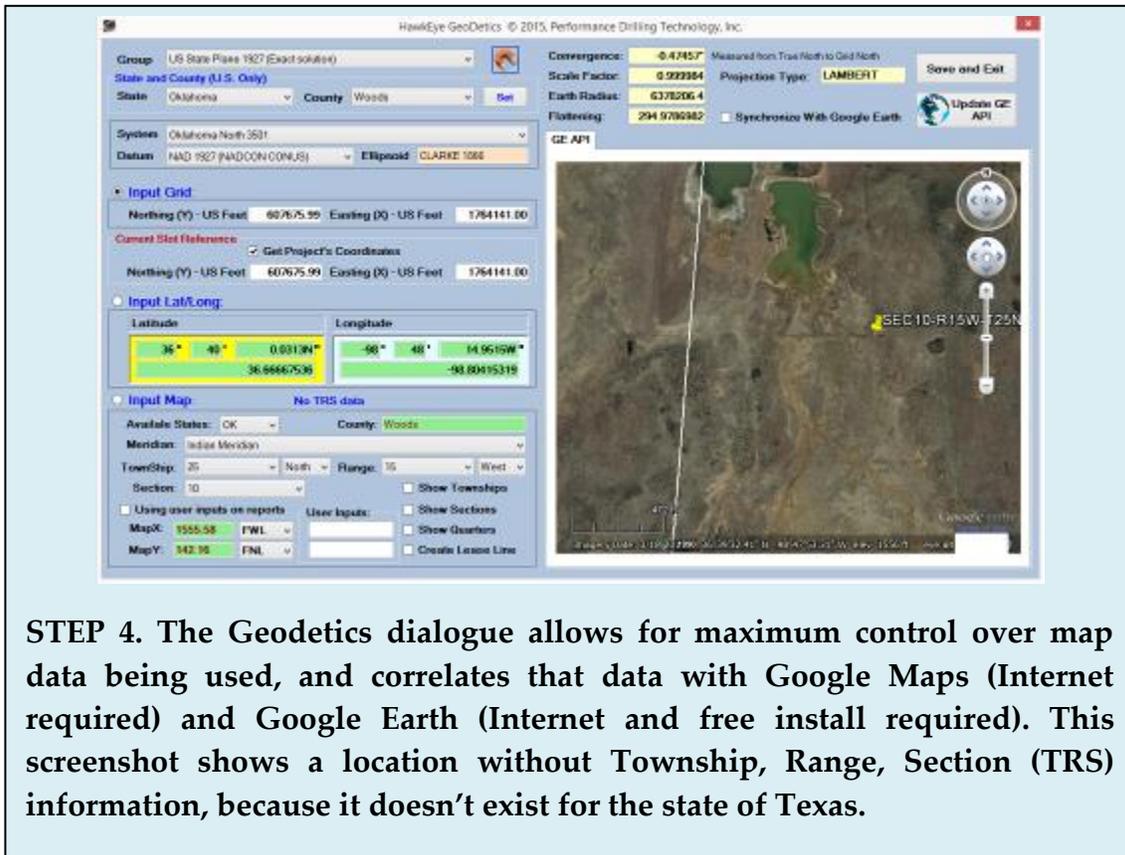


The screenshot shows a "Job Information" dialog box with the following fields and controls:

- Curve Name:** Text field containing "Actual" (highlighted in yellow).
- Job ID:** Dropdown menu.
- Available BHAs:** Dropdown menu with "0" selected.
- Company:** Text field.
- Lease / Well:** Text field.
- Location:** Text field.
- API JOB #:** Text field.
- Rig Name:** Text field.
- State/Province:** Text field.
- County/Parish:** Text field.
- Country:** Text field.
- Comment:** Large text area.
- Get From Winsurv2:** Checkbox (unchecked).
- Buttons:** "OK", "Cancel", and "Copy To Winsurv2".

STEP 3 of the Project Quick Start Wizard allows the user to be as thorough as they wish when creating a new project. Furthermore, job data is readily available from any available WinSurv2 data.

STEP 4 Click on the “Geodetics Information” button and open up the Geodetics dialogue. Choose the Group to be used.² If the computer is connected to the Internet, then Google Maps will automatically come up with the current location. If you are working in international territory, it is likely that a UTM will be used, either southern or northern hemisphere. All of these are available in the first pulldown menu at the top of the dialogue. Then click “Save and Exit.”



STEP 4. The Geodetics dialogue allows for maximum control over map data being used, and correlates that data with Google Maps (Internet required) and Google Earth (Internet and free install required). This screenshot shows a location without Township, Range, Section (TRS) information, because it doesn't exist for the state of Texas.

² If you do not have the geodetics information yet, that is okay. Just select “None” from the Group pull-down list. This will simplify the Slot Geodetics dialogue and allow you to work with local coordinates until the geodetics can be entered at a later time.

After completing the final step of the Wizard, click “Ok.” Now you will have a fresh project waiting in the Data Tree. The Wizard provides the following by default:

-  Platform/Pad
-  Slot/Wellhead
-  As Drilled Curve
-  Proposal Curve
-  (First) Target

You can delete or edit these initial objects by right-clicking on any of them and choosing an edit action from the contextual menu.

II. PROJECT DATA

1. Adding Basic Project Data

Although the Quick Start Wizard is great for getting started, the user will inevitably have to dive into the Data Tree and add things like slot/wellheads and curves. But doing so is an intuitive process.

a. Adding Projects and Platform/Pads

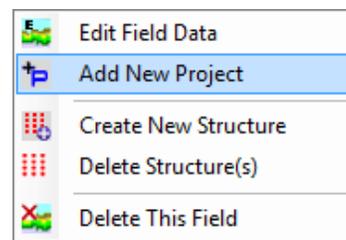
ADDING FIELD/COMPANY: Starting from the top, in order to add a new Field to the currently open database, right-click on the FIELDS/COMPANIES label at the very top of the Data Tree and select “Add New Field.”



This opens up a small dialogue in which you can enter the Field Name and the Location. Location as entered in this dialogue is not used anywhere in the program, but it is a useful reference datum.



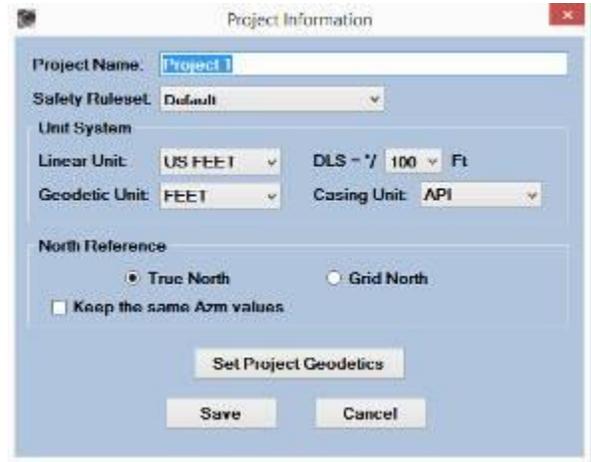
ADDING PROJECT: Once a new Field is added, right-click *on that field* in the Data Tree and select “Add New Project.” This will pull up the Project Information dialogue, where name, units and other basic relevant data can be added. Geodetics can also be set from this dialogue.



NOTE: If you don't want to set geodetics just yet, you can do it later, but you still have to go into the Geodetics dialogue and then Save and Exit in order to finish the Project Information dialogue.

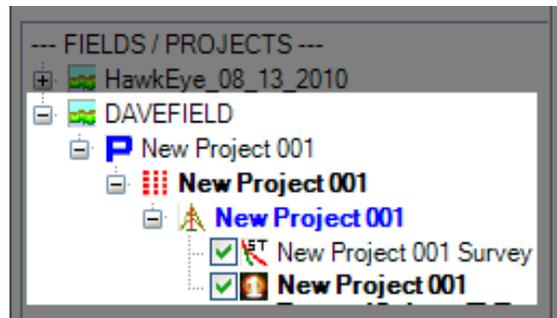
ELEVATION (To Mean Sea Level):

The current version allows only one mode of elevation, which is the platform/pad's elevation plus the RKB height.

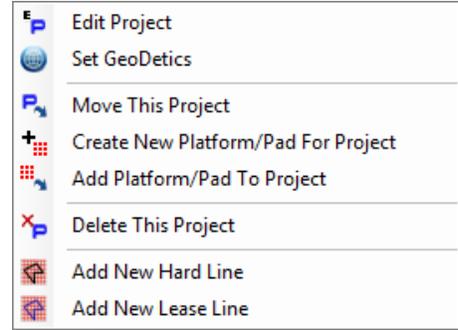


Once a Project is created here, HawkEye™ will provide a default Platform/Pad, Slot/Wellhead, dummy Wellpath and First Target. The dummy surveys are placeholders waiting for the user to modify them, and will show up in the 3D space as short vertical curves by default.

Once a Project is created, HawkEye™ will provide for it a default Platform/Pad, Slot/Wellhead, Wellpath and First Target. If there was no survey then there would not be a visible component in the 3D space. This is the equivalent of what you commonly see on a data tree that has a '+' to the left of a closed tree item.

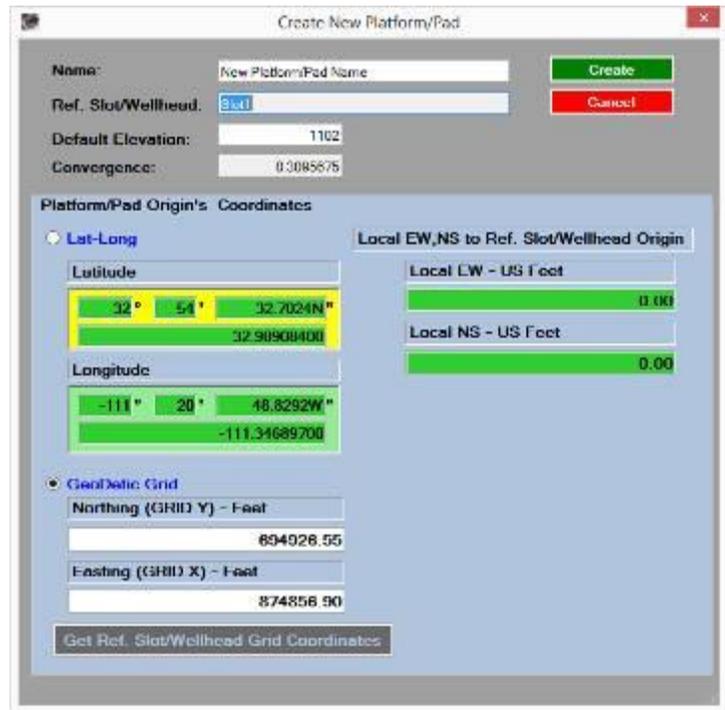


ADDING Platform/Pads: To add a Platform/Pad, simply right-click on the Project **P** in the Data Tree you want the Platform/Pad to be associated with, then select “Create New Platform/Pad For Project.”

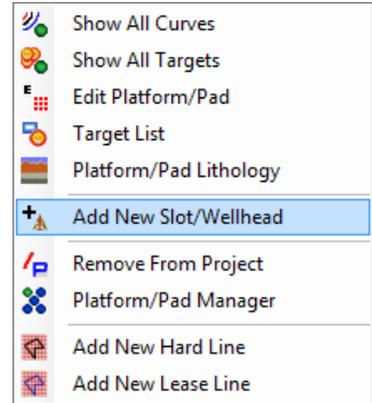


In this dialogue, platform/pad data (name, reference slot/wellhead, elevation and convergence) and platform/pad coordinates can be added. To finish, click the “Create” button and the platform/pad will appear in the Data Tree.

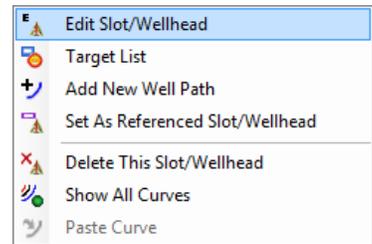
Along with the new platform/pad, there will be a default slot/wellhead and a default survey and proposal curve.



ADDING SLOT/WELLHEADS: To add a new Slot/Wellhead, right-click on the Platform/Pad , then select “Add New Slot/Wellhead” .



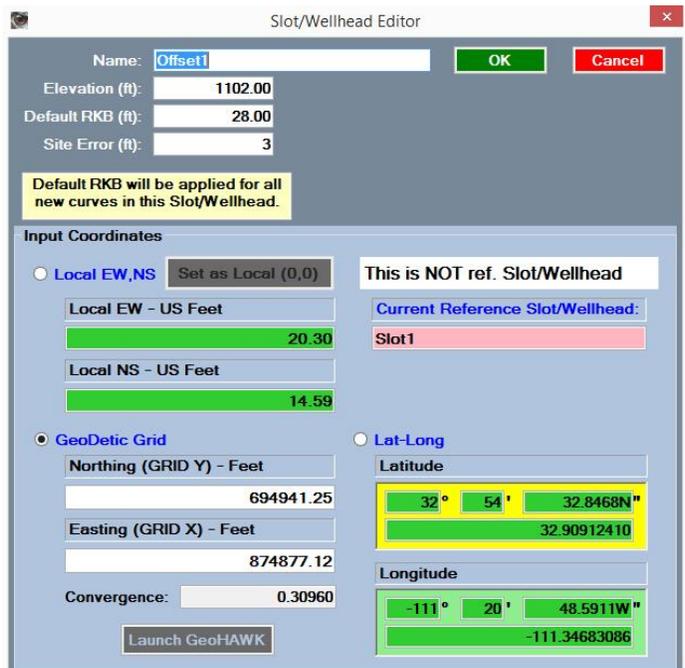
EDIT SLOT/WELLHEAD: This invokes the Slot/Wellhead Information dialogue, which allows the user to input the Slot/Wellhead name, and add a variety of different coordinates defining it.



Coordinate information can be added by way of Latitude-Longitude, GeoDetic Grid, or Local EW NS values.

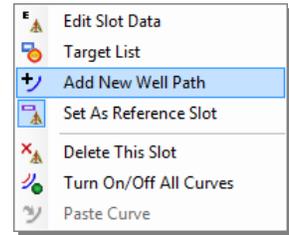
Click “Launch GeoHAWK” to see the slot/wellhead’s exact location through Google Earth.

Click “OK” to save and close out this dialogue.



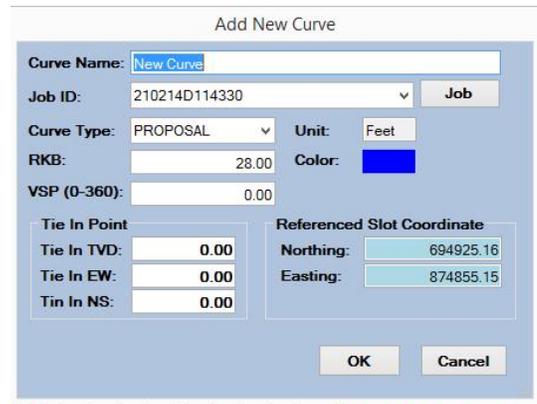
b. Adding Wells and Sidetracks

ADDING A WELL: To add a well or curve, right-click on the associated Slot/Wellhead  in the Data Tree to pull up the contextual menu, then select “Add New Well Path”.



In the “Add New Curve” dialogue, you may enter the Curve name, Job Name (new or pulled from a WinSurv2 database), Survey Type (proposal or survey), RKB, tie in point and referenced slot/wellhead coordinate.

The curve will appear as named under the slot/wellhead you right-clicked on in the Data Tree.

A screenshot of the “Add New Curve” dialog box. The fields are: Curve Name: New Curve; Job ID: 210214D114330; Curve Type: PROPOSAL; Unit: Feet; RKB: 28.00; Color: Blue; VSP (0-360): 0.00; Tie In Point: Tie In TVD: 0.00, Tie In EW: 0.00, Tin In NS: 0.00; Referenced Slot Coordinate: Northing: 694925.16, Easting: 874855.15. There are OK and Cancel buttons at the bottom right.

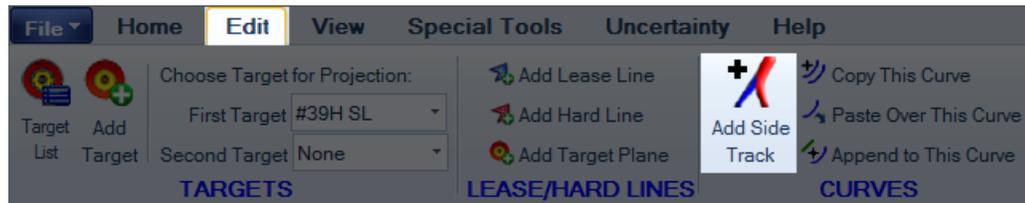
NOTE: The “Tie in Point” in this dialogue should not be used to create a new wellhead at surface. This is for sidetracks.

To create a new slot/wellhead, right-click on the Structure/Pad in the Data Tree and select “Add New Slot/Wellhead.” From there, define that wellhead with the proper location info, and create a new wellpath under that new wellhead.

ADDING A SIDETRACK:

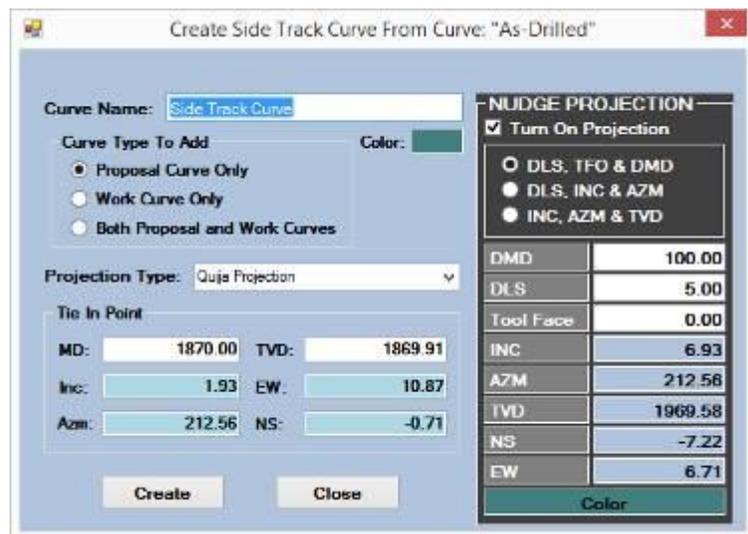
Add a side track curve by either:

- 1) Selecting the “Add Side Track” button from the “Edit” tab.



- 2) Or right-click on the associated curve either in the Work Mode or Proposal Mode to pull up the contextual curve menu, then select “Add Side Track” .

In the Create Side Track dialogue, you define the sidetrack curve as an entirely new curve which starts at the defined tie-in point. Additionally, you can define the sidetrack as any kind of projection before creating it, using the “Projection Type” dropdown menu.



CURVE NAME: When you click on the “Create” button, a new curve will be generated either as a Proposal Curve, Work Curve or both, and it will be named whatever you name it. The default is “Side Track Curve.”

CURVE TYPE TO ADD: When you generate this curve, you may create it as either a proposal curve, work curve or both. Make sure to select the type you want in order to avoid confusion later on.

PROJECTION TYPE: You can select from four projection types in the Side Track dialogue: Nudge, Slant, Aligned and Back-On-Track. When you select a projection type,

its corresponding control panel will appear inside the Side Track dialogue and you can tweak the side track projection from there.

TIE IN POINT: This set of parameters is arguably the most important aspect of the side track curve. From here you will define where along the parent curve the side track will emerge, either by MD or TVD. The inclination, azimuth and coordinates are calculated automatically.

REFERENCE: This is a passive data display based on the Tie In Point information provided.

CREATE: Once the parameters of the Side Track have been tweaked to your liking, click the “Create” button and a new curve will be created, branching off from the parent curve. This new curve will extend all the way back up to the surface for torque and drag calculation purposes.

c. Importing Surveys from Excel, .CSV, or .SAY

1. Copy and Paste Surveys

Surveys can be imported in HawkEye™ or they can be added and edited manually within the program. One simple way to import surveys into HawkEye™ is to copy them from a spreadsheet and paste them directly into the 3D or survey window.

STEP 1

Grab the data from the spreadsheet by selecting it and copying (Ctrl+C or right-click and select “Copy”).

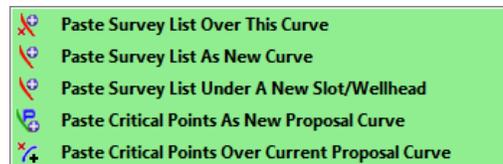
NOTE: HawkEye™ will accept spreadsheet data from Microsoft Excel, OpenOffice and all other common spreadsheet programs.

IMPORTANT: Spreadsheet column order must be in MD, INC and then AZM from left to right in order to paste properly in HawkEye™.

MD	INC	AZM	MD	INC	AZM	MD	INC
0	0.00	0.00	0	0.00	0.00	0	0.00
146	0.10	136.60	163	0.80	128.70	162	0.50
356	0.50	185.00	363	0.80	167.20	361	1.00
590	1.20	171.60	653	1.30	177.20	552	1.60
783	1.80	198.60	745	1.40	202.40	732	2.10
914	1.00	185.10	835	1.23	196.32	1832	1.60
1155	1.00	231.70	925	0.97	198.75	1332	0.30
1365	0.10	337.60	1015	0.79	197.35	1632	0.40
1665	1.20	177.60	1105	0.62	207.10	1841	0.60
1965	1.00	198.70	1195	0.26	268.54	2142	0.60
2027	1.32	121.32	1285	0.18	276.98	2441	0.40
2117	2.29	99.53	1375	0.26	320.13	2652	0.38
2287			1465	0.26	223.83	2816	0.30
2387			1555	0.53	194.31	2947	1.00
2477			1645	1.41	173.21	3127	0.60
2567			1735	0.79	190.32	3667	2.30
2657			1825	0.88	156.48	3757	4.60
2747			1915	0.70	151.56	3847	5.80
2837			2005	0.88	143.38	3937	6.20
2927			2095	2.29	142.86	4027	7.40
3017			2185	2.81	152.86	0	0.00
3107			2275	3.08	159.64	0	0.00
3197			2365	2.81	144.60	0	0.00
3287			2455	4.20	101.92	0	0.00
3377			2545	3.07	68.20	0	0.00
3467			2635	2.64	107.61	0	0.00
3557			2725	2.90	109.62	0	0.00
3647			2815	2.81	65.11	0	0.00
3737			2905	2.81	91.94	0	0.00

STEP 2

Right-click in HawkEye in either the 3D space, Data Tree or on the Survey List Panel, and select from one of five options. NOTE: These options highlighted in green will only appear if you’ve just copied surveys from a CSV or spreadsheet.



- **Paste Survey List Over This Curve:** If you have right-clicked on a specific curve in the Data Tree or 3D space, you will overwrite the old surveys with your new copied surveys.
- **Paste Survey List as New Curve:** Takes whichever surveys you have copied and puts them into a new curve under your current slot. You will be prompted to name that slot and designate any tie-in info if applicable.
- **Paste Survey List Under New Slot/Wellhead:** This will create a new curve with your copied surveys, as well as a new slot/wellhead under which it will be located.

NOTE: Be sure to right-click on the slot/wellhead after pasting and set the proper slot location, RKB and elevation because that is all zero by default.

- **Paste Critical Points As New Proposal Curve:** If you copied a list of critical points, this will paste them in as a new curve, then automatically interpolate (generate surveys in between) with a default frequency of surveys every 30 feet on a curvature
- **Paste Critical Points Over Current Proposal Curve:** Replaces your Current Proposal curve with the surveys you just copied. "Current Proposal" means the active proposal that you have set as "Current" as indicated by the bold letters in Data Tree.
- and every 100 feet on straight tangents. NOTE: A typical list of critical points is 5-8 surveys. If you try to paste more, HawkEye will prompt you. If it is over 20 surveys, HawkEye will not let you paste as critical points.

NOTE: The other way to interpolate a list of critical points is to enter the critical points in as surveys, then go to the Report Generator, for Report Type choose "Interpolate Survey," put in your interpolation frequency, then click "Keep Curve."

NOTE: If you copy surveys and include the header for the columns, you can include tie-in information, namely the TVD, N-S and E-W of the first survey. But make sure the first three columns are still MD, INC and AZM in that order.

2. Importing WinServe .SAY files

Individual curves can be exported from WinServe as .SAY files. They can be imported into HawkEye in four ways:

- 1) Right-click on the .SAY file in Windows without having to open it, and select "Copy," then in HawkEye right-click in the Data Tree and select "Paste .SAY surveys." It will appear in the current slot you are in. NOTE: This method works with EDM files as well as WinServe .SVY files.
-OR-
- 2) Drag the .SAY file from Windows and drop it into the 3D space in Windows. It will automatically appear under the current slot you are in.
-OR-
- 3) Go to File and select "Import WinServe .SAY File, select the file from the explorer and it will appear as a curve under the current slot you are in.
-OR-

- 4) Open the .SAY file in Excel (delimited with spaces) and then copy the MD, INC and AZM columns. Right-click in the 3D space in HawkEye and choose one of the pasting options highlighted in green.

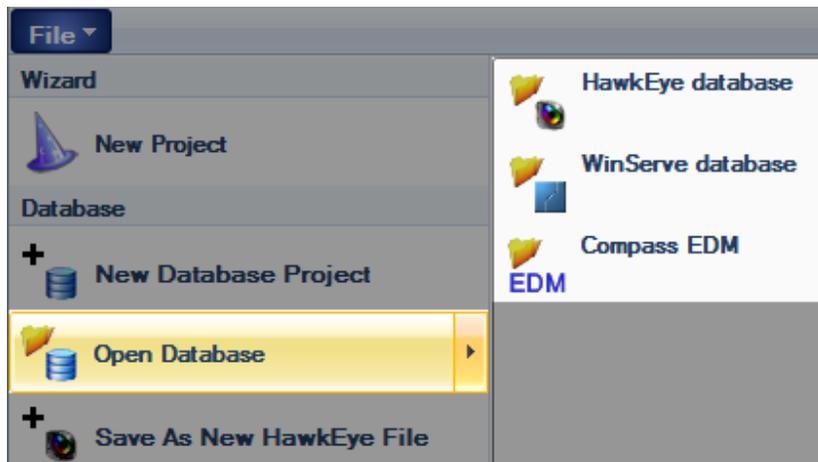
3. Importing and Exporting

Worthy of special mention in the curve right-click contextual menu are the **Export** and **Import** options. (Also found in the File Menu on the top left). Surveys can be exported to five types of files. NOTE: Any additional standard formats that may be required can be included per request by the user.

- a. **.SAY files** – A special survey format that works with PDT's other survey products, WinServe™ and WinSurv2™.
- b. **MMS files** – A special survey format that for the Mineral and Mines Service in the United States.
- c. **DIMMS files** – A special file format to supply survey data to DIMMS, a Landmark rig reporting system.
- d. **Compass™ files**- The import options on the menu should be fairly obvious. However, one very important option is not on the menu and that is the import of a Compass™ transfer file.
- e. **CSV files** – Comma Separated Values files that can be easily imported into spreadsheets and databases.

d. Importing Compass or WinSERVE Projects

- 1) **From the File Menu:** Open the File menu on the top left and select “Open Database.” Choose the file format and open the file.



- 2) **Drag and Drop:** Importing a project file from a WinSERVE™ or Compass™ file is also done by dragging and dropping. Simply drag the file (either .svy or edm.xml format) from the folder into the 3D space in HawkEye and drop it in. HawkEye will automatically parse out any and all curve, target, casing and other project information, and create new project data at whatever level the data contains. (e.g. If an edm.xml file has only curve information, then HawkEye will only create a new curve with that information, not an entirely new field/project/platform/slot).

2. Editing Critical Info

a. Job Data



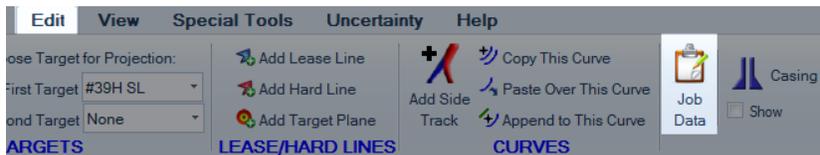
Job data is used for several reasons:

- Job data is where WinSURV2™ and HawkEye™ communicate
- Job data is displayed in report headers
- Job data is displayed in wall plot headers

EDITING JOB DATA:

When a project is started through the Project Wizard, the “Job Information”

button is one of the four steps. However, a user can change job information at any time by clicking on the “Job” icon at under the “Edit” tab.



Note the very top line of the Job Information dialogue, “Curve Name.” This indicates which curve is being referenced, and can be changed in the main interface by changing the current curve.

If you want to go from a proposal curve to a work curve, remember to switch to Proposal Mode. The Mode toggle is in the Home.

Job Information

Curve Name: **As-Drilled**

Job ID: 1 Get From Winsurv2

Available BHAs: 0

Company:

Lease / Well:

Location:

API JOB #:

Rig Name:

State/Province:

County/Parish:

Country:

Comment:

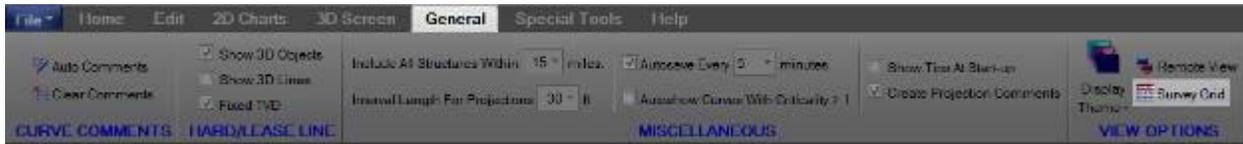
GET FROM WINSURV2: Once the right curve is selected, then a Job ID can be selected. If a job has already been created in WinSURV2™, just select the “Get From Winsurv2” box and the dropdown list for Job ID will be populated with all of your WinSurv2™ jobs.

This will not only retrieve any job header information from a WinSurv2 job, but it will also bring in all BHA lists from that job, as well as slide records. The BHA records can be used by turning on the “BHA ID” in the Survey List Panel (right-click on the survey list header and select “Grid Manager” to add the column, and then using the pulldown menu to associate a particular BHA with a particular survey.

Slide information can be used in HawkEye by grabbing it from WinSurv2 as described above, and then turning on “Show Sliding” under the 3D Screen tab.

COPY TO WINSURV2: You may fill out this job information form and send it to WinSURV2™ as a new job. It will appear in WinSURV2™ as a new job containing all of the information that you entered in HawkEye™.

The full spread of data in the survey window is extensive, offering 47 different types of data for each survey entry. Customize the columns by selecting the Survey Grid button:



The following is a list of the data displayed for each survey:

List of Survey Data Columns				
No.	BHA ID	MD	Azm Deg	Inc Deg
NS	EW	TVD	Closure Dir Deg	Closure
Comment	NN (ft ²) *	EE (ft ²) *	VV (ft ²) *	NE (ft ²) *
NV (ft ²) *	EV (ft ²) *	HH (ft ²) *	LL (ft ²) *	AA (ft ²) *
HL (ft ²) *	HA (ft ²) *	LA (ft ²) *	Minor	Major
Vertical	Minor Azm Deg	HLA Major	HLA Minor	HLA Depth
HLA Azm Deg	Survey Type	Subsea	DLS °/100	Build Rate °/100
Walk Rate °/100	VS	TFA Deg ⁺	Easting	Northing
Latitude Deg	Latitude DMS	Longitude Deg	Longitude DMS	RKB
CL	BHA ID			

* Measurements may be in feet or meters, depending on project settings.

⁺ TFA stands for Tool Face Angle and is the same as TFO.

ADDING SURVEYS ONE BY ONE: Click the blue plus icon on the far left in the Home tab to open the Survey Editor. In this dialogue all of the surveys for the currently selected well will appear, and several of their parameters may be edited.



The primary way to add a survey is, once inside the Survey Editor, type the Measured Depth, press ENTER, then type in the Inclination, press ENTER, and then type in the Azimuth and press ENTER. After the third “ENTER,” your new survey will have been created.

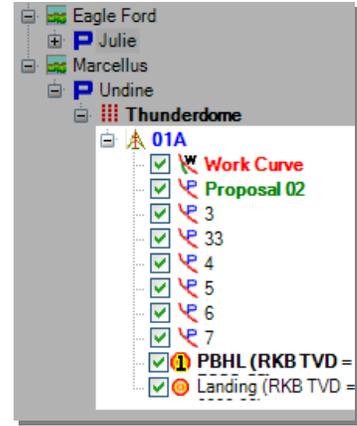


c. Slot/Wellheads

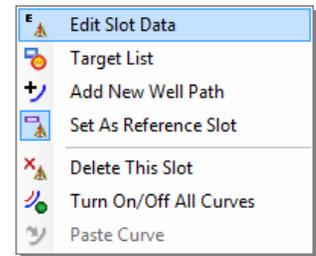


The Slot/Wellhead is the most-used data level of a given project. All curves and targets are associated under a given slot/wellhead at any given time. The slot/wellhead in HawkEye is represented with a “rig” icon.

A platform/pad will contain as many slot/wellheads as are needed, and only lithology information, target planes and hard/lease lines are associated to a platform/pad.



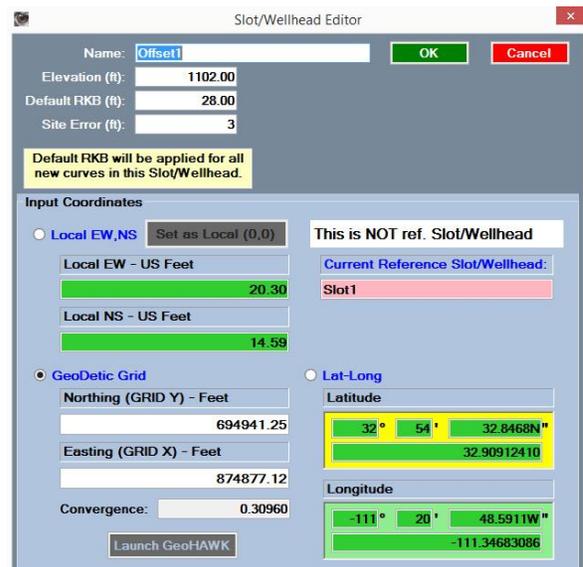
RIGHT CLICK ON THE SLOT/WELLHEAD: To change slot/wellhead information, right-click on the rig icon in the Data Tree and select “Edit Slot/Wellhead Data.” Notice that the right-click menu for slot/wellheads has virtually everything you will need which is slot/wellhead-related. Only from this right-click menu can you do the following:



- Edit Slot/Wellhead Data (also from large icon, see below)
- Add New Well Path
- Set slot/wellhead as the reference slot/wellhead
- Delete the slot/wellhead

EDIT SLOT/WELLHEAD INFORMATION: When “Edit Slot/Wellhead Data” is selected, it will open the Slot/Wellhead Information dialogue.

You may also get to the *current* slot/wellhead’s information by clicking on the large rig icon at the top of the screen. The Slot/Wellhead Information dialogue has all of the location information associated with that slot/wellhead.



SLOT/WELLHEAD NAME: This is the only place where the name of the slot/wellhead can be changed besides initially in the Project Wizard or the Platform/Pad Manager (Well Planning Version only).

INPUT COORDINATES: All of the parameters inside of the green background are used to define the slot/wellhead's location, either by local coordinates, Northing and Easting coordinates, or Lat-Long coordinates.

CONVERGENCE: This value is derived from the location data of the slot/wellhead, and indicates the number of degrees difference between grid north and true north. This number is also displayed in the Geodetics dialogue when defining surface location.

LAUNCH GEOHAWK: When the "Launch GeoHAWK" button is clicked, it launches a special version of the Geodetics dialogue. In this special version, the user cannot change any surface location data (highlighted on the right). Only the specific location data for the slot/wellhead can be altered.

The point of GeoHAWK is to utilize the power of the Geodetics dialogue, which uses Google Maps and Google Earth (if installed), for slot/wellheads. In this fashion, slot/wellhead location can be defined, visualized and mapped out with great precision.

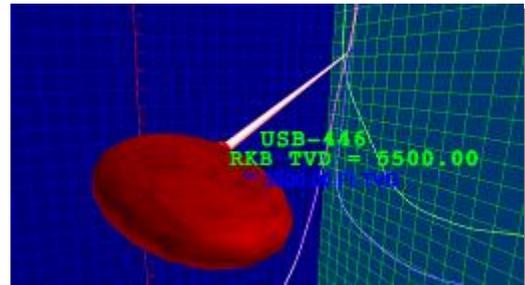
d. Targets (regular)



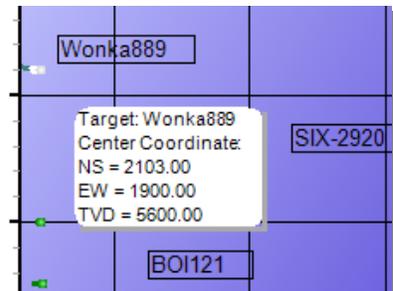
1. Creating and Managing Targets

Targets in HawkEye™ have several important functions: to act as designation points for the so-called targeted projections (Slant, Aligned, BOT and Horizontal, explained in Ch. 4 Projections), to serve as visual aids in the 2D and 3D space as representations of , and to act as placeholders or bookmarks in an active work space.

IN 3D SPACE: Targets appear in the 3D space by way of their own parameters which define appearance, orientation and location. They do not follow curves or other platform/pads and their specific parameters must be re-defined in order to be moved around or changed in any way.



IN THE 2D VIEWS: The targets appear in the Vertical Section and Top Views on the right hand windows of the default screen. Their labels can be customized in the Graphics Properties panel, which can be accessed by clicking on the top left icon  in either 2D window.



The target labels can be moved around in the 2D windows simply by left-clicking and dragging them.

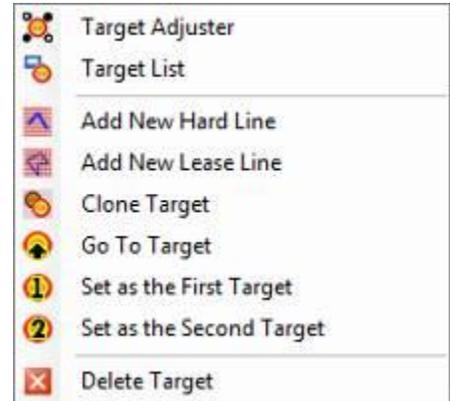
Any target can be right-clicked on in the 2D views to pull up a quick synopsis of critical target information.

IN THE DATA TREE: Targets  can be found in the Data Tree where they are associated with a particular slot/wellhead. When the Quick Start Wizard is used to start a new project, the Wizard will create a single default target under the default slot/wellhead. Otherwise, a target must be added manually. Any new target can be found in the Data Tree as well as the Target List. They are associated with the slot/wellhead under which the current proposal curve is located.

ADDING TARGETS: There are several ways to add a target to a project:

1.  **Add Target:** Click this icon, which is located on the Home tab. The target appears at a default shape and size at 5000 TVD.
2.  **In the Target List:** Click on the Target List in the Home tab to add multiple targets. (More on the Target List later in this chapter).
3.  **In the Curve Menu:** Right-click on any curve and select “Create Target at This Point” and the target will appear at that exact point (ONLY for Proposal Curve).
4.  **In the Crosshairs Menu:** Right-click on the red Crosshairs and select “Save as Permanent Target.” It will appear in that exact spot. (More details under subsection on Crosshairs in Ch. 3 Projection Tools).
5. **In the Survey List Grid:** Select a survey in the list grid of surveys at the bottom of the main screen. Then press Shift+T. This will create the target instantly at that survey station.

TARGET RIGHT-CLICK MENU: The target contextual menu is pulled up by right-clicking on a target name in the Data Tree or the target in the 3D space. All of the primary functions of the target can be found in this right-click menu.



- TARGET ADJUSTER:** This option in the right-click menu will open the TARGET ADJUSTER panel, which is the primary main screen platform for editing targets. This control panel is explained in detail in the next subsection.
- TARGET LIST:** This option in the right-click menu invokes the TARGET LIST, which is a comprehensive, interactive list of all targets in a project and includes the TARGET ADJUSTER PANEL. This control panel is explained in detail in one of the following subsections.
- ADD NEW HARD LINE:** This will first prompt the user to enter a name for the new hard line, then that hard line will appear in the Data Tree. To edit the hard line coordinates, RIGHT-CLICK on the hard line in the Data Tree and select “Edit Hard Line Coordinates.” For more information on hard lines, see the section following this one.
- ADD NEW LEASE LINE:** This will first prompt the user to enter a name for the new lease line, then that lease line will appear in the Data Tree. To edit the lease line coordinates, RIGHT-CLICK on the lease line in the Data Tree and select “Edit Lease Line Coordinates.” For more information on lease lines, see the section following this one.
- CLONE TARGET:** Select this option in the right-click menu to duplicate the target and all of its parameters. The depth is automatically made 100 length units deeper than the target being cloned, so this will probably need to be changed along with the target coordinates.
- GO TO TARGET:** This right-click option is a navigation tool for the 3D space. It will take the Look-at Point or current point of view and center it on the

selected target. This is useful for zooming around and getting spatially adjusted in the 3D space quickly.

- **SET AS THE FIRST TARGET:**  This right-click option is a critical tool in using the targeted projections. Under any platform/pad, there is only one designated First Target at a time. Any target can act as the First Target as long as it is designated as such. When it is set, the First Target is a designation point for the projection calculations of Slant, Aligned, BOT and Horizontal projections. If any of these projections are attempted without a First Target, HawkEye™ will prompt the user to set a First Target before continuing.
- **SET AS THE SECOND TARGET:**  This right-click menu option is used only for Aligned Projections, which may require a second registered target for certain calculations. When a Second Target is required yet not set, HawkEye™ will prompt for the designation of one.
- **DELETE TARGET:**  This option will instantly delete the target from the database. NOTE: To make a target invisible but retain it, just select “Hide” from the right-click menu or uncheck its box in the Data Tree.

HORIZONTAL TARGET RIGHT-CLICK MENU: You can create a horizontal target by clicking on the large Target icon in the main screen and selecting

“Add Target Plane.” 

Then right-click on the target plane either in the 3D space or the Data Tree. The menu is almost identical to the normal target right-click menu, except that here you can also designate the target plane as the “Horizontal Target Plane,” which is used with the Horizontal Projection.

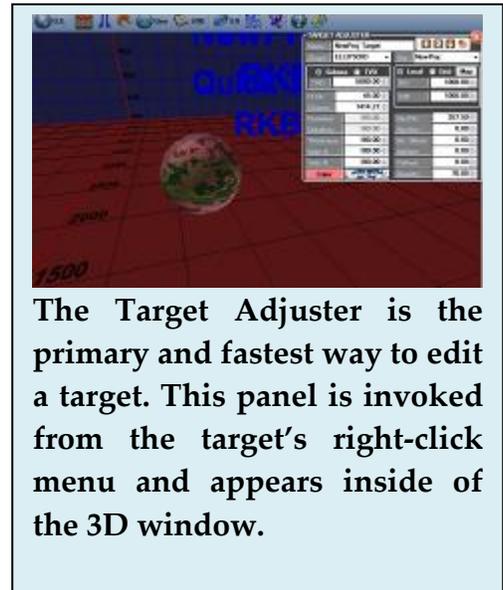
2. Target Adjuster

The panel that appears inside of the 3D space to the right contains all of the parameters associated with a target. Its name, assigned slot/wellhead, color, texture, general shape, orientation and location can all be changed through this panel.

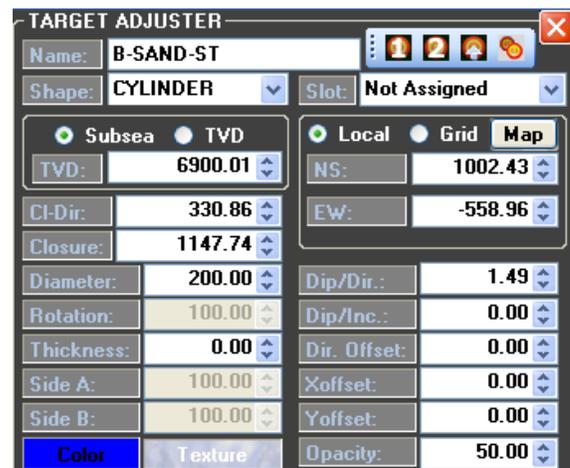
Pull up the Target Adjuster by right-clicking on a target in the Data Tree or 3D space and selecting “Target Adjuster.”  This panel will also always appear in the TARGET LIST, which is a panel explained in a following subsection.

The top four icons in the Target Adjuster are the same options found in the right-click menu:

Set as First Target, Set as Second Target, Go to Target and Clone Target.



NAME, SHAPE, SLOT: The next three fields allow the user to edit some critical information. The “Name” field is an open field and the target can be called anything. The “Shape” drop-down menu will instantly shape the target into one of several default 2D or 3D shapes: cylinder, cube, polygon, circle, ellipse, square, circle, ellipsoid, point and other. The “Slot” drop-down menu contains all slot/wellheads in a platform/pad to choose for a target’s assignment.



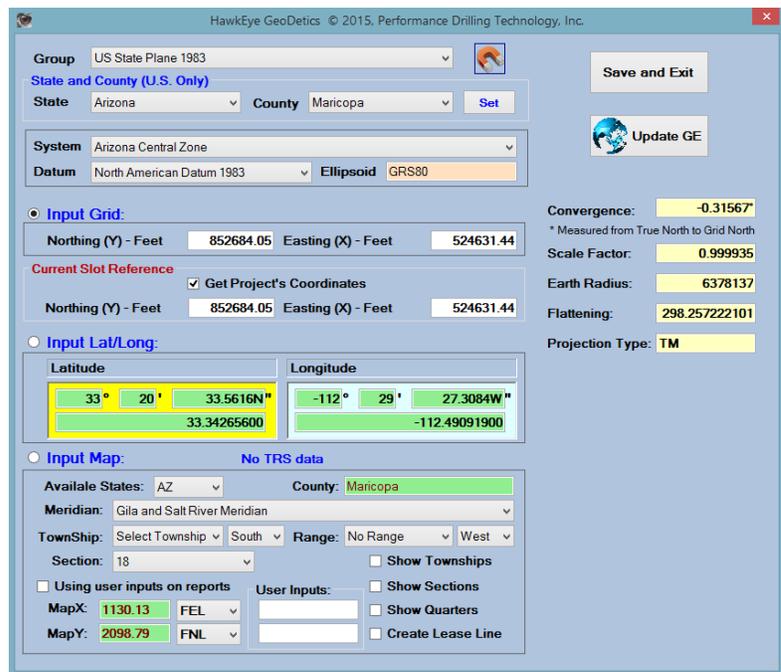
TVD: A Total Vertical Depth can be entered manually, and must either be defined as a subsea or an RKB TVD.

COORDINATES: The coordinates for the target are either Local or Grid and the NS and EW values can be input manually.

MAP: The “Map” button will invoke a separate control panel in which specific, advanced location data can be entered for the target. The target “Map” panel will allow the user to control specific coordinate and mapset information.

The magnetics icon in the top left will launch the Magnetics dialogue, which controls the magnetics adjustment data for the entire project. This can also be launched from the main screen through the same icon at the top.

Group, System Zone and Datum are displayed, but not editable. These can only be changed at the Project level, through the Geodetics dialogue.



The Current Slot/Wellhead Reference box allows the retrieval of a project's coordinates; this can only be changed at the Slot/Wellhead level by selecting the desired slot/wellhead, and then right-clicking and selecting the Set as Reference option.

“Launch Google Earth”: This launches an instance of the Google Earth program loaded with the current coordinates. If the Google Earth program is already running separately, this button will send the program the current geodetic information. Coordinates can be entered either by Grid coordinates or Lat/Long coordinates. Select the option first and enter the values.

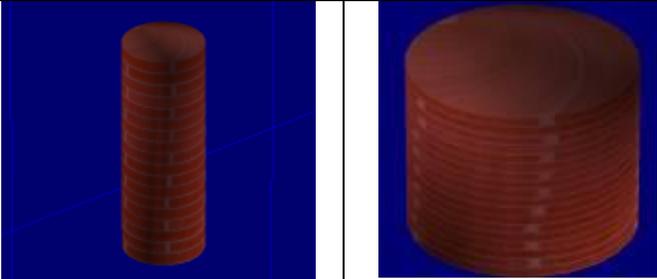
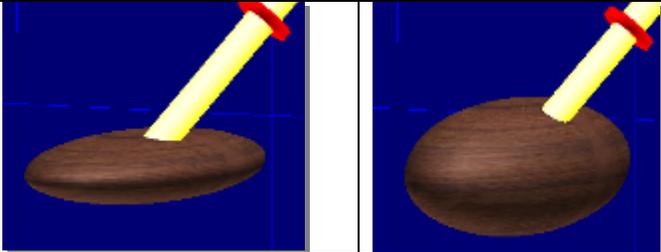
At the bottom, several more parameters are displayed which are relevant to the grid system being utilized. They are not editable. Below, a brief description of what each parameter is.

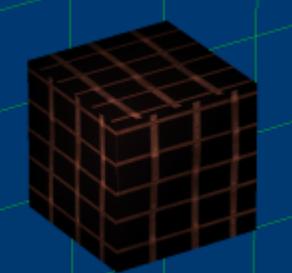
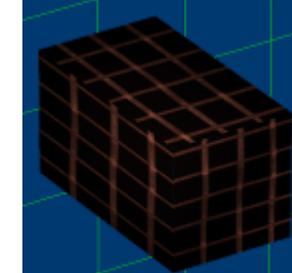
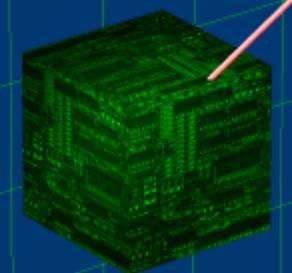
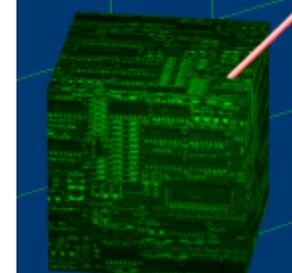
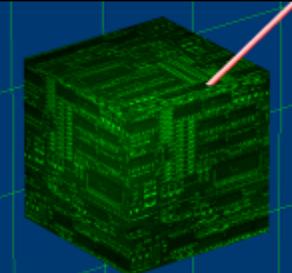
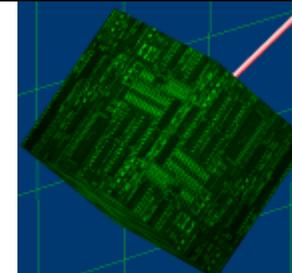
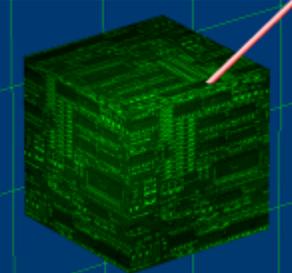
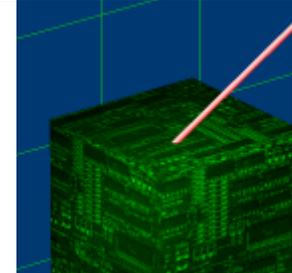
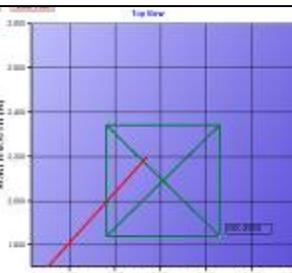
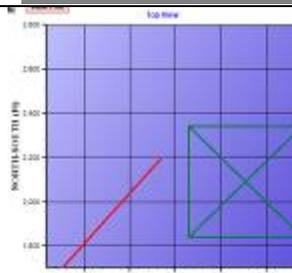
- **Convergence:** The angle of difference in degrees between grid north and true north. This is measured from True North to Grid North.
- **Scale Factor:** The error associated with the map projection as a result of approximating the surface of the earth as a plane instead of the curved surface it actually is.
- **Projection Type:** This is the type of mathematical projection system used. Nearly all systems utilized are either Lambert or Transverse Mercator. Many

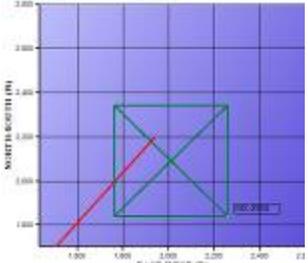
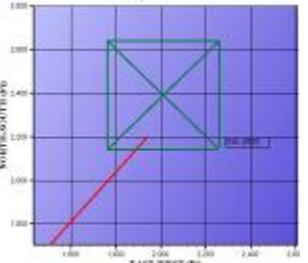
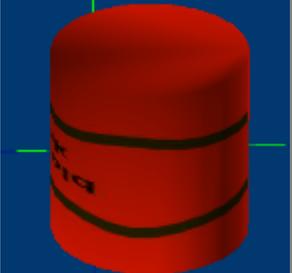
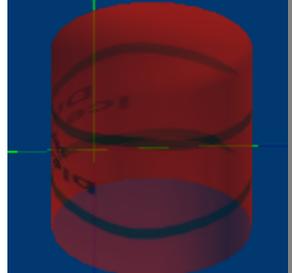
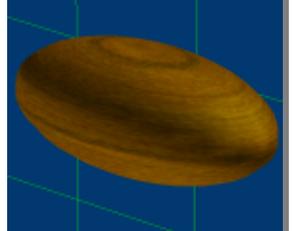
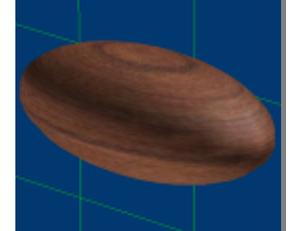
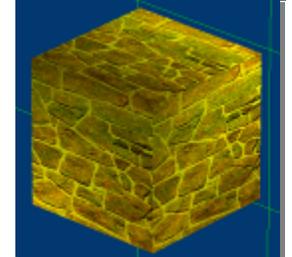
projections systems are used in cartography, but most legal systems around the world involve at least a variation of one of the two mentioned systems.

- **Earth Radius:** This is the radius from the earth’s equator to the center of the earth.
- **Flattening:** This is a mathematical constant representing the amount of flattening the earth has as a result of its rotation. The earth is not completely spherical mostly because of the fact that at the equator it is moving 1000 miles an hour and the centrifugal force causes the earth to bulge at the equator.

The remaining parameters in the Target Adjuster can be changed by the drop-down menu arrows in increments of 1, or values may be manually entered to any specificity unless otherwise noted. Length units are either in feet or meters, depending on which unit is chosen for the project.

CL-DIR: Direction from the surface location to the Target center	
CLOSURE: Horizontal distance from the surface location to the target center	
DIAMETER: Controls the total width of the circular ends (of cylinders only).	
ROTATION (THICKNESS): This parameter does not apply to any shapes, but in its place “Thickness” appears when a hardline or leaseline is selected.	
THICKNESS: This controls the amount of vertical space which the target occupies. (Not applicable to 2D shapes.)	

<p>SIDE A AND B: These two parameters control the length of the default x-axis and y-axis sides of a non-circular shape. (Side B is not applicable to 2D shapes.)</p>		
<p>DIP/DIRECTION: This controls the degrees in which the target is turned from its geometric center (i.e. its azimuth). Pictured is 0 and 45 degrees, with the target rotating clockwise.</p>		
<p>DIP/INCLINATION: This controls the degree of tilt that the target shape assumes. Pictured is 0 and 45 degrees, with the top of the target tipping to the left.</p>		
<p>DIR. OFFSET: This controls the directional offset of the target, which is the distance along the hole, up or down. Pictured is 0 and -200, where the target appears to drop in elevation.</p>		
<p>X OFFSET: This value, in units of length, displaces the target off of its defined location on the X-axis. Pictured is the Top View and an X Offset of 300.</p>		

<p>Y OFFSET: This value, in units of length, displaces the target off of its defined location on the Y-axis. Pictured is the Top View and an Y Offset of 300.</p>		
<p>OPACITY: This controls the translucency factor of the target, ranging from 5-100.</p>		
<p>COLOR: Although the entire palette of colors is available for targets, there may be discoloration depending on the underlying texture chosen for that target.</p>		
<p>TEXTURE: A wide variety of default textures are available for the targets. In addition, user textures can be selected from the file explorer on the top left of the dialogue.</p>		

3. Target List

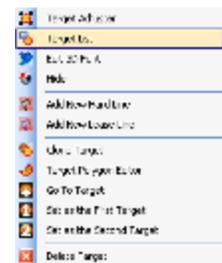


The Target List is the comprehensive control center for all targets associated under a slot/wellhead or platform/pad. It includes the Target Adjuster within it.

The screenshot shows the 'Target List' window. On the left, there are controls for 'Targets On' (Current Slot, Current Structure), 'Sort By' (TVD, Closure Distance), and a 'Show TARGET ARRAY' checkbox. The 'TARGET ADJUSTER' panel in the center allows for adjusting target parameters like Name, Shape, TVD, NS, EW, etc. Below this is a table with columns: Target Name, Target Shape, RKB TVD, Subsea TVD, N-S Coordinate, E-W Coordinate, Closure Direction, Closure Distance, INC From Last Target, AZM From Last Target, Slot, and Visible. The table lists targets like 'intermediate', 'KOP', 'Landing', 'PBHL', and 'Landing 2'.

<input type="checkbox"/> Check All	Target Name	Target Shape	RKB TVD	Subsea TVD	N-S Coordinate	E-W Coordinate	Closure Direction	Closure Distance	INC From Last Target	AZM From Last Target	Slot	Visible
<input checked="" type="checkbox"/>	intermediate	CYLINDER	3609.93	2479.93	-11.35	-12.69	228.1932	17.03	0.0000	0.0000	Slot1	<input checked="" type="checkbox"/>
<input type="checkbox"/>	KOP	CUBE	5099.70	3969.70	-18.01	-17.23	223.7374	24.92	0.3099	214.2896	Slot1	<input checked="" type="checkbox"/>
<input type="checkbox"/>	Landing	CYLINDER	6350.02	5220.02	-913.05	-63.52	183.9798	915.26	35.6334	182.9607	Slot1	<input checked="" type="checkbox"/>
<input type="checkbox"/>	PBHL	CYLINDER	6450.02	5320.02	-6257.68	4988.45	141.4391	8002.70	89.2210	136.6124	Slot1	<input checked="" type="checkbox"/>
<input type="checkbox"/>	Landing 2	CYLINDER	6450.02	5320.02	-912.42	-73.38	184.5982	915.36	90.0000	316.5600	Slot1	<input checked="" type="checkbox"/>
<input type="checkbox"/>									170.2373	4.5982		<input type="checkbox"/>

OPEN THE TARGET LIST: Access the Target List by right-clicking on a target in either the Data Tree or the 3D space, then selecting “Target List.” Or press “T” when the cursor is hovering over the 3D space. Regardless of the target clicked on, the Target List will display data on an entire slot/wellhead or entire platform/pad’s target array.



TARGETS ON: Choose either “Current Slot/Wellhead” or “Current Platform/Pad” to select the range of targets to be displayed in the list below.

SORT BY: Organize all displayed targets by either “TVD” or “Closure Distance.”

SHOW TARGET ARRAY: This toggle will turn on the “Target Array” fields, which allow the user to select any sequence of targets for multiple-target projection setups. Such a setup can only be taken advantage of in the HawkEye™ Command interface. See the section on HawkEye™ Command (Ch. IV. Section 4) for more details.

PARAMETERS: Targets are defined in the List across 11 parameters, each of which can be changed in this panel. The order of the columns is not changeable.

Target Name	Target Shape	TVD ▲	N-S Coordinate	E-W Coordinate	Closure Direction	Closure Distance	INC From Last Target	AZM From Last Target	Slot	Visible
-------------	--------------	-------	----------------	----------------	-------------------	------------------	----------------------	----------------------	------	---------

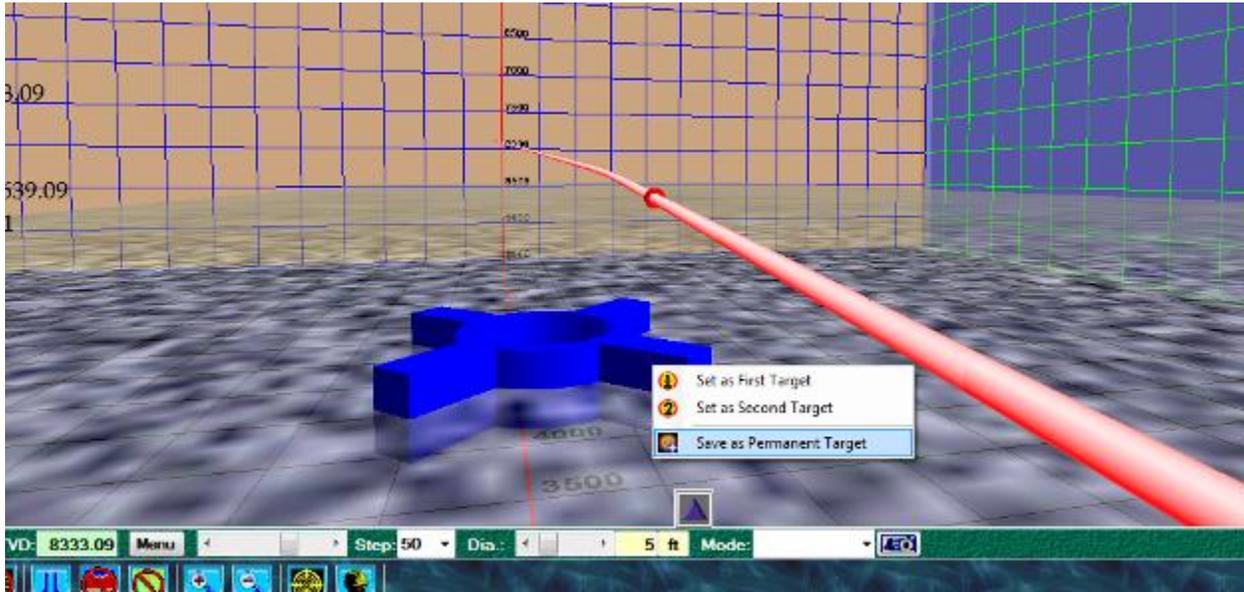
TARGET ADJUSTER: The Target List contains the Target Adjuster within it. As described in the previous sub-section, simply click on the name of the target in the list and its specifics will appear in the Target Adjuster panel above, where they can be changed.

4. Target Array



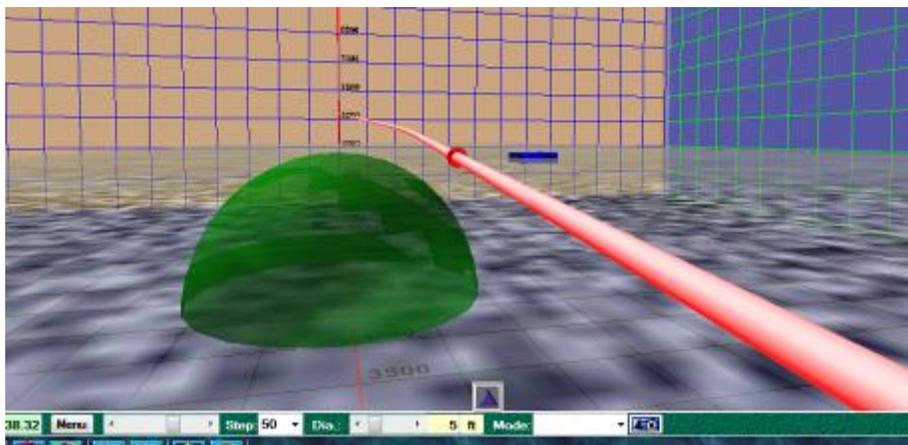
The Target Array is used only in a specific projection sequence in which a number of targets are hit with a series of tie-ins that are created simultaneously in the Proposal mode. See the section on HawkEye™ Command (Ch. IV. Section 4) for details.

CREATE A TARGET ON THE TARGET PLANE: You can create a target directly centered on the plane by grabbing the blue “handle” that is located at the center of every target plane. Simply drag the blue handle to the place on the plane where you would like the target to be generated, then right-click on the handle and select “Save As Permanent Target.”



To get the exact location you want before making this target, check your Handle Coordinates which appear when you drag the handle around. The Handle Coordinates are located on the top right inside the 3D window.

When a new target is created, the blue handle resets to the middle of the target plane for future service.



f. Geodetics (Surface Location)

Accurate mathematical positioning of a well site and the associated targets, lease lines, hard lines and offset wells is extremely important in any drilling operation. With directional drilling the need for accurate positioning is enhanced not only by concerns for the drilling operation with regard to no-drill zones that are defined by hard lines, but also legal concerns that are defined by lease lines. This is true all around the world, of course, but in the U.S. where many wells are drilled to the benefit of many mineral rights owners, this knowledge is even more vital.

Thus, it is important for drilling engineers, geologists and directional drillers to have a functional understanding of the mapping system being employed for their well. The following sections will briefly describe the systems most widely used, first in the U.S. and second in the rest of the world. For anyone interested in expanding their knowledge about geodetics in general, a few hours poking around on the internet can lead to a very interesting learning experience. A good place to start is with www.wikipedia.com.

1. Geodetics Systems Generally

STATE PLANES and the PLSS SYSTEM: If working in the U.S., then you will likely be working with one of the State Planes or Township-Ranges-Sections or both. HawkEye™ does not have support for all states that use the PLSS system, but does fully support the original western states that adopted the system. In some states like Louisiana, Oklahoma and Florida, there are modified TRS systems being used, but available digital information can't be immediately utilized by HawkEye™ because it is not in a standard format. Eventually PDT will convert these non-standard formats for use in HawkEye™.

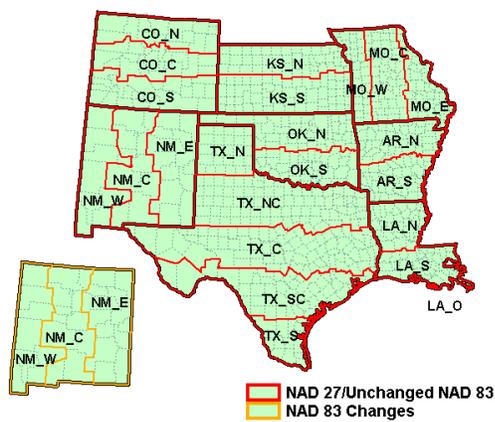
STATE PLANE COORDINATE SYSTEM

“The State Plane Coordinate System (SPS or SPCS) is a set of 124 geographic zones or coordinate systems designed for specific regions of the United States. Each state contains one or more state plane zones, the boundaries of which usually follow county lines. There are 110 zones in the continental US, with 10 more in Alaska, 5 in Hawaii, and one for Puerto Rico and US Virgin Islands. The system is widely used for geographic data by state and local governments.

Its popularity is due to at least two factors. First, it uses a simple Cartesian coordinate system to specify locations rather than a more complex spherical coordinate system (the

geographic coordinate system of latitude and longitude). By thus ignoring the curvature of the Earth, "plane surveying" methods can be used, speeding up and simplifying calculations. Second, the system is highly accurate within each zone (error less than 1:10,000). Outside a specific state plane zone, accuracy rapidly declines, thus the system is not useful for regional or national mapping.

"Most state plane zones are based on either a transverse Mercator projection or a Lambert conformal conic projection. The choice between the two map projections is based on the shape of the state and its zones. States that are long in the east-west direction are typically divided into zones that are also long east-west. These zones use the Lambert conformal conic projection, because it is good at maintaining accuracy along an east-west axis. Zones that are long in the north-south direction use the Transverse Mercator projection because it is better at maintaining accuracy along a north-south axis. The panhandle of Alaska, whose maximum dimension is on a diagonal, uses an Oblique Mercator projection, which minimizes the combined error in the X and Y directions."³



The figure to the left illustrates an eight-state region showing the NAD27 and NAD83 zones for the SPSC. The dashed lines are county lines. The dark orange lines within the states are the NAD27 zone lines and the light orange lines are the NAD83 zone lines. In this example, only New Mexico has any changes between the two datums. (NAD27 and NAD83) Within each of these zones there is assigned a specific projection method, along with specific references from which grid coordinates are measured.

One common problem in well planning is knowing which zone a surface location is in. Of course the operators should already have recorded this, but more often than not it is not recorded in any immediate records, so it is left up to the well planners or directional drillers to figure it out for themselves.

HawkEye™ makes this very easy; all you need know is what county your surface location is located in, something that is commonly recorded in many records.

³ From Wikipedia.com

PLSS (Public Land Survey System) SYSTEM

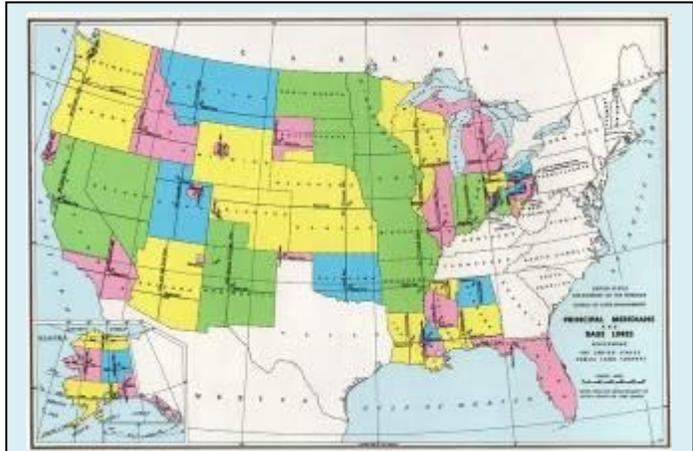
“The [PLSS] system was created by the Land Ordinance of 1785. It has been expanded and slightly modified by Letters of Instruction and Manuals of Instruction, issued by the General Land Office and the Bureau of Land Management and continues in use in most of the states west of Pennsylvania, south to Florida, Alabama, and Mississippi, west to the Pacific Ocean, and north into the Arctic in Alaska.”⁴

States with complete BLM (Bureau of Land Management) coverage

Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming

States with limited BLM coverage

Alabama, Arkansas, Florida, Illinois, Indiana, Kansas, Michigan, Minnesota, Mississippi, Missouri, North Dakota (central and western portions are covered), Ohio, Oklahoma, South Dakota (western part is covered).



Map shows the PLSS coverage in the US (from Wikipedia).

This mapping system was designed to help map out the uncharted territories in a general mathematical way. Numerous meridians were established that are the origins from which Townships and Ranges are measured. They are the black cross hairs seen on the above map. The map is divided up, as a general rule, into 36 one mile square blocks referred to as Townships (not shown) and each square mile is referred to as a Section. Sections are commonly divided into quarter sections and quarter-quarter sections and so on. Now, if you have been involved with surveying for long it shouldn't be much of a surprise to find out that there are exceptions to the 36 square mile rule. There are lots of exceptions, in fact. The boundaries of townships that butt up to a river or a state border are truncated. Sections, in some rare cases, can actually have the same number in the numerical reference system, but not be connected. Let's not stop with the confusion there. The coordinate that measures North or South of the meridian reference line is called Township and the east-west coordinate is called Range. So, a Township's location nomenclature is defined by a (Township, Range) coordinate which seems a bit confusing, but only because two different things are being called by the same name.

⁴ From Wikipedia.com

Geodetics in the Rest of the World

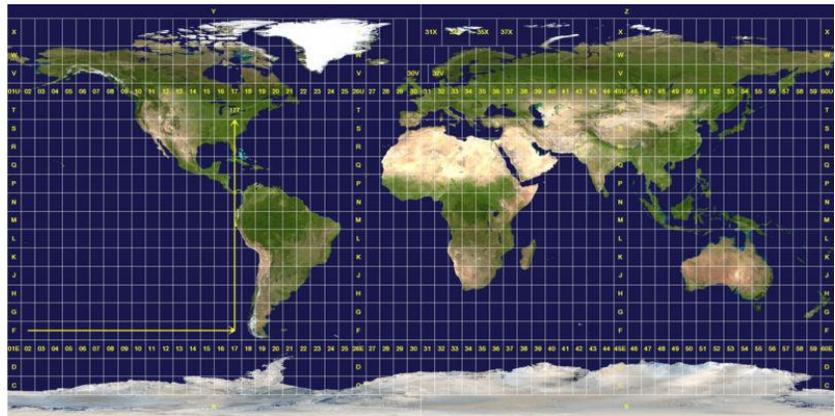
Different countries employ different systems and datums depending upon the particular history of the given country. Each surface location should specify either grid coordinates, and the associated zone, or the geographic latitudes and longitudes down to the 5th or 6th decimal place in seconds. HawkEye™ can accommodate most systems used in the oil industry.

Generally, by selecting the Group, System Zone and datum, one can set up the grid mapping system for most places in the world where the oil field operates. The most common mapping system used in the world is the Universal Trans Mercator, or UTM. HawkEye™ divides this system into two groups, the Northern Hemisphere and the Southern Hemisphere. The diagram below illustrates how the UTM overlays the world.

“The Universal Transverse Mercator (UTM)

coordinate system is a grid-based method of specifying locations on the surface of the Earth that is a practical application of a 2-dimensional Cartesian coordinate system. It is a horizontal position

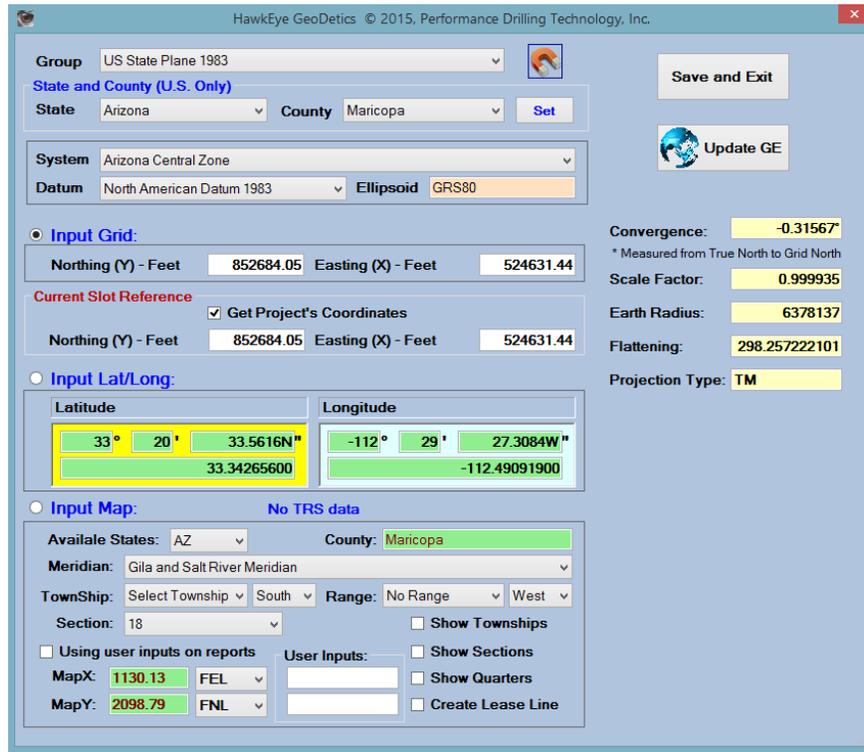
representation, i.e. it is used to identify locations on the earth independently of vertical position, but differs from the traditional method of latitude and longitude in several respects.



“The UTM system is not a single map projection. The system instead employs a series of sixty zones, each of which is based on a specifically defined secant transverse Mercator projection.”

HawkEye’s ability to display a map with Google Earth or Google Maps is a useful tool for many reasons, but one of the most important reasons is that if an input is incorrect such as a positive longitude instead of a negative longitude it will be pretty obvious if the map puts you in the middle of China instead of the US.

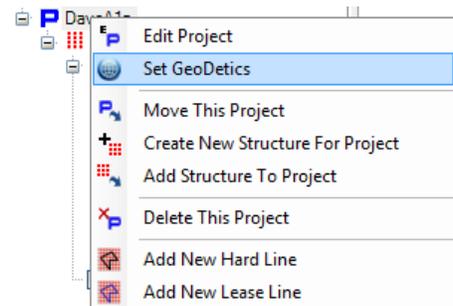
2. Geodetics in HawkEye



GETTING TO THE PROJECT GEODETICS:

Geodetics in HawkEye™ is handled from two different perspectives, for projects and for individual slot/wellheads. The main geodetics dialogue for projects can be accessed in three places:

- 1) By setting up the geodetics through the Project Wizard, or
- 2) At any time by right-clicking on the project in the Data Tree and selecting “Set GeoDetics,” or
- 3) By clicking on the Project Control Panel, then clicking the “Edit Project” button at the top, or
- 4) Clicking the “Edit” tab and selecting “Geodetics” on the far right

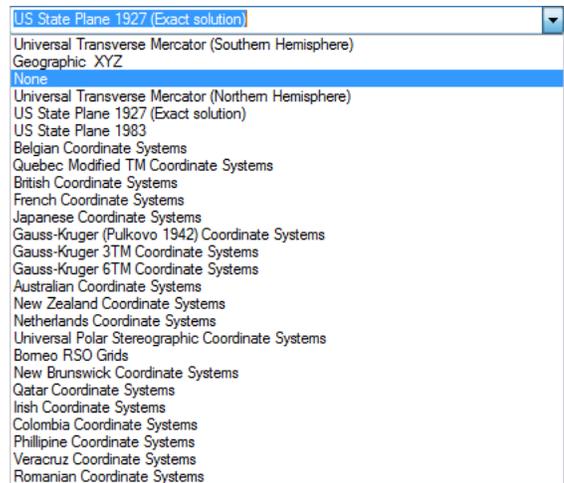


SLOT/WELLHEAD GEODETICS

The other perspective of geodetics in HawkEye is by slot/wellhead. To access a slot/wellhead's geodetics, be sure to have a well currently selected under that slot/wellhead, and then click the Slot/Wellhead Editor button at the top of the screen. This opens up the Slot/Wellhead Information dialogue (which can also be opened by right-clicking on the desired slot/wellhead  in the Data Tree and selecting "Edit Slot/Wellhead Data"). The Slot/Wellhead Editor is used to re-name a slot, as well as specify location data.

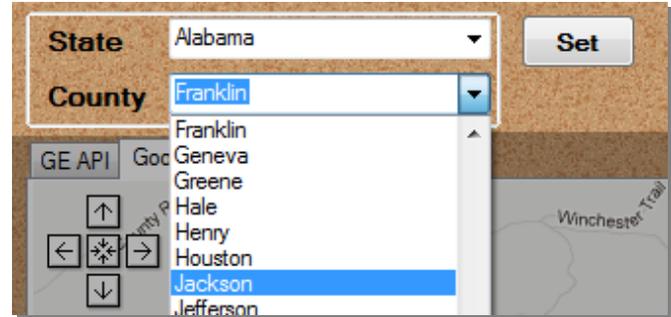
LAUNCH GEOHAWK: The purple button at the bottom of the Slot/Wellhead Editor launches GeoHAWK, which is almost exactly like the Geodetics dialogue except that the Group, System Zone, Datum and State/County cannot be edited. It is used to allow slot/wellhead location data to be tied in with the Google Earth interface.

CHOOSING A GROUP, OR NOT: When a new project is started with the Project Wizard, the user is prompted to set geodetics. At the very top left of the Geodetics box, the drop-down menu allows this. However, if the user does not yet have the geodetics data, the choice "None" can be selected. This will eliminate the display of the Easting/Northing and the Lat/Long fields in the Slot/Wellhead Editor dialogue, thereby making location interaction simpler, at least until the geodetics can be entered for the project later.



DON'T SWITCH IT UP: Since each of these above-mentioned groups has different sets of valid locations, switching between groups is not recommended. Conflicting coordinates as paired with invalid groups will likely crash HawkEye and you may lose all unsaved project data. Best bet is to put the geodetics information in right the first time.

SET STATE AND COUNTY: One powerful method available to help accelerate determining what the proper State Plane to use is the State/County-> Set tool. The control box is located in the upper central part of the Geodetics dialog. To use this, select the State and County where the rig site is located.



Then, be sure to click the **“Set”** button after selecting the desired county. You will note that the program has now automatically selected the proper State Plane and System Zone associated with that county. The coordinates that have been automatically entered for the Lats and Longs and Northings and Eastings are the default values for that county, normally the center of the county.

CHOOSE INPUT: You should select the radio button for either the INPUT GRID or INPUT Lat/Long and enter in the associated site values. The program will determine all corresponding numbers and if you are connected to the internet Google Maps and Google Earth will display the location in the Map tab to the right of the screen.

LAUNCH GOOGLE EARTH: Click the “Launch Google Earth” button to start the Google Earth program. HawkEye will load the current project’s information into Google Earth so that curves and lease/hard lines can be seen superimposed over Google’s satellite imagery.

3. Google Earth Support

HawkEye™ can superimpose the 3D curves of a project onto a Google Earth. Make sure to have the Google Earth program installed. Find the link to download the program for free at <http://earth.google.com>.

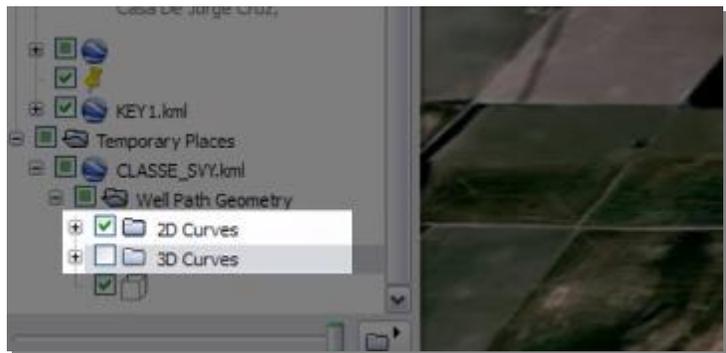
The Google Earth module will do two principle things. First, it will illustrate over a satellite image of the planet's surface any geodetically section information defined in a project. This boundary is illustrated with a green line and offset with a white line:

The second function of the module is to illustrate the scope and location of a project vis-à-vis its location in a zone. The project information that is displayed on the surface map appears to sit aboveground, although obviously any well would be underground.

The Google Earth module requires that Google Earth be installed. It will also require a live internet connection to run. Download the program for free at <http://earth.google.com>

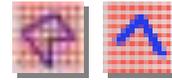
One major setting to keep in mind is the 2D and 3D Curves toggle, found in the bottom left options tree.

By turning on both 2D and 3D Curves, the image will display not only the image of the well with the bottom touching the surface and extending to the sky, but also a line of where the curve travels with respect to the surface.



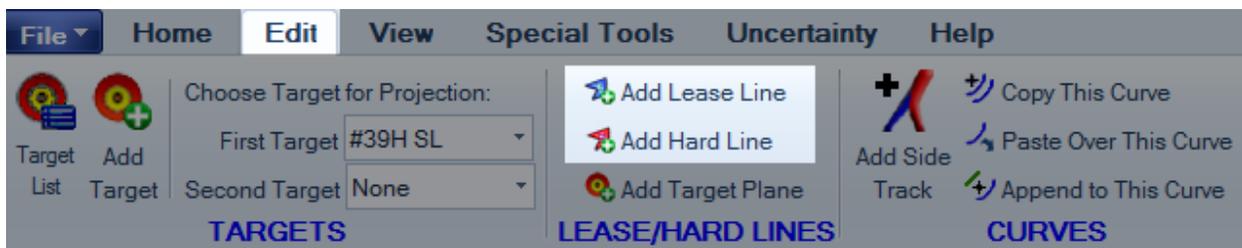
3. Editing Non-Critical Info

a. Hard Lines and Lease Lines



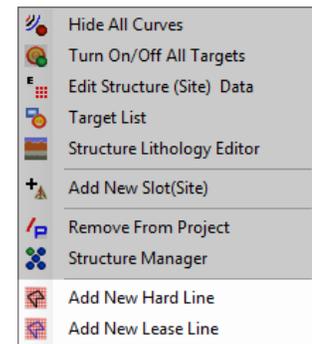
Hard lines are boundaries beyond which one does not wish to drill, a no-go zone. Lease lines are legal boundaries that often have to be visually incorporated into a well plan to illustrate how far the well is from the lease line or its offset line. For all practical purposes, HawkEye™ treats the creation of both lines almost identically for most practical purposes.

Add a lease or hard line by first clicking on the option in the “Edit” tab...



Or right-click on any Project **P** or Structure/Pad **||||** in the Data Tree and select the option at the bottom.

You will need to name the lease/hard line. Then find it in the Data Tree, right-click and select “Edit Lease/Hard Line Coordinates.”



TWO WAYS TO DEFINE LEASE/HARD LINES:

- 1) **IMPORT THE SPREADSHEET OR TEXT:** Lease line boundaries can be very complex. The data for building them normally comes from data a survey company the operator has utilized to specify the surface location of a well. If you can obtain a spreadsheet with the coordinates of the points specified in any one of several styles, you can cut and paste the data into the spreadsheet editor used to input hard/lease line data. **This is by far the easiest and best way to input this kind of data because it is very quick and it reduces the likelihood of input errors** that can be confounding with a long list of lease line coordinates.

The next best method to utilize is importing a delimited text file that has the data arranged in lines with the values separated by commas, tabs, or spaces. This process involves more steps than the first method but has the advantage of reducing input errors, same as the first method.

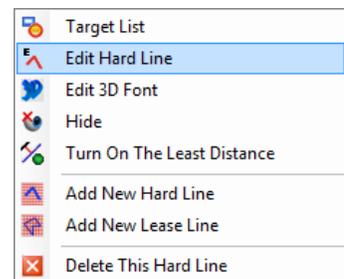
The first step is to copy the data from the spreadsheet or text. The data usually comes in one of several common formats: Local Coordinates, Grid Coordinates, Direction-Distance or DMS-Distance.

This will open up the Lease Line or Hard Line editor. Right-click in the table section on the bottom half of the editor and you will be given a number of choices on how to paste the data. **NOTE: How you paste the data here needs to match how the data was oriented in the original spreadsheet or text file.**

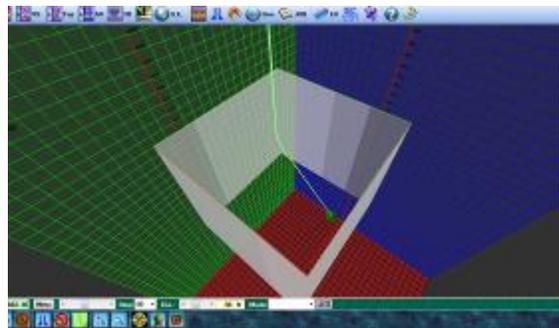
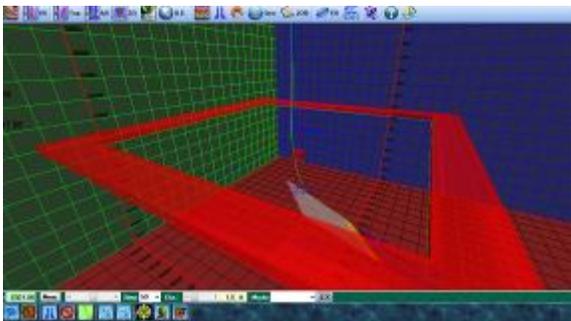
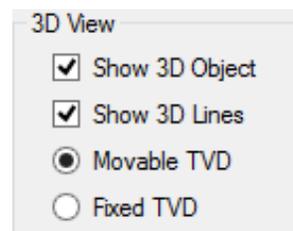
The first seven options when pasting in hard/lease line data are composed of two columns. The last option, DMS-Distance, is a five-column format. Choose the method of pasting and the data will import and get calculated. Each of the numbers are editable once entered in this fashion.



ADJUST THE LINE: There are two aspects to any hard/lease line: its coordinates and its 3D display properties. To edit a hard/lease line, right-click on the line in the Data Tree and select “Edit Hard Line” or “Edit Lease Line.”



SEE THE LINE IN 3D: To see the lease/hard line in the 3D space as more than just 2D lines, right-click on the lease/hard line in the Data Tree and select “Edit Lease/Hard Line Coordinates.” In the form that opens, you will find the 3D view options for that line.

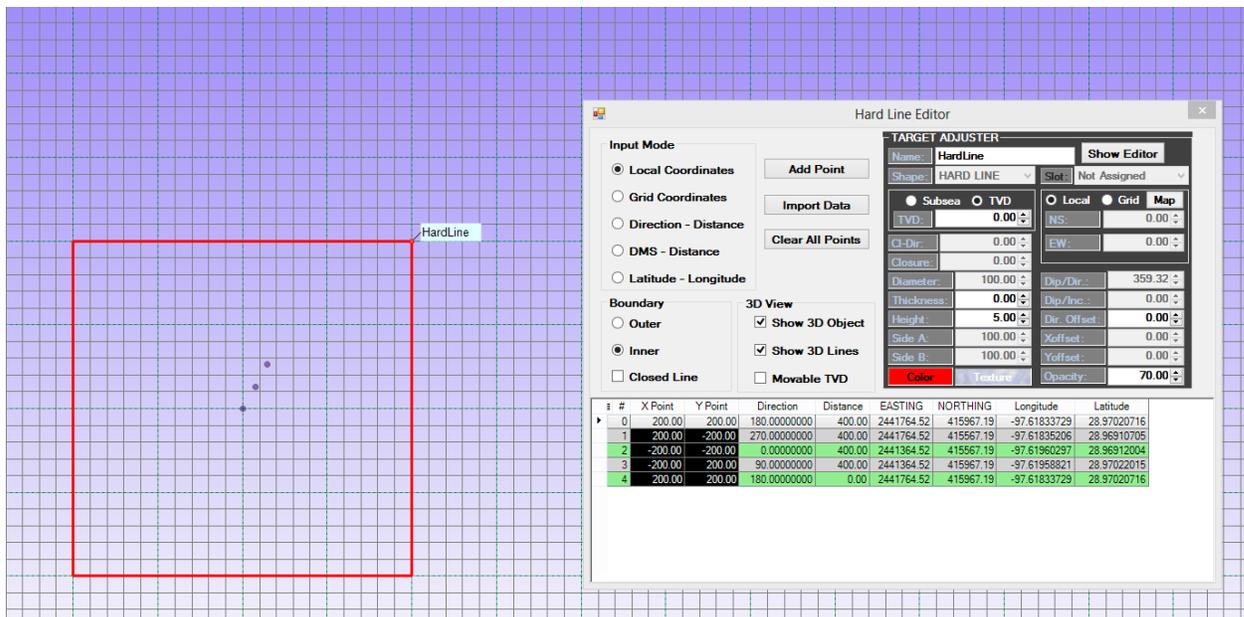
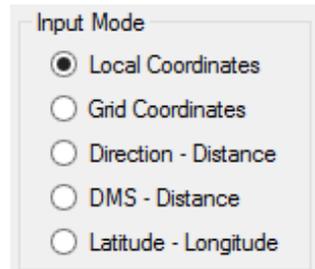


2) **ENTER COORDS MANUALLY:** If you do not have access to a spreadsheet or text file with the data and you have a lot of points, you can enter each of the

coordinates manually. If you only have a few points to enter, then using HawkEye’s editor to input the values is not a problem.

The following screenshot shows the Lease Line Editor open, and the lease line displayed in the 2D space with a 500 ft internal offset represented by the dotted line.

Note that there are five different Input Modes, which are also the coordinate display modes:



Next to the Input Mode box is the Boundary offset box. Internal and external offsets can be set by entering the distance and then selecting the radio button for what you want (Inner or Outer). HawkEye™ will calculate the line and display it. The ‘Close Line’ option is for when the last point is automatically set to the first point, so that a closed lease line can be more easily input. The 3D View box has options on how to display the line in the 3D space.

In the example shown the data was automatically generated by HawkEye™ from a PLSS Township, Range, Section definition.

To enter data manually it is usually best to count the number of points you will be entering and the use the “Add Point” button that many times, creating a blank spreadsheet in the Editor that has all the space you will need.

Next, decide what Input Mode you will be using. If it is Local Coordinates, Grid Coordinates or Longitude, Latitude coordinates all you need do is enter each pair of coordinates, either line by line or by going down each column and entering all the EW coordinates, for example, and then proceeding to the next column and filling in all the NS coordinates.

#	X Point	Y Point	Direction	Distance	EASTING	NORTHING	Longitude	Latitude
0	547.39	1054.79			1618058.32	506374.13		
1	670.66	1360.36			1618185.84	506677.95		
2	629.17	680.02			1618134.87	505998.25		
3	626.04	629.34			1618131.04	505947.62		
4	566.05	-213.74			1618059.32	505105.46		
5	565.99	-214.66			1618059.25	505104.54		
6	565.22	-236.25			1618058.18	505082.96		
7	565.87	-257.84			1618058.52	505061.36		
8	567.92	-279.35			1618060.28	505039.83		
9	571.38	-300.67			1618063.44	505018.46		
10	576.23	-321.72			1618068.00	504997.34		
11	582.44	-342.41			1618073.92	504976.57		

ANCHOR POINT: If you are inputting coordinates in Direction-Distance, the most important thing to remember is to **FIRST**, input the starting Xpoint, Ypoint. This is the “anchor” point, and is labeled line “0” in the coordinates table. From that point on you will only need to enter the direction and the distance.

HARDLINE INNER AND OUTER OFFSETS: Mostly everything that is true for Lease Lines is true for Hard Lines. With Hard Lines you can also have offsets if you so desire. (The “Outer” offset may appear as an inner offset. This is not rendering incorrectly, it is

just that the coordinates were put in clockwise. There is no computational error here. Just pick the offset that matches the one you are looking for).

MULTIPLE HARD LINE PASTING: However, with the spreadsheet cut and paste option with Hard Lines, there is an option you are presented with when pasting the data to the grid which **allows a list of independent hard lines to be added simultaneously**. In this mode, each successive pair of points constitutes a single line. HawkEye™ will automatically generate a Hard Line definition for each pair of points. You can then edit them independently for color, names and offsets by editing their target parameters if you so choose. When you paste in the data, HawkEye™ will prompt you for this option.

EDITING THE LINE'S

APPEARANCE: Aside from the coordinates, a hard line or lease line can be edited for appearance. The "Target Adjuster" portion of the Editor form controls this aspect of the line. The greyed-out fields are not editable.

Editable parameters include:

- Name
- Depth (if "Fixed TVD" is selected)
- Thickness – This refers to the offset, which is either inside or outside the line, depending on if you choose "Mode A" or "Mode B" under the Boundary box.
- Height- This appears in the 3D space
- Directional Offset- a depth offset
- Opacity

b. Lithology



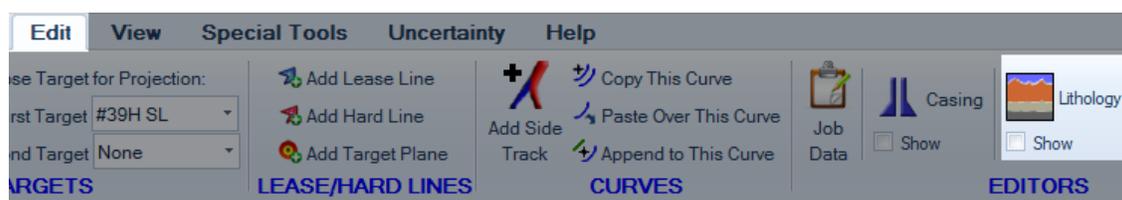
Lithology in HawkEye™ is a tool that allows the user to enter known geological data as it relates to the range of the well. The lithology data, graphically represented by colored patterns, appears in the 3D space as well as in the plots and reports if desired. The lithology datasets can either be metaphorical graphical representations or geological snapshots and cross-sections of actual field seismographs (“picture” lithology) if such data is available.



Displaying the data in the 3D space allows for important visualization of the known material types in proximity to a well.

OPENING THE LITHOLOGY EDITOR:

1) Click on the Lithology icon  at the top of “Edit” tab.

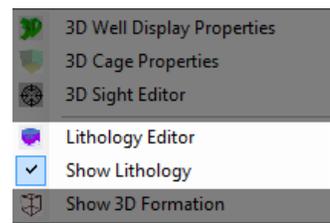


2) RIGHT-CLICK anywhere in the background of the 3D space or on a curve and select “Lithology.” Also notice that in this menu is the “Show/Hide Lithology” option just below the Editor.

TURNING LITHOLOGY ON AND OFF:

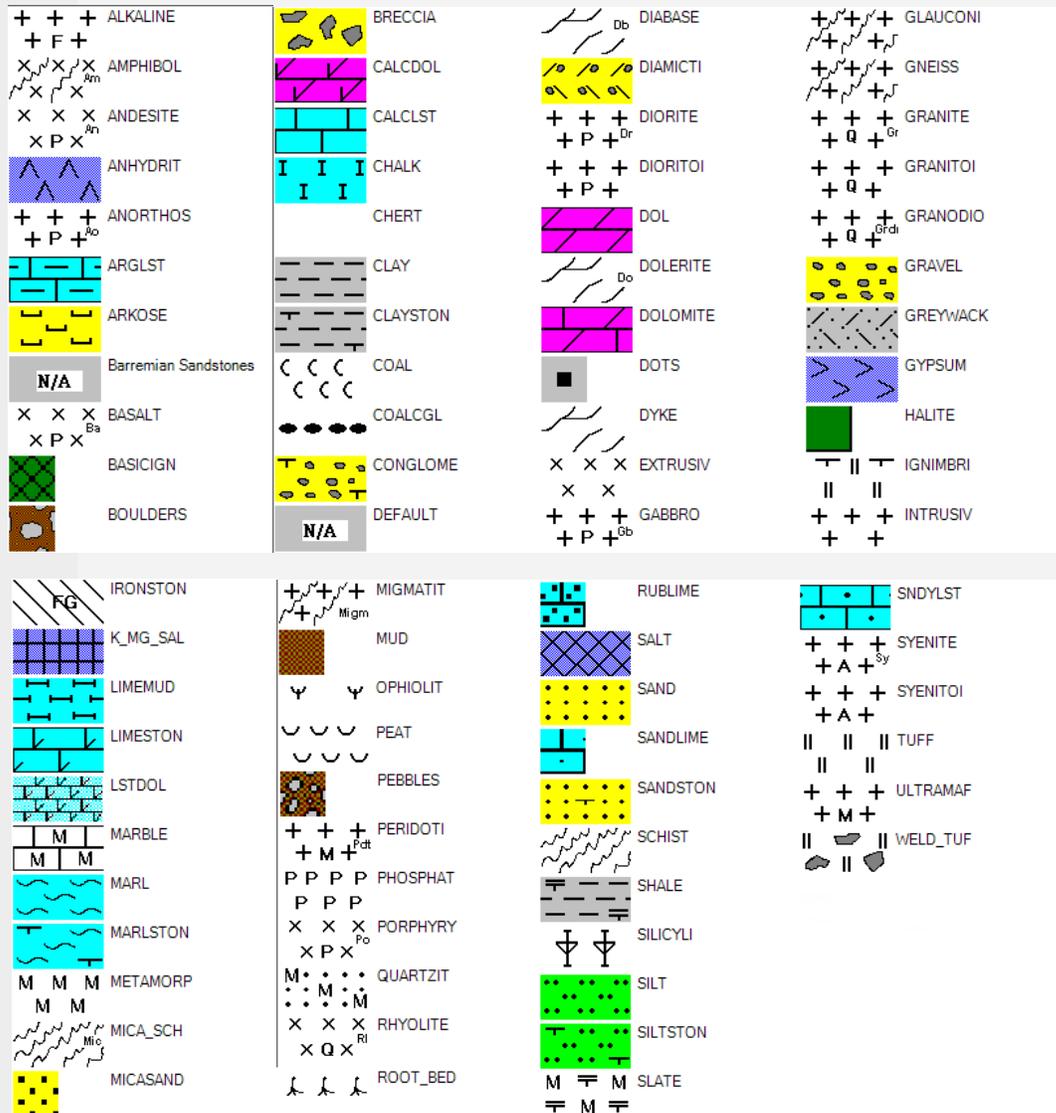
1) Check or uncheck the “Show” button under the Lithology icon in the “Edit” tab (pictured above).

2) RIGHT-CLICK anywhere in the background of the 3D space and select “Show Lithology” or “Hide Lithology,” depending on if it’s already on or off.



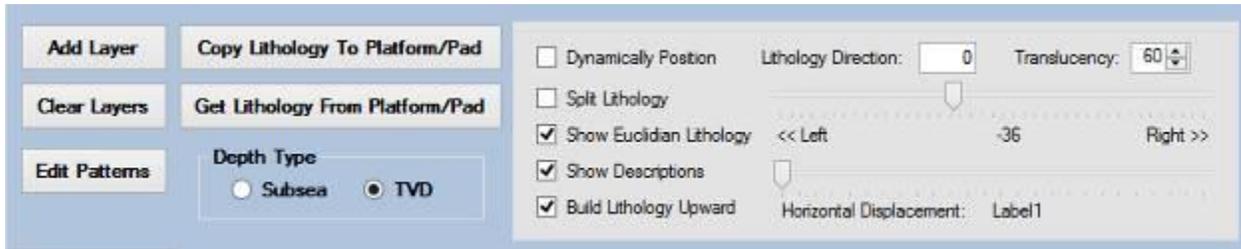
LITHOLOGY TEXTURES

The function of the Wellpath Lithology editor hinges on lithology layers chosen by drop-down menus. Each new layer will have a material type to be assigned to it. HawkEye™ provides a number of materials to choose from:



NOTE: Any of these patterns can be replaced with custom pattern files by clicking on “Edit Patterns” in the top left of the Wellpath Lithology panel.

LITHOLOGY CONTROLS: At the top of the Wellpath Lithology panel there are a number of functions:



ADD LAYER and **CLEAR LAYER:** This may be the first place to go when using lithology, where each layer can be added manually or cleared entirely. Each new layer is by default Euclidian and given a depth of 200 ft/m.

EDIT PATTERNS: All of the lithology materials from the layer's drop-down menu have particular pattern associated with them. But they are easily changed out with user-provided pattern files in the Edit Pattern dialogue. The pattern family is HawkEye™ by default but can be switched to the Compass family or customized by group or individually here.

COPY LITHOLOGY TO PLATFORM/PAD: Any given set of lithology data is associated with the select curve, so it must be actively attached or associated with a platform/pad. This button will take the curve's lithology data as currently displayed and copy it to the platform/pad under which the curve is associated.

GET LITHOLOGY FROM PLATFORM/PAD: This button will retrieve the lithology information from the platform/pad and apply it to the current curve. NOTE: There must be a lithology data set copied to the platform/pad first.

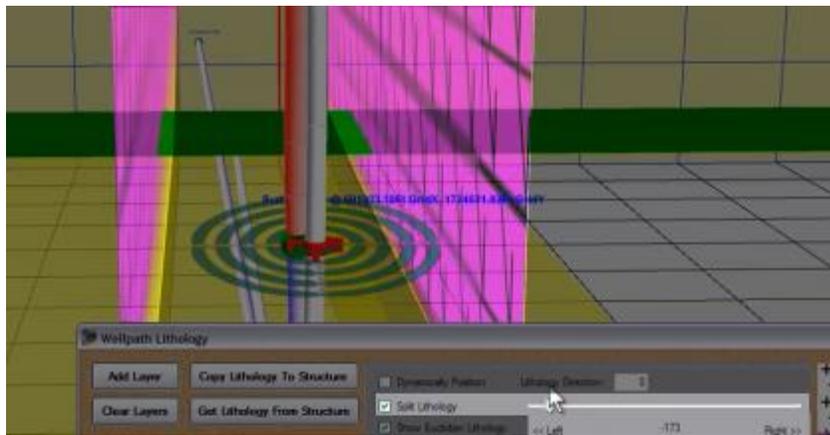
(E.g. If a lithology is set up with a proposal curve, it is not automatically going to display when the as-drilled work curve is being followed. To share the lithology between the two, "copy lithology to platform/pad" when it's being displayed along with the proposal curve, then follow the work curve and click the "Get Lithology From Platform/pad" button.)

DEPTH TYPE: It is important to know the method in which the depth for each lithology layer is defined. Subsea depths start from sea level and go down. TVD depth type includes the RKB and the elevation.

DYNAMICALLY POSITION and **LITHOLOGY DIRECTION**: Either one or the other of these can be selected at a time. These affect the direction the lithology plane is pointed. With Dynamic positioning turned on the direction is affected by the direction at the current focus point. If the formation has a dip, and there is a significant change in direction such as in a turn zone then the lithology plane will be recalculated after the scroll wheel as stopped moving. If Dynamic Positioning is turned off then the lithology points in the direction specified by the Lithology Direction input.

TRANSLUCENCY: Control the translucency of the currently displayed lithology set. The range is from 0 to 100.

SPLIT LITHOLOGY: This will create two copies of the lithology layer in the 3D space and they will “sandwich” the current look-at point. Use the slide control to move how far away the duplicate layers are from the point of interest. This feature is useful for creating a valley effect in which the well can be referenced against the lithology data from more angles.



SHOW EUCLIDIAN LITHOLOGY (DEFAULT): This allows the lithology to be defined by the basic input list be displayed. Sometimes when using a ‘real’ lithology it is not desirable to show both the Euclidian and real lithologies.

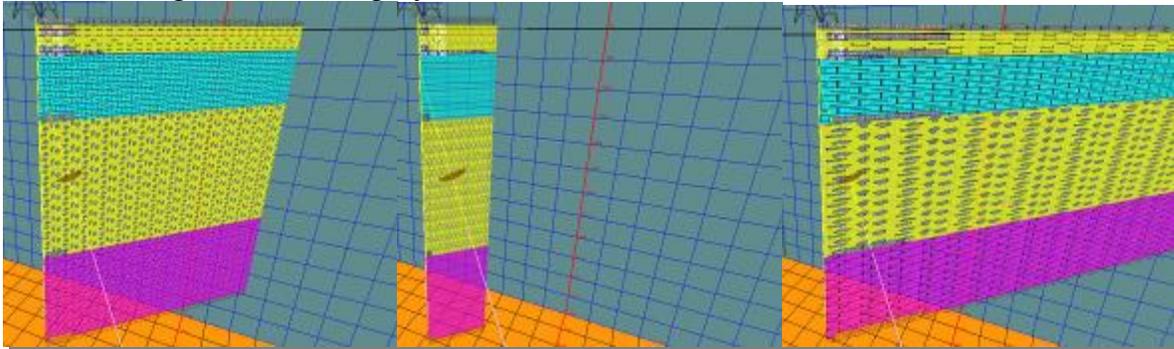
SHOW DESCRIPTIONS: Descriptions are entered in the layer editing segment under the Euclidian Lithology tab. When “Show Descriptions” is selected, a small text box will appear in the 3D space inside of the lithology’s plane on the bottom left corner.



BUILD LITHOLOGY UPWARD: The lithology picture is built by default from the top

down. If all dips are the same for all the lithologies then the algorithm for the order in which layers are drawn is irrelevant. However, if the dips are non-zero and some are greater than others then the order can be potentially important. This is not a really important feature, but it could possibly turn useful.

HORIZONTAL DISPLACEMENT: This slider controls the horizontal span of the entire lithology display in 3D space. It will crunch or stretch the patterns along the horizontal plane. The range is from roughly 1,000 to 25,000 feet.



EUCLIDIAN LITHOLOGY (DEFAULT): Once the Wellpath Lithology panel is open, simply click “Add Layer” on the top left to begin adding lithology data to the project. Each layer will be blank and have a number of drop-down menu or text field to define the layer. Click on each box to edit it.

Euclidian Lithology Picture Lithology

Lithology For Curve: Slot 3 - Survey								
Type	Name	Description	Top Depth	Bottom Depth	Lithology		Dip Angle	Dip Direction
Euclidian	Name	Lithology Description	0.00	10.00		SA LT	0.00	0.00
Euclidian	Name	Lithology Description	10.00	20.00		AN H.	0.00	0.00
Euclidian	Name	Lithology Description	20.00	30.00		W E.	0.00	0.00
Euclidian	Name	Lithology Description	30.00	40.00		AR K.	0.00	0.00
Euclidian	Name	Lithology Description	40.00	50.00		C O.	0.00	0.00
Euclidian	Name	Lithology Description	50.00	60.00		AR G.	0.00	0.00
Euclidian	Name	Lithology Description	60.00	70.00			0.00	0.00

TYPE: Euclidian or Real. Euclidean is the default type that is displayed, and it is characterized by its straight horizontal borders dividing each layer. “Real” lithology is

characterized by its irregular border between layers, the undulating thickness which is a more realistic representation of the geology.

NAME and **DESCRIPTION**: The Name, as of now, is not really used in reports or output, but the Description is used. It is used in the presentation plots and also as a description for interpolated comments

TOP DEPTH and **BOTTOM DEPTH**: Directly enter the depth of the layer. HawkEye™ will not have the layers overlap and will give notice if there is a depth conflict. Each new layer is given a default depth of 200 (ft/m) from the last layer.

LITHOLOGY: Choose from the drop-down menu what type of material the layer represents. The list is comprehensive and should encompass most types encountered in the field.

DIP-ANGLE and **DIP DIRECTION**: Number fields here define the dip of the particular lithology plane.

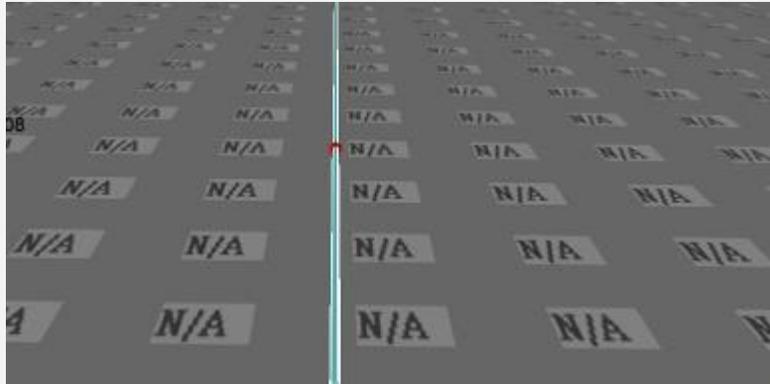
PICTURE LITHOLOGY: The Picture Lithology tab will allow the user to utilize any available seismographic imagery for use in place of the colored lithology patterns provided. **NOTE**: These slices of 3D seismographic data are not always available from the company in charge of geological survey and assessment.

Click “Browse” to select the bitmap. Be sure to check the “Show Picture Lithology” box to display the custom picture, and define the picture loaded by TVD, Direction, Width and Height in the provided fields. Define the lithology here by one of three modes, selected with each of the respective radio buttons: Lat-Long, Local EWNS, or by Geodetic Grid.

DEFINE CASING BY THE LITHOLOGY: See more in the next section on casing on how to place casing automatically for where a proposal curve crosses a lithology boundary.

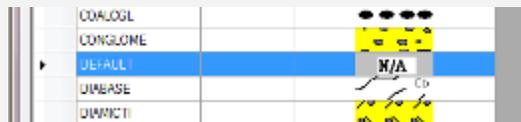
HOW TO SET A DEFAULT LITHOLOGY

If you make a target plane (e.g. right-click on any curve and select “Create Target Plane”) for any given reason and you don’t have the lithology set for that TVD, the program will give you this for a texture:

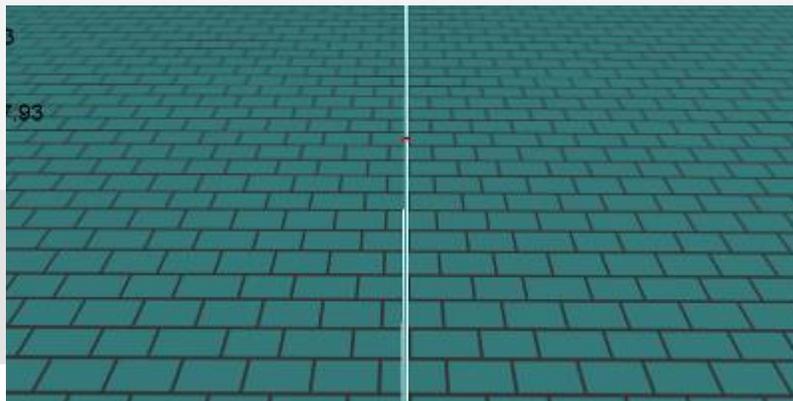


Since this is not a convincing or appealing texture, you may want to set a default other than “Not Available.” Here’s how:

- 1) Open up the Lithology module.
- 2) Click on “Edit Textures” at the top left.
- 3) Scroll down to the texture titled “Default.”



- 4) Double-click on the “N/A” texture.
- 5) Choose your new default texture.

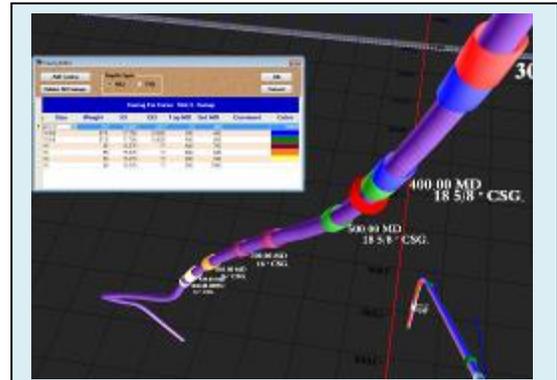


b. Casing



Adding casing in HawkEye™ is a process similar to adding lithology. It is done layer by layer and each entry can be customized. To get to the Casing Editor, click on the casing icon in the “Edit” tab.

The Casing Editor will allow the appending of casing information to the selected curve. The first step is to click the “Add Casing” button. This will add a casing entry to the selected curve, wherein all the vital information can be entered in any order.



Casing is added layer by layer in the Casing Editor. Each casing entry is customizable and commentable.

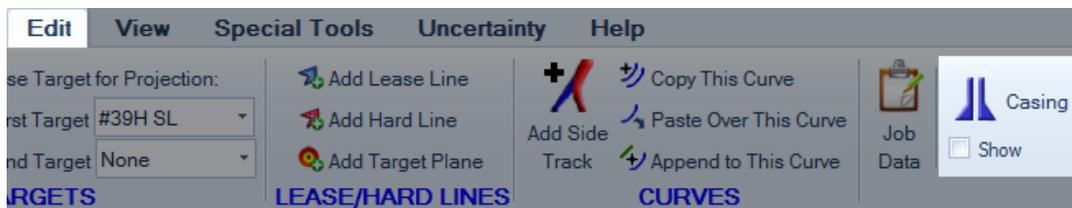
The size is defined from a lookup menu of different casing sizes. The selected size will determine the choices for the weight of each casing. The sizes available are as follows:

List of Casing Sizes

10 ¾	11 ¾	11 7/8	13 ½	13 3/8	14
16	18 5/8	20	24 ½	4 ½	5
5 ½	6	6 5/8	7	7 ¾	7 5/8
8 5/8	9 ¾	9 5/8	Riser		

OPEN THE CASING EDITOR:

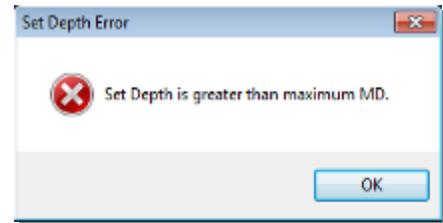
- 1) Click the Casing icon under the “Edit” tab.



2) Right-click on specific curve in the 3D space, Data Tree or on the “Curve Menu” button and select “Casing.”

CASING IN SI (METRIC): Casing sizes and weights can be entered in metric units. The units for casing are set at the project level. To get to that setting, right-click on a Project in the Data Tree and select “Edit Project,” then select “SI” for casing.

SET DEPTH ERROR: The Casing Editor will give a “Set Depth Error” if the user tries to add casing with a set depth greater than the maximum MD.



Aside from casing size and weight, which are selected from drop-down menus, other parameters are defined manually.

ID/OD: Internal and Outer Diameter in inches.

TOP MD: This number defines the beginning of the casing from the top down along the wellpath.

SET MD: This is measured depth or TVD to which the casing is run.

COMMENT and COLOR: Click on the Comment field to add any relevant notation to be associated with the casing. The color field opens to a palette when clicked on.

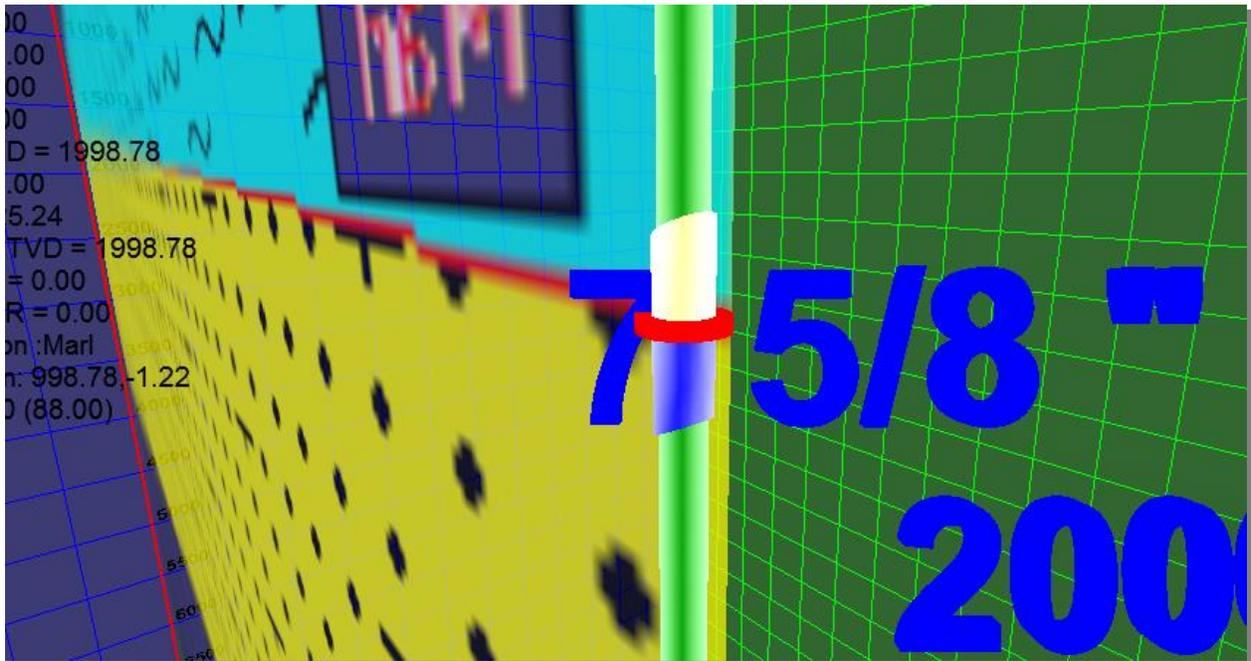
	Size	Weight	ID	OD	Top MD	Set MD	Comment	Color
▶	20	94	19.124	21	0	30		15595911
	18 5/8	87.5	17.755	19.625	30	60		
	18 5/8	87.5	17.755	19.625	60	90		
	18 5/8	87.5	17.755	19.625	90	120		
	14	92.68	12.7	14.5	120	150		
	13 5/8	88	12.375	14.375	150	180		
	13 5/8	88	12.375	14.375	180	210		
	13 3/8	48	12.715	14.375	210	240		
	13 1/2	81.4	12.34	14.375	240	270		
	11 7/8	71.8	10.711	12.76	270	300		
	11 7/8	71.8	10.711	12.76	300	330		
	10 3/4	32.75	10.192	11.75	330	360		

DEFINE CASING BY THE LITHOLOGY: Casing can be defined in the Lithology editor⁵. To do this, right-click on a proposal curve and select “Lithology.” A lithology dialogue will open, but it will be specifically associated with the current proposal curve. You will see the name of the proposal curve in the title bar of the Lithology editor.

Description	Top	Bottom	Lithology	Dip	Dip Dir.	CSG. Size, Weight	CSG. Offset
logy rption	0.00	1000.00	++ + ALKALINE	2.00	0.00	7 5/8, 77.9	0.00
logy rption	1000.00	2000.00	+ F + MARL	2.00	0.00	7 5/8, 20	0.00
logy rption	2000.00	3000.00	X X X SANDSTON	-2.00	0.00	7, 38	0.00
logy rption	3000.00	4000.00	X X X ANDESITE	4.00	0.00	7, 23	0.00
logy rption	4000.00	5000.00	WELD_TUF	-5.00	0.00	7, 20	0.00
logy rption	5000.00	6000.00	BASICIGN	2.00	0.00	6, 26	0.00

Once inside the Lithology editor, you will notice two additional columns on the right side of the normal spread of parameters. These columns are where you can add casing that starts and ends with respect to wherever the lithology boundaries are.

The two columns are the Casing Size/Weight, wherein the casing can be defined, and the Casing Offset, where the casing tops can be defined as not having to start exactly at the layer borders.



When casing is defined here in the Lithology Editor, the casing will appear in the normal Casing Editor.

⁵ For proposal curves only, since a work curve will not usually have casing defined by lithology boundaries, despite the best plans of mice and men.

COPYING TO PLATFORM/PAD: When you add casing in the lithology editor, and then click “Copy Lithology to Platform/Pad,” it will also copy the added casing. To prevent this, you must delete all casing entries by selecting “none” for the Size/Weight and “0” for Offset before copying to the platform/pad.

DOES NOT WORK ON SIDETRACKS: Adding casing through the Lithology Editor will not work on sidetrack proposals since they do not start at 0 TVD.

c. Comments and Annotations

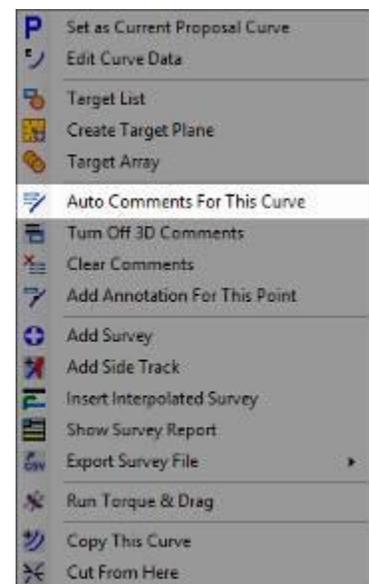
1. COMMENTS

ADD COMMENTS: Comments are generated in HawkEye at any given survey, either in the Work Mode or Proposal Mode. They can be entered manually at the survey by typing in the comment in the List Panel below in the space for comments.

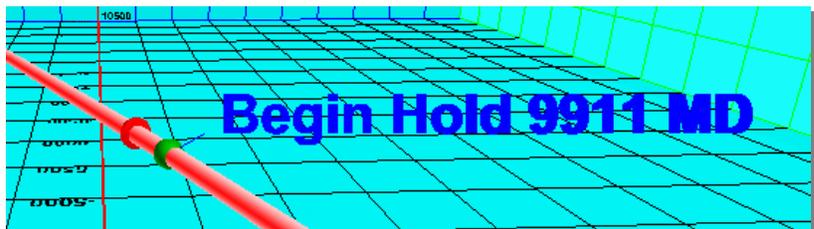
2411001.04	400912.32	
2411698.26	488826.75	Begin Hold 9911 MD
2411700.00	400912.32	

AUTO-GENERATE COMMENTS: Comments may be generated automatically for proposal curves by right-clicking on the desired curve for comment in the Data Tree, and selecting “Auto Comments For This Curve.”⁶ This will create a comment at each critical point in the proposal (e.g. KOP, Begin Build, Begin Turn, PBHL). You cannot generate auto-comments for a **work** curve since each survey would be considered a critical point due to its irregular, non-geometrical nature.

You may also Auto-generate comments by clicking on the option under the “General” tab. Here you can clear all comments for current curve as well.



When a comment is created, it will appear in the 3D space at the point on the curve on which it was created, marked by a green sphere.



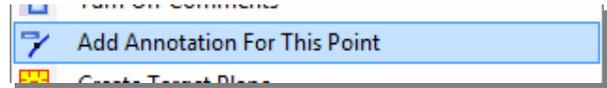
DELETE A COMMENT: To delete a comment, erase the text from the Survey List Panel at the bottom of the main screen (the field in black as pictured above). Or to delete ALL the comments of a curve, go into the curve’s menu and select “Clear Comments.”

⁶ Auto-generating comments for a curve will erase all previous comments for that curve, including ones you may have added manually.

2. ANNOTATIONS

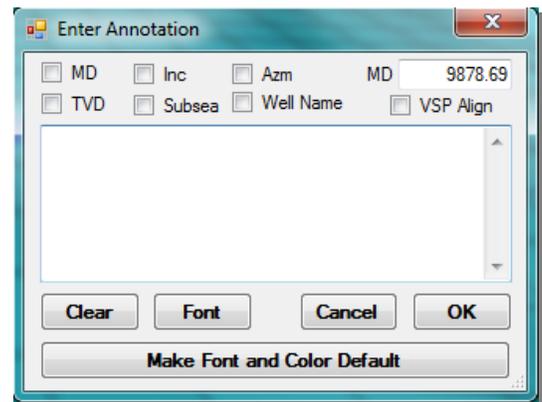
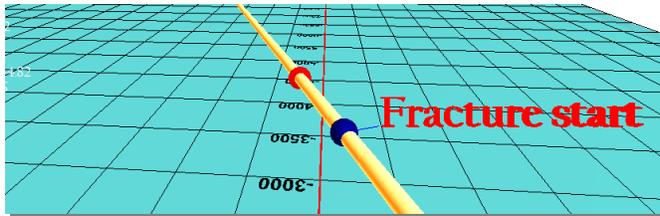
Annotations are slightly different from comments in that they can only be generated manually. In other words, there is no way to auto-generate annotations. Think of them as personalized notes outside the bounds of what is to be included in a plot or report.

ADD ANNOTATION: To add an annotation to a curve, go to that curve's menu and select "Add Annotation."

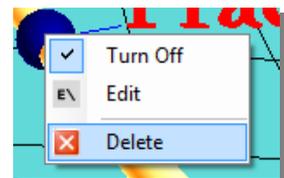


You can also add an annotation for a specific point by clicking the button "Create Annotation" under the "General" tab.

The Enter Annotation box has a number of options, including choosing the exact depth and type of depth at which the annotation will appear along the curve, as well as the font and color of the annotation.



DELETE AN ANNOTATION: The only way to delete an annotation is to right-click on the blue sphere where it resides on the curve, then select "Delete."



NOTE: Sometimes it is tricky to get the right-click menu to come up for the annotation, and may require adjusting the point of view and zoom in order to nail the sweet spot on the blue sphere.

d. Survey Tool Manager (Error Models)



The Survey Tool Manager is an interface for importing or exporting advanced error modeling files. These files are usually provided by engineers who are familiar with the schema and are generally not tweaked from within HawkEye, although they may if the user is knowledgeable and comfortable with the parameters.

OPENING THE MANAGER: The Survey Tool Manager is found in the “Special Tools” tab at the top of the screen.

NOTE: It is not recommended to change or alter the tool profiles in the Survey Tool Manager unless you understand the various parameters. Since the error models are highly mathematical and settings dependent on one another, simple mistakes could render the error model that you are using unusable or worse.

The screenshot shows the Survey Tools Manager interface. On the left is a tree-style list of tools categorized by vendor. The right side features a configuration panel for a selected tool, including fields for Vendor, Short Name, Description, and Template, along with buttons for Import, Export, View, Save, and Delete. Below the configuration panel is a table listing various error models with their parameters.

Name	Vector	Tie-on	Units	Magnitude	Formula	Range Inc	LowerInc	UpperInc
w12	i	n	-	1	sin(inc)	<input type="checkbox"/>	0	0
w34	i	n	-	1	abs(cos(inc))	<input type="checkbox"/>	0	0
mis1	i	s	d	0.1	w12	<input type="checkbox"/>	0	0
mis2	l	s	d	0.1	-w12	<input type="checkbox"/>	0	0
mis3	m	s	d	0.2	w34	<input type="checkbox"/>	0	0
vsaq	i	q	d	0.1	sin(inc)	<input type="checkbox"/>	0	0
axcant	i	n	d	17	1	<input checked="" type="checkbox"/>	0	90
axcant	i	n	d	-17	1	<input checked="" type="checkbox"/>	90	150
abiasxy	i	s	-	0.005	1/(9.8*cos(inc-axcant))	<input type="checkbox"/>	0	0
ascale	i	s	-	0.0005	tan(inc-axcant)	<input type="checkbox"/>	0	0
amisxy	i	s	d	0.05	1	<input type="checkbox"/>	0	0
qbias	i	s	-	0.005	tan(inc-axcant)/9.8	<input type="checkbox"/>	0	0
dran	e	r	m	0.5	1	<input type="checkbox"/>	0	0
dref	e	w	m	0.5	1	<input type="checkbox"/>	0	0
dscale	e	s	-	0.001	tmd	<input type="checkbox"/>	0	0
dstretch	e	q	im	5E-07	tmd*tvd	<input type="checkbox"/>	0	0
nredfac	a	n	-	1	1	<input type="checkbox"/>	0	0
pqbx1	a	n	-	0.1	sin(azi)/(erot*cos(inc))	<input checked="" type="checkbox"/>	0	3
qbx1	a	s	-	1	pqbx1	<input type="checkbox"/>	0	0
pqbx2	a	n	-	0.1	cos(azi)/erot	<input checked="" type="checkbox"/>	0	3
qbx2	a	s	-	1	pqbx2	<input type="checkbox"/>	0	0
pqxyran	a	n	-	0.1	sqrt(1.001-(cos(azi)*sin(inc))^2)/(erot*cos(inc))	<input checked="" type="checkbox"/>	0	3
qxyran	a	r	-	1	pqxyran	<input checked="" type="checkbox"/>	0	3

On the lefthand side of the Survey Tools Manager is a tree-style list of the different models being implemented. Along the top are the fields displaying:

- Vendor (dropdown list)
- Short Name
- Description

IMPORT/EXPORT: The Survey Tool Manager works with the industry standard .ipm files, which may be imported or exported.

DEFAULT SURVEY TYPE: Choose from Magnetic, Gyro, or unknown.

TEMPLATE: Choose from a dropdown list of available .ipm files to load an ISCWSA template.

LOCK/DEFAULT: Check either of these buttons to lock in the current template selection and to make the selection your default, respectively.

e. ISCWSA Error Calculating



RECALCULATE ERROR MODEL: One click of the ISCWSA icon at far left of the “Special Tools” tab will automatically recalculate the error model for the project. These corrections are based on a comprehensive compilation of error models authored by a committee of engineers, scientists and mathematicians from around the world.

The following is excerpted from the Industry Steering Committee on Wellbore Survey Accuracy website (www.ISCWSA.org):

“

The primary aim of this group is to produce and maintain standards for the industry relating to wellbore survey accuracy.

- To set standards for terminology and accuracy specifications.
- Establish a standard framework for modeling and validation of tool performance.
- Raise awareness & understanding of wellbore survey accuracy issues across the industry.

The Industry Steering Committee on Wellbore Survey Accuracy (ISCWSA) is seeking to dispel the confusion and secrecy currently associated with wellbore surveying and to enable the industry to produce consistent, reliable estimates of survey-tool performance in today's wells. This will be achieved through the production and maintenance of standards covering the construction and validation of tool error models.

Work focused initially on MWD systems. They provide a large proportion of the total directional survey data world-wide and, because of their similarities between suppliers, are more amenable to specification standardization than other types of survey tool.

”

III. PROJECTIONS in the FIELD MODE

TWO MODES: There are two overall modes in HawkEye. The Field Mode is default and available in both versions. It is used for directional drillers who are not creating much in the way of complex proposals or well plans. Whereas the Well Planning Mode, available only in the Well Planning version of HawkEye™, is used to create complex well plans.

VERSION OF HAWKEYE	MODES AVAILABLE	
	Field	Well Planning
Field Version		
Well Planning Version		

1. What You Need to Know

HawkEye’s Field Mode offers eight types of projections that can be used by directional drillers as well as well planners. They are:

- Sensor-to-Bit
- Measured Depth (Straight Line)
- Total Vertical Depth (Straight Line)
- Nudge
- Multi-Nudge
- Horizontal
- Slant
- Aligned
- Back on Track (BOT)

MODES: FIELD v. WELL PLANNING

The principle difference to keep in mind between the Field Mode and Well Planning Mode is that, although they both have the same arsenal of projections which can be appended end to end, only in the Well Planning Mode can a projection be edited at any segment.

In other words, in the Field Mode, only the last appended projection can be edited, so that in order to edit a part further up the curve, the user must delete all appended parts of the curve made subsequent to that higher up part before editing it. In the Well Planning Mode, all parts of the curve are editable at all times.

Each of these projections can be quickly generated and edited from the main screen by clicking on the corresponding icon:



These can be broken down into two broad categories of projections. The “Targetless” projections can be created from any point on a curve without having to select a target. “Targeted” projections, on the other hand, require a target toward which a projection is created.

TWO GENERAL FAMILIES OF PROJECTIONS

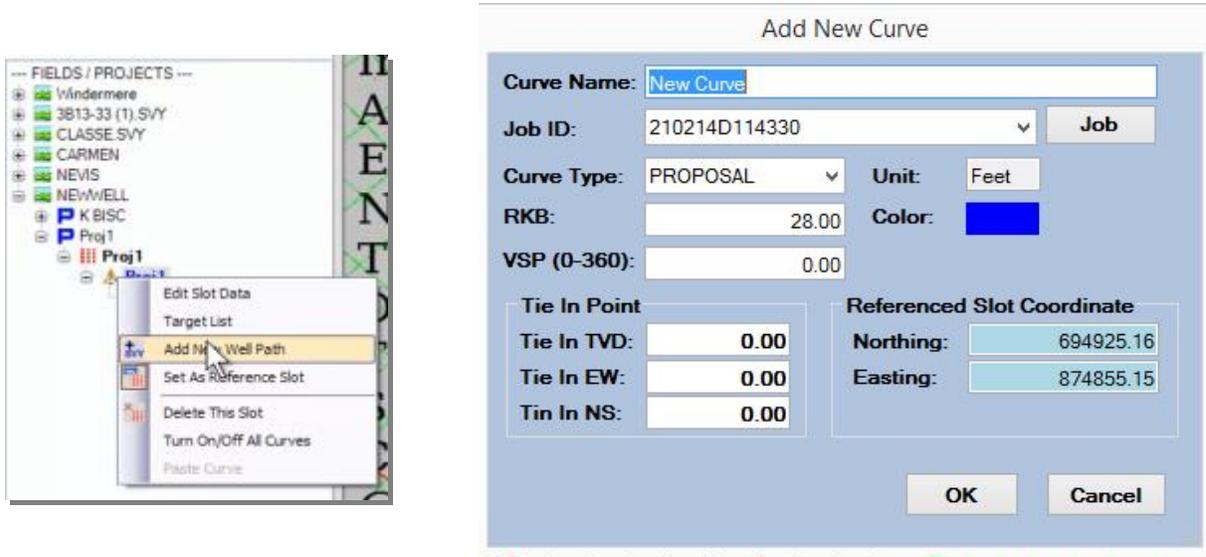
TARGETLESS PROJECTIONS:

- **MD & TVD Projections-** Hold a particular inclination and azimuth and go in a straight path for a certain user-defined distance.
- **Nudge and Multi-Nudge Projections-** Mimics minimum curvature calculations but allows for the nudging of a variety of different parameters.
- **Bit or Compound Projections-** Allows a projection to be strung to a bit from where your survey position is. From there you can append other kinds of projections to the end.

TARGETED PROJECTIONS:

- **Slant Projections-** a.k.a. DLS projections, Build-and-Hold Projections. Can solve for a hold angle by providing a dogleg severity or solve for dogleg severity by providing a hold angle.
- **Aligned Projections-** Set two dogleg severities, as well as desired inclination and azimuth at target.
- **Back-on-Track (BOT) Projections-** Set two dogleg severities and a minimum distance in order to intersect your proposal.
- **Horizontal Projection-** Will project to a horizontal plane, which is considered a 2D target. Horizontal plane is defined by an RKBTVD, a max dip angle and a max dip direction.

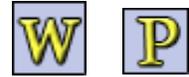
CREATING A NEW CURVE: To create a projection from scratch, RIGHT-CLICK on the slot/wellhead (🗑️) in which the new curve is to be created and select “Add New Well Path.” This will open up the “Add New Curve” dialogue under that slot/wellhead.



When defining a new curve in this dialogue, there are a few major data points to be filled in:

1. **Curve Name**
2. **Job Name:** this is a drop-down menu displaying all existing jobs in the database. The “Job” button opens the “Job Information” dialogue which both displays detailed information about existing jobs and allows for the creation of new jobs.
3. **Survey Type:** Choose either “PROPOSAL” or “SURVEY” from the drop-down menu. Proposal curves will appear under the current slot/wellhead with this icon: **P**. Survey curves will appear with this icon: **W**.
4. **Unit and Color:** Choose between feet or meters, as well as the color of the curve. The color can be easily changed later when right-clicking on the curve in the Data Tree, 3D space or Project Control Panel.
5. **RKB:** This is the Rotary Kelly Bushing Elevation above the datum, either the ground or mean sea level.
6. **Tie In Point-** These fields will define a specific tie in point for the new curve. Otherwise, the curve will begin from the slot/wellhead’s platform/pad at the surface location.
7. **Referenced Slot/Wellhead Coordinate:** This field will define (or redefine if it already has been defined) the exact surface location of the current slot/wellhead under which this curve is being created.

a. Work Mode vs. Proposal Mode



The most important thing to understand when in HawkEye's 3D space is that there are two modes for building and navigating between your curves: the Work Mode and the Proposal Mode. You can toggle between the two modes by clicking the W/P icon in the "Home" tab:



WORK MODE: The primary difference between the two modes is that the Work Mode will allow you to follow along the currently selected Work Curve.⁷ Also, when you make a projection, it is automatically starts from the end of the work curve, but will not stay there unless you append it.



See more on appending projections to your curve in the following section.

PROPOSAL MODE: In the Proposal Mode, you are able to follow the Proposal Curve.⁸ **When you make projections in the Field Mode, your new one will replace whichever projection was active previously.**



There are exceptions to this, however. You can build up proposal curves projection by projection with the following two methods: 1) **Append to Curve**- after a projection has been generated, click on the "Append" button at the right-hand end of the row of projections, 2) **HawkEye Command**- type in a direct alphanumeric command that instantly generates and appends the projection (see section under Special Tools chapter).

NO BIT PROJECTION IN PROPOSAL MODE: You will notice that the Bit Projection (Bit to Sensor Projection) is not available in the Proposal Mode. This is because the Bit Projection is assumed to only be used only with the Work Curve. It adds a certain length of measured depth at the end of any projection in order to simulate the course length to the bit not yet reached by the sensor.

⁷ Set any survey curve in your Data Tree as the "Work Curve" by right-clicking on it and selecting "Set as Work Curve."

⁸ Set any proposal curve in your Data Tree as the "Proposal Curve" by right-clicking on it and selecting "Set as Proposal Curve."

b. Appending Projections to Curve



The **Append** function allows the user to append a projection to the end of the current curve, either in the **Work Mode** or **Proposal Mode**. This will be needed frequently for any user who needs to make a projection with minimal complication. Fortunately, the process is intuitive and simple.

Step 1- Select your curve: Make sure you are focused on the curve that you want to append to. Typically this is a proposal curve, since the only way you want to add to a work curve is by actual surveys. When you find the proposal curve you want to append to, right-click on it and select “Set as Proposal Curve.”

Step 2- Create a Projection: Select the projection that you want to append and play around with the parameters to make sure it is what you want. (See next section on details of each projection).

Step 3- Click “Append”: When you click the Append button (in the “Home” tab), your currently displayed projection will become a part of the current curve.



GENERATING COMMENTS: Comments can be added to surveys either manually or automatically. To do so manually, go to the bottom right of the main screen in the survey window and add comments at all the various critical points like the kick-off point and the hold angle, etc.

But to generate these comments automatically, **RIGHT-CLICK** on the well and select “Auto Comments For This Curve.” The critical points comments will appear in the comments section on the bottom right.

NOTE: You can only auto-generate comments for proposal curves.



2. Creating a Projection in Field Mode

APPEND TO BUILD: It is worth repeating here that you can append each of these projections permanently to the end of either your Work Curve or Proposal Curve by using the Append button, described in the preceding section.

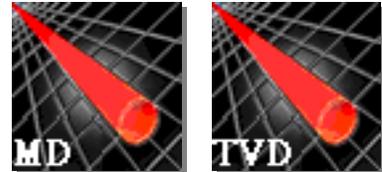
a. MD & TVD Projections

Measured Depth and Total Vertical Depth projections are of the simplest kind of projections available. They simply add a straight extension for a given distance, holding for the existing inclination and azimuth.

The only difference between the two projections is the type of depth measurement used, with either measured depth or total vertical depth. The mechanics of the projection calculations are identical.

MAKE THE PROJECTION: To make the projection, just enter an Added Depth to add how much from the endpoint you wish to progress in a straight line. OR put in a Total depth value and HawkEye™ will figure out how much added is required.

Clicking “Turn On Projection” will trigger the calculations and activate the projection in the 3D space. You can also hit the TAB button after entering a value to get HawkEye™ to recalculate a parameter.



MD PROJECTION	
<input type="checkbox"/> Turn On Projection	
ADDED MD	1500.00
TOTAL MD	1600.00
Color	

TVD PROJECTION	
<input type="checkbox"/> Turn On Projection	
ADDED TVD	100.00
TOTAL TVD	200.00
Color	

MD and TVD projections simply add a certain amount of straight distance from a point, holding the existing inclination and azimuth.



b. Nudge Projections

The Nudge projection is the best way to nudge a curve and may be the first kind of projection used when setting about to making a proposal curve. It is also useful for predicting how the motor and rotary steering system will behave by setting up the known parameters. Seeing this projection rendered in 3D space helps to visualize a job with the information already in hand.

Once Driller's View is set and Sights toggled off, you can select the Nudge tool from the row of projections and open up the dialogue. There are three solve modes, each allowing for the entry of up to three parameters at a time out of six:

- Delta (change) Measured Depth
- DogLeg Severity
- Tool Face Orientation
- Inclination
- Azimuth
- Total Vertical Depth

- NUDGE PROJECTION - [X]	
<input type="checkbox"/> Turn On Projection	
<input checked="" type="radio"/> DLS, TFO & DMD	
<input type="radio"/> DLS, INC & AZM	
<input type="radio"/> INC, AZM & TVD	
DMD	100.00
DLS	5.00
Tool Face	0.00
INC	27.00
AZM	4.00
TVD	780.00
NS	
EW	
Color	

c. Multi-Nudge Projections



NOTE: Multi-Nudge projections are only available in the Work Mode. If you activate the Multi-Nudge while in Proposal Mode, it will start the projection from the end of your Current Work Curve anyway.

The Multi-Nudge allows users to string together an unlimited number of nudge projection end to end. Each segment is organized from the top down, and new segments can be added by either tabbing to a new row below, or clicking the “Add” button.

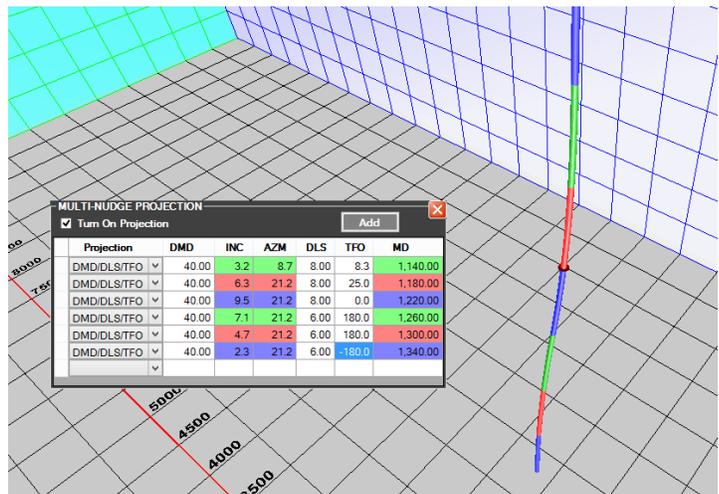
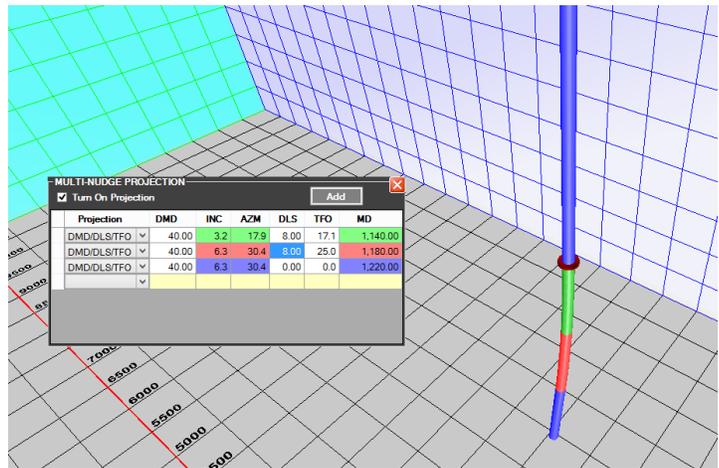
Turn on the projection with the checkbox on the top left of the form.

The segments (each individual nudge projection) are color coded and the row in the form matches the 3D projection. Unlike other projections, these colors are not customizable. They are Green, Red, Blue.

After the first three segments, the color sequence begins again.

Just like in the Nudge Projection, there are different solve modes. The user can do one of several things for each segment:

- **DMD/DLS/TFO-** You can input Delta MD, DogLeg Severity and ToolFace Orientation, but not the other parameters
- **INC/AZM/DLS-** You can put in Inclination, Azimuth and DogLeg
- **DMD-** This simply adds the length you specify, with no build or turn
- **HOLDTODMD-** this will extend the projection to the Measured Depth that you specify



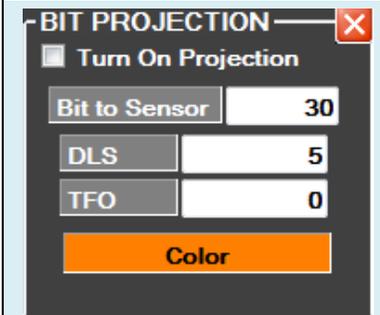
d. Bit or Compound Projections



NOTE: BIT projections are only available in the Work Mode. You cannot access the BIT projection in the Proposal Mode at all. As the name implies, the Bit projection will make a projection to the bit. It can be created in two ways:

1. Straight line projection
2. Nudge projection (w/ DLS and TFO)

APPENDING/COMPOUNDING PROJECTIONS: The Bit projection works with most of the other projections by being able to be appended to. This allows for a projection past the estimated current bit location. It works by 1) opening the Bit projection dialogue and creating the initial Bit projection, 2) opening the dialogue for the secondary projection (take your pick).



The BIT PROJECTION dialog box includes a 'Turn On Projection' checkbox, a 'Bit to Sensor' input field with a value of 30, a 'DLS' input field with a value of 5, and a 'TFO' input field with a value of 0. A 'Color' button is located at the bottom.

Bit projections can be made as straight line or nudge-style projections.



Two screenshots of the software interface showing projection dialog boxes. The left screenshot shows the BIT PROJECTION dialog box with 'Turn On Projection' checked and 'Bit to Sensor' set to 30. The right screenshot shows the BIT PROJECTION dialog box with 'Turn On Projection' checked and 'Bit to Sensor' set to 30, along with a 'SLANT PROJECTION' dialog box with 'Turn On Projection' checked and 'Hold Inc on Turn' selected.

Open the Bit Projection panel to make an initial projection then open another projection panel to append to the Bit Projection. Make corrections on the fly on either panel to nudge the compound projection into place.

e. Slant Projections

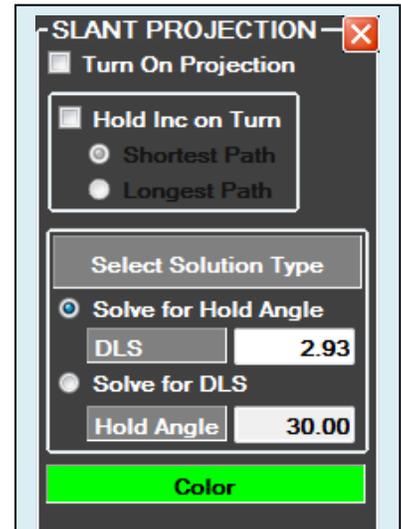


Unlike the Back-on-Track projections, the Slant projections (a.k.a. “Build and Hold” projections, “DLS” projections) do not take the proposal curve into consideration. You give it either a Hold Angle or a DLS to shoot for and it will create the smoothest possible curve to the target.

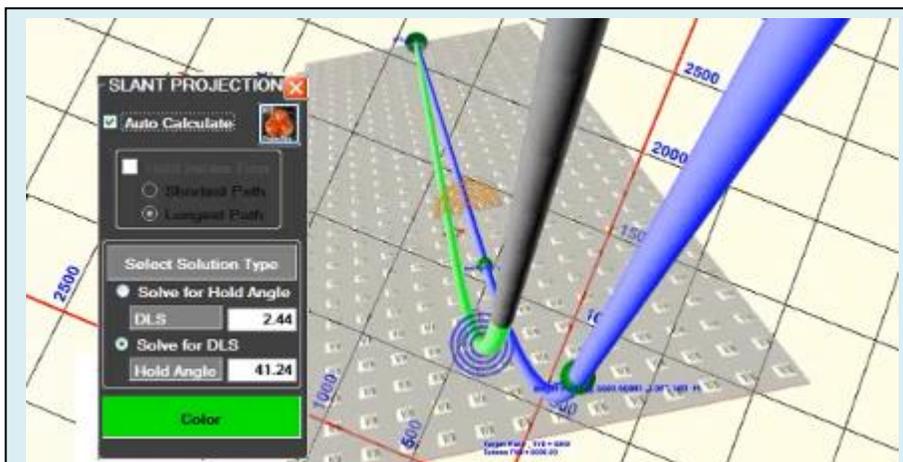
To create the Slant projection, RIGHT-CLICK on a target and select “Set as First Target,” then open up the Slant projection dialogue. You can either choose a DLS or a Hold Angle, allowing HawkEye™ to solve for the other. Then click “Auto Calculate.”

Clicking “Turn On Projection” will trigger the calculations and activate the projection in the 3D space. You can also hit the TAB button after entering a value to get HawkEye™ to recalculate a parameter.

Since the job may not always call for being exactly on the proposal line, the Slant projection might be a favorable option for planning a smooth and easy path with minimal dogleg severity and maximum straightaway distances.



Select a target and set it as “First Target,” then use a Slant projection to get a smooth curve to that target, ignoring any proposal curve.



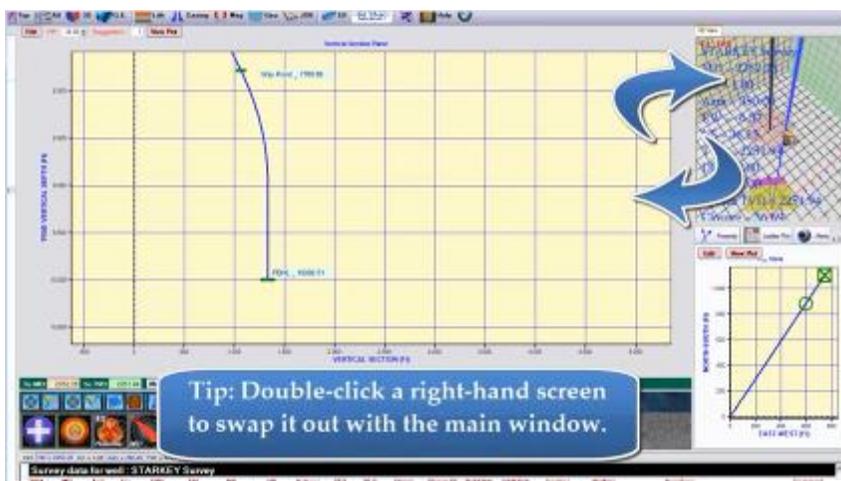
The Slant projection here (in green on the left) took a user-defined hold angle of 41.24 and came up with a 2.44 DLS to get the easiest ride to the target, outside of the proposal.

f. Aligned Projections



The most powerful and complicated of the projections, the Aligned projection requires user input for both dogleg severities and the desired inclination and azimuth at the first target.

To illustrate the Aligned projection, the 2D view mode is used here. NOTE: To display 2D in the main space in HawkEye™, just double-click on the 2D window on the top right and it will swap out with the 3D space in the center:



ALIGNED PROJECTION ✕

Calculate

Turn On Projection

DLS1	10	🔒
DLS2	10	🔒
Inc @ Target	90	
Azm @ Target	182	

Set DLS1 = DLS2

Tangent 9994.91

Line up to hit 2nd Target

Extend Before	0	
Extend After	0	

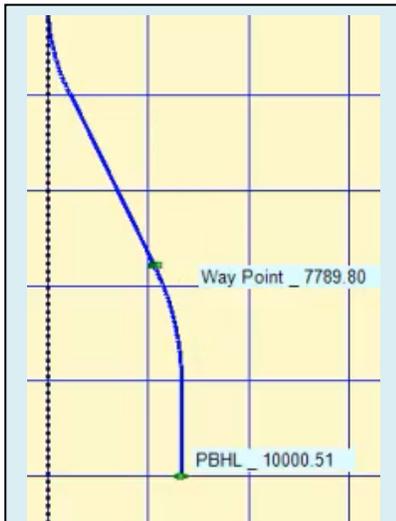
Extend to 2nd Target

Color

The Aligned projection panel is the most powerful of them all.

HIT CALCULATE: After any change in parameters, the “Calculate” button must be pushed. This is in order to cut down on unnecessary and unwanted rendering of calculations:

The following examples illustrate the basic functions of the Aligned projection panel. However, the full potential of this tool, like all the rest of the projections can only be discovered by tweaking and experimenting with the parameters to see how they behave.



1. At the start, there are two targets, with a proposal curve going through each.



ALIGNED PROJECTION ✖

Calculate

Turn On Projection

DLS1	2	🔒
DLS2	2	🔒
Inc @ Target	0	
Azm @ Target	0	

Set DLS1 = DLS2

2. Here's a DLS of 2 for both turns (arrows), and 0 for inclination and azimuth at target for a vertical orientation. The projection goes to the first target. Make sure to set first target in the target's right-click menu.



Inc @ Target	0
Azm @ Target	0

Set DLS1 = DLS2

Tangent

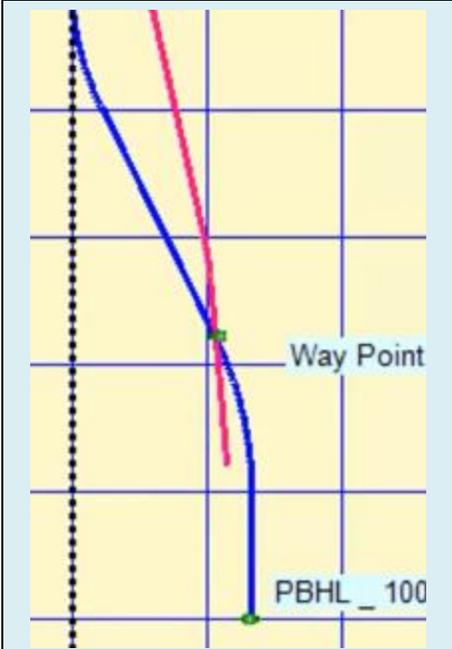
Line up to hit 2nd Target

Extend Before	500
Extend After	1000

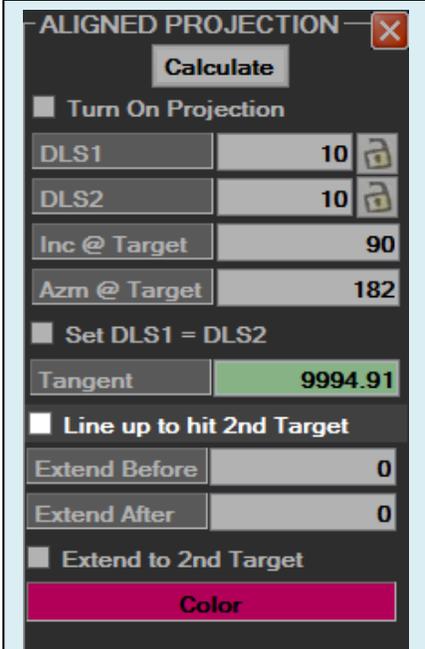
Extend to 2nd Target

3. Putting in an Extension Before of 500 makes a straight line for 500 feet BEFORE hitting the target, thus the second turn (big arrow) comes earlier. With a 1000 for Extend After, the projection will go straight for 1000 feet after the target.

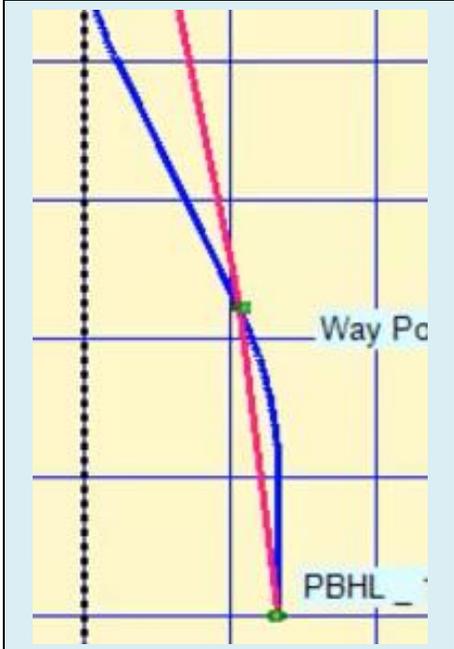
Line up to hit 2nd Target: The Aligned projection tool can line up to hit two targets with relative ease. To get the aligned projection to line up in anticipation for a second target, the first step is to go to the DATA TREE, then RIGHT-CLICK on a target and select “Set as Second Target.”



1. It might take a long time to manually nudge this projection directly into the second target at the bottom.

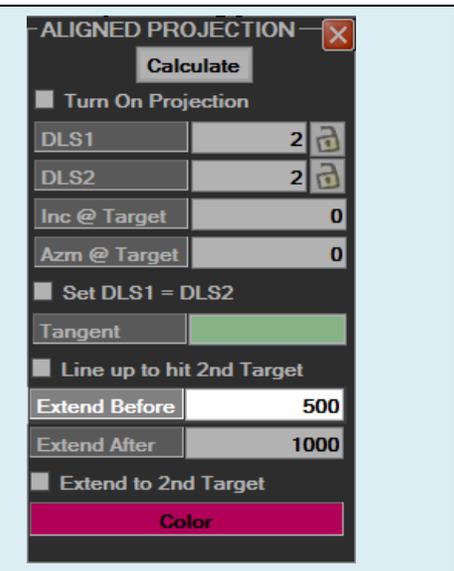


2. Check “Line up to hit 2nd Target” in order to get the curve lined up for Target 2.



3. Then hit CALCULATE and the projection will do the work of hitting both targets.

4. Add an Extend Before length and the final turn will come earlier (big arrow, 500 ft before the first target), while the Extend After will be a straightaway. >>>>>>>



Set DLS1 = DLS2: This option forces both DLS values to be equal to each other, and will solve for the lowest possible needed build rate. When set, the DLS fields will become green and uneditable.

The “Tangent” describes the length of the hold between the two build sections of the projection. The longer the tangent, the higher the Needed Build Rates (two DLSs) have to be.

g. Back-on-Track (BOT) Projections



Back-on-track projections will create a curve that will try to realign itself with the current Proposal Curve within two turns equal or as close to the DLS provided, within the minimum distance given.

The program will increase the DLS values as necessary when calculating the minimum curvature to get back on track.

Clicking “Turn On Projection” will trigger the calculations and activate the projection in the 3D space. You can also hit the TAB button after entering a value to recalculate a parameter.

Back On Track to Way Point: Checking the “Back on Track to Way Point” will turn on a projection that ends at the current Way Point position, while using the two DLS values and minimum distance that you have provided.

Set the Way Point position by going into Proposal Mode and moving the red Crosshairs to the position where you want it, then right-clicking on the red crosshairs and selecting “Move Way Point to Here.”

BOT PROJECTION ✖

Turn On Projection

Back On Track To Way Point

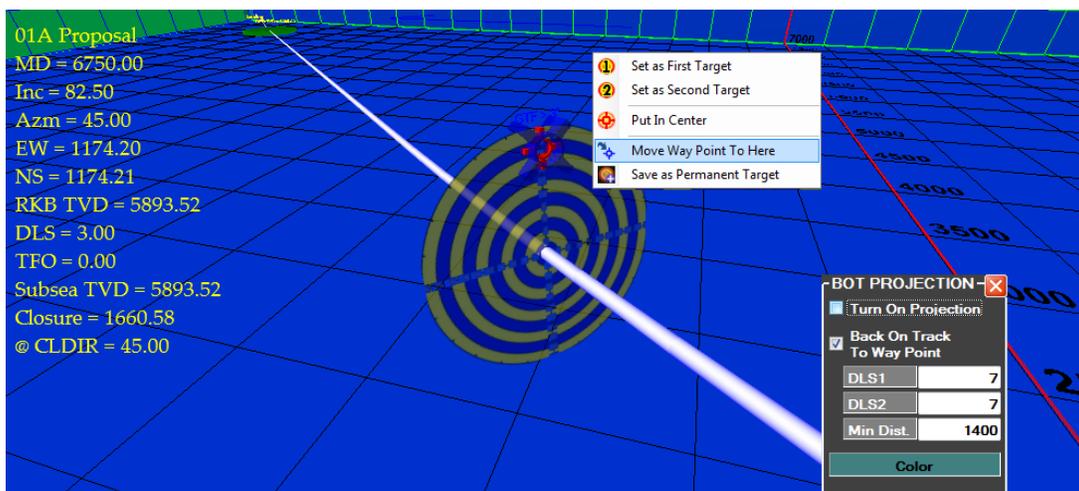
DLS1	0
DLS2	0
Min Dist.	0

Set DLS1 = DLS2

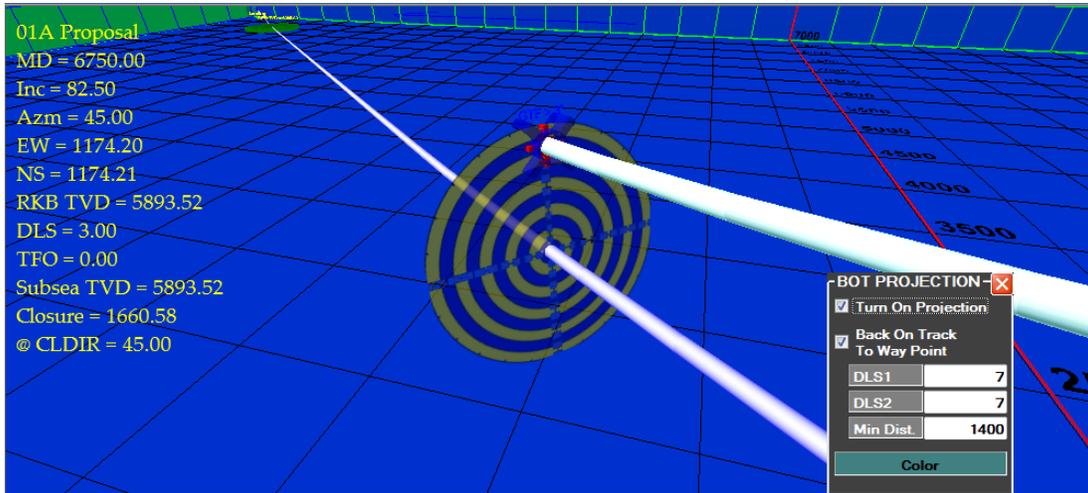
Tangent	0.00
---------	------

Color

BOT projections require two dogleg values and a minimum distance in order to intersect the Proposal Curve and thus

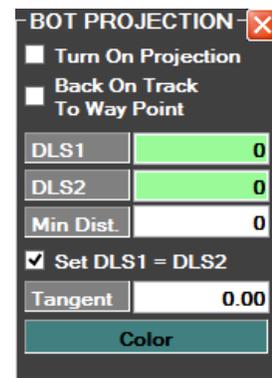


Once the blue Way Point has been set, turn on the BOT projection with the “Back On Track To Way Point” box selected and the projection will go to the Way Point rather than back into the Proposal Curve.



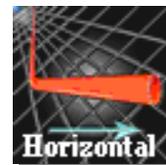
Set DLS1 = DLS2: This option forces both DLS values to be equal to each other, and will solve for the lowest possible needed build rate. When set, the DLS fields will become green and uneditable, while the “Tangent” field will become editable.

The “Tangent” describes the length of the hold between the two build sections of the projection. The longer the tangent, the higher the Needed Build Rates (two DLSs) have to be.



Dynamic (Constant) Back-on-Track: The BOT projection can be in an “always on” mode. Go into the Proposal Mode and activate the BOT projection. This will make the projection go to anywhere you move the Look-at Point along the proposal curve.

h. Horizontal Projections



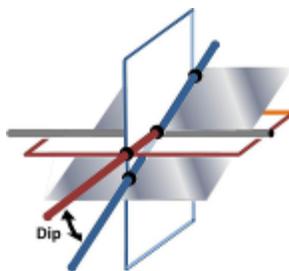
NOTE: Horizontal projections are only available in the Work Mode. You cannot access the horizontal projection in the Proposal Mode at all.

Although Horizontal projections are “targeted projections,” they require horizontal target planes rather than the normal targets to be set as the anchored tangential object.

The three parameters describing the horizontal plane itself are:

1) The RKB TVD, which is the depth below the surface location all the way to the point of intersection with the plane.

2) The Max Dip, which has a positive value for leaning toward the observer and a negative value for leaning away from the observer. NOTE: The quickest way to understand this value is to change it a few times and look at the difference in HawkEye’s 3D space.



3) The Max Dip Direction is defined in 360 degrees counting clockwise. Visualize looking from the top down on a well and simply define the direction as one would an azimuth. The formation would thus lean into that direction.



Horizontal Projection	
<input type="checkbox"/> Turn On Projection	
RKB TVD	3000
Max Dip	0
Max Dip Dir.	0
<input type="radio"/> User defined Strike Inc	
<input checked="" type="radio"/> User defined Strike Azm	
Strike Inc	90
Strike Azm	30
Extension	0
DLS (NBR)	5.73
Color	Make Target Plane

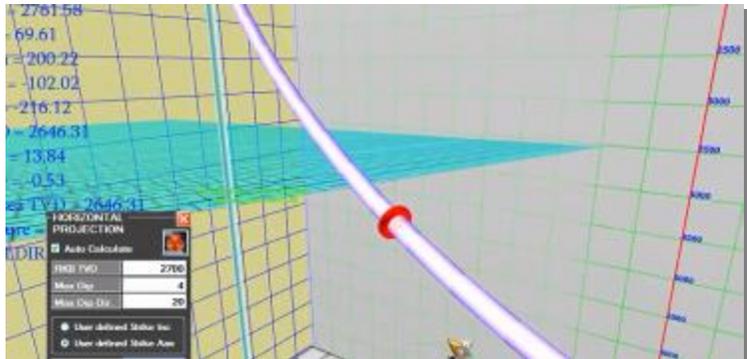
Horizontal projections are a more hands-on projection requiring several user-generated parameters, calculated by defining a horizontal plane.

CREATE A TARGET PLANE: To set a horizontal plane, RIGHT-CLICK on a straight (tangent) section of a curve, then select “Create Target Plane.” A two-dimensional target plane will appear in the 3D space along the tangent. Now RIGHT-CLICK on the target plane itself and select “Set as Horizontal Target Plane.”

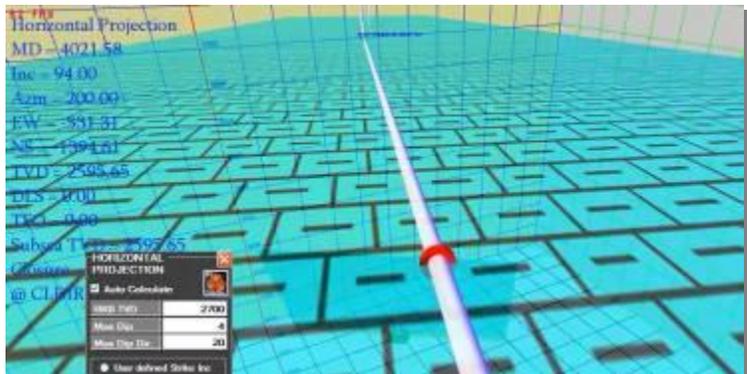


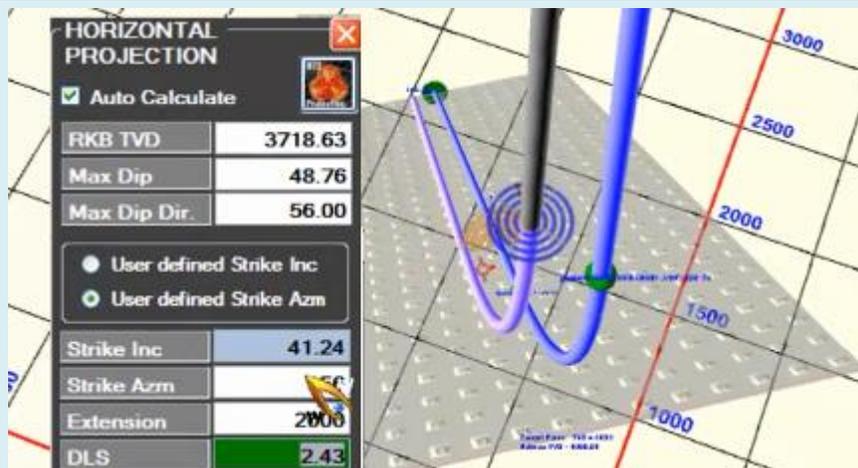
NOTE: It always helps to put an extension (tangent) on a horizontal projection (just add some length in the Extension field in the panel). This elongates the projection and allows for better visualization of where the projection and the attendant target plane will be situated. Also note that the texture of the plane itself reflects the data entered in the LITHOLOGY panel.

NOTE: When creating a target plane, it will be generated from zero closure towards the active direction in which the projection is made. So if you then take the projection 180 degrees in the other way, there won't be any target plane in that direction.



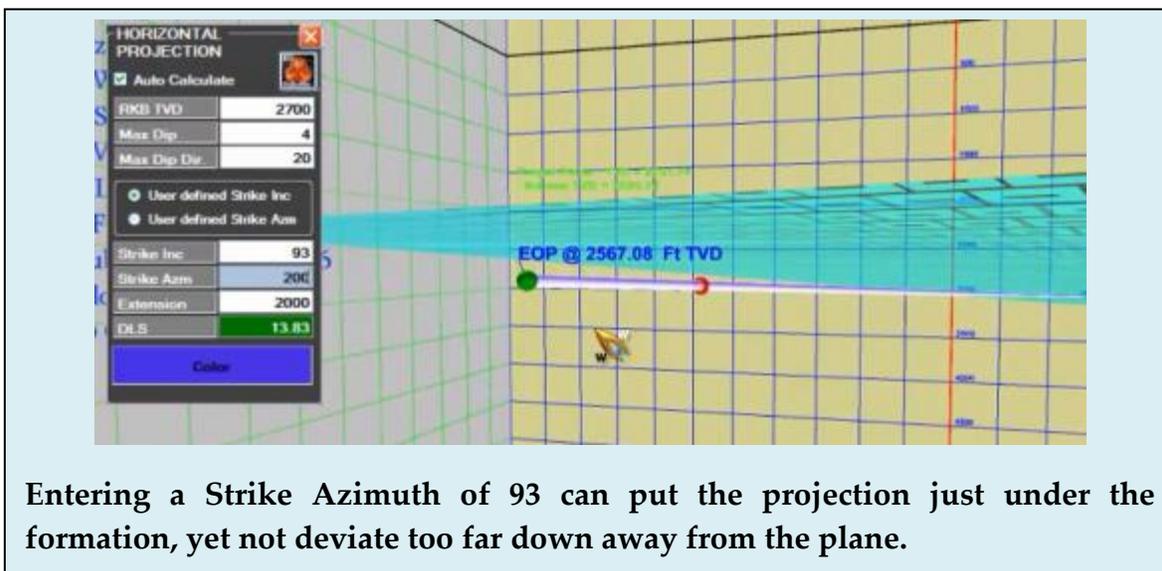
To extend the target plane in the other direction, just repeat the process of selecting the curve, RIGHT-CLICKING on it, and select “Make Target Plane.” This will extend the target plane in your new direction and link up with the first one.





Horizontal projections will allow the user to enter either the strike azimuth or the strike inclination.

BORE DOWN JUST UNDER THE FORMATION: The Horizontal projection panel will only allow for the change of either strike inclination or strike azimuth at any one time. But they can be modified in succession. To get the projection to get right under the formation and cruise along underneath, simply determine the proper strike azimuth, then enter a user-defined Strike Inclination of anything a little over 90 (because a 90 degree strike inclination will put the projection directly on the formation plane).



Entering a Strike Azimuth of 93 can put the projection just under the formation, yet not deviate too far down away from the plane.

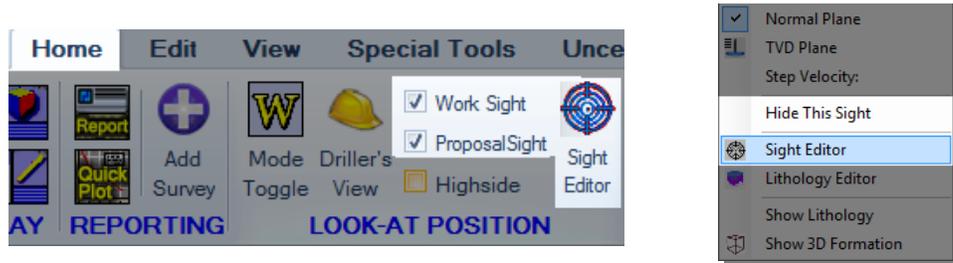
NOTE: Although you cannot define the DLS in this mode, it is the all-important number to keep an eye on after every parameter change and is thus highlighted in green.

3. Other Projection Tools

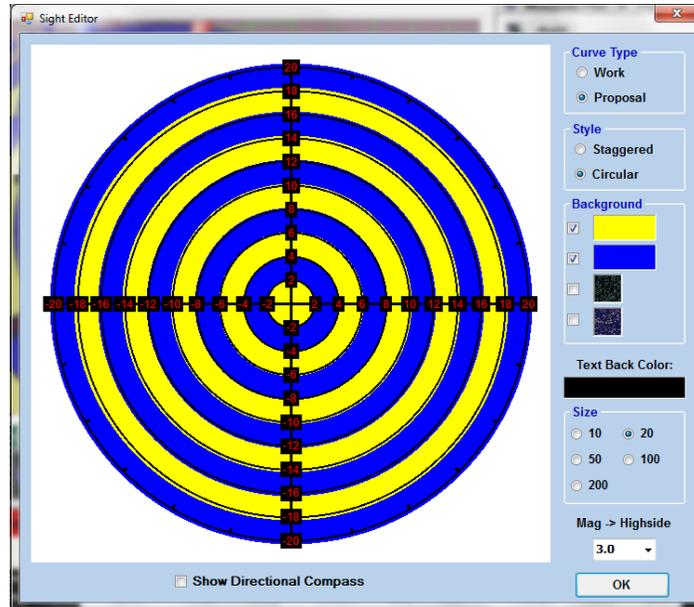
a. The Sight

The Sight is a critical part of the 3D window in HawkEye™, a visual aid that follows the user's Point of View or "Look-at Point" along a curve. It is highly customizable and can also quickly be toggled on and off.

TWO SIGHTS: There are two Sights in HawkEye™. One is associated with the Work Curve and the other with the Proposal Curve. Each may be toggled on or off with their own checkbox in the "Home" tab. Each of the Sights is only visible in their own mode, and each retains their own customization settings (e.g. diameter, colors). A Sight may ALSO be toggled off also by right-clicking on it and selecting "Hide This Sight."



SIGHT EDITOR: Either Sight can be edited by RIGHT-CLICKING on the icon, or RIGHT-CLICKING on the 3D space and selecting "Sight Editor." The Sight Editor allows for the customization of every aspect of the current Sight and changes are automatically saved.



The Sight Editor controls all of the appearance options of the Sights for both the Work and Proposal curves. The parameters are:

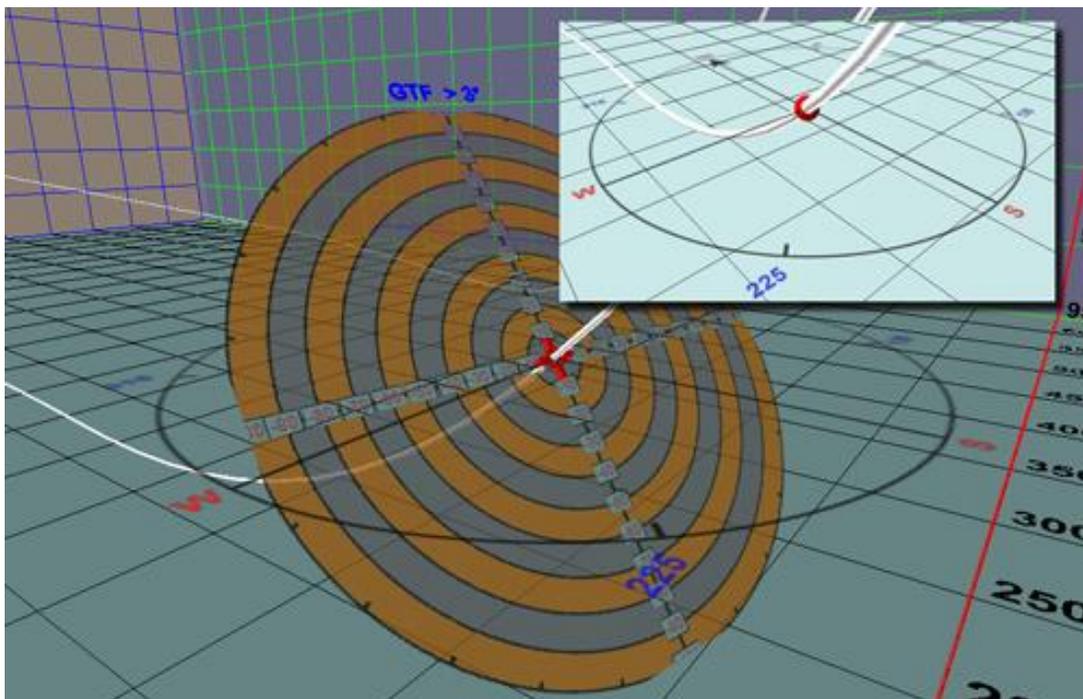
- **Curve Type-** Choose either the Work or Proposal Curve Sight to edit.
- **Style-** Choose either contiguous circles or a quartered stagger.
- **Background-** Choose from a combination of either two colors, two textures or one of each. The colors to choose from run the entire visible spectrum, and there are about 100 default textures to choose from. But the user may provide a custom texture by choosing the folder location when prompted.
- **Text Back Color-** Choose the background color of the numbers on the Sight.
- **Size-** This feature defines actual size of the Sight and dictates the distances defined by the numbers on Sight itself.
- **Mag->Highside-** This drop-down menu ranges from 0.0 to 5.0 in .5 intervals and defines the inclination the user wants to switch from Magnetic Tool Face to Gravity Tool Face. When the inclination exceeds this value the sight will be oriented so that the top is at Tool Face 0. When the inclination is less than or equal to this value the top of the sight will be pointed due north.

Click “OK” to save all changes to the Sight.

THE DIRECTIONAL COMPASS: The floating Directional Compass can be turned on and off through the Sight Maker options dialogue. When turned on, it is a compass that follows the Look-At Point to constantly show either True North or Grid North, depending on the current project's settings.

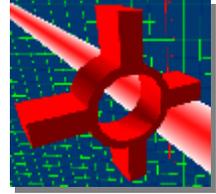
The Directional Compass will always be the size of the Sight, and will always be oriented horizontally.

Hit the comma (,) key while the cursor is hovering over the 3D space in order to toggle the directional compass.

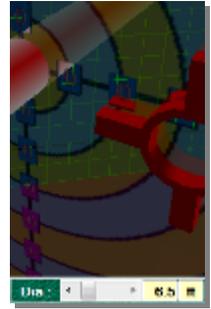


b. Projection to the Crosshairs

The crosshairs can be used in the projection mode to act as a “First Target” for certain targeted projections (Slant and Aligned). In order to have the Crosshairs active on the screen, HawkEye™ needs to be in Proposal Curve Mode with the Sight turned on. Toggle the Proposal Sight on by clicking on the checkbox next to the Proposal Sight under the “Home” tab.



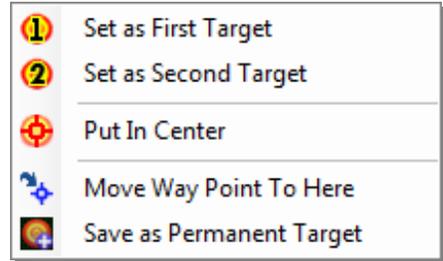
SIZING: The Crosshairs is always red, and is always sized along with the diameter of the curve. To change the curve display diameter, use the slide control just below the 3D window.



MOVE THE CROSSHAIRS: The Crosshairs appears by default in the center of the Sight, hugging the active curve. To place it anywhere on the Sight, just left-click and drag it to the area, then drop it. Right-click on it and select “Put in Center” to re-center.

SET AS A TARGET: Pull up the Crosshairs contextual menu by right-clicking on it.

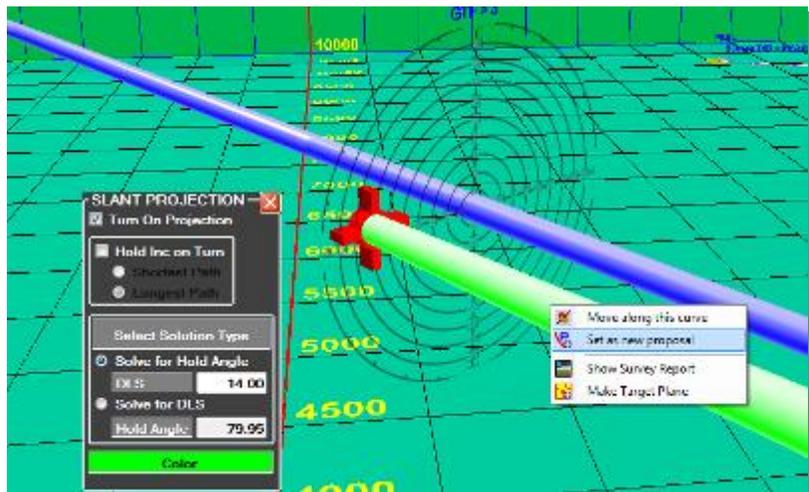
When The Crosshairs object is set as First Target (or Second), it becomes a target for projection purposes only and is not a listed target that can be found in the Target List or Data Tree.



PROJECT TO CROSSHAIRS TARGET: Once the Crosshairs are set as a target through the right-click menu (see above), one of two targeted projections (Slant or Aligned) can be made to the Crosshairs.

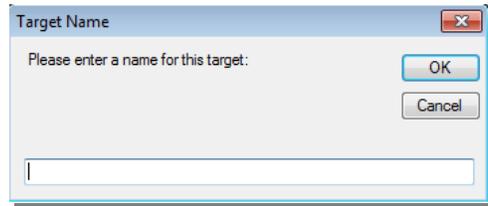
The projection will be redrawn constantly as you move the Sight up and down your reference curve.

Right-click on the new curve and select “Set as new proposal” to create a new curve which goes to that current point.



c. Target at the Crosshairs

SAVE AS PERMANENT TARGET: Right-click on the Crosshairs and select “Save as Permanent Target.” A name prompt will appear and then the target will have been created at the exact current location of the Crosshairs. In this fashion, the Crosshairs can act as a Johnny Appleseed of targets, making it easy to drop simple targets near a proposal curve without having to input coordinates or offsets.



	Set as First Target
	Set as Second Target
	Put In Center
	Move Way Point To Here
	Save as Permanent Target

Select “Save as Permanent Target” from the Crosshairs right-click menu and a target will be generated in that very spot.

ALSO NOTE ANOTHER WAY TO GENERATE TARGETS QUICKLY

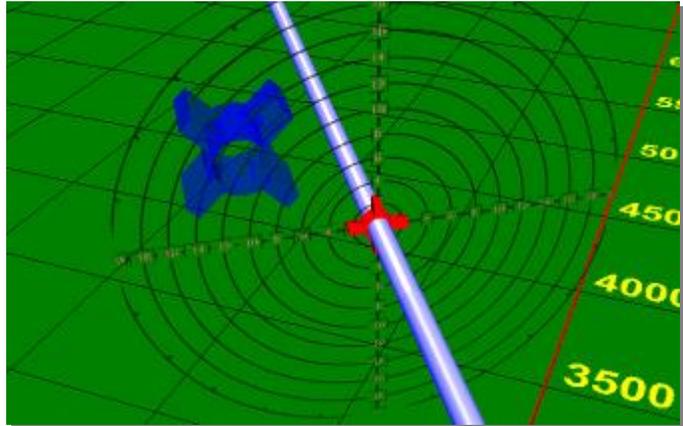
	Add Target
	Target List

Click on the “Add Target” button in the middle of the Home tab to create target at the current Look-At Point of the 3D space.

These targets, like any real target, can be found in the Data Tree and Target List. They are associated with the slot/wellhead under which the current proposal curve is located.

d. The Waypoint Target

A quick-use target can be set anywhere on the Sight in order to quickly drop in an intermediary target for projection purposes. This target, called the Waypoint, is set by right-clicking on the red Crosshairs and selecting "Move Way Point To Here."



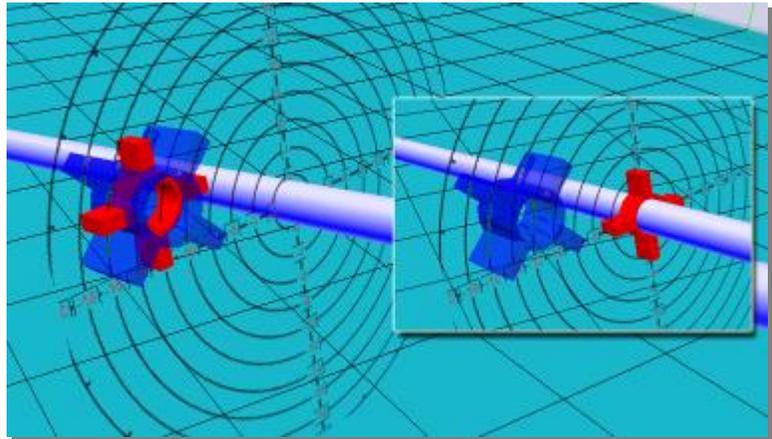
The Waypoint will appear as a blue object in the 3D space.

It will also appear as a target in the Data Tree under the name "WP*". It may be deleted via the Data Tree right-click menu, or if it is repositioned through the Crosshair menu, it will simply exist in a new location.

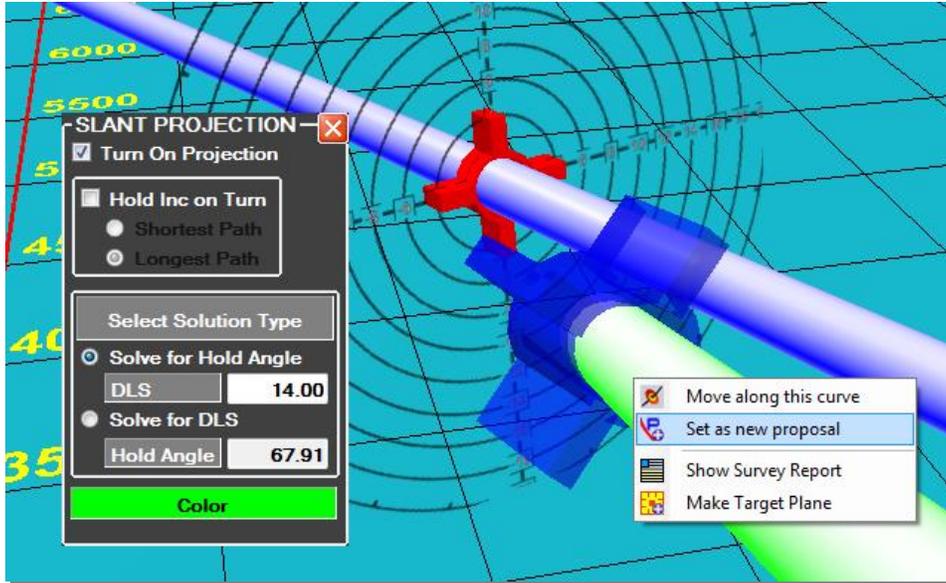


NOTE: There is only one Waypoint in the 3D space at any given time.

PLACING THE WAYPOINT: As mentioned above, to place the Waypoint, just move the red Crosshairs anywhere on the Sight, right-click on the Crosshairs and select "Move Way Point To Here." The blue Waypoint will appear exactly where the Crosshairs is located. Even if the Sight is moved away, the Waypoint will remain in the original placement location.

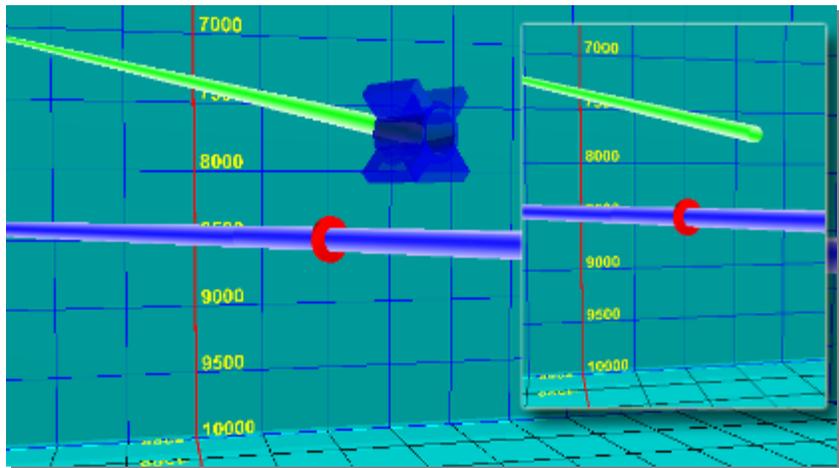


PROJECTING TO THE WAYPOINT: To actually use the Waypoint, first place it, then simply right-click on it and “Set as First (or Second) Target.” The targeted projections will treat it like a designated target in this fashion, and it can act as a quick way to make a sort of anchor between locations.



SET AS NEW

PROPOSAL: Just as with regular targets, if a projection is made to a Waypoint and then that projection is made into a “proposal curve,” the curve will remain there even if the Waypoint is deleted or repositioned somewhere else.



IV. REPORTS AND QUICKPLOTS



Reports in HawkEye™ can be produced for six different dataforms: survey, projection, critical points, criticality, least distance and interpolated survey reports.

SIX TYPES OF REPORTS IN HAWKEYE

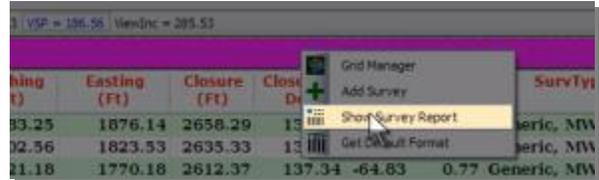
1. **Survey Reports-** This is the default type of report, which presents all of a curve's surveys under critical points headings. May include currently active projection.
2. **Interpolated Survey Reports-** This report is useful for interpolating across different types of wells. It has different interval options between a proposal and a survey well.
3. **Projection Only-** Displays the surveys of the projection that is active just before opening the Report Generator.
4. **Critical Points Reports-** This report displays only the geometrically defined critical points and user comments for a curve.
5. **Criticality Reports-** A special kind of least distance report where several different wells can be compared to determine dangerous proximities.
6. **Anti-Collision Reports-** A comparison report between two or more curves which displays a suite of separation factor-related values.

OPENING THE REPORT GENERATOR: There are four ways to get to the Report Generator in HawkEye™.

1. In the top left of the main screen, second from the left, click on the Report Generator icon. The survey which appears is of the well path that is the current center of focus in the 3D space
2. **RIGHT-CLICK** on any curve in the Data Tree and select "Show Survey Report." This will bring up the surveys for that particular curve selected.

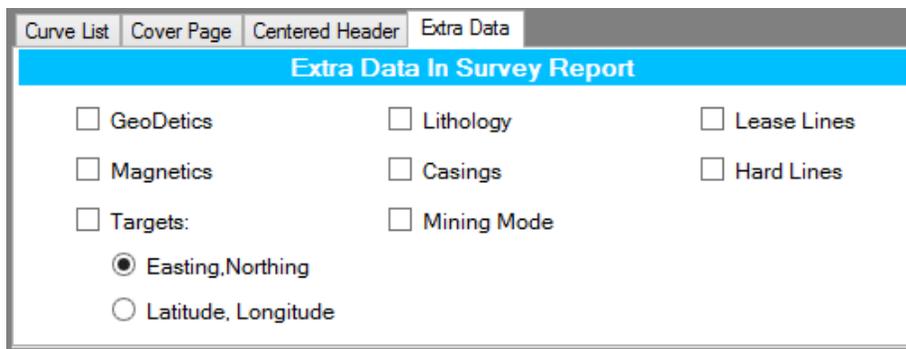
NOTE: Right-clicking on a curve brings up a long list of curve-related options, and in fact, these such contextual menus are the basis for navigating the various functionalities of HawkEye™.

3. RIGHT-CLICK on a curve in the 3D space, then select “Show Survey Report.” This will bring up the surveys related to that curve.
4. RIGHT-CLICK on the colored bar just above the Survey List Panel (located at the bottom portion of the main screen) and select “Show Survey Report.” This will bring up the survey related to the currently focused well.



EXTRA DATA IN SURVEY REPORT:

Most of the optional items that can be added to a Survey Report are self-explanatory. The “Extra Data” tab can be found at the bottom left of the Report Generator.



Two items bear some explanation:

Mining Mode bears some explanation: It subtracts 90 degrees from every inclination reading. This convention is used in the mining industry, where their “0” is horizontal.

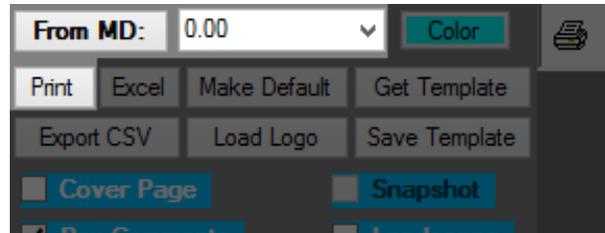
Easting, Northing and **Latitude, Longitude** on the bottom pertain to targets. When “Targets” are checked, their location can be displayed in either one or the other format.

1. Survey Reports

TEMPLATES: Any of the 41 data types found in the blue columns on the left can be added to a report template in any order, and any number of templates can be saved and loaded. This is useful for various customers with different specs for their reports. To add a data column, LEFT-CLICK on it from the left hand blue column and it will appear in the display list column. To remove, select it on it in the right hand column by left-clicking on it, then RIGHT-CLICK on it and it will disappear.

To place them in a certain order, they must be removed and “stacked” or re-added to the righthand column in the desired order.

PRINTING REPORTS: Printing a report is as simple as clicking the “Print” button at the top of the Report Generator panel, or by clicking the printer icon at the top of the panel. A user may also print from a certain depth. To do that, they would simply select



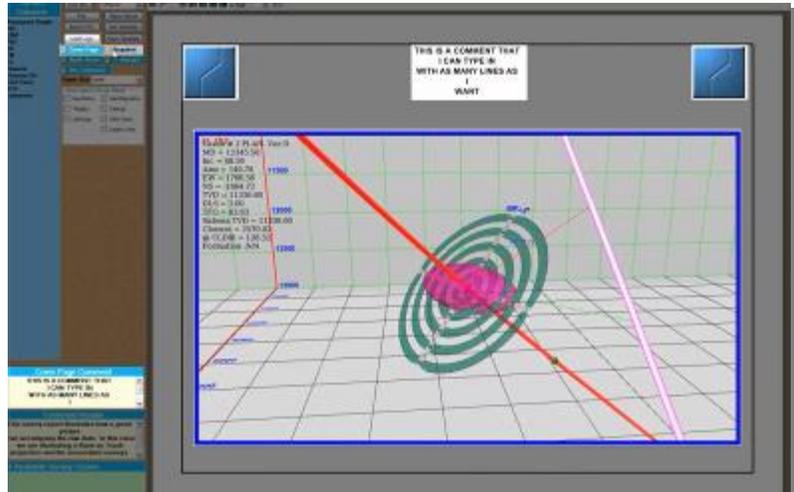
the starting survey from which to print from the drop-down menu, then click “Print.” This is useful for avoiding having to print out an entire battery of surveys when for example only the last ten are needed on paper.

PRINTING TO PDF: HawkEye™ installs with CutePDF, a program which allows anything which can be printed onto paper to be printed into a PDF instead. Using this is as simple as selecting “CutePDF Writer” as the printer in the print settings and then selecting a target folder for the file when prompted.

(CutePDF Professional is a step up from the free version and can be purchased at their website (www.cutepdf.com). It includes a ton of features for around \$50, but none of them are necessary with HawkEye.).

COVER PAGE: A cover page can be added, and may contain any of three major elements: a logo, a title or comment, and a snapshot from the 3D space.

To add a cover page, first select the “Cover Page” checkbox in the top left. To add a logo, click “Load Logo” in the top left and select a graphic that will appear on the top left and right of the cover page.

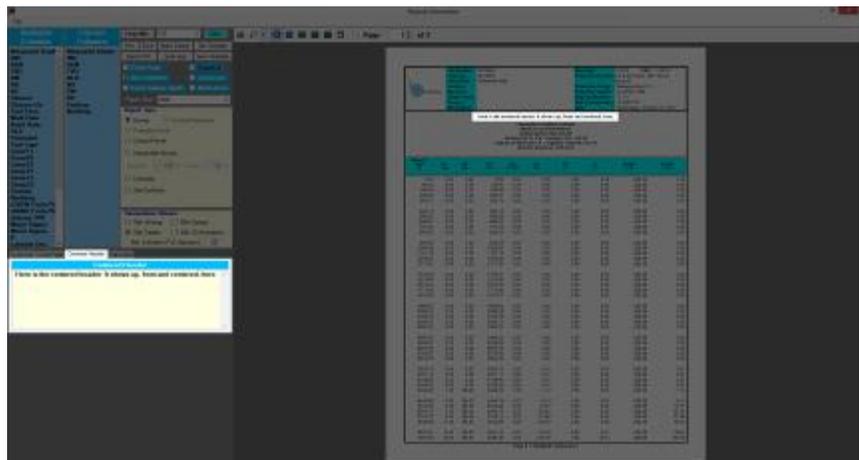


To add comments, simply type in whatever desired text into the “Cover Page Comment” text field in the bottom left of the Report Panel. It will appear instantaneously on the cover page.

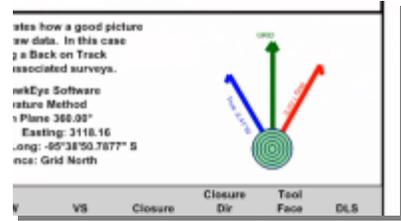
SNAPSHOT: By turning on the Snapshot option, the cover page will show the last 3D view seen before opening the Report Generator. So to adjust the snapshot, the user simply closes the Report Generator and navigates the 3D space to get just the right angle, then opens the Reports back up again.

CENTERED HEADER: A block of additional header text can be added to the first non-cover page of a report simply by adding text to the “Centered Header” text field in the bottom left of the Reports

panel (under the “Centered Header” tab). Any added header text will appear above the mandatory header information that always appears in the header zone of a report.



NORTH ARROW: Toggle on the North Arrow with the checkbox in the top left and such an arrow will appear in the first non-cover page of the report. This arrow set displays True north, grid north and magnetic north. (For more on this arrow, see the Magnetics Report section at the end of this chapter).



BOX COMMENTS: Comments for each survey can be added here and are usually a necessary part of reports. To add box comments, just click the “Box Comments” checkbox and a column of comment fields will appear in the report.

PAPER SIZE: Choose from Letter or A4.

EXTRA DATA: Additional supplemental data can be appended to the bottom of a report by checking them in the “Extra Data in Report” panel. When selected, the corresponding data will be generated, organized and displayed under any displayed surveys.

11843.00	37.18	252.50	11343.02	-1994.81	1552.88	-1994.81	2527.75	142.10	0.00	0.27
11856.00	37.18	252.50	11434.17	-2006.84	1516.63	-2006.84	2514.75	142.91	0.00	0.00
Projected										
12052.05	37.18	252.50	11510.74	-2023.35	1461.41	-2023.35	2495.93	144.16	0.00	0.00
GEODETTIC INFORMATION										
Latitude: 31°45'43.5024" N					Geodetic Zone: None					
Dec. Latitude: 31.51208399					Geodetic Datum: CLARKE 1866					
Longitude: -05°38'50.7877" W					Easting: 0.00					
Dec. Longitude: -05.64744102					Northing: 0.00					
Geodetic Group: None					Convergence: 2.45					
TARGET DATA										
Name	Shape	Northing (Ft)	Easting (Ft)	TVD (Ft)	NS (Ft)	EW (Ft)	Side A (Ft)	Side B (Ft)	Diameter (Ft)	
Target 1	CYLINDER	-859.42	767.27	10130.00	-939.42	767.27	200.00	0.00	200.00	
TURN PT	CUBE	-1571.78	1517.20	10991.69	-1571.78	1517.20	50.00	50.00	30.00	
Target 2	CYLINDER	-2516.42	2555.27	11950.00	-2516.42	2055.27	200.00	0.00	200.00	

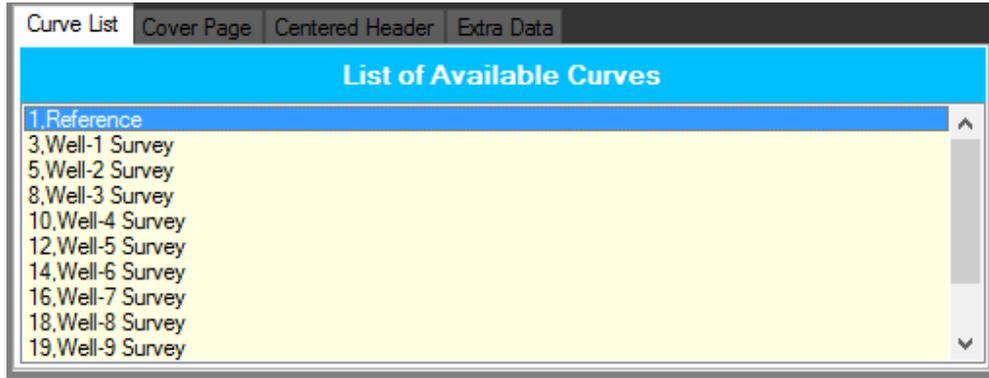
REPORTS NAVIGATION:

The tools at the top of the Report Generator panel controls the view modes and zoom. Reports may be viewed one, two, three, four or six pages at a time. The currently displayed page can be controlled here as well.

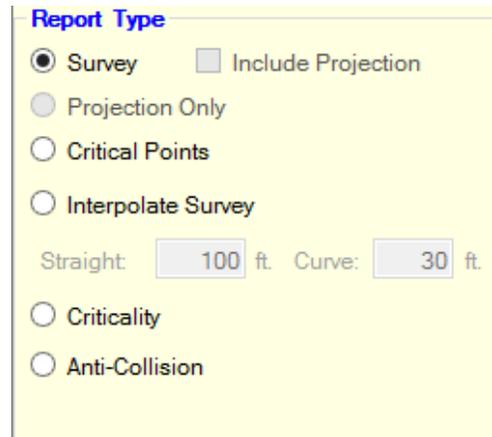


NOTE: Pages can also be navigated by scrolling the mouse wheel up and down while the cursor is over the report page itself. Also, left-clicking on the report itself will zoom out one step, while right-click once will zoom in one step.

SELECTING SURVEY OR PROPOSAL: Select the curve on which to base the report by clicking on it in the bottom left window of the panel. You may either choose a survey or proposal curve. They are automatically numbered by the sequence in which they are listed in the project's database. When a curve is clicked on, the report will be immediately generated via all the parameters specified in the Report Generator panel.



REPORT TYPE: Choose your report type in the middle left of the panel. A survey entry can be generated at different frequencies depending on whether the path section is straight or curved. That frequency input is located in the same window where the report type is selected and can be entered manually.



The default Survey Report will display each of the survey readings of a curve. The survey entries are organized readings under critical point headings that describe each part of the curve.

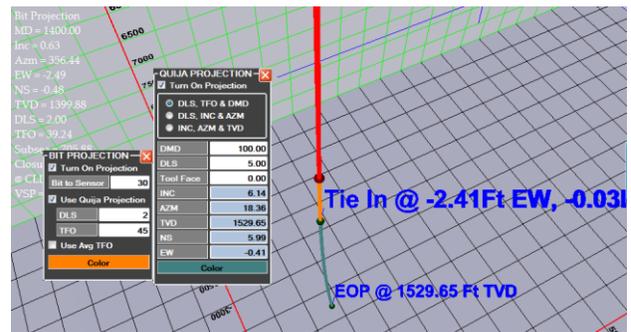
ENTERING SURVEYS: Surveys are not entered in the Report Generator, but rather only displayed in a report. Surveys can be entered manually in the survey window at the bottom of the main screen or in the Survey Editor, which can be opened by clicking on the blue plus icon on the far left end of the projection icons.

COPY AND PASTE: Surveys can be quickly copied from a spreadsheet and pasted directly into the Survey Grid in HawkEye™. See more about this process in Ch.3 Project Data, Section 2 Job Information: Adding and Editing, under the first sub-section "Surveys."

Up/Down and Left/Right: Of the many columns of data that can be added to a survey report, often favored are the UD/LR columns. When these are added to a report, they will always compare the referenced curve against the Current Proposal Curve, whichever that may be.

Furthermore, the values will be expressed as UD/LR only in surveys where the inclination is above a certain threshold (which can be set in the Sight Editor on the bottom right corner of the form). If a survey contains an inclination under the threshold, then the distances are expressed in terms of North/South and East/West of the proposal curve.

INCLUDE PROJECTION: The default survey report has a checkbox which allows the user to include any projections that were active in the 3D space at the time the Report Generator was launched. In the picture to the right, there are two projections activated, a Bit and a Nudge projection. By leaving them on and launching the Report Generator, you have the option to include them in the survey report, as illustrated below.



Just check the “Include Projection” box in the Report Type area, and the surveys for the projections will be automatically added and labeled at the end of the as-drilled surveys.

	1264.00	1.32	273.53	1263.90	-0.44	-1.88	-1.88	1.93	-32.45	1.00	0.66 (N)	-13.68 (W)
	1298.00	1.32	286.93	1295.90	-1.16	-1.75	-1.75	2.10	41.88	0.00	0.59 (N)	-12.95 (W)
	1328.00	1.32	304.99	1327.89	-1.81	-1.43	-1.43	2.31	56.44	0.00	0.34 (N)	-12.27 (W)
	1358.00	1.01	325.12	1357.88	-2.24	-1.02	-1.02	2.46	67.10	-1.03	-0.02 (S)	-11.80 (W)
	1391.00	0.70	343.62	1390.88	-2.47	-0.58	-0.58	2.54	56.06	-0.94	-0.42 (S)	-11.54 (W)
	BIT PROJECTION - Begin Build and Turn @ 1400.00MD, 2.00"/100 Ft											
	1400.00	0.63	356.44	1399.88	-2.49	-0.48	-0.48	2.54	0.00	0.00	-0.52 (S)	-11.51 (W)
	1405.00	0.70	2.20	1404.88	-2.49	-0.42	-0.42	2.53	115.25	1.49	-0.58 (S)	-11.50 (W)
	1410.00	0.78	6.83	1409.88	-2.49	-0.36	-0.36	2.51	92.52	1.60	-0.64 (S)	-11.50 (W)
	1415.00	0.87	10.58	1414.88	-2.47	-0.29	-0.29	2.49	75.01	1.68	-0.71 (S)	-11.51 (W)
	1420.00	0.96	13.66	1419.88	-2.46	-0.21	-0.21	2.47	61.54	1.74	-0.79 (S)	-11.52 (W)
	Begin Build and Turn @ 1425.00MD, 0.00"/100 Ft											
	1425.00	1.05	16.21	1424.88	-2.43	-0.12	-0.12	2.44	51.13	1.79	-0.87 (S)	-11.53 (W)
	QUILJA PROJECTION - Begin Build @ 5.00"/100 Ft											
	1430.00	1.14	18.36	1429.88	-2.41	-0.03	-0.03	2.41	0.00	0.00	-0.96 (S)	-11.55 (W)
	1435.00	1.39	18.36	1434.88	-2.38	0.07	0.07	2.38	0.00	5.00	-1.07 (S)	-11.57 (W)
	1440.00	1.64	18.36	1439.88	-2.33	0.20	0.20	2.34	0.00	5.00	-1.20 (S)	-11.60 (W)

Page # 1 <Wellpath: Work Curve>

You may also generate a report that contains ONLY projection surveys by clicking on the “Projection Only” button in the Report Type. Remember, the projection needs to be active before launching the Report Generator for this to work.

2. Other Reports

a. Critical Points Reports

There are two kinds of critical points in HawkEye™, the geometrically defined critical points and user-created comments HawkEye™ treats as critical points. With a Critical Points report, each of these data are put into a report in the order in which they occur as a function of depth.

To create a Critical Points report, select “Critical Points” from the Report Type, then select the reference curve on the bottom left. The report will be immediately generated, displaying all the geometrically defined points as well as user-generated comments for that curve.

Measured Depth (Ft)	INC Deg	Major Axis (Ft)	Minor Axis (Ft)	Major Sigma (Ft)	TVD (Ft)	AZM Deg	EW (Ft)	NS (Ft)	VS (Ft)	Closure (Ft)	Closure Dir Deg
Begin Nudge / 200 TVD, Build @ 2.50°/ 100', 130° Azimuth											
200.00	0.00	0.00	0.00	0.00	200.00	0.00	0.00	0.00	0.00	0.00	0.00
Begin Hold @ 5.00°, 130.00° Azm											
400.00	5.00	0.43	0.40	0.43	399.75	130.00	6.68	-5.61	-5.61	8.72	130.00
9 5/8" casing											
771.67	5.00	1.44	1.26	1.28	770.00	130.00	31.50	-26.43	-26.43	41.11	130.00
Begin Drop @ -1.50°/ 100'											
1200.00	5.00	2.62	2.26	2.27	1196.70	130.00	60.09	-50.42	-50.42	78.45	130.00
Vertical											
1533.33	0.00	2.23	1.65	1.65	1529.61	130.00	71.23	-59.77	-59.77	92.98	130.00
Begin Curve / Build @ 10.00°/ 100', 158° Azimuth											
6037.72	0.00	11.54	11.42	11.42	6034.00	158.00	71.23	-59.77	-59.77	92.99	130.00
Target / Begin Turn @ -5.00°/ 100'											
6937.79	90.00	18.08	13.11	12.99	6607.00	158.00	285.88	-591.05	-591.05	656.56	154.19
End Turn /Hold @ 130.93° Azimuth											
7479.20	90.00	26.64	13.35	13.02	6607.00	130.93	597.64	-1027.54	-1027.54	1188.70	149.82
Proposed End of Lateral											
10980.52	90.00	106.65	34.06	14.32	6607.00	130.93	3242.94	-3321.36	-3321.36	4641.99	135.68

The Critical Points report will display all relevant data points of a curve. Simply select “Critical Points” as the report type and select the desired reference curve.

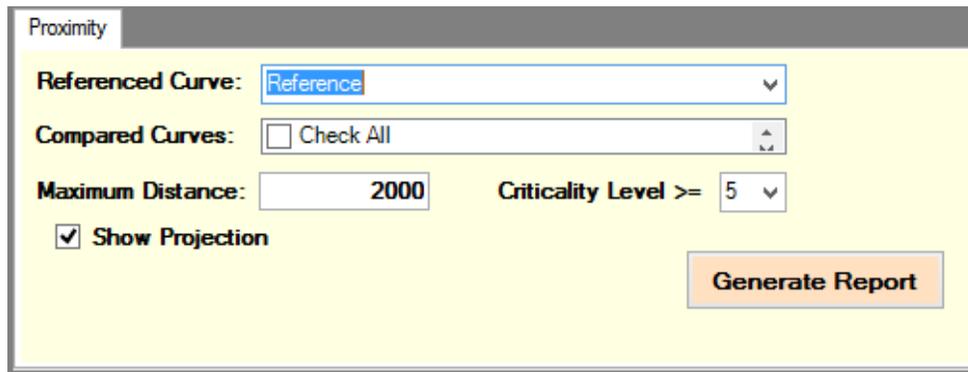
In addition to the standard comments, additional comments for Lithology, casing and targets can be included in the critical points report. In order to include those, just click the associated check box for the Interpolation Options. An icon for lithology, casing or a target will precede the description.

If two critical points are defined by the same point then all the comments are joined and the icon provides a visual cue as to the nature of the comment.

b. Criticality Report

The Criticality report will graphically represent any dangerous proximities on a distance plot. All curves in a project are shown with a key at the bottom of the graph.

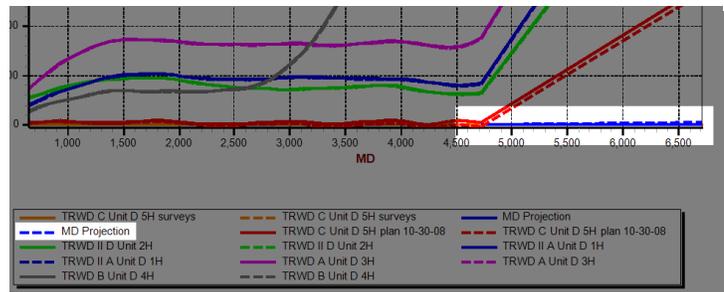
Be sure to select the desired reference curve from the drop-down menu at the bottom left of the panel when “Criticality Report” is selected. A Maximum Distance can be set, a range to which criticalities will be displayed. When a new reference curve is selected, click “Create Report” in order to refresh the graph.



The screenshot shows a software interface titled "Proximity". It contains the following controls:

- Referenced Curve:** A dropdown menu with "Reference" selected.
- Compared Curves:** A dropdown menu with "Check All" selected.
- Maximum Distance:** A text input field containing the value "2000".
- Criticality Level >=:** A dropdown menu with "5" selected.
- Show Projection:** A checked checkbox.
- Generate Report:** A button located at the bottom right of the panel.

SHOW PROJECTION: Check the “Show Projection” box to show any curve’s projection in the graph. It is recommended that the projection be made a different color than the preceding curve in order to enhance visibility in the graph

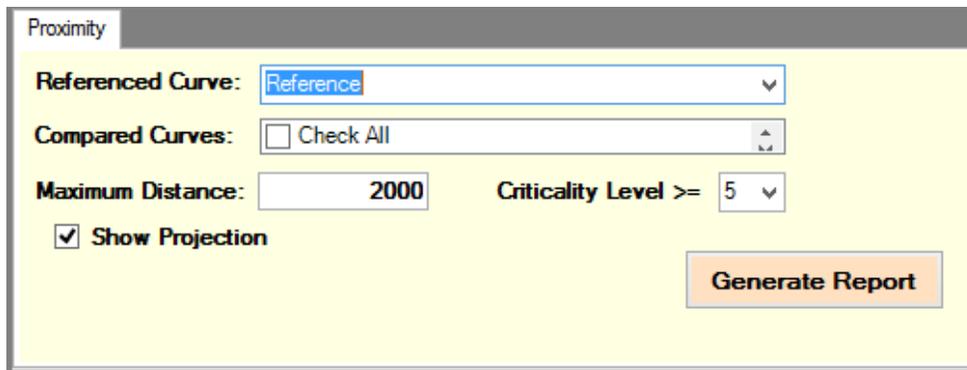


The text output associated with the criticality report will highlight only Criticality 3, 4 or 5. Criticality 1 and 2 are ignored. This helps to keep the report to a manageable size.

c. Anti-Collision Report

An Anti-Collision report will generate a list of surveys comparing any of two or more curves, as well as a ladder plot to help discern any dangerous proximities. Any well that is close to the base line of the plot indicates a potential problem at that measured depth.

SELECT COMPARE CURVES: To create a least distance report, just select “Anti-Collision” in the Report Type window, then select the one or more reference curves from the drop-down menu that will appear just below. After selecting the compare curves, click “Create Report.”

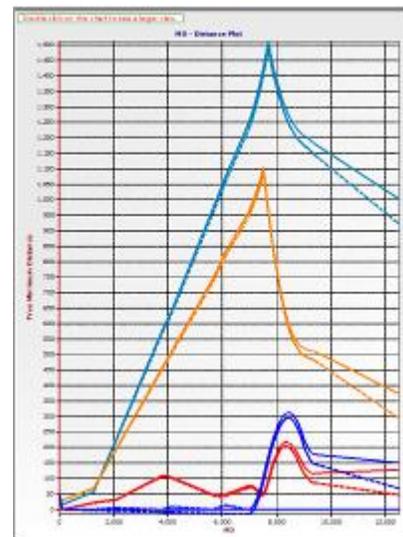


The screenshot shows a software window titled "Proximity" with a yellow background. It contains the following controls:

- Referenced Curve:** A dropdown menu with "Reference" selected.
- Compared Curves:** A dropdown menu with a "Check All" checkbox.
- Maximum Distance:** A text input field containing the value "2000".
- Criticality Level >=:** A dropdown menu with "5" selected.
- Show Projection:** A checked checkbox.
- Generate Report:** An orange button located at the bottom right of the window.

The header at the top of each page of the report will clearly state which two curves are being compared.

The first non-cover page of the Anti-Collision report is the ladder plot comparing the curves:



The subsequent pages contain the survey list. This list will have a number of columns containing specific distance and separation factor values.

Reference Well: Wellhead 1 - Plan 1										Offset Well: Wellhead 1 - As-Drilled								
Measured Depth (Ft)	REFERENCE WELL			OFFSET WELL			To TVD (Ft)	Between Centers (Ft)	DISTANCES		SEMI-MAJOR AXES		Highside Toolface Deg	PROXIMITY		Criticality/Warning		
	From NS (Ft)	From EW (Ft)	From TVD (Ft)	To NS (Ft)	To EW (Ft)	To MD (Ft)			Between Ellipses (Ft)	Minimum Separation (Ft)	Reference (Ft)	Offset (Ft)		+/- N-Plane (Ft)	SF			
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
100.00	0.00	0.00	100.00	100.00	0.00	0.00	100.00	0.00	0.00	0.45	0.22	0.22	0.00	0.00	0.00	0.00	SF ES CC	Level-5
1250.00	0.00	0.00	1250.00	1250.31	21.88	1.52	1249.99	21.93	21.18	0.75	0.00	0.75	3.99	-0.01	3.85			Level-2
2100.00	0.00	0.00	2100.00	2099.06	32.88	4.30	2098.58	33.19	26.72	6.47	4.72	1.75	7.45	-1.42	2.91			Level-2

The following is a breakdown of each of these columns:

Distances

Between Centers: The minimum 3D distance between the reference well and the offset well.

Between Ellipses: The distance between the ellipses.

Minimum Separation: The minimum allowable separation distance. This is generally calculated according to the ruleset being used. The default rule is that the minimum separation is the sum of the ellipses radii. With a pedal curve calculation, that means the distance to the pedal curves.

Semi-Major Axes

Reference: Length of the Semi-Major Axis of the projected 2D ellipse onto the TVD plane of the reference well.

Offset: Length of the Semi-Major Axis of the projected 2D ellipse onto the TVD plane of the offset well.

Proximity

Highside Toolface: This is the tool face angle on the normal plane of the reference well that lines up with the offset well.

+/- N-Plane: This is the distance the center of the offset well is behind or in front of the reference well. This is included so that one can determine whether or not the well is in front or behind the reference point.

Separation Factor: The general definition of this number is the ratio of the center to center distance divided by the sum of the ellipses radii. A SF greater than one means that the ellipses are completely separated, and there is no overlap. A SF of one means that the ellipses are touching and a number less than one means that the ellipses are overlapping one another. When the diameters of the well and casings are taken into consideration, the formula for calculating the SF changes. Different operator rule sets impose different approaches to calculating this number, there is no one way. One of the most common methods for measuring the radii of the ellipses is called the pedal curve method (PCM). This method creates a pedal curve around the outside of the ellipse and radii are measured to that curve, not the edge of the ellipse.

A more detailed understanding of the calculation and the different approaches to it can be found in Angus Jameisons e-book, which can be found at this address:
<http://www.uhi.ac.uk/en/research-enterprise/energy/wellbore-positioning-download>

Criticality/Warning:

The Levels 1-5 indicate warning levels. Level 1 is the lowest and level 5 is the highest warning level. Rulesets defined by different oil companies will define different levels of warning, generally based upon the value of the separation factor. The lowest level generally means proceed ahead as planned, continuing the quality control (QC) procedures defined for the well. Level 5, or whatever the highest level the company has defined, generally means stop dead in your tracks and wake up all the bosses so they can decide what to do.

SF – Indicates that the survey has the minimum Separation factor for the current offset well.

ES –Indicates that the survey has the minimum Separation between ellipses for the current offset well.

CC –Indicates that the survey has the minimum center to center distance for the current offset well.

d. Interpolate Survey Report

Additional interpolated surveys can be generated for either survey or proposal curves.

When a survey curve is selected under the Interpolate Survey report type, an Increment field appears within which the user may define an interpolation interval. When a proposal curve is selected, the interval fields allow the user to define both the straight segment and curve segment frequency of interpolated surveys.

The reason proposal curves have two interpolation intervals to define and regular surveys is because frequently users want to see a proposal with the curve section interpolate by one value, say 30 feet and the hold sections interpolated every 100 feet. A proposal can be represented by simply inputting the critical points as surveys. A proposal's critical points will calculate exactly the same closure and coordinates as the same proposal that is interpolated every foot.

KEEP CURVE: The Interpolated Report can be used to generate an entire curve from just a few critical points. This process takes the critical points and extrapolates them into a usable proposal curve. Just follow these steps:

1. Enter the critical points as surveys into a new or existing curve.
2. Go to Report Generator and select "Interpolate Survey" as the report type.
3. Define the increments of interpolation you want for the curve.
4. Click the KEEP CURVE button.

NOTE: The interpolated surveys will OVERWRITE the current list of surveys.

MAX INCLINATION (TVD APPROACH): For use with targets. The threshold inclination here tells the program at what inclination to stop drawing a TVD plane line to the curve from the center of target and start drawing a least distance line. For example, if the max inclination here is set to 85 degrees, then as long as the inclination of the curve is below 85 degrees all TVD interpolation values from the center of targets

The screenshot shows a software interface for configuring an 'Interpolate Survey' report. It is divided into three main sections:

- Report Type:** Contains radio buttons for 'Survey', 'Projection Only', and 'Critical Points'. The 'Interpolate Survey' option is selected. There is an unchecked checkbox for 'Include Projection'.
- Interpolation Settings:** Features a 'Keep Curve' button and two input fields: 'Straight: 100 ft.' and 'Curve: 30 ft.' Below these are radio buttons for 'Criticality' and 'Anti-Collision', both of which are unchecked.
- Interpolation Options:** Contains four checkboxes: 'With Lithology' (unchecked), 'With Casings' (unchecked), 'With Targets' (checked), and 'With 3D Annotations' (unchecked). At the bottom, there is a field for 'Max. Inclination (TVD Approach): 85 °'.

to the curve will be calculated as a straight line along the TVD plane. Once the curve is above 85 degrees, the distance from target to curve will be calculated by least distance.

e. Projection Only Report

This report will generate the survey list for the projection(s) activated just before launching the Report Generator. If there is no projection turned on when the Report Generator is activated, then this report type will not be available.

f. Magnetics Report



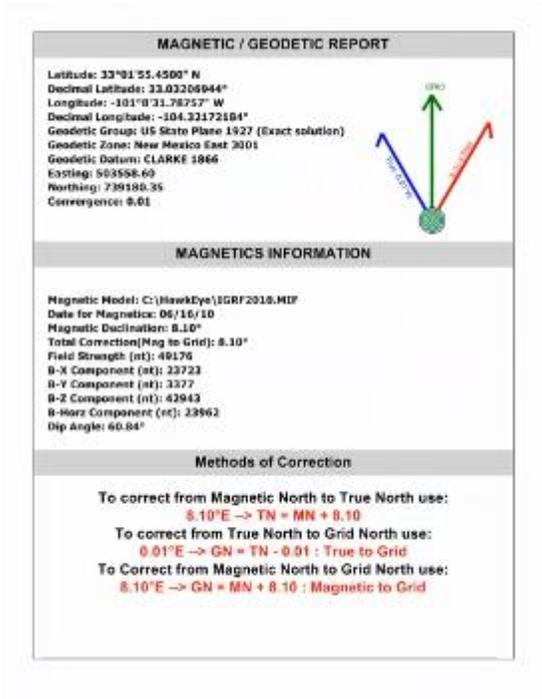
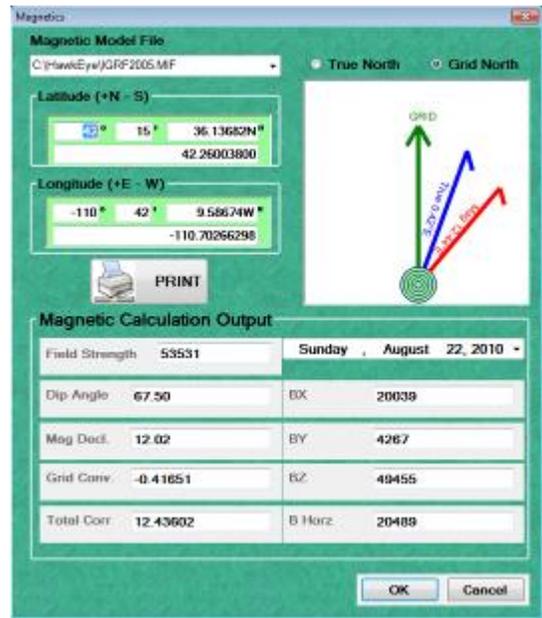
Magnetics is particularly important when taking magnetically measured surveys, for example determining applied declination, etc. HawkEye™ allows for a high amount of customization in magnetics configuration.

To get to the Magnetics dialogue, click on the magnet icon at the top center of the *main* screen.

MAGNETICS MODELS: Once inside, the first step is to select a magnetic model file. HawkEye™ uses the IGRF (International Geomagnetic Reference Field) and WMM (World Magnetic Model) magnetic models. (Future models will include those developed by National Oceanic and Atmospheric Administration and the British Geological Survey). The BMMG model is available for those users who have a paid license for it, but is currently not available standard with HawkEye™. It is important to have the right model selected. The IGRF2010 model is good until 2015.

SURFACE LOCATION: Magnetics is automatically calculated when a surface location is entered in a project, but that location (Lat-Longs) can be manually changed in the Magnetics panel in the fields highlighted in light green at the top.

PRINTING: Just click the “PRINT” button and a handy one-page Magnetics/Geodetic Report is generated, containing not only all pertinent magnetics information, but several methods of correction based on which north the user needs to correct from.



3. QuickPlot

The QuickPlot module will meet most users' needs. It includes virtually all elements for a smaller-sized plot, and the interface is What-You-See-Is-What-You-Get.

The use of the module is encapsulated in the Quickstart guide below:

27. QuickPlot: This is the go-to plot maker, a vast improvement over the Presentation Plots for most purposes.

Right-click on most objects in the QuickPlot to open up the options menu for that object.

Double left-click to switch between the two modes of the left button.

Scroll Zoom:
Zoom in and out of the plot while the cursor is hovering over the plot preview area.

Pan Around:
Hold the right mouse button down in the preview space to pan the view around.

Right-click Menu:
Click on almost any object in the preview space to open up that object's options menu.

Zoom or Ruler

Major/Minor Grid: Toggle b/g grids for the plots.
Reset/9-circles: Resets the grid view and zoom to default. The 9-circle for Horizontal also acts as a positional reset.
Axis TVD: In Vertical Plot this defines the depth at which the X-axis is displayed.
V.S.P.: Vertical Section Plane defines the angle at which the vertical section is viewed.
vScale and hScale: Defines the number of feet or meters represented by each division in the plot.
Auto: Adjusts the Scale to fit the curve within the screen as best it can.

Vertical Plot

Major Grid
 Minor Grid

Reset

Axis TVD:

V.S.P.:

vScale: Auto

Horizontal Plot

Major Grid
 Minor Grid

hScale: Auto

Click on the Orientation Mode between Portrait or Landscape. Include Vertical, Horizontal, or both plot types. Or choose TC for a traveling cylinder plot.

Hold down left button to draw a zoom box around an area for quick zoom.

Hold down left button to draw a line for distance and bearing info in red.

The Graph Properties options box seems like a lot of things, but really just controls a few basic parameters: grid styles, colors and fonts.

Click on any of the graph items on the right to activate the Color Selector for that item. The Color Selector is the set of tools in the top left of the box.

HOW TO PRINT:

Choose Printer/Paper: Printer | Then print to paper/PDF: PRINT | Or directly to PDF: SAVE .PDF

Check or uncheck boxes to add objects to a plot. Right click on the object itself to configure. The "Save" and "Get Template" buttons are an easy way to save and share all graph settings between computers or users.

Save Template
Get Template

a. Different Types of Charts

The QuickPlot has several options for charts, all of which can be chosen from the top right corner of the QuickPlot module by clicking on one of the buttons:



1. Vertical Section Chart – either in portrait or landscape.
2. Horizontal Section Chart (top view) – either in portrait or landscape
3. Vertical AND Horizontal Section Chart- portrait or landscape
4. Traveling Cylinder – Portrait orientation only

b. Printing, Tweaking and Customizing

Right underneath the mode buttons just described, the yellow, green and blue buttons contain all printer and color options for the charts. Below those buttons are two areas, one for controlling the Vertical Plot, and the other for the Horizontal Plot.

Here are some comments on each of these controls:

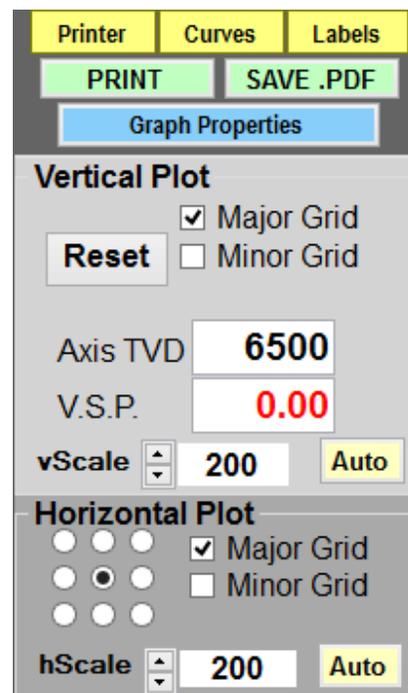
PRINTER: The user must choose a printer and the paper size here FIRST. If any problems arise when trying to print to PDF, it is recommended that you choose CutePDF as the printer.

*NOTE: When you select a printer here, it becomes your Windows system default printer.

CURVES: This is the same Curves List that can be invoked in the main screen under the Curve Menu.

LABELS: This is the same lables manager that can be invoked in the main screen under the Graphics Properties.

PRINT: This will AUTOMATICALLY print to whichever printer has been selected under the Printer button.



VERTICAL PLOT tip:

- The V.S.P. can be set here, or in the main screen in the V.S. View. Each slot/wellhead has a V.S.P. that will be remembered after being entered.

BOTH VERTICAL AND HORIZONTAL PLOT tips:

- Keep Minor Grid turned off in order to maximize smoothness of navigation when zoomed out.
- When the zoom is out of whack, click the “AUTO” button to return to a home view. NOTE: this resets the label positions as well.

c. Plot Options

The checkboxes in the black box will add any of a number of objects directly onto the plot itself. There are also custom text and image buttons in blue. Once activated, the object can be resized from its edges. There are a couple of special cases:

- The “Add Text” and “Add Image” buttons can be added in unlimited amount. To delete them the user must right-click on the text box or graphic itself and select the “Delete” option there.
- **Show 3D:** This portal into the 3D space is fully navigable. **To move the window around in the plot, the user must grab the upper left corner of the window with the left mouse button.**

All color options and object placements can be saved to a template by clicking the “Save Template” button.

Loading a template can be done by clicking the “Get Template” button.

The infobox in black and white at the bottom indicates where the cursor is with respect to depth and local offset from the current Reference Slot.

If all is lost (e.g. the colors and zoom are irreversibly messed up, the “Reset All” button will return all settings back to default. From here the user can load a template if one has been saved.



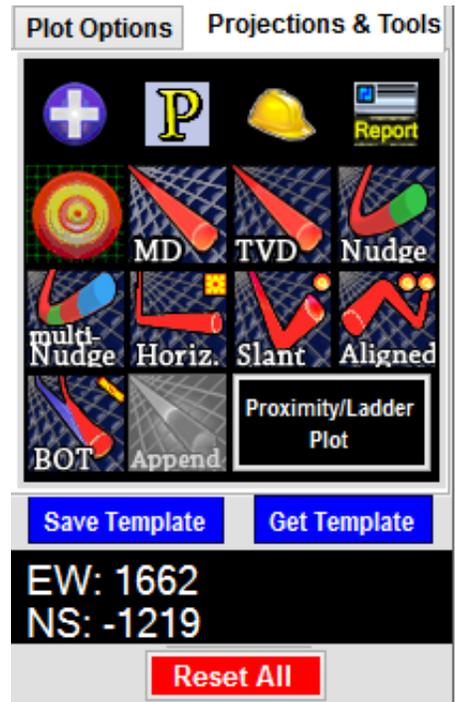
d. Projections and Tools

The “Projections and Tools” tab on the bottom right simply allows the user to use ALL THE BASIC TOOLS that are normally found in the main screen.

NOTE: It helps to have the “Show 3D” option activated so that the 3D space is available in the plot area.

Neither the Reports nor the Proximity/Ladder Plot windows can be included directly in a plot. These buttons are merely shortcuts to the other parts of the program.

All active projections will be shown in the 2D charts and the 3D space.



e. Traveling Cylinder

1. What is a Traveling Cylinder?

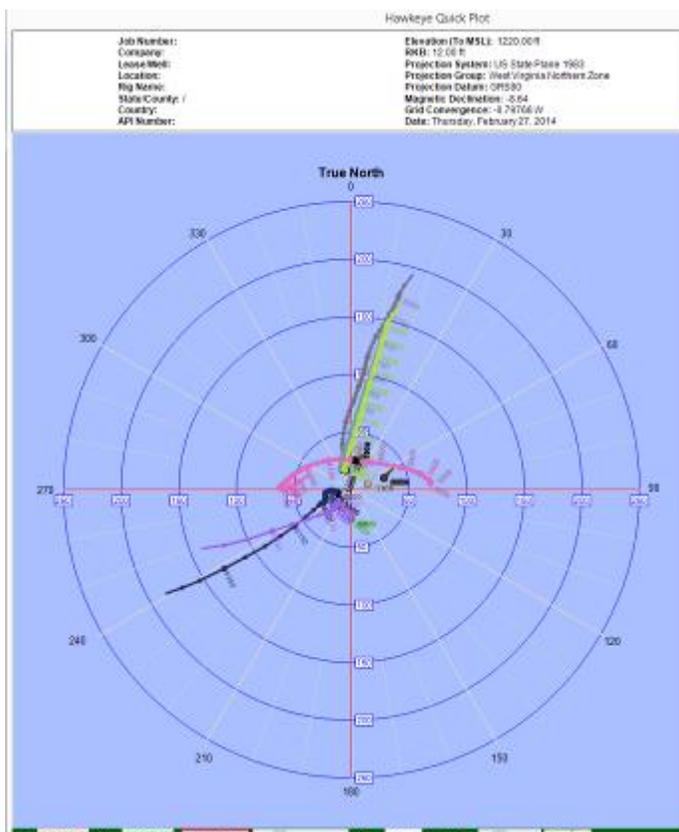
Traveling Cylinder Plot (TCP) is one of a collection of tools that operators have traditionally used to plan and drill safely through a maze of wells. Most common usage is on wells that are drilled from offshore platforms or wells that are drilled from land pads with multiple adjacent wells.

Their principle usage is in the vertical hole sections near the surface where collision risks are generally the highest.

2. How to read a Traveling Cylinder Plot

Understanding how to read a traveling cylinder plot can be a bit of a challenge. The first issue to comprehend is that the plot represents a two dimensional representation of a solidly three dimensional problem.

The center of the plot represents *all* the points along the reference well, regardless of the geometry of the well. For a well planner the reference well would be the plan and for a directional driller the reference well would be his as-drilled plus his projection to the bit and beyond the bit, if the plot is being maintained by a computer. If a wall plot is being used by the directional driller (DD), the wall plot will have the proposal as the reference curve, and the DD plots his as-drilled points on the wall plot. Should his plot points cross a no-go zone on the TCP then that would be indicative of an operator's rule-set violation. A DD needs to know how to calculate the plot points on a calculator or by hand, should the computer program he is using not provide the plot points for him.



Since the TCP is normally used in vertical portion of wells the natural plane on which to

measure distances is the normal plane, the plane which is perpendicular to the direction of the reference point at any given depth. In vertical wells this plane approximates the TVD plane. For low inclinations, which is what the TCP is used for primarily, the DD can use the EW,NS coordinates of the survey to calculate his plot point. Although this is not entirely accurate the discrepancies are minor. With non-vertical wells the normal plane is the plane the directional driller uses to steer from high side. In vertical wells the directional driller steers with magnetic tool face so the TCP is normally referenced to either true north or grid north. Some companies demand that true north always be used, but there are some very good reasons to use grid north if a grid system was used to plan the wells. Certainly, if one were to use a traveling cylinder plot in higher angle holes the use of GTF reference instead of north reference is desirable since the goal of a TCP is to provide an effective steering guide.

3. Constructing the Traveling Cylinder Plot

Since the reference well is represented by a single central point on the TCP, plotting all of the uncertainty ellipses for all of the depths around that point would result in a blur of meaninglessness at the center of the plot, since it is near impossible to associate which ellipse is associated with a given depth. The comparison wells, on the other hand, can have meaningful ellipses drawn around their survey points, but they only represent half the uncertainty. In order to overcome this issue, a TCP summarizes the uncertainty of the reference well with the uncertainty of the offset well and displays that uncertainty around the offset well. This is accomplished by summarizing the covariance matrices⁹ of the reference well and the offset well, and then displaying the resulting ellipse/ellipsoid/elliptical cylinder on the offset well. With this method the reference well in the center stays unmarked and thus uncluttered.

4. Shortcomings of the Traveling Cylinder Plot

Shortcoming 1: One rather critical issue with TCPs in vertical wells is how to handle “flipped” survey stations. If all the crossings of a well are not inserted into a survey list, and the only the surveys are used to calculate least distance then there are instances, as the one shown below indicates (fig2), where it appears on the TCP that there is a head on collision with the reference well. One can easily see from the plot that these two wells did not collide, so what is the problem? The problem is that no crossing was calculated between the two successive surveys, as it should have been. What the crossing represents is the point of closest approach between the offset segment bound by the two surveys and the reference well. If the crossing is determined and then

⁹ The covariance matrices are the mathematical tool that is used to determine the uncertainty of multidimensional uncertainty.

plotted it clearly shows how the offset well misses the reference well. There have been other ways of dealing with this issue, but this is the best way.

Shortcoming 2: Another issue with TCPs is that in tight spiraling adjacent wells, plotting the entire depth of the reference well can lead to some confusing imagery, so it is best to plot the TCP out in sections so that several TCP plots are used for the entire well.

Shortcoming 3: The TCP requires the user to abstract numerous concepts and for a casual user, such as a company representative, it can be difficult to understand at first glance.

Shortcoming 4: TCPs also suffer from the limitations of normal plane distance calculation, a method that will only pick a point on a well that intersects with the normal plane of the reference well, and completely miss a well that is directly in front of the bit. (Of course, a good complete anti-collision policy should pick up that type of collision easily).

Shortcoming 5: Another weakness is that for highside calculations on the normal plane, manually calculating the point of intersection and determining the appropriate plot point without a computer or a rather complex calculator program is highly impractical. Computer programs such as HawkEye™ which maintain a dynamic TCP while drilling are the best way to use a TCP, as they help to reduce the amount of human error that can occur by mis-plotting TCP data manually. A computer program can also use the as-drilled instead of the proposal as the reference well since the errors attributed to the reference well are actual as opposed to “planned.”

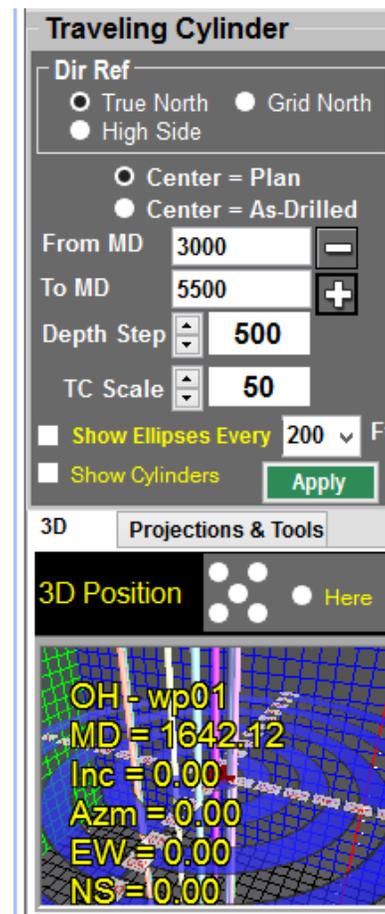
5. In Conclusion

The judicious use of a TCP in conjunction with ladder plots and proximity reports makes for an effective anti-collision package. The advantage to the method is that it can be maintained on a wall plot and does not necessarily have to be maintained by a directional computer program. Once a DD understands how to use the plot he has a very effective steering tool to aid him in avoiding other wells. However, it is likely that the use of TCPs will diminish as robust 3D interfaces become more widely available. This is because the visualization of such systems is immediately comprehensible and much less likely to foster misunderstandings.

6. Controlling the Traveling Cylinder in HawkEye

When TC is selected from the very top right corner of the QuickPlot window, the TC control panel will appear on the right. There are a number of controls to consider:

- **Dir Ref (Directional Reference):** Choose from True North, Grid North or High Side.
- **Center-:** This will make the centerpoint of the TC plot either based on the Current Proposal Curve (“Plan”) or the Current Work Curve (“As-Drilled”)
- **From MD/To MD:** Use the Plus and Minus buttons to advanced or retreat the location of the area along the curve to be reviewed
- **Depth Step:** This will affect the distance by which the plus and minus signs move you up and down the curve
- **TC Scale:** This will change the overall scope of the TC plot itself
- **Show Ellipses:** This will turn on ellipses of uncertainty, based on ISCWSA models and the survey tools chosen for the surveys
- **Show Cylinders:** NOTE: This display option is for the 3D window only. It will turn on cylindrical ellipses of uncertainty for all wells in the 3D space. See more about the 3D space below.



7. The 3D Window

The 3D window on the bottom right of the TC panel can be navigated just like in the main screen. The six radio buttons will place the 3D window either on the TC Plot or “Here,” meaning inside the small panel.

- With the cursor hovering over the 3D window, hit “I” on the keyboard to toggle the 3D Info.
- The 3D window, even if placed on the TC plot itself, will not show up in the printed form. It is for visualization on-screen only.

V. Special Tools

1. Interpolation



Interpolation is a method of constructing new data points within the range of a discrete set of known data points. In HawkEye™, the Interpolation tool allows the user to either merely CALL FOR A SURVEY ENTRY into a list one at a time, or to go ahead and use an interpolation point as a TIE-IN POINT for a sidetrack curve.



Open the panel from the “Special Tools” tab. Once inside the panel, there are two major choices: 1) to invoke either an MD or a TVD interpolation, and 2) whether to merely have that interpolation point or to use the point as a tie-in for a sidetrack curve.

The first step is to enter either the MD or TVD depth in the top left. Then hit TAB and HawkEye™ will calculate the interpolation, filling in all the data down the middle “Interpolate” column. The columns to the left and right are survey stations displayed for reference.

The second step is to decide whether to INSERT that interpolation into the survey list, which only requires clicking on the “Insert” button; or making that interpolated point a tie-in point for a sidetrack curve.



The Interpolation panel breaks down into two choices at the top: 1) MD or TVD as the mode of measurement, and 2) either insert the interpolation or make it tie-in for a sidetrack curve.

By clicking on the “Make Tie In” button, a dialogue will appear for creating a new curve and you can enter the parameters for a sidetrack proposal. Once created, it will appear in the Data Tree just like any other proposal curve, with all the attendant options associated with it.

1. Interpolating from Lists

The interpolation tool includes two options for interpolating surveys directly from simple text files that could be set up with NotePad or WordPad. Simply input MD or TVD, (comma) comment or formation top, whatever. Input as many lines as you need, then save the file. You can use that file on other curves and save yourself the hassle of interpolating tops for each iteration of a what-if scenario being played out with geologists and drilling engineers that keep changing specifications.

2. Interpolating Lithology, Casing and Targets via Survey Report

The survey report is covered in detail elsewhere in this documentation, but it is worth mentioning here that interpolation of Lithology, Casing and Target points can be implemented ‘on-the-fly’ in the survey reports. A small icon is placed next to each comment, indicating the type of comment. The snapshot below shows a section of the report screen. The box labeled Interpolation Options shows the choices available for interpolation. The survey report itself shows the icons and how they are displayed in the report:

Print Move Default

Export CSV Get Template

Load Logo Save Template

Cover Page Snapshot

North Arrow Landscape

Box Comments

Paper Size Letter

Report Type

Survey Critical Points

Interpolate Survey Criticality

Least Distance

Interpolation Options

With Lithology With Targets

With Casings

Extra Data in Survey Report

GeoDetos GeoMagnetics

Targets Casings

Lithology Hard Lines

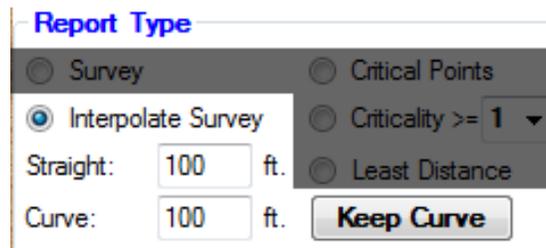
Lease Lines

Measured Depth (Ft)	INC Deg	AZM Deg	TVD (Ft)
Surface Location ■ Layer1 Casing 20"			
0.00	0.00	0.00	0.00
 Casing 13 5/8"			
30.00	0.21	16.70	30.00
144.00	1.00	16.70	143.99
174.00	1.50	14.00	173.99
241.00	1.10	297.80	240.97
331.00	2.70	250.60	330.92
422.00	4.00	241.60	421.77
513.00	4.90	236.90	512.49
600.00	6.13	230.30	599.09
605.00	6.20	230.00	604.06

3. Interpolating an Entire Curve from Critical Points

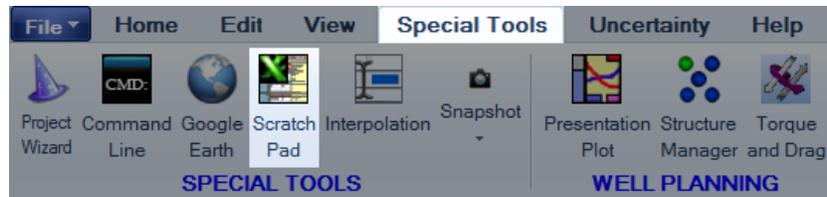
The Interpolate Report can be used to generate an entire curve from just a few critical points. Just follow these steps:

- i. Enter the critical points as surveys into a new or existing curve.
- ii. Go to Report Generator and select “Interpolate Survey” as the report type.
- iii. Define the increments of interpolation you want for the curve.
- iv. Click the “KEEP CURVE” button.



The screenshot shows a dialog box titled "Report Type" with a dark grey background. It contains several radio buttons and input fields. The "Interpolate Survey" radio button is selected. Below it are two input fields: "Straight: 100 ft." and "Curve: 100 ft.". To the right of these fields are three more radio buttons: "Critical Points", "Criticality >= 1" (with a dropdown arrow), and "Least Distance". At the bottom right of the dialog is a button labeled "Keep Curve".

2. Cut-and-Paste with ScratchPad



Well Planning Version ONLY

Well Planning can be a tortuous process no matter how powerful a well planning tool one has available. More often than not, just getting the base data one needs to execute a plan can take days. The following is a list of common information that is necessary to do a directional well plan:

- **Project Information** – Information about datums, geodetics, job data and units of measurement
- **Well Site Location** - Often needed: State, County, Geodetic Zone or Township-Section Range Data, Map Offsets, 1927 or 1983 Datum, Grid Coordinates or Latitude and Longitude.
- **Name of Structure** or platform/pad area
- **Name of Company or Field**
- **Lithology List** of tops and bottoms, dips and directions
- **Casing List** of Size, Wt and Set Depth and Run to Depth
- **Offset Well Data** which includes the surveys and the surface location data for each well
- **Lease Line List** information and necessary legal offsets
- **Hard Line List** Data
- **Targets List** – Location of targets, Shapes, Sizes
- **Well Plan Information** – This is the specialty of HawkEye, but often operators will already have a plan they want to execute. They will either have a set of surveys or a set of critical points.

As one can see from the above data, there are lots of lists involved. As it turns out, in the preplanning stages much of this data is already available on a spreadsheet being maintained by whomever is responsible for qualifying the data, be it a geologist or a drilling engineer. So, wouldn't be nice to just be able to drag and drop that data directly into a program and have it all processed so that it does not have to be re-input? Hawkeye's answer to this question is ScratchPad.

First off, Hawkeye manages a database. When Hawkeye is open, it is by default, opened to the last project that was open when Hawkeye was last closed. You can, of course, select another project in the database, or create a new project with the Wizard, or open up another existing database or create a new database.

When you have an existing project open, the focus of that project is the current work curve and current proposal curve; and thus all the parameters above the well site level are selected, those of Slot/Site, Platform/Pad, Project Data, Field/Company.

1. Primary Keywords

Get started with some special vocabulary. They are words you already know so remembering them shouldn't be a problem. We will call these the Primary Keywords. If you have ever done any computer programming, the concept of a keyword is nothing more than a command like 'PRINT or IF THEN or END'. Conceptually what we are going to be doing here is similar, but friendlier than most programming.

We don't have to create a complex process, just remember things like a [DATABASE] has a *Name*, or a [SLOT] has a *Latitude* and a *Longitude* or a [WELLPATH] can be a *Survey*, *Plan* or *Proposed Survey*.

These are called the *properties* of each Primary Keyword. The following shows the keywords and the properties and options to different properties for each:

[DATABASE]

Name

[COMPANY/FIELD]

Name

[PROJECT]

Name, UOM either feet or meters, Direction Reference, Latitude and Longitude (preferably of current slot) or State, County

[STRUCTURE/PAD]

Name, Elevation or...

[SLOT/SITE]

Name, RKB, Latitude and Longitude, REFERENCE (or Not)

[WELLPATH]

*Name, Type Wellpath (PLAN, PROPOSAL, SURVEY)
List of MD, INC, AZM*

[JOB]

Job Number, Company Name, Rig Name, Location Description

[CASING]

List of Size, Wt, Top Depth, Set Depth

[LITHOLOGY], BY TVD or BY MD

List of Name, Description, Top Depth, Bottom Depth, Pattern

[TARGETS]

By TVD or SUBSEA Depth, Shape, Size, Color

[HARDLINES]

Name, ALL or NONE

Input Mode: List all possibilities

List according to Mode

[LEASELINES]

Input Mode: List all possibilities

List according to Mode

2. How the Cut and Paste Works

The following presents a normal operational scenario in which dragging and dropping data can be implemented. First, we will manually build up a spreadsheet and then we will show how easy it is to use existing spreadsheets to prepare a customized project or sub project.

SCENARIO ONE: You want to create a new Project in a new Database.

In this case you have opened HawkEye already and it is displaying the contents of a project in the current database. To create a new database with drag-and-drop, type the following on two lines of the spreadsheet:

[DATABASE]

Name: MYNEWNAME

You can now copy the two lines by selecting them with the mouse, and then move to above the 3D space in Hawkeye, right-click and then select “Paste.” HawkEye will close out the current database and start a new one with the name you specified. The database itself will be stored in the default Hawkeye directory.

Easy enough, you say, but why bother when all I need to do in Hawkeye is: *File> New Database Project?* Because with ScratchPad, creating a new database or project is just the beginning.

Included in the Hawkeye/ScratchPad subdirectory is a spreadsheet, **HawkeyeScratchpad.xlsx**. The following page shows an example of this spreadsheet.

There are four columns on this spreadsheet and numerous row groups that are separated by colored headers. The Header groups straight down are:

- DATABASE
- COMPANY/FIELD
- PROJECT
- STRUCTURE (PLATFORM/PAD)
- SLOT (WELLHEAD)
- WELLPATH
- JOB DATA
- CASING
- LITHOLOGY
- TARGET
- HARDLINE
- LEASELINE

What You Ought to Know About Spreadsheets

It is assumed that the user has familiarity with manipulating a spreadsheet. If not, it would be well worth one’s time to learn a few spreadsheet tricks by studying the tutorials and documentation associated with the spreadsheet. In virtually every office there is someone who knows more than a little on how to manage a spreadsheet. So if nothing else, you can get them to teach you. There are two ‘tricks’ you will have to master to make effective use of the ScratchPad spreadsheet: 1) how to copy rows and then insert those copies in the right place. And 2) know how to take a few columns of numbers and convert them into a comma delimited format using Notepad (another Windows program), then paste them into the spreadsheet.

This column contains the names of the Primary KeyWords and the Properties associated with each one of them.

FILL IN THE DATA VALUES IN THIS COLUMN

SET ANY DEFAULTS IN THIS COLUMN. HAWKEYE WILL USE THE DEFAULT IF VALUE IS LEFT BLANK.

This columns explains what each column is. It can be changed to reflect the spoken language of the user.

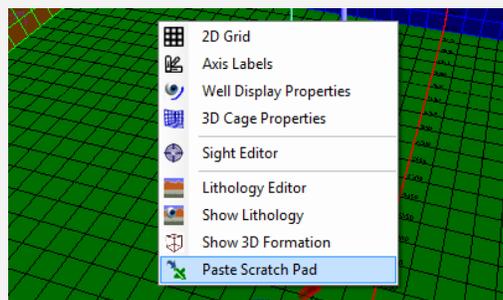
KEYWORD and PROPERTIES	VALUE	DEFAULTS	NOTES
[DATABASE]			
Name:	MyDB	Hawkeye_DB_+Date+Time	Name of Database to Create
[FIELD/COMPANY]			
Name:	OIL COMPANY	OIL COMPANY	
[PROJECT]			
Name:	MyProject		Name of Project
UOM:	Feet	Feet	Units of Measurement used in this project
DIRECTION REF:	GRID NORTH	GRID NORTH	The Reference direction is either True North or Grid North
Location Options:	Latitude,Longitude	Latitude,Longitude	Method Used to Describe the location
Comma Separated Location:	34.564433,-91.34322333		The location as described by Location Options
[STRUCTURE]			
Name:	MyStructure	First Slot Name	Name of Structure/PAD
Elevation:	0	0	Elevation above Sea Level
[SLOT/SITE]			
Name:	REFERENCE SLOT	First Slot is REF unless specified	Make as many copies of this [SLOT/SITE] / [WELLPATH]
Name:	SLOT1	SLOT1	Name of Slot, Defaults to SLOT +Slotcount
Location Options:	Latitude,Longitude	Latitude,Longitude	
Comma Separated Location:	34.564433,-91.34322333	Project Location	
[WELLPATH]			
Name:	Proposed Plan	Proposal	Name of Well Path
Type:	PLAN	PROPOSAL	Type of Survey
RKB:	0	0	
PBHL Target:	YES	YES	Automatically Generate a Default Target for end of well
Use Default Casing?:	YES	YES	
Use Default Lithology?:	YES	YES	
Data Options:	MD,INC,AZM	MD,INC,AZM	Order of the data to be inserted below this point for this PLAN or SURVEY
0,0,0			
2000,0,0			
2500,90,34.33			
6000,90,34.33			
< Insert Surveys here...			
[TARGET]			
SHAPE:	CYLINDER	Cylinder	
Depth Type:	TVD	TVD	
Location Options:	Latitude,Longitude	EW,NS	
Comma Separated Location:	34.564433,-91.34322333	End of Proposed Path	
Comma Separated Parameters:	5,BLUE,100	5,Blue, 100	Thickness,Color,if CUBE then SIDEA,SIDEB,If CYLINDER then Diameter if POLYGON then EW,NS, Pairs)
[JOB DATA]			
Default Job for ALL wells:	YES		If more than one Job is selected this will be ignored
Job Number:	New Job		Internal Reference number used by company
Lease Well:	Lease		Lease / Well Description
Location:	Whatever		Legal Description of Wellsite location
API JOB#:	3234323		Official Reference Number used by local government
Rig Name:	Big Rig		Name of Rig
Country:	USA		Country where Well Site is located
State/Provence:	TEXAS		County or Provence
County/Parish/Borough	Harris		
Comment:	This job is an example job being used to illustrate how the use the Hawkeye ScratchPad		Comment about Job
[CASING]			
Default Casing?	YES	YES	Determines if this casing profile is to be applied to all wellpaths
Depth Type:	TVD	TVD	
	Casing Size, Wt	Top Depth, Bottom Depth	
CASING1:	20,94	,0,300	ADD ",TOP,BOTTOM" TO THE SELECTED WT AND SIZE OR LEAVE BLANK
CASING2:	13 3/8,80.7	,300,4000	REMEMBER TO START THE SECOND COLUMN WITH A ',' (comma)
CASING3:	7 5/8,55.3	,0,5000	
CASING4:			
CASING5:			
CASING6:			
CASING7:			
CASING8:			
<<<<<< Insert Additional Casing Here			
INSERT MORE CASING ROWS IF NECESSARY			

Three Steps to Grabbing Data from ScratchPad

40	Create Target Planes:	YES	NO	This sho
41	Auto Comment Proposal and Plans?:	YES	YES	Autocon
42	Data Options:	MD,INC,AZM(EW,NS,TVD)	MD,INC,AZM(EW,NS,TVD)	Order of
43		0,0,0		
44		1300,0,0		
45		1600,90,45		
46		3000,90,45		
47	< Insert Surveys here...			
48	[TARGET]	C:\HawkEye\ScratchPad\Standard\ScratchPad.xlsx		
49	Name:	Target 3	Target + Cnt	
50	SHAPE:	CUBE	Cylinder	
51	Color:	Red	Blue	
52	Thickness:	50	5	
53	Depth Type:	TVD	TVD	
54	TVD DEPTH of Target:	5000	5000	
55	Location Options	NS,EW	Latitude,Longitude	
56	Comma Separated Location:	-1000,2000	End of Proposed Path	
57	SideA,SideB:	200,100	100	Enter tl
58	[JOB DATA]	From Winsurv2 if Available		
59	Default Job for ALL wells:	YES	YES	If more t
60	Job Number:	Job Number	OK08009EO	Internal
61	Company:	Company Name	EOG	
62	Lease Well:	Curve 1	Carminati #4	Lease / \
63	Location:		Montague County, TX	Legal De
64	API JOB#:	Some Reference	0	Official I

STEP ONE: In the spreadsheet, when selecting a body of data, select the **entire** category. Then right-click and hit “copy.”

STEP TWO: In HawkEye, be sure to select the wellpath that you want your copied data to be associated with, if applicable.



STEP THREE: In HawkEye, right-click anywhere in the 3D space in, and select “Paste ScratchPad.”

Each one of the data groups in the spreadsheet can be copied and pasted into Hawkeye independent of one another. Hawkeye will figure out the “context” of the data but only for the selected wellpath.

For example, if you cut and pasted a Casing Group, Hawkeye would apply it to the current focused wellpath, replacing the one that was there if it already existed. If a Database group is included in the pasted data, Hawkeye will check to see if that name already exists and open it if it does, otherwise Hawkeye will create a new database with the specified name. The same goes for any named group. If it exists already, Hawkeye will set its focus there.

If it does not exist, it will create a new object as long as the information provided is properly formatted. The included spreadsheet found in Hawkeye/ScratchPad, **HawkeyeScratchpad.xlsx**, is a good starting point to see how the data is formatted.

If you copy and paste all the data from the default spreadsheet described above, you would have created two slot/wellheads and two well paths along with a platform/pad, casing for a well, lithology, hard lines and lease lines. In some cases special flags have been set indicating to Hawkeye how to handle the data. In other cases defaults are indicated if no value is given.

If Hawkeye absolutely has to have some data, it will stop and inform you. This spreadsheet has in effect been our “scratch pad” for laying out the project; now all we have to do is cut and paste into HawkEye. HawkEye will parse each section and create all the objects. It will figure out where we are in the world from the latitude and longitude provided and what is the most probable Geodetics for that area.

Where Township, Section and Range are used the program will automatically determine the TSR and the map offsets AND it will create a lease line for display!

Note that the first slot/wellhead’s location was specified with Lat and Long and the second slot/wellhead was specified with EW and NS. The first slot/wellhead was specified as the Reference which indicates that it is the zero, zero from which other slot/wellheads can be measured. The second slot/wellhead *could* have been specified with Lat and Long instead of EW and NS.

The advantage to this mode of data preparation is that it divorces the user from the Hawkeye interface until needed. **This means that other people can work on the data preparation, doing their part; when all is ready, it can be collected on to a single spreadsheet, then copied and pasted into HawkEye.**

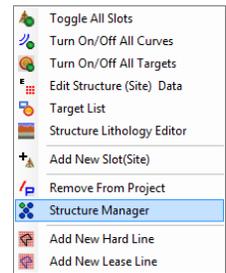
3. Platform/Pad Manager



Well Planning Version ONLY

The Platform/Pad Manager, which is only available in the Well Planning Version of HawkEye, is used to start a multiple-slot/wellhead project quickly. It organizes any number of initial slot/wellhead points and numbers them in a user-defined pattern. Their positions can be defined by any of the possible patterns found in the field, and can save a lot of time in getting the slot/wellheads made in the project database.

OPEN THE PLATFORM/PAD MANAGER: Right-click on the Platform/Pad icon  found in the Data Tree on the lefthand side of the main screen. This will open up the Platform/Pad submenu.

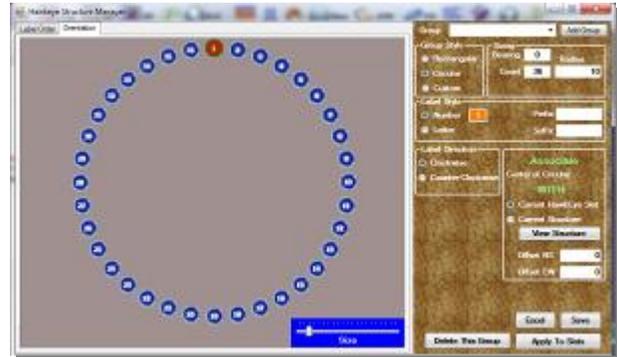


Select the Platform/Pad Manager  from this list. The slot/wellheads made from here will be associated with that platform/pad that was right-clicked on.

Ord #	Label	Local NS	Local EW	Grid Northing	Grid Easting	Latitude	Longitude	Latitude DMS	Longitude DMS
1	1	0.00	0.00	997687.69	741496.54	33.740040994	-105.455601985	33°44'24.1476" N	-105°27'20.1671" W
2	2	4.10	-11.28	997691.79	741485.26	33.740052512	-105.455638971	33°44'24.1890" N	-105°27'20.3003" W
3	3	8.21	-22.55	997695.90	741473.99	33.740064029	-105.455675957	33°44'24.2305" N	-105°27'20.4334" W
4	4	12.31	-33.83	997700.00	741462.71	33.740075547	-105.455712943	33°44'24.2720" N	-105°27'20.5666" W
5	5	16.42	-45.11	997704.11	741451.43	33.740087064	-105.455749929	33°44'24.3134" N	-105°27'20.6997" W

The panel on the right-hand side of the Platform/Pad Manager is dedicated to the placement and labeling of the slot/wellheads:

GROUP STYLE: The general orientation of the slot/wellhead group can be rectangular, circular or custom. (NOTE: Custom option is not available in current version).



LABEL STYLE, ORDER & DIRECTION:

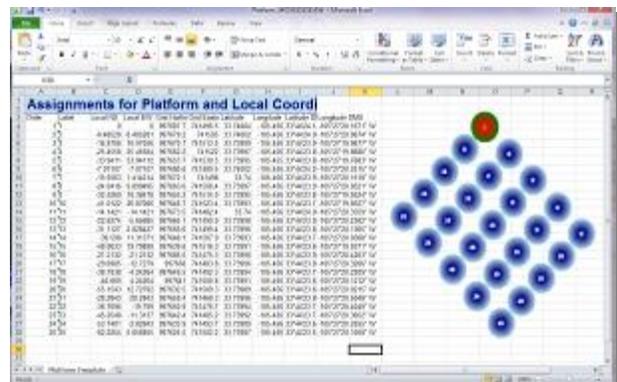
These options create the way the slot/wellheads are numbered, and cover all iterations of sequential labeling for rectangular and circular slot/wellhead groups. The START CORNER radio buttons determine where the sequential labeling begins. Additionally, the slider in the bottom left corner of the picture window toggles label orientation.



SIZING: Bearing and distance between each slot/wellhead can be defined here.

ASSOCIATE WITH: Any of the slot/wellheads can be designated as the Reference Slot/Wellhead, and that Reference Slot/Wellhead can be associated with either another slot/wellhead or the current Platform/Pad. The Reference Slot/Wellhead can also be given a coordinate offset.

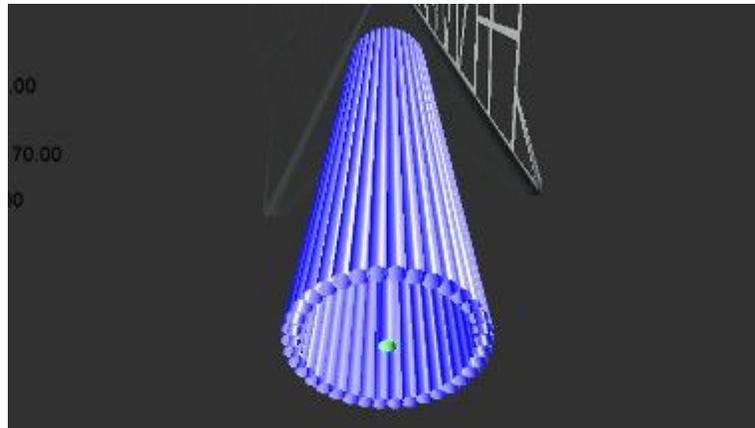
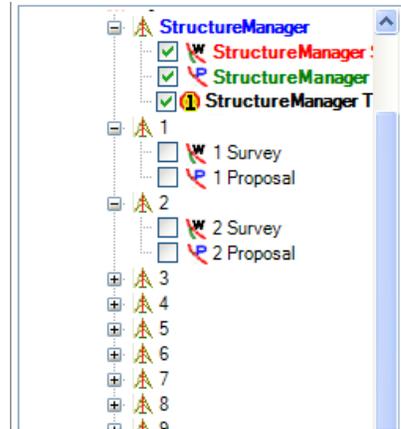
EXCEL: Once a slot/wellhead group has been set up, click the “EXCEL” button and the slot/wellhead coordinates will be exported into an Excel spreadsheet, complete with a floating picture of the slot/wellheads that can be placed anywhere on the spreadsheet.



ADD GROUP: Any set of slot/wellhead parameters can be saved as a custom group by clicking on the “Add Group” button at the top of the Manager.

CLICK “SAVE” FIRST: Once a Platform/Pad’s slot/wellheads are labeled and oriented, click the SAVE button. Then click “APPLY TO SLOT/WELLHEADS.” This will close out the Platform/Pad Manager and begin building each slot/wellhead under the current platform/pad. Those slot/wellheads will appear in the 3D space as well as in the Data Tree.

Each newly made slot/wellhead will have a survey and proposal curve named after its slot/wellhead label.



NOTE: After a slot/wellhead group has been made and curves built from the respective slot/wellheads, going back to change the orientation and labeling of the slot/wellheads in the Platform/Pad Manager is not recommended. Thus it is best to get the details of the slot/wellheads correct before beginning to build curves from any of the slot/wellheads created.

4. HawkEye™ Command



Well Planning Version ONLY

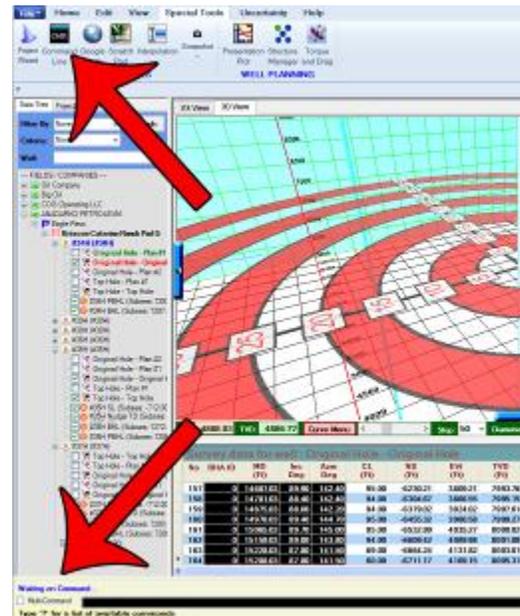
HawkEye™ Command is one of the most powerful tools in the user's arsenal. The interface allows users to input direct text commands, which appear immediately in the 3D space as well as the database. They can bypass the graphical user interface (GUI) and create new project data more directly. Once users know what strings of commands they need on a regular basis, they can cut-and-paste long strings of commands (macros) into the Command interface; their routine will be rendered every time.

a. How to Access Command Line

At the top left of the “Special Tools” tab, click on the “CMD” icon. This will toggle on and off the Command bar at the very bottom of the screen.

When the Command window is open at the very bottom, direct DOS-style commands can be given in order to instantly generate various objects that will appear in the 3D space or manage the data of the current project. These commands can be referred to by different names. The following section contains a comprehensive list of each of these commands.

Type “?” at bottom for the list of all commands.



b. How Command Works



THREE LINES: At the very bottom left, Command is composed of three lines. The top line is the hint line. It informs the user of what is expected. The middle line has a “Multi-Command” toggle button (This should be checked when one wants to type in

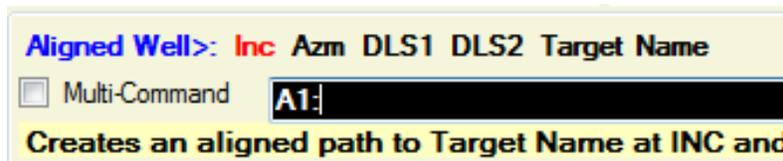
more than one command before executing). The black field is for entering the actual commands. The bottom line is a message line describing whatever has been entered.

When a command is typed into the black field, the lines above and below change to accommodate that command. For example, when the command for defining a kickoff point is typed, “KOP,” the remaining parameters are prompted above and a description of the command is displayed below:

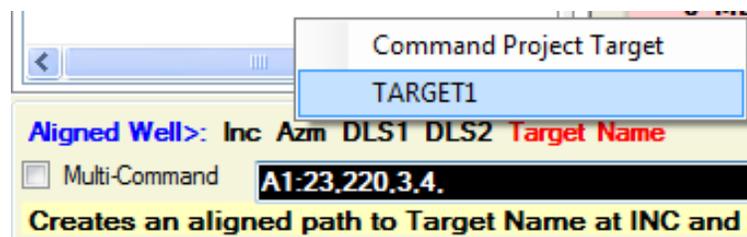


Here, the user typed “KOP” and Command automatically added the colon in the black field. Above in red is the next and only parameter needed for this command, the Measured Depth. Simply enter a number for the MD and hit ENTER. This will automatically create a path with a KOP of whatever specified.

Some commands require more than one parameter after you type it in:



In the example above, the command “A1” invokes the Aligned Well command, which requires a string of parameters. Enter those by typing in the data and hitting ENTER AFTER EACH ITEM. For example:



In the example above, what was typed was:

“A123[ENTER]220[ENTER]3[ENTER]4[ENTER]”

A breakdown of that command is: an aligned well, with an Inclination of 23 degrees, Azimuth of 220 degrees, first DLS of 3 degrees per hundred, a second DLS of 4 degrees per hundred, with the intent to strike the target named "TARGET1."

As seen in the picture above, when it comes to entering a target (or curve) name, Command automatically prompts the user with all available targets (or curves) in a pulldown list. As can be seen above, two targets are available from the prompt. (Only targets under the current platform/pad are available). Use the mouse or arrow keys to choose one, then hit ENTER. This will finish the command and create what was defined in the command string.

Mind the Backspace

HawkEye Command is a powerful tool which can be sensitive to a particular key, the Backspace. When entering a command string, hitting Backspace to correct a typo is a very instinctual thing to do. Avoid this tendency. When Backspace is pressed in the middle of a command, unseen code that has been stacked and readied for execution gets jumbled up, and the entire command is compromised.

So instead, hit the DELETE key to clear the line and start over. For longer multi-command strings in which re-typing would be a pain, it is a good idea to type it out just right on a Notepad file and then copy-and-paste into Command.

MULTI-COMMAND STRINGS: First thing to remember: when the Multi-Command mode is enabled, the ENTER key will not execute the string. It will merely prompt for the next parameter or command. In order to submit a multi-command string, the user must hit SHIFT.

Multi-command allows the user to daisy-chain a number of commands and execute them all at once. This is where HawkEye Command really shines and can be an enormous time-saver for well planners.

One example of a multi-command string would be the following:



When “Multi-Command” is checked, the ENTER key will only end the command and add a divider (NOTE: The divider “|” is not the letter “I.” It is the character above your ENTER key. You won’t need to type it¹⁰ but hold SHIFT to get to it.)

In the above example, there are three different commands, each divided by “|”:

Command #1:

NW:PROPOSAL1, PROPOSAL,0,BLUE

This means: new well with a name of “Proposal1,” being a proposal type (and not a survey type well), with an RKB of 0 and the color blue.

Command #2:

HOLD:2000

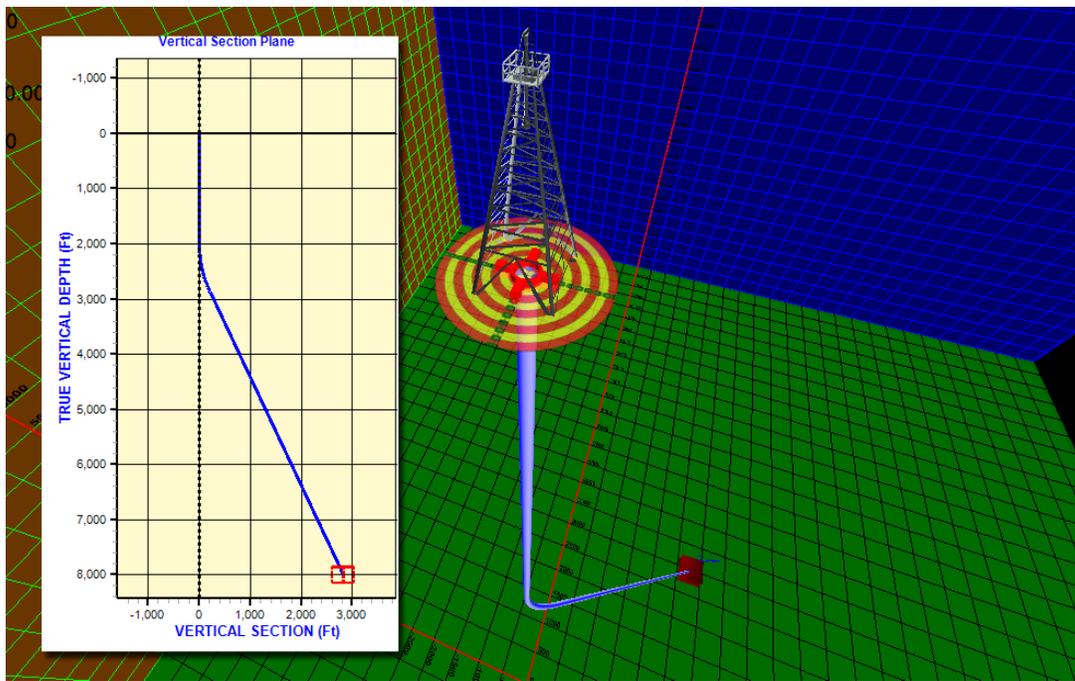
Starting from the end of the previous command’s build (which was at RKB 0), hold in the current direction for a straight 2000 feet.

Command #3:

SLANTDLS:3,TARGET1

Starting from the end of the previous straightaway, with a DLS of 3, build to Target1.

Remember to hit “SHIFT” at the end of a multi-command to finish it:



¹⁰ Actually, the “|” is needed if you type up long multi-command strings in a notepad file and save them for use as custom profiles, then cut-and-paste them into HawkEye when needed.

In one simple Multi-Command like this, the user can create a proposal well, drill down 2000 feet, then break off with a DLS of 3 to hit a previous made target at 8000 feet.

More examples of multi-commands are provided in one of the following subsections.

c. The List of Commands

NOTE: To pull up the following list of commands in HawkEye, just enter “?” into the Command line at the bottom.

In the list below, the primary name of the command is shown; that is the standard name. (e.g. 'SLANTDLS' can be referenced with 'SD', and 'SLANTHOLD' can also be referenced with 'SH').

The list of parameters for each command are shown. In order for the command to be successfully implemented, the user should select a value for each parameter. A few commands don't have any parameters; the '?', for example, immediately displays this help screen. The commands below are displayed in there general groupings.

a. Data Types

In the list, a letter is assigned to each of the listed commands to indicate its data type.

A - Alpha-Numeric

N - Number : [Min Value, Max Value]

O - Options: [Options are in brackets]

L - Lookup: Usually points to data lists that need to be populated but also is used to open special Hawkeye Forms for easier input.

b. Special Function Keys



Erases the last command in the Command Line. Applying repeatedly will erase the entire line.



Jump to the end of the Command Line.



Navigate the command line without automatically invoking popup screens when a popup parameter is encountered. To force the popup, click on the item.

b. The Command List

Command Name: New Well - aka > *NW, NEW WELL, NEWWELL*

Purpose: Creates a New wellpath

Parameters:

- Name - A
- Type - O[Survey|Proposal]
- RKB - N[0|1000]
- Color - L[Color]

Command Name: Sidetrack - aka > *SIDETRACK, ST*

Purpose: Creates a named Sidetrack from specified curve and makes it the focus point

Parameters:

- From Wellpath Name - L[Wellpath]
- Type SideTrack - O[Survey|Proposal]
- Sidetrack Name - A
- Measured Depth - N
- Color - L[Color]

Command Name: ADD Survey - aka > *ADD SURVEY, AS*

Purpose: Add as survey to the current Work Curve

Parameters:

- MD - N[0|50000]
- INC - N[0|180]
- AZM - N[0|360]
- Comment - A

Command Name: ADD Course Length Survey - aka > *ADD CL SURVEY, ACL*

Purpose: Add current course length to last MD for New MD as survey to the current Work Curve

Parameters:

- CL - N[0|50000]
- INC - N[0|180]
- AZM - N[0|360]
- Comment - A

Command Name: Auto Comments - aka > MKCOM

Purpose: Create comments automatically for current proposal curve

Command Name: Make target plane - aka > MKPLANE

Purpose: Make target plane from the last station of current proposal curve

Command Name: Add Surveys - aka > SURVEYLIST

Purpose: Invokes the survey editor so user can add more than one survey

Parameters:

- Curve Name - L[Wellpath]

Command Name: Rotate Plan - aka > ROTATEPLAN, RP

Purpose: Rotate the current plan with an input angle.

Parameters:

- Angle - N[-360|360]

PROJECTION TOOLS

Command Name: SLANTDLS - aka > J, SLANTDLS, SLANT, SLANTWELL

Purpose: Creates a Slant projection to named target using DLS specified

Parameters:

- DLS - N[0|120]
- Target Name - L[Target]

Command Name: Aligned Well - aka > ALIGN1, A1

Purpose: Creates an aligned path to Target Name at INC and AZM using DLS1 to Build and DLS2 to turn

Parameters:

- Inc - N[-180|180]
- Azm - N[0|360]
- DLS1 - N[0|120]
- DLS2 - N[0|120]
- Target Name - L[Target]

Command Name: Aligned Well - aka > *ALIGN2, A2*

Purpose: Create an aligned projection with DLS1 and DLS2 so that Target1 is lined up with Target2

Parameters:

- DLS1 - N[0|120]
- DLS2 - N[0|120]
- Hold - N[0|50000]
- Target Name1 - L[Target]
- Target Name2 - L[Target]

Command Name: Vektored Curve - aka > *VECTORED CURVE, VC*

Purpose: Creates a wellpath that aligns Target1 and Target2 with the specified DLS's. KOP is solved.

Parameters:

- DLS1 - N[0|120]
- DLS2 - N[0|120]
- Target Name1 - L[Target]
- Target Name2 - L[Target]

Command Name: SlantHold - aka > *SLANTHOLD, SH*

Purpose: Creates Slant Projection with specified Hold Angle to Target

Parameters:

- Hold Angle - N[0|180]
- Target - L[Target]

Command Name: Back On Track - aka > *BACKONTRACK, BOT*

Purpose: Creates a projection from the Work Curve to the Proposed Curve with specified parameters

Parameters:

- DLS1 - N[0|120]
- DLS2 - N[0|120]
- Distance - N[0|50000]
- HoldDLS1 - O[Yes|No]
- HoldDLS2 - O[Yes|No]
- HoldDistance - O[Yes|No]

Command Name: SLANTKOP - aka > *SLANTKOP, SK*

Purpose: Finds the KOP for a Slant well with given Hold Angle and DLS to specified Target

Parameters:

- Hold Ang - N[0|180]
- DLS - [N[0|120]
- Target - L[Target]

Command Name: SWELLKOP - aka > **SWELLKOP, SWK**

Purpose: Finds the KOP for a SWELL with given parameters

Parameters:

- DLS1 - N[0|120]
- HoldAngle - N[0|180]
- DLS2 - N[0|120]
- EntryAngle - N[0|180]
- Extension - N[0|10000]
- Target - L[Target]

Command Name: NUDGEDLS - aka > **NUDGEDLS, ND**

Purpose: Creates a Nudge Projection using DeltaMD and DLS at TFO

Parameters:

- DeltaMD - N[-20000|20000]
- DLS - N[0|120]
- TFO - N[-180|360]

Command Name: NudgeINCAZM - aka > **NUDGEINCAZM, NI**

Purpose: Creates a Nudge Projection to given Inc and Azm at specified DLS

Parameters:

- Inc - N[0|180]
- Azm - N[0|360]
- DLS - N[0|120]

Command Name: NudgeTVD - aka > **NUDGETVD, NT**

Purpose: Creates a Nudge Projection to a TVD with Inc and Azm specified

Parameters:

- Inc - N[0|180]
- Azm - N[0|360]
- TVD - N[0|50000]

Command Name: HoldMD - aka > **HOLDMD, STRAIGHT, HOLD, HD, KOP**

Purpose: Creates a straight line projection by Delta MD

Parameters:

- DeltaMD - N[0|50000]

Command Name: HoldTVD - aka > **HOLDTVD, HT**

Purpose: Creates a straight line projection by Delta TVD

Parameters:

- DeltaTVD - N[0|50000]

CURVE NAVIGATION

Command Name: Focus - aka > *FOCUS*

Purpose: Sets the viewer's focus to either the work curve or the proposal curve at the beginning or end

Parameters:

- Focus Curve - O[WORKCURVE|PROPOSAL CURVE]
- Location - O[BEGINNING|END]

Command Name: Switchto - aka > *SWITCHTO*

Purpose: Switches to different project or wellpath and sets focus

Parameters:

- Object - O[Wellpath|Slot/Site|Project]
- Name - L[Object]

Command Name: Turn On/Off - aka > *ONOFF*

Purpose: Turn on/off the selected flag.

Parameters:

- Flag - O[Target Names|Target Bounding Box|3D Information|Walls|Curve Bounding Box|Curve Vertical Line|TFO Arrow|Projection Comments|2D Ellipses|Use Texture For Cylinder]
- On/Off - O[On|Off]

Command Name: MoveToMD - aka > *MOVETO MD*

Purpose: Moves focus to MD on designated wellpath

Parameters:

- Wellpath - L[Wellpath]
- MD - N[0|50000]

Command Name: Moveto TVD - aka > *MOVETO TVD*

Purpose: Moveto TVD of given wellpath

Parameters:

- Name - L[Wellpath]
- TVD - N[0|50000]

Command Name: Advance MD - aka > +

Purpose: Advances the focus pt on current wellpath relative to the beginning

Parameters:

- DeltaMD - N[-50000|50000]
- Relative - O[Relative|Absolute]

Command Name: Go Back MD - aka > -

Purpose: Backs up focus from THE END of the current wellpath

Parameters:

- DeltaMD - N[-50000|50000]

TARGET DEFINERS

Command Name: TargetDef1 - aka > TARGETDEF1, T1, TNSEW

Purpose: Creates a New Target using NS and EW Local coordinates

Parameters:

- Name - A
- TVD - N[0|50000]
- NS - N[-50000|50000]
- EW - N[-50000|50000]

Command Name: TargetDef2 - aka > TARGETDEF2, T2, TCLDIR

Purpose: Creates a New Target using Closure and Closure Direction to define Local coordinates

Parameters:

- Name - A
- TVD - N[0|50000]
- Closure - N[0|50000]
- ClosureDir - N[0|360]

Command Name: TargetDef3 - aka > TARGETDEF3, T3, TLATLONG

Purpose: Creates a New Target using Latitude and Longitude Geographic coordinates

Parameters:

- Name - A
- TVD - N[0|50000]
- Latitude - N[-89.99999|89.99999]
- Longitude - N[-180|180]

Command Name: TargetDef4 - aka > *TARGETDEF4, T4, TGRIDYX*

Purpose: Creates a New Target using GridY(Northing) and GridX(Easting) Geodetic coordinates

Parameters:

- Name - A
- TVD - N[0|50000]
- GridY - N
- GridX - N

Command Name: HorzPlaneDef1 - aka > *HORZPLANEDEF1, H1, HNSEW*

Purpose: Creates a New Target on a plane using NS and EW Local coordinates

Parameters:

- Name - A
- Plane - L[TARGETPLANE]
- NS - N[-50000|50000]
- EW - N[-50000|50000]

Command Name: HorzPlaneDef2 - aka > *HORZPLANEDEF2, H2, HCLDIR*

Purpose: Creates a New Target on a plane using Closure and Closure Direction to define Local coordinates

Parameters:

- Name - A
- Plane - L[TARGETPLANE]
- Closure - N[0|50000]
- ClosureDir - N[0|360]

Command Name: HorzPlaneDef3 - aka > *HORZPLANEDEF3, H3, HLATLONG*

Purpose: Creates a New Target on a plane using Latitude and Longitude Geographic coordinates

Parameters:

- Name - A
- Plane - L[TARGETPLANE]
- Latitude - N[-89.99999|89.99999]
- Longitude - N[-180|180]

Command Name: HorzPlaneDef4 - aka > *HORZPLANEDEF4, H4, HGRIDYX*

Purpose: Creates a New Target on a plane using GridY(Northing) and GridX(Easting) Geodetic coordinates

Parameters:

- Name - A
- Plane - L[TARGETPLANE]
- GridY - N
- GridX - N

Command Name: Make Target to Right or Left - aka > *DEFTARGR-L, MTRL*

Purpose: Create a Target NAME left or right of MD on WELLPATH, DISTANCE from point. (Multilateral uses)

Parameters:

- Target Name - A
- Wellpath - L[Wellpath]
- FromMD - N[0|50000]
- Distance(Left is negative) - N[-10000|10000]

EDITING TOOLS

Command Name: Edit Target - aka > *EDIT TARGET*

Purpose: Edit an existing Target

Parameters:

- Scope - O[Slot|Structure]
- Target - L[Target]

Command Name: Edit Structure - aka > *EDIT STRUCTURE*

Purpose: Edit Existing Structure definition

Parameters:

- Name - L[Structure]
- Elevation - N[0|30000]

Command Name: Edit Slot - aka > *EDIT SLOT, EDIT SITE*

Purpose: Edit an selected slot definition

Parameters:

- Name - L[Slot]

Command Name: Edit Wellpath - aka > *EDIT WELLPATH, EDIT PATH*

Purpose: Edit an existing wellpath

Parameters:

- Name - L[Wellpath]

Command Name: Fix To End - aka > *FIXTOEND*

Purpose: (Proposal curve only) Shifts the entire curve such that the *end* of the current curve ends at the input TVD, and extends the beginning of the curve vertically all the way back up to the surface. Use this to build your curve first, then drop it down to the desired TVD. (Use a negative value to reduce final TVD).

Parameters:

- Delta TVD – N[-10000|20000]

Command Name: Fix To TVD - aka > *FIXTOTVD*

Purpose: (Proposal curve only) Shifts the entire curve up or down the specified depth in TVD. Any additional distance from the surface is automatically extended vertically. Use this to shift an entire curve a specified depth. (Use a negative value for a reduction in TVD).

Parameters:

- To TVD – N[-10000|20000]

Command Name: Rotate To - aka > *ROTATETO*

Purpose: Rotates the current curve to a specified final angle. Useful in adjusting an entire plan.

Parameters:

- Input Angle – N[0|360]

Command Name: Surface From - aka > *SURFACEFROM*

Purpose: Solves for a surface location by attaching the end of the current curve to a specified target (retaining final INC and AZM), then extending the beginning of that curve all the way up to the surface. (NOTE: Every time you execute this command, it creates a new slot with a new curve that hits your target).

Parameters:

- Target - L[Target]

Command Name: Edit Project - aka > *EDIT PROJECT*

Purpose: Edit an existing project definition

Parameters:

- Name - L[Project]

Command Name: Edit Job - aka > *EDIT JOB*

Purpose: Pops up a Data Entry form for the job data

Parameters:

- JobID - L[JOB]

Command Name: Make Project - aka > *MAKE PROJECT, CREATE PROJECT*

Purpose: Make New Project definition

Parameters:

- Name - A

Command Name: Make New Slot - aka > *MAKE SLOT, MAKE SITE, CREATE SLOT, CREATE SITE*

Purpose: Create a new Slot definition with option that sets new slot as the referenced slot

Parameters:

- Name - A
- Set As Referenced Slot - O[Yes|No]

Command Name: MAKE Structure - aka > *MAKE STRUCTURE, CREATE STRUCTURE*

Purpose: Add New Structure definition

Parameters:

- Name - A
- Elevation - N[0|30000]

Command Name: Delete - aka > *DELETE, DEL, ERASE*

Purpose: Deletes one of the objects from the database.

Parameters:

- Object - O[Project|Structure/Pad|Slot/Site|Wellpath|Target\line]
- Name - L[Object]

SPECIAL EDITING

Command Name: MagSwing - aka > *MAGSWING, MS*

Purpose: Adjust the direction of the Wellpath fromMD toMD for Magnetic Ranging

Parameters:

- Wellpath - L[Wellpath]
- FromMD - N[0|50000]
- ToMD - N[0|50000]
- Right - Left (Left is negative) - N[-10000|10000]
- Confidence - N[-10000|10000]

FILE MANAGEMENT

Command Name: Save - aka > **SAVE**

Purpose: Saves Current Log file to text file

Parameters:

- Filename - A"

Command Name: Load - aka > **LOAD**

Purpose: Loads and attempts to execute a Saved Log File

Parameters:

- Filename - A

Command Name: LogOn - aka > **LOGON**

Purpose: Starts a log file of the command lines that are input

Parameters:

- Filename - A

Command Name: LogOff - aka > **LOGOFF**

Purpose: Turns Off the command line logging

Command Name: REPEAT Command Line - aka > **REPEAT**

Purpose: Repeat command line operations(Only can be used with Relative Navigation)

Parameters:

- Number of Times - N[0|100]

Command Name: Help - aka > **?**

Purpose: Directs user to different types of help

Parameters:

- TypeHelp - O[Quick Screen]

Command Name: Show Curves - aka > **SHOW CURVES, SC**

Purpose: Turn on or off different curves

Parameters:

- On or Off - O[On|Off]
- Scope - O[Project|Current Slot|All]

REPORTING

Command Name: Survey Report - aka > ***SURVEY REPORT, SR***

Purpose: Invokes survey report for named wellpath

Parameters:

- Curve Name - L[Wellpath]

Command Name: Critical Points Report - aka > ***CRITICAL POINTS REPORT, CR***

Purpose: Invokes Critical Points Report for named wellpath

Parameters:

- Curve Name - L[Wellpath]

d. Multi-Command

The Command interface can receive multiple commands simultaneously. This is where the power of the interface lies: in being able to create long custom strings of commands and simply cut-and-paste them into Command.

To enable multiple commands, check the “Multi-Command box” on the left.



Some examples of multi-commands are illustrated below:

Example 1: Create an Aligned Well to Hit Two Targets

Take a look at the multi-command string entered here:



There are four commands contained in this line:

Command #1:

NW:PROPOSAL2,PROPOSAL,0,BLUE

NW stands for New Well, here named “Proposal2” and designated a proposal-type curve (as opposed to a survey curve), with a TVD or starting point of 0 feet, and the color blue.

Command #2:

HOLD:1000

Hold for a straight measured depth of 1000 feet.

Command #3:

NUDGEINCAZM:15,100,3

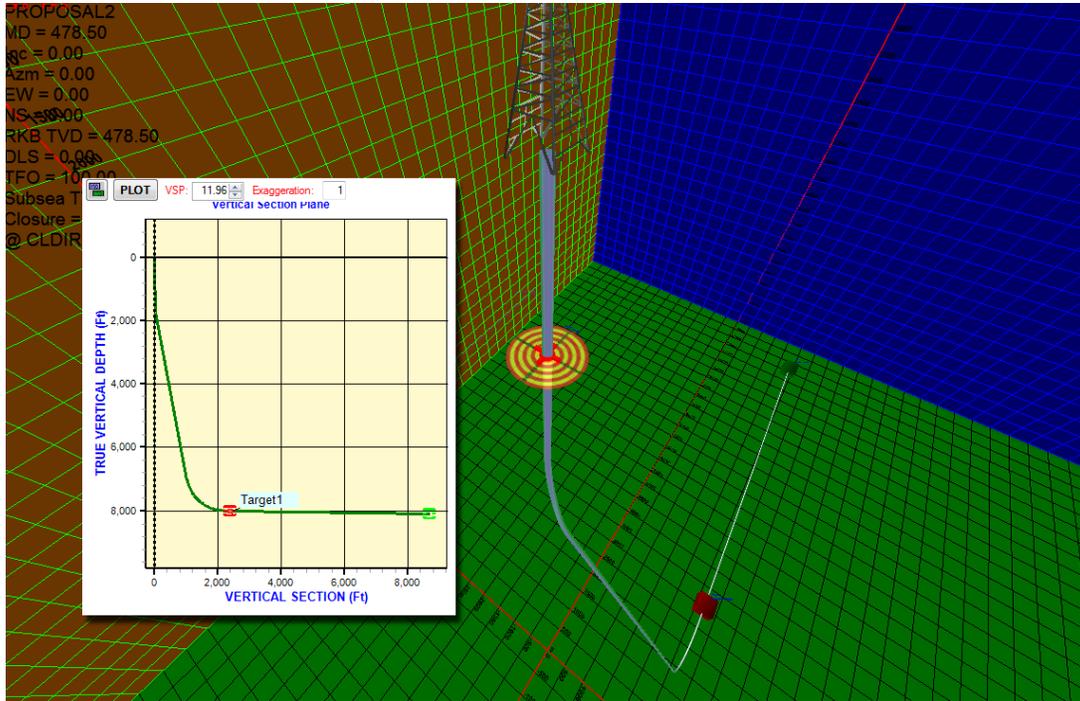
From the end of the straight tangent, build a nudge section with an inclination of 15 degrees, an azimuth of 100 degrees, and a dogleg of 3 degrees per 100. (Remember that you can use the shortened version of the longer worded commands. In this case, “NUDGEINCAZM” can also be entered as “NI.”)

Command #4:

ALIGN2:2,4,200,TARGET1,TARGET2

At the end of the nudge section, build an aligned projection with an initial DLS of 2, a second DLS of 4, a 200 degree hold angle, and designation to hit the targets “Target1” and “Target2” in that order.

Remember to press the SHIFT key to finish a multi-command. This is the result:



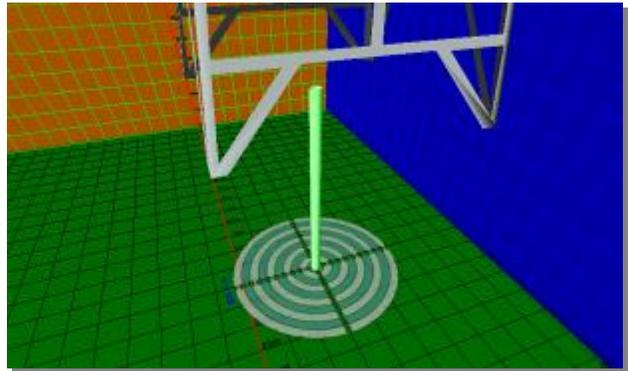
Notice in this example that you must already have your targets made, but everything else has been generated from the command itself.

Example 2: Create a spiraled or pattern well

The “ACL” command stands for Add Course Length. It is useful for adding a short segment to the end of a curve with its own inclination and azimuth. In HawkEye, Added Course Length only applies to the **work curve** .

REALISTIC LOOKING WELL: The effect of the same Added Course Length repeated over and over with a **uniform relative inclination and azimuth** can create a realistic spiraling well. This can be useful when a realistic-looking survey curve is needed quickly, without having to use real data or build the curve piece by piece. It’s simply done by defining one bit of course length with inclination and azimuth, then repeating it a number of times with a relative added value:

Start with a work curve that ends at 100 feet. Actually, for this illustration, it does not matter where the work curve ends. But remember that the Add Course Length (ACL) command starts at the end of the selected work curve.



Then enter the multi-command:



The command here breaks down as two separate commands:

Command #1

REPEAT:60

Note: when the user types “repeat” into the Command line, the “Multi-Command” box will automatically be checked on. This is because “Repeat” cannot be used without at least one other command. Here, the command is to execute whatever follows 60 times. The REPEAT command requires that any objects it replicates contain at least one dynamic parameter (a number preceded by either “R” or “P”).

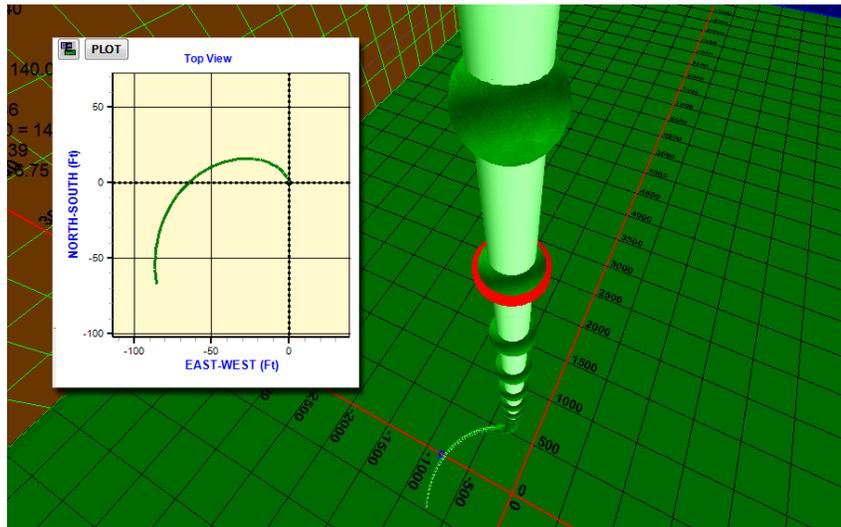
Command #2:

ACL:10,R.5,R-3.2,SPIRAL

Add course length of 10 feet, with an inclination of a RELATIVE 0.5. The “R” added before the inclination value means that the segment will be 0.5 degrees more than the previous segment’s inclination. As for the following “R-3.2,” which defines the azimuth, it means that the segment is to take an azimuth of 3.2 degrees going counter-clockwise from the previous segment’s azimuth. (A positive azimuth value would be clockwise). These relative (“R”) values are how organic and realistic curves are built, since each little added segment is going to build relative to the previous one in a set pattern.

The final word in the command, “SPIRAL,” is merely a comment to be inserted at every course length. To skip adding a comment, just hit SPACE, then ENTER.

Press “SHIFT” to end the multi-command and submit it for calculation:



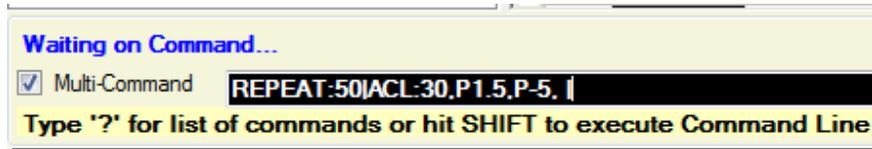
Notice at the top of the string of added course lengths how it seems straight, but then it begins a parabolic arc that is not symmetrical. This sort of build mimics the geometry of actual as-drilled wells. If the command had been repeated a 1000 times instead of 60, a spiral would take shape in some unique fashion.

“REPEAT” Needs at Least One Dynamic Parameter

When “R” is entered before a parameter, it is signaling that value to be either more than the previous iteration of that value. Thus, when using the REPEAT command, the “R” modifier is absolutely necessary for at least one parameter (or the “P” randomizer, see more below). Why? Because with just absolute hard parameters and no dynamic parameters, REPEAT will generate the same object in the same place over and over.

Example 3: Create a realistic random wandering well

Using the same tools as in the previous example, REPEAT and ACL, users can generate a wandering curve with random (within a given range) parameters. This would have the same use as the spiraling curve from the previous example: to display a real-looking as-drilled well quickly and without having to use actual surveys or build it piece by piece.



Here there are two commands:

Command #1:

REPEAT:50

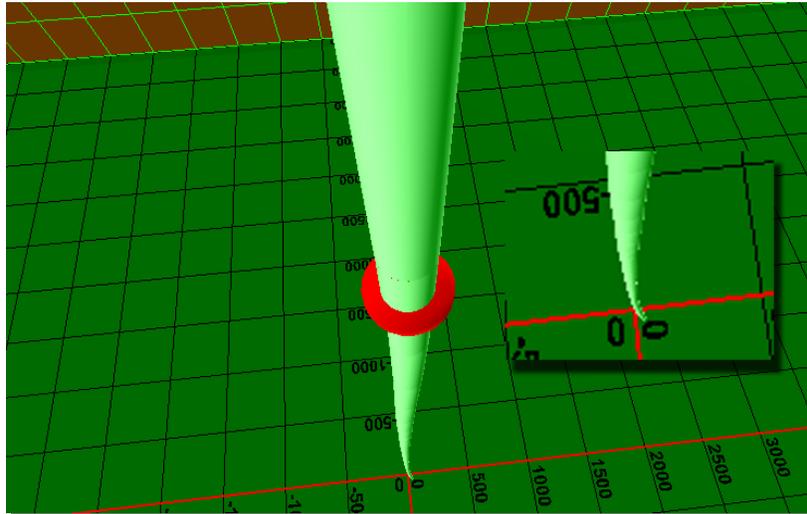
Note: when the user types “repeat” into the Command line, the “Multi-Command” box will automatically be checked on. This is because “Repeat” cannot be used without at least one other command. Here, the command is to execute whatever follows 50 times.

Command #2

ACL:30,P1.5,P-5 [space]

Added course length of 30 feet, with an inclination of “P 1.5.” The “P” before this parameter indicates a range of Probabilities. When “P1.5” is entered, HawkEye will generate a new value for each repeat ranging from -1.5 to 1.5 degrees. The second parameter for azimuth is entered “P-5.” This means the value will be randomized between -5 and 0. Hit SPACE to skip entering a comment, then ENTER.

Press “SHIFT” to end the multi-command and submit it for calculation:



What is generated here is not a provocative spiral or pattern. When the “P” (randomized) parameters are entered conservatively, like in this example, a very subtly imperfect wellpath. In the picture above, you have to squint to notice the accumulated curvature created by the randomization ranges of the inclination and azimuth over 1500 feet (30ft course length adds X 50 repeats).

But this is an exquisitely fast and easy way to create realistic looking and feeling curves in HawkEye without having to enter or port in actual survey data.

“P” Stands for Probability

When “P” is entered before a parameter in Command, it designates the following single number to establish a range. How can a single number define a range? Here’s how:

- When the number has no symbol, it goes both ways: (**P10 makes -10 to 10**).
- When the number has a + symbol, it goes from zero up: (**P+10 makes 0 to 10**).
- When the number has a – symbol, it goes from zero down: (**P-10 makes -10 to 0**).

c. Advanced Multi-Commands and the Target Array

The Target Array tool allows the user to select any sequence of targets for multiple-target projections. Such setups **can only be taken advantage of in the HawkEye™ Command interface**. It acts as a list of targets in sequential order which satisfy targeted projections as they (the projections) are generated in a repeating pattern command. A target array, or user-defined sequence of targets, can be associated with a specific curve, or one may be set up generically.

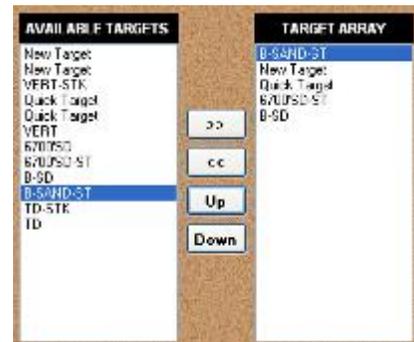


OPEN THE TARGET ARRAY: To find the Target Array button, right-click on either the work curve  or the proposal curve  in the Data Tree. You may also right-click on any curve in the 3D space. Once the right-click menu pops up, select “Target Array” towards the top of the list. Or open up the Target List and toggle the “Show TARGET ARRAY” box on the left.

Once the Target Array dialogue is open, you will notice that it contains the Target List and the Adjuster dialogues within it.

These internal instances of the List and Adjuster have all of the functionality that they would normally have, so the user can edit all target parameters here while also assigning targets to a specific array, or sequence.

The Target Array works simply by selecting from the lefthand list of available targets and ordering them in the righthand column. Use the transfer (<< and >>) and “Up” and “Down” buttons to transfer and order the targets.



The column of “available targets” on the left can only be edited through the Target List.

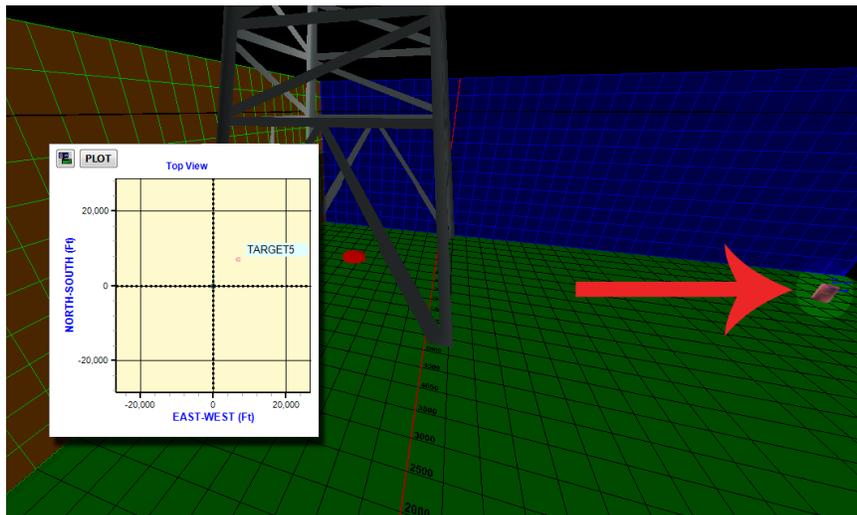
Watch how the Target Array is used in the following example.

Advanced Example 1: Create Four Targets and reach them with Sidetracks

The following example involves four steps: 1) Creating an initial target and proposal, 2) Create four more targets, 3) Add those four to a target array, and 4) Generate a series of sidetrack proposals that hit every target in the array.

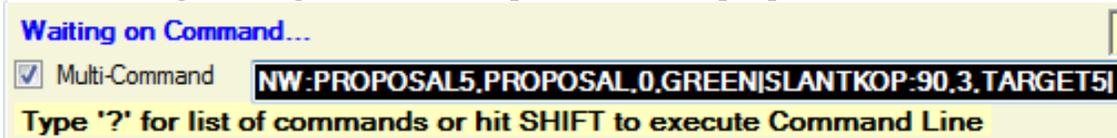
The example is provided to illustrate several key functions of Command. Namely that the user can generate a series of targets placed at precise perpendicular vectors away from a curve, and that the user can use the target array to hit those vectors with sidetrack proposals. All in two commands.

STEP ONE: CREATE AN INITIAL TARGET AND PROPOSAL:



Once a user creates a target with Command, they may find it faster and easier than with the GUI.

After making the target, the next step is to create a proposal and build it as a slant:



Command #1

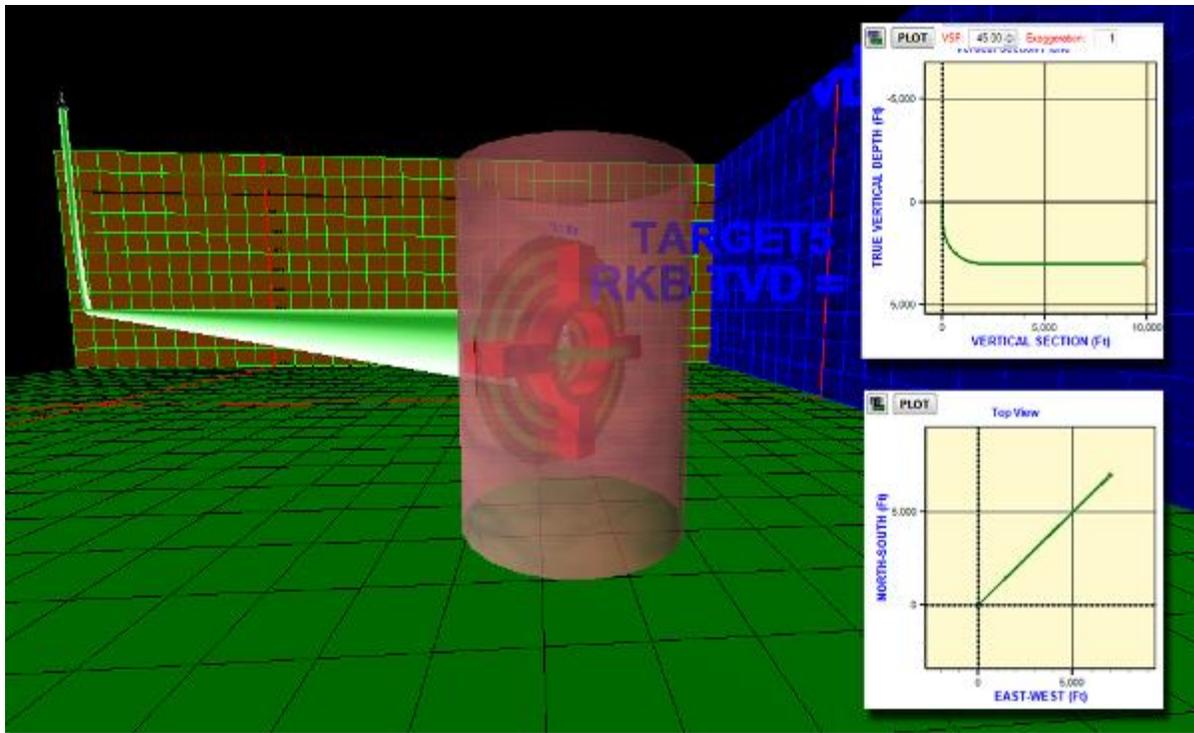
NW:PROPOSAL5,PROPOSAL,0,GREEN

This creates a New Well named "Proposal5," and is designated as a proposal curve (as opposed to a survey/work curve), with a TVD of 0 feet, and the color green

Command #2

SLANTKOP:90,3,TARGET5

The "SLANTKOP" command can also be typed in as "SK." This command finds the kickoff point for a slant well when given a specific hold angle and DLS to a specified target. Here, the slant proposal is given a hold angle of 90 degrees, with a DLS of 3 degrees per hundred, and told to hit "Target5."



Notice the vertical section graph, how the command creates a hold angle of 90 degrees and a DLS of 3.

STEP TWO: CREATE FOUR TARGETS WITH POSITIONS RELATIVE TO THE CURVE:

The next command will create two targets to the left of the curve, and two to the right.



Command #1

MOVETO MD:PROPOSAL5,8000

The "Move To" command is handy, but make sure to add a SPACE after "MOVETO." Here, we move our focus point to a particular measured depth on the curve named "Proposal5," at an MD of 8000 feet.

Command #2

REPEAT:2

This will execute whatever comes next 2 times.

Command #3

MTRL:RIGHT,PROPOSAL5,R1000,880

The "MTRL" command stands for Make Target Right Left, and will create targets respective of the current focal point on the current curve, to the right and/or left. Here, the name of the target is "Right," and location is based off of "Proposal5," with an MD of "R1000." The "R1000" means that it is built another 1000 feet MD beyond the current MD (so 8000+1000). The final parameter is 880 feet from the new focal point of 9000 MD, due right from an exact perpendicular angle from that point on the curve. It is at that point that a target is created.

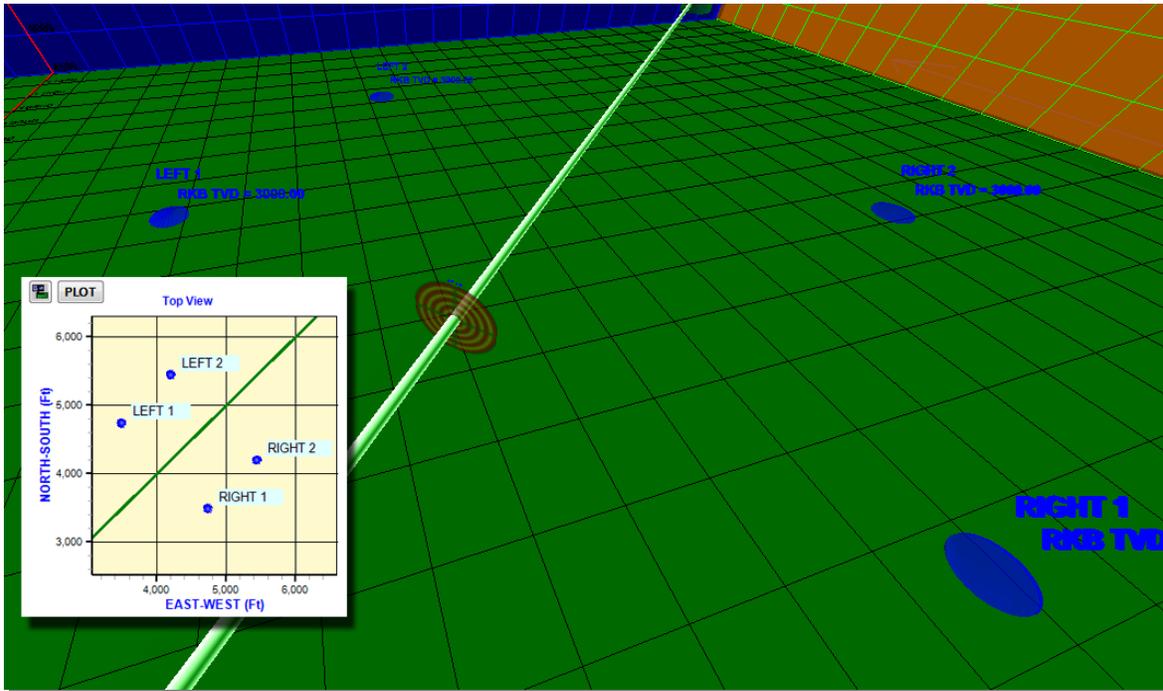
Command #4

MTRL:LEFT,PROPOSAL5,R0,-880

The MTRL is invoked again, this time creating a target called "Left," based on the curve called "Proposal5." This target is located off of MD "R0," which means it's a Relative 0 feet from the last focal point. The last focal point remained at 9000 feet (see command above). From that point, the distance is -880 feet (negative value means left of the curve). So a target is made at the same MD as the last target, but at the exact distance the other way.

Since these two commands are repeated once, an interesting thing happens. Those Relative MDs are repeated relative to their previous iterations. They build on each

other. So in the first target, the MD was R1000 to the right, then R0 to the left, then R1000 to the right, and R0 to the left. This translates in actual MD to 9000, 9000, 10000, 10000. The result is a uniform placement of targets to the left and the right.



With the MTRL command, targets are created in a perpendicular line away from the target at a specified MD, either to the left or to the right. Using Relative (R) MD values and the REPEAT command, ladder-like or staggered target patterns can be created along the curve.

STEP THREE: ASSIGN THE TARGETS TO A TARGET ARRAY:

Finally we get to see how the target array works. As mentioned at the beginning of this section, the user can access the Target Array setup by getting to the Target List in any number of ways. **NOTE: Here it is important to right-click on the proposal curve and access the Target List there, in order to build a Target Array that is associated with the curve.**

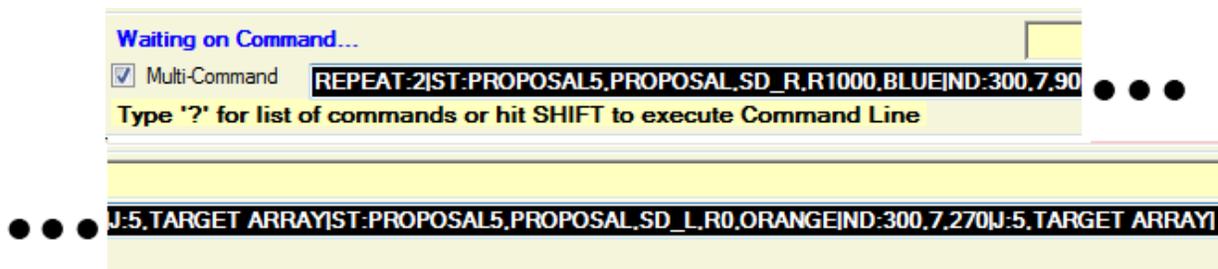
Check the “Show TARGET ARRAY” box on the left inside the List, and the dialogue will appear. Order the targets into an array in the following order: Right1, Left1, Right2, Left2.

Putting them in the wrong order will render the next command in this example rather useless.



STEP FOUR: GENERATE A SERIES OF SIDETRACK PROPOSALS TO HIT THE ENTIRE ARRAY

The principle here is to use the initial proposal curve as a launch point for each sidetrack. Each of the sidetracks is defined by a nudge section and a slant projection. The command looks like this:



This is seven commands: a repeat, create sidetrack right, make it a slant, give it a nudge, then create sidetrack left, make it a slant, give it a nudge. Here are the commands in detail. Note, we are already starting at an MD of 5000.

User can put in “MOVETO[space]MD:PROPOSAL5,5000” (or type it into the focal point box just under the bottom left corner of the 3D space and hit “TAB”):

COMMAND #1

REPEAT 2

Execute the following commands twice.

COMMAND #2:

ST:PROPOSAL5,PROPOSAL,SD_R,R1000,BLUE

Create a SideTrack with "ST." Here, it is based off of Proposal5, designated a proposal-type (as opposed to a survey/work curve), named "SD_R" and given a kick off MD of "R1000." The R1000 means that it will kick off relatively 1000 feet further than the current focal point. Since the current focal point was set at MD 6000ft, this sidetrack will kick off at MD 7000ft.

COMMAND #3:

ND:300,7,90

The NudgeDLS tool requires a DeltaMD, here 300 feet, a DLS which here would be 7 degrees per hundred, and a TFO, here 90 degrees.

COMMAND #4:

J:5,TARGET ARRAY

The "J" command creates a slant or J-well curve, which here is defined by a DLS of 5 and a target of... Target Array. This is where the Target Array comes into play. Instead of designating a single target, we have a sequence of them that will be hit in succession as this command string is repeated and targeted projections are generated several times.

COMMAND #5:

ST:PROPOSAL5,PROPOSAL,SD_L,R0,ORANGE

This creates another set of SideTracks, based again off the Proposal5 curve, designated as proposal-type curves themselves, named "SD_L" and given a kick off MD of "R0." The "R0" means that it will kick off 0 feet past the last known focal point, so just opposite its rightside counterpart defined above. Color orange.

COMMAND #6:

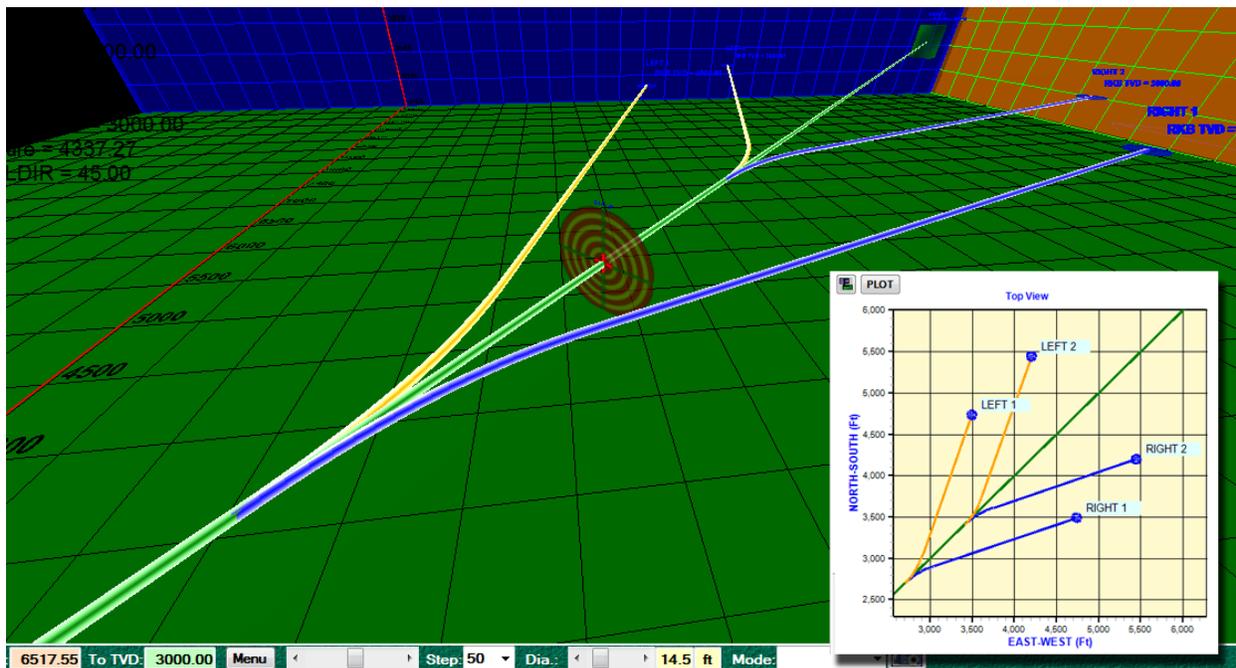
ND:300,7,270

The NudgeDLS tool requires a DeltaMD, here 300 feet, a DLS which here would be 7 degrees per hundred, and a TFO, here 270 degrees. The TFO is 180 degrees more than the rightside sidetracks because we want to go in the opposite direction.

COMMAND #7

J:5, TARGET ARRAY

Just as with the righthand side, the slant portion of the sidetracks are created with a DLS of 5 and the target array as targets.



The reason that the Target Array (composed of four targets) works in this multi-command is because the command string itself calls for four targets.

5. Uncertainty Options



RECALCULATE MODEL (F9): This button will refresh all uncertainty calculations, something that happens automatically when changing parameters, but should be done if any aberrations are observed in the 3D display of uncertainty.

DISPLAY MODE: The “Display Mode” dropdown list contains a number of checkboxes that allow for display of various aspects of the uncertainty:

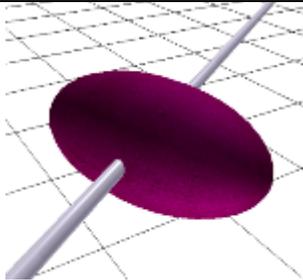
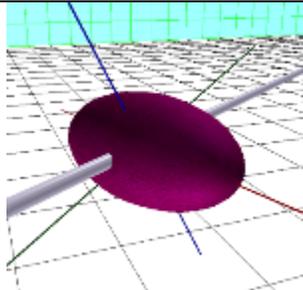
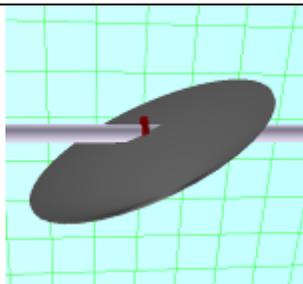
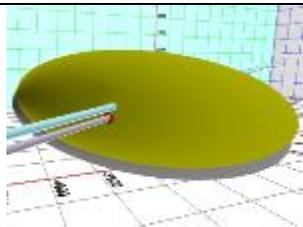
- No display (F3)
- Ellipsoid (F4)
- Ellipsoid with Wire Cylinder (F5)
- Wire Cylinder (F6)
- Ellipsoid with Solid Cylinder (F7)
- All Solid Cylinders (F8)

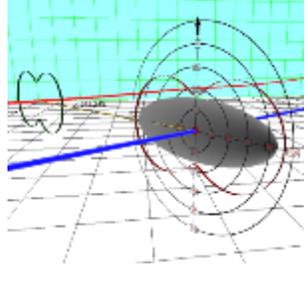
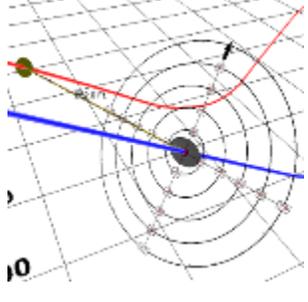
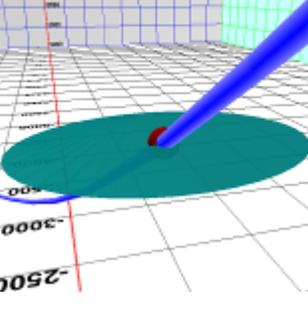
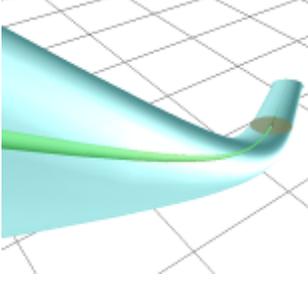
Each of these options shows either the true shape of the zone of uncertainty at any given MD (typically a sphere near the surface and an ellipsoid near the bottom). Or it will show the outer edge of all the zones of uncertainty combined, creating cylinder-like shape along the wellpath.

ISCWSA SIGMA: Adjusting this value controls the confidence level to be calculated by the ISCWSA model. For example, let’s say the confidence level is 95%, or 2 sigma in statistics jargon. What this means is an ellipsoid displayed along the well will illustrate the volume for which we have 95% certainty that the true survey point is in that volume. The larger the confidence level, the bigger the ellipsoid. Most operators use two sigma or three sigma confidence levels, two sigma being the most common.

ADVANCED UNCERTAINTY OPTIONS: These options apply only to the 3D space. Most of them require that the Proximity Calculation be turned on. Turn on Proximity by opening the “Proximity” tab on the right panel of the main screen and checking “Calculate Proximity.”

Some of these options are greyed out, unless others of these options are activated.

OPTION	DESCRIPTION	SCREENSHOT
Show Ellipsoid (Alt+M)	This turns on the 3D ellipsoid at the current focus point. Right clicking on this ellipsoid will show the dimensions.	
With 3D Vectors (Alt+X)	(requires "Show Ellipsoid" turned on) This turns on the axes of the ellipsoid, also referred to as Eigenvectors. The purpose of showing these is to lend confidence that the ellipsoid is properly constructed.	
Show LD Ellipses (Alt+E)	(requires Proximity to be turned on, along with at least one offset curve) (Least Distance)The ellipses from which the SF (Separation Factor) is calculated. These ellipses are constructed by projection onto the plane created by the minimum distance vector and the offset's direction vector.	
Show Compared Curve's Ellipsoid (Alt+O)	(requires Proximity and "Show LD Ellipse" to be turned on) This is the offsets's LD ellipse. It is on the same plane as the other LD ellipse on the reference well.	

<p>Pedal Curves* (Alt+P)</p>	<p>(requires Proximity and “Show LD Ellipse” to be turned on) This turns on the pedal curve graphic around each of the LD ellipses. The use of pedal curve is explained in the footnote at the end of this chart.</p>	
<p>Show LD Plane (Alt+V)</p>	<p>(requires Proximity to be turned on) The LD plane is the plane that the LD ellipses on which the LD ellipses for the reference and offset wells are generated. This can be turned on for greater clarity of what the plane is.</p>	
<p>NE Referenced Ellipse (Alt+N)</p>	<p>(North-East) This is the 2D ellipse that is created by projecting the ellipsoid onto the TVD plane. It is the ellipse that is drawn on 2D plots.</p>	
<p>HL Referenced Ellipse (Alt+H)</p>	<p>(Highside-Lateral) This is the ellipse that is created by projecting the ellipsoid onto the normal plane. The elliptical cylinders are constructed by connecting successive HL ellipses to one another.</p>	

*Pedal Curve- Without 3D representation of ellipsoids and elliptical cylinders the accepted way of visualizing the ellipsoids is to generate the various 2D ellipses that are detailed here.

It is understood, however, that these 2D ellipses can often lead to an underestimation of the collision condition of the actual ellipsoids. So, in order to avoid those situations a pedal curve is mathematically generated from the mathematical definition of the ellipse.

This pedal curve provides a much more conservative estimation of the radii of the ellipses and helps to ameliorate the possibility of underestimating collision

conditions. (A collision in this case is defined when two ellipsoids intersect with one another)

Unfortunately, using the pedal curve can often lead to way too conservative estimations of the separation factor, especially in non-vertical drilling. With 3D representation it becomes quite obvious when the pedal curve is too conservative.

6. Formation Line Editor

The **Formation Line Editor** in Hawkeye™ is designed to make it easy for the DD to adjust the plan without demanding an entire new well plan from the well planner's in the office. **The plan becomes a target line as opposed to a list of proposed surveys.** Once the new target line is established the DD can make projections to the line and determine the feasibility of drilling the proposed change. Once accepted, he then has a defined target from which he can calculate how far right/left or up/down he is from it.

How it works...

To begin with, this planner is for straight lines only. It is a useful tool for creating a target line disguised as a survey course length. The DD then will be responsible for executing the projections to this line, or around the line, and determining if it is drillable.

The DD can alter the plan to which he wants to drill by easily creating a new plan from the point on the current plan where he wants to change it, normally the point where he is currently at. Let's say the geologist decides that they should be drilling to a target line that is ten feet higher than where the bottom hole is currently.

1. The original plan (O-plan) will be copied so that it can be preserved.
2. The copy of this plan will be called the ~F0 plan.
3. All additional modifications will have curve names as of ~F1,~F2,~F3, etc.

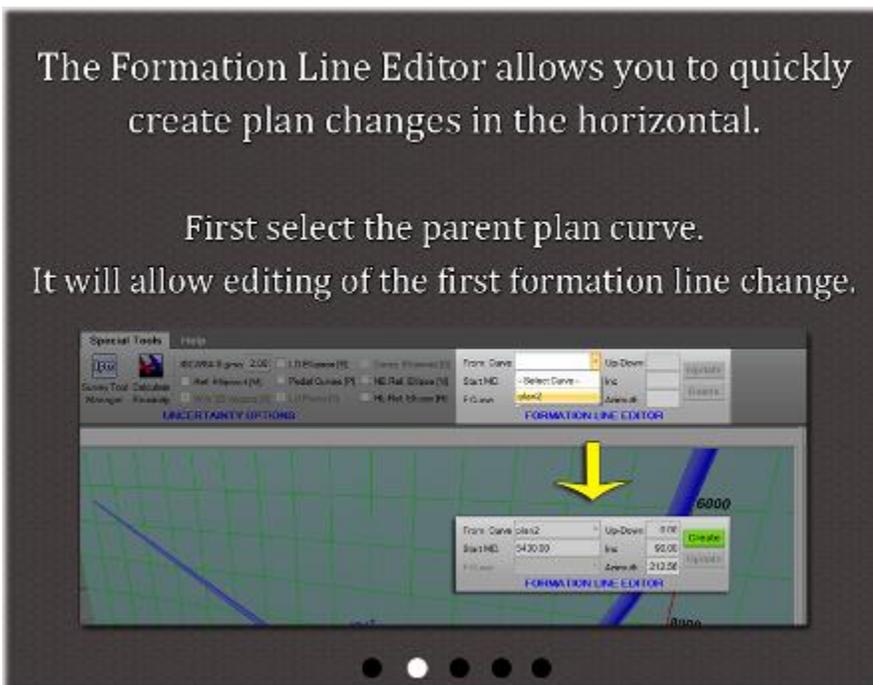
The DD would simply create a new plan from the current MD point and define how much above or below he wants the new plan to be. The program then would create a curve tied into the EW, NS, TVD of the selection point and adjust that tie in point up or down. In this case, the new curve will automatically be named ~F1. The new plan will automatically be extended to the MD at the end of the proposed plan and truncate the last plan so as not to have a bunch of confused lines. (Why look at an extended line from a previous F plan when it is not being used?)

Now let's say that the geologist decides after drilling an additional 100 feet that the dip should be something different. All the DD need do is create a new plan with the new dip from the ~F1 curve he created 100 feet earlier.

The new plan will automatically be called ~F2. The ~F1 plan will be truncated from the beginning of ~F2, and ~F2 will be automatically extended to the end of the original plan, or O-plan. This process of modifying the plan dynamically as it is being drilled can be

extended indefinitely. In addition to helping the DD modify his target for the ever changing plan, a record of the decisions of the geologist is maintained.

Below is a simple tutorial of where to find the Formation Line Editor and how it works:

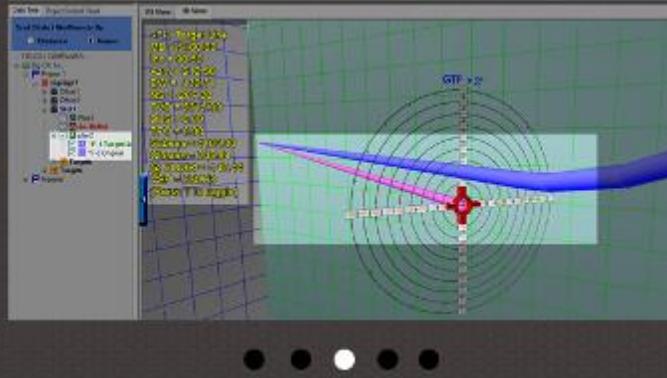


Enter parameters of the plan adjustment and click Create.

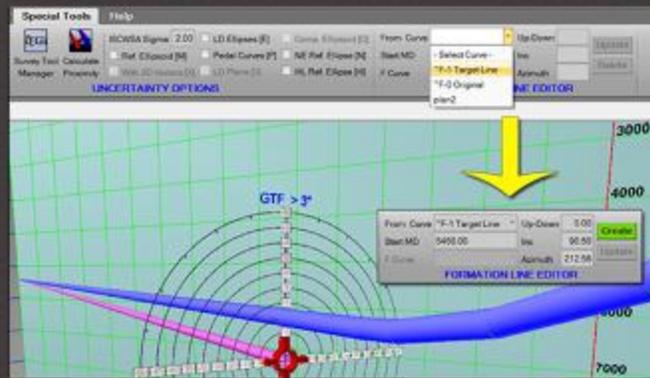
From Curve	plan2	Up-Down	15	Create
Start MD	5460.00	Inc	90	
F Curve		Amplitude	212.56	Update

FORMATION LINE EDITOR

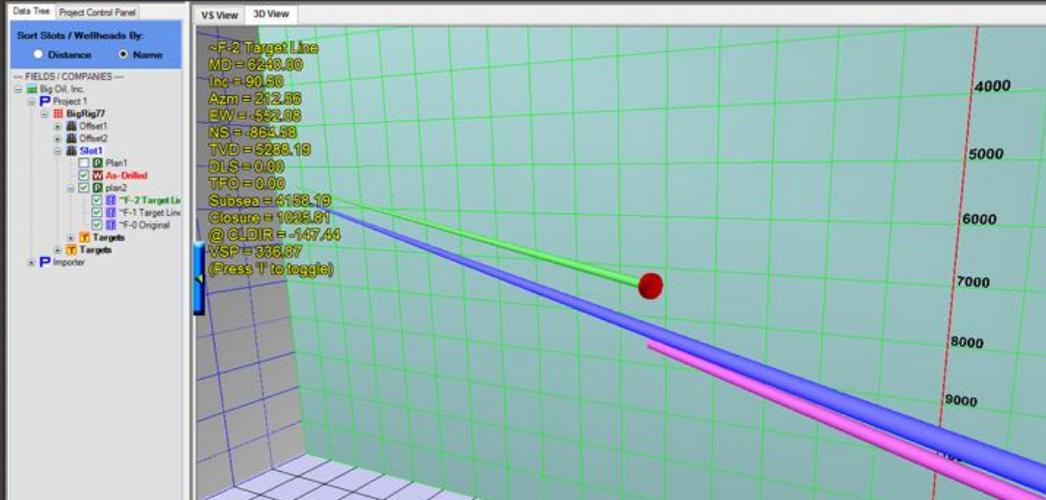
A special "F" curve will be created.



For the next plan adjustment, select the previous F curve, then enter the new parameters and click Create.



The previous F Curve will cut off at the MD where the new F Curve begins. This process can be repeated as needed.



F. PRESENTATION PLOTS

1. Presentation Plot Designer



a. How the Presentation Plot Designer Works

The Presentation Plot Designer in HawkEye™ is one of the most powerful and complex aspects of the program, and can be used to create wallplot-sized plots. It utilizes scalable vector graphics (SVG) when generating wall plots, making for very clean and precise visual representations of the native data retrieved from the project database.

But SVG also allows a high degree of flexibility as far as zooming and resizing. The SVG is in fact handled by a dedicated program called Inkscape™, which installs with HawkEye™. Inkscape™ itself a tremendously powerful SVG editor that, when even only minimally understood, will produce very professional and sharp presentation-caliber plots.

SCALABLE VECTOR GRAPHICS (SVG)

SVG has been in development since 1999 by a group of companies within the W3C after the competing standards Precision Graphics Markup Language (PGML) were submitted to W3C in 1998. SVG drew on experience from the designs of both those formats. SVG drawings can be dynamic and interactive. SVG allows three types of graphic objects: vector graphics, raster graphics and text.

Graphical objects, including PNG and JPEG raster images, can be grouped, styled, transformed, and composited into previously rendered objects. Text can be in any XML namespace suitable to the application, which enhances search ability and accessibility of the SVG graphics. The feature set includes nested transformations, clipping paths, alpha masks, filter effects, template objects and extensibility.

The SVG Specification contains provisions for rich graphics, and is unlike XHTML, whose primary purpose is communication of content, not presentation, and therefore specifies objects to be displayed but not where to place such objects. Conversely SVG is an ideal PDL for print-oriented uses, as it contains all the functionality required to place each glyph and image in a chosen location on the final page.

WORKFLOW FOR A PLOT

The Plot Designer in HawkEye works in conjunction with other software in order to make complex plots. There is a division of labor here amongst the programs. Here is the sequence generally:

STEP ONE: In HawkEye™

- **Insert** all the graphs, charts, lists, graphics and components that you want.
- **Tweak the data** aspects of graph grids, lists, as well as and colors.

[Click] 



STEP TWO: Inkscape

- **Position** the various items to where you want them.
- **Tweak non-data elements** like label placements and indentations, etc.

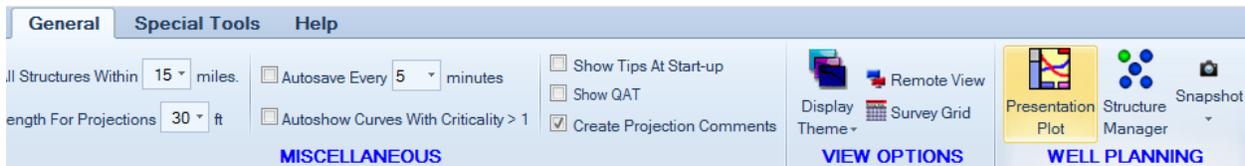
[Print to PDF]



STEP THREE: Adobe Reader

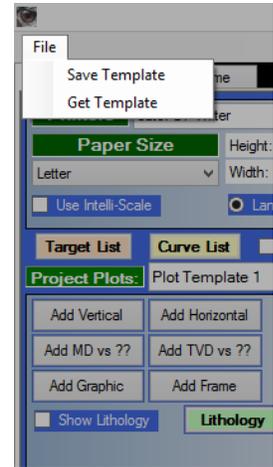
- **Choose** your paper size once your PDF is open.
 - **Print** to paper.
- NOTE: Do Not Print to large formats directly from Inkscape.**

OPENING THE PLOT DESIGNER: Click on the Presentation Plot icon under the “Special Tools” tab.



FILE MENU: In the top left of the screen is the “File” menu. It contains all the essential plot file management options:

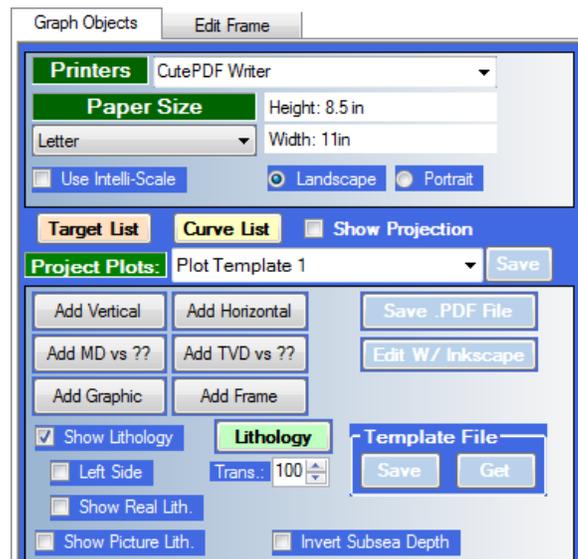
- **Save Template:** This will save whatever frames are currently displayed in the plot designer as a template file (.plt). User can define the name and location of the template file. The default location where all default HawkEye™ templates are stored is c:/HawkEye™/plottemplates.
- **Get Template:** This simply opens a file launch dialogue to load any template (.plt) file into the Plot Designer.



MAIN CONTROL PANEL: Although the Plot Designer has individual panels for each element of a plot which can be opened and closed, there is a Main Panel that always stays at the top left. **It is broken into two tabs, the Graph Objects and Edit Frame tabs at the top.**

Under the Graph Objects (default open) tab, the user may select printer, paper size and orientation, as well as templates, adding frames and adding other elements to a plot.

Click “Save PDF File” to get an instant PDF of whatever is currently displayed without using Inkscape. This is useful for quick plots containing relatively few elements (e.g. VS v. Horizontal view)



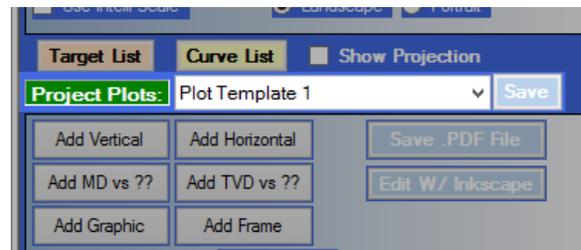
PRINTING: The Print button, located just next to the paper selection drop-down menu, allows for a wide variety of print sizes. When the CutePDF Writer is selected as the printer, this selection contains virtually all print sizes. However, only in the Well Planning version of HawkEye™ will the larger wall plot sizes be available for printing. In other words, the Field version of HawkEye™ only has the conventional non-plotter sized options for a paper sizes up to A3. Also note, a paper size is simply not available if the selected printer will not support it.

PRINTING PLOTS: FIELD v. WELL PLANNING VERSIONS

The difference between the Field version and Well Planning version of HawkEye™ with plotting is that only in the Well Planning version will the larger wall plot sizes be available for printing and exporting. Only the smaller paper sizes are available in the Field version since it is assumed that users of the Field version will not need a plot printout larger than A3.

Exclusive Well Planning version print sizes include: A4, A2, 11x17, ISO A0-2, ISO B1, B1-B4(JIS), ARCH A-E1, Folio [8.5x13in], 22x36in, 24x48in, 24x60in, 24x72in, 24x84in, 24x96in, 24x108in, 36x42in, 36x60in, 36x72in, 36x84in, 36x96in, 36x108in and PostScript Custom.

PLOT TEMPLATES: Each project is given up to four customizable templates. Select 1-4 from the Project Plots drop-down menu in order to open a template, and to save to it, just have it selected and click the “Save” button next to the drop-down menu. The template names can be changed to whatever descriptive name the user wants.



ADD COMPONENTS: There are dedicated buttons in the plot designer’s main control panel for adding certain components:

- **Add Vertical-** add a Vertical Section view graph to the plot
- **Add Horizontal-** add a Horizontal view graph to the plot
- **Add MD or TVD vs ??-** Add a graph which charts MD or TVD against any given parameter you chose.
- **Add Graphic-** Drop any sort of image file into the plot. **NOTE: Any graphic located within a folder path that contains special characters such as “&” will not load into the SVG environment!**
- **Add Frame-** This button encompasses a long list of additional types of frames which can be selected from the drop-down menu in the sub-panel created. Those frames include:
 - Header
 - Footer
 - General Data
 - Critical Points
 - Hard Lines
 - Lease Lines

- Lithology
- Casing
- Job Data
- Slot/Wellhead Data
- Text
- Last 3D View
- 3D Perspectives
- Geomagnetism
- Geodetics
- North Arrows

See more in the last two sections of this chapter titled “Add Frame.”

SHOW LITHOLOGY: This checkbox will display any entered lithology data as the background of a graph.

LEFT SIDE: When the user does not want to display the lithology across the entire width of a VERTICAL SECTION graph, the “Left Side” toggle will limit the display to only the left side of the displayed curve. This is useful for when the lithology data only includes tops, which do not actually define dips across an extended horizontal plane.

TRANS: This is a translucency control that will determine opacity of the lithology background, ranging from 1-100.

SHOW REAL LITHOLOGY: This toggle will overmap any data entered into the lithology which reflects thicknesses, vertical section departure etc, from the surface location.

PRINT PDF FILE: This button will pull up the print dialogue and automatically select the CutePDF Writer as the printer for PDF export of the plot as it appears.

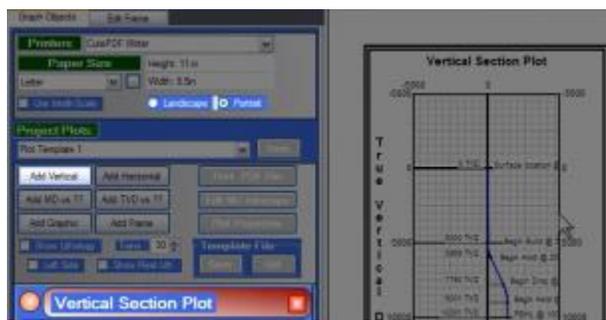
EDIT W/ INKSCAPE™: This button launches the all-important InkScape™ application, which utilizes scalable vector graphics (SVG) in order to move, place and resize all the existing elements of the plot. It cannot be used to edit the plot’s actual data, however.

TEMPLATE FILE: The “Save” button under “Template File” will save the current plot configuration to a template file (.PLT). Clicking “Get” will open the folder where template files are stored. HawkEye™ installs with about a dozen default templates to choose from.

b. Vertical Section Plots

The vertical section frame is normally included in the default plot templates since it is staple information for plots. But for a user wanting to start from scratch on building a plot, the VS frame is easily added.

Add a graph depicting a vertical section view of a project to the plot by clicking the “Add Vertical” button in the main control panel. Depending on the nature of the wells, either Landscape or Portrait may be more appropriate. However, if the plot is very large this preference will not hinge on the shape of the vertical section frame alone.



GRID FEATURES: The checkboxes in the blue field of the sub-panel will control whether any of the grids or the outer frame is displayed. Click on the circle to the left of any of the grid boxes to open a color dialogue and select a color for the element from the palette.

RESIZING: Height and width can be changed with the drop-down menus. The boxes in between these menus toggle whole-page vertical and horizontal expansion of the graph. The “Outer Scale” slide control will resize the frame as a whole. Further fine-tune resizing can be done in InkScape™. (Launch InkScape™ by clicking the “Edit w/ InkScape™” button in the main control panel on the top left quadrant of the Plot Designer).



PLACEMENT: The 9-circle grid on the top right will control the general placement of the graph. However, for fine-tune placement (as well as resizing), InkScape™ is used. This grid is only for rough draft placing.

AUTO CALC: When this is toggled on, the Plot Designer will calculate the best way to fit the relevant portion of the VS view into the graph space displayed. When turned off, several manual fields are activated, including the vertical exaggeration factor and the “Div/Tick” drop-down menu, which allows the user to define the number of graph ticks

per division. By increasing the ticks per division, there is a zoom effect on the graph. By default, graph treats each tick as one inch, but to “zoom out” and increase the distance per division, just slide down the “Inner Scale” slide control in the sub-panel.

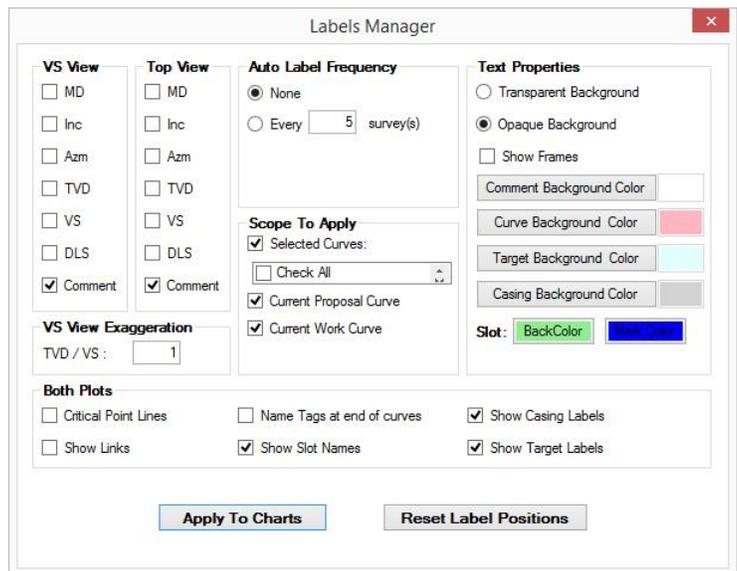
VIEW CHANGES: VSP will change the angle at which the vertical section are being seen, by degrees. The Start VS and TVD fields control the depth at which the curves begin on the graph. Adjusting these two parameters when AutoCalc is turned off allows the user to position the graphics within the grid.

GO TO CHART: The “Go to Chart” button allows the user to leave the Plot Designer for a moment and re-adjust the positioning of the graph in the main HawkEye™ environment. The “chart” launched is merely the VS View, where zooming and panning can be done in order to get a better view. To get back out of the VS View and back to the plot, just click the “View Plot” button at the top of the window. The next step is to click the “PLOT FROM CHART” button. This button will take whatever immediately preceding adjustments made in the VS View and implement them in the current VS plot frame.

LABEL MANAGER: Click the “Label Manager” button at the far left of the “2D Charts” tab in the main screen.

This general panel controls both VS and Top view label and grid characteristics. In order to get VS and Top view graphs to look exactly as desired, it is important to experiment with and understand this control panel.

At the bottom, all settings can be applied to this plot, all plots or all charts.



VERTICAL SECTION WITH LITHOLOGY

Lithology information of a project can be graphically displayed as the background of a vertical section plot within the Plot Designer. The first step is to make sure there is lithology data entered the way the user wants it into the project's database. (See section on Lithology, Ch.3).

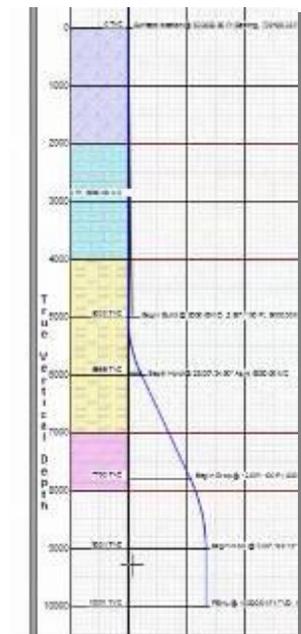
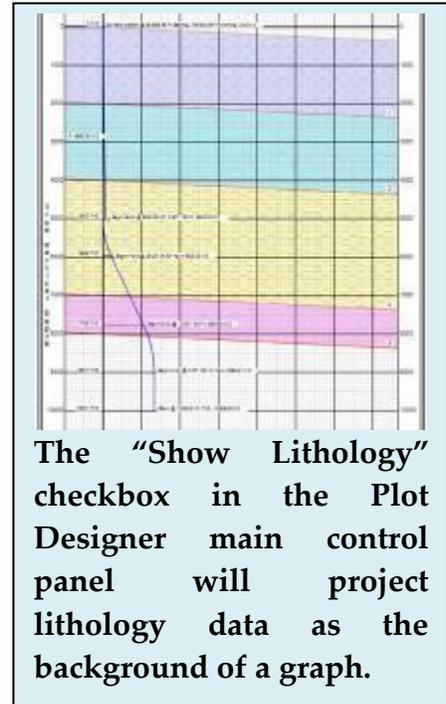
Once a vertical section plot frame has been created (Click "Add Vertical" in the main control panel of the Plot Designer), the option to "Show Lithology" will appear as a checkbox. Toggle on the "Show Lithology" and the rest of the controls will appear.



TRANS: This is a translucency control that will determine opacity of the lithology background, ranging from 1-100.

SHOW REAL LITH.: This toggle will overmap any data entered into the lithology which reflects thicknesses, vertical section departure etc, from the surface location.

LEFT SIDE: When the user does not want to display the lithology across the entire width of the vertical section plot, the "Left Side" toggle will limit the display to only the left side of the displayed curve. This is useful for when the lithology data only includes tops, which do not actually define dips across an extended horizontal plane.



c. Horizontal Plots

A horizontal plot is simply the “Top View” found in the main HawkEye™ module. A horizontal plot can be added to a plot by clicking “Add Horizontal” in the main control panel. Be sure to select the desired Paper Size and orientation above.

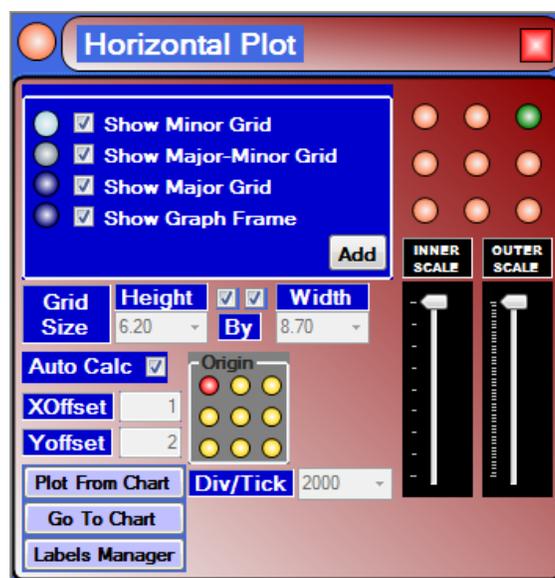
Once the frame has been created, its sub-panel will appear below under the header “Horizontal Plot.”

GRID FEATURES: The checkboxes in the blue field of the sub-panel will control whether any of the grids or the outer frame is displayed. Click on the circle to the left of any of the grid boxes to open a color dialogue and select a color for the element from the palette. The “ADD” button will add an entirely new generic frame.

RESIZING: Unlike many other frames in the Plot Designer, the Horizontal Plot frame (as well as Vertical Section View frame) is resized and edited to a great degree without InkScape™. The controls in the Horizontal Plot sub-panel contain most of the tools needed. Click the boxes between the Height and Width fields to maximize the Horizontal plot vertically or horizontally. Both boxes checked means that the graph will occupy the entire plot.

AUTO CALC: When this is toggled on, the Plot Designer will calculate the best way to fit the relevant portion of the Horizontal plot into the graph space displayed. When turned off, several manual fields are activated, including the Origin grid. X and Y Offset fields, and the “Div/Tick” drop-down menu.

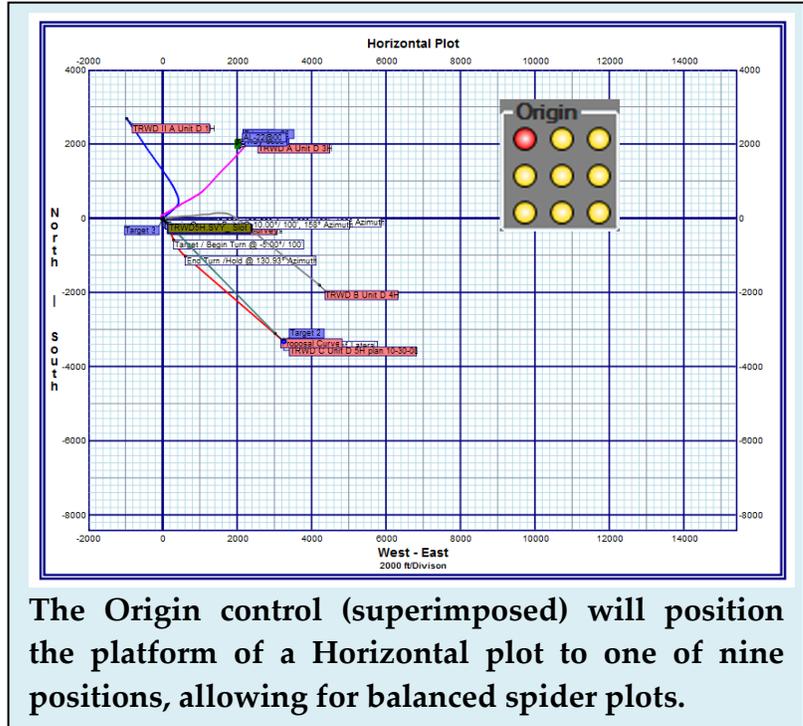
DIV/TICK: By increasing the ticks per division, there is a zoom effect on the graph. By default, the graph treats each tick as one inch, but to “zoom out” and increase the distance per division, just slide down the “Inner Scale” slide control in the sub-panel.



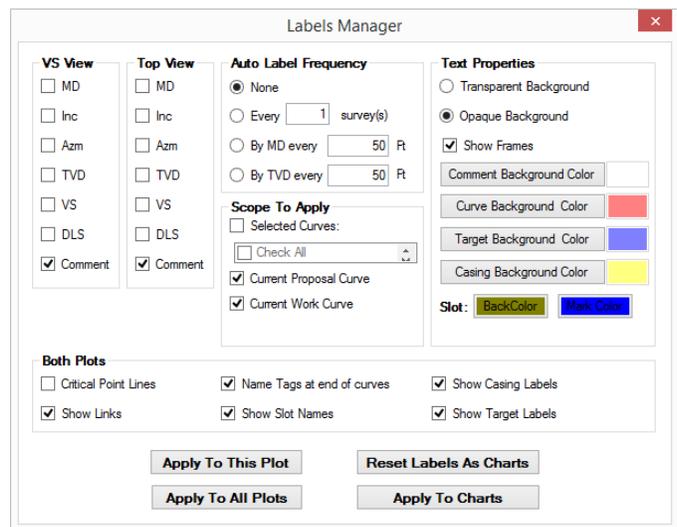
ORIGIN: When “Auto Calc” is turned off, this grid controls where the heart of the graph’s information is positioned. This is useful for spider plots of any symmetry.

PLACEMENT: The 9-circle grid on the top right will control the general placement of the graph. However, for fine-tune placement (as well as resizing), InkScape™ is used. This grid is only for rough draft placing.

GO TO CHART: The “Go to Chart” button allows the user to leave the Plot Designer for a moment and re-adjust the positioning of the graph in the main HawkEye™ environment. The “chart” launched is merely the Top View, where zooming and panning can be done in order to get a better view. To get back out of the Top View and back to the plot, just click the “View Plot” button at the top of the window. The next step is to click the “PLOT FROM CHART” button. This button will take whatever immediately preceding adjustments made in the Top View and implement them in the current Horizontal plot frame.

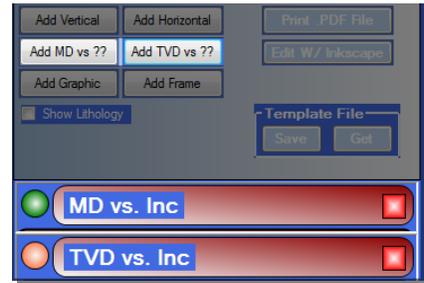


LABELS MANAGER: Click the “Labels Manager” button at the bottom of the sub-panel to launch the standard Graphics Properties Labels controller. This general panel controls both VS and Top view label and grid characteristics. In order to get VS and Top view graphs to look exactly as desired, it is important to experiment with and understand this control panel. At the bottom, all settings can be applied to this plot, all plots or all charts.



d. MD and TVD Function Plots

The Plot Designer can create graphs which plot the measured or total vertical depth of a curve as a function of another parameter. To add this kind of frame to a plot, just click “Add MD vs ??” or “Add TVD vs ??” and the frame’s sub-panel will appear below.



From the “vs” drop-down menu in the respective sub-panel, the user can choose which measurement to add the depth as a function to. By making the selection here, the graph is generated automatically in the plot and can be resized or moved around.

GRID FEATURES: The checkboxes in the blue field of the sub-panel will control whether any of the grids or the outer frame is displayed. Click on the circle to the left of any of the grid boxes to open a color dialogue and select a color for the element from the palette. The “ADD” button will add an entirely new generic frame.

PLACEMENT: The 9-circle grid on the top right will control the general placement of the graph. However, for fine-tune placement (as well as resizing), Inkscape™ is used. This grid is only for rough draft placing.

DIV/TICK: By increasing the ticks per division, there is a zoom effect on the graph. By default, the graph treats each tick as one inch, but to “zoom out” and increase the distance per division, just slide down the “Inner Scale” slide control in the sub-panel.

e. Add a Graphic

ADD A GRAPHIC: To add pictures and graphics to a plot, first click the “Add Graphic” button in the main control panel. This will create a sub-panel labeled “Picture” with a sequential number. Then click the “Get File” button at the bottom of the sub-panel to open the file selection dialogue through which any graphic file format can be selected. HawkEye™ installs with a number of logos to choose from (default folder: c:/HawkEye™/oilfield.logos) but any image file may be added to the plot.

To add a second graphic, simply click the “Add Graphic” button again and another “Picture” subpanel will appear.

RESIZING: Resizing the graphic is done in two ways: either manually adjusting height and width in the sub-panel, or by sliding the “Outer Scale” slide control on the right. (Fine-tune resizing is done in InkScape™. Click “Edit w/InkScape™” in the main control panel to launch).



ADJUSTING TRANSLUCENCY: By sliding down the “Inner Scale” slide control, a graphic’s opacity is reduced. This is useful for creating watermarks on a plot.

PLACEMENT OF GRAPHIC: The 9-circle grid in the sub-panel will give the graphic a rough placement on the plot, but any fine-tune placement and resizing of the graphic and of any frame is done in InkScape™, the scalable vector graphics program attached to the Plot Designer. Click the “Edit w/ InkScape™” button in the main control panel to launch the program. (More on InkScape™ below).

f. Add Frames: Most Commonly Used

Most of what can be added to a presentation plot falls under the “Frame” category. The list of frames that can be added are the following:

- Header
- Footer
- General Data
- Critical Points
- Hard Lines
- Lease Lines
- Lithology
- Casing
- Job Data
- Slot/Wellhead Data
- Text
- Last 3D View*
- 3D Perspectives*
- Geomagnetism
- Geodetics
- North Arrows

* Explained in the following section “Add Frame: Screenshots”

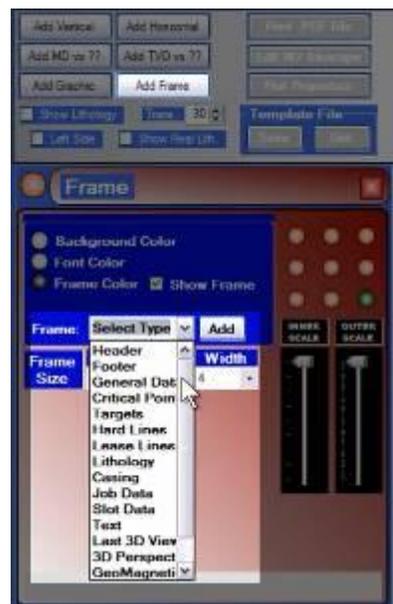
The following sections detail the most commonly used frames:

- 1. Add/Edit/Delete Frames*
- 2. Header*
- 3. Lithology, Casing and Target Lists*
- 4. Targets List*
- 5. Critical Points List*
- 6. Geodetics, Magnetism and a North Arrow*

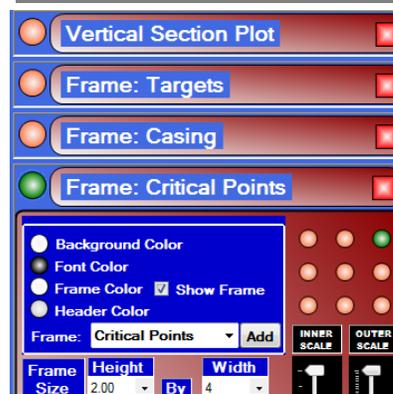
1. Add/Edit/Delete Frames

ADD FRAME: After clicking the “Add Frame” button from the main control panel, a component bar appears below the main panel labeled “Frame.” In this sub-panel, the frame type can be selected from the “Frame” drop-down menu. There are 17 types of frames to choose from.

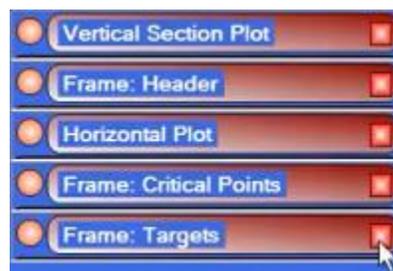
Most of the frames, once chosen and placed, will have the same set of controls for editing. That control set will be located in this very same sub-panel, but there will be slight variations on the controls depending on which frame is selected.



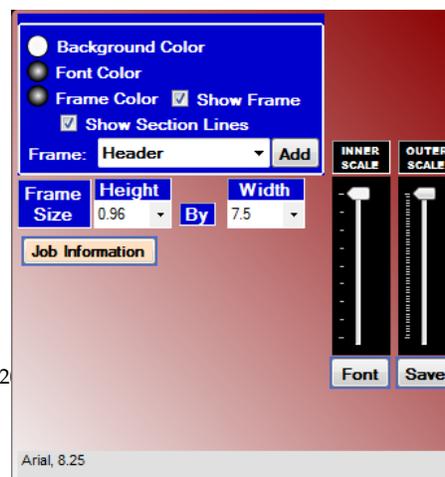
SELECT FRAME: Only one frame can be selected at a time for editing. To select a frame, click on the circle to the left of the component header. When not selected, this circle is pink. When a frame is selected, its circle is green and its sub-panel is expanded.



DELETE FRAME: To delete a frame, just click on the red box on the right end of the sub-panel header. This will instantly remove the frame and all of its settings from the current plot, so make sure to have any templates saved before killing a frame.

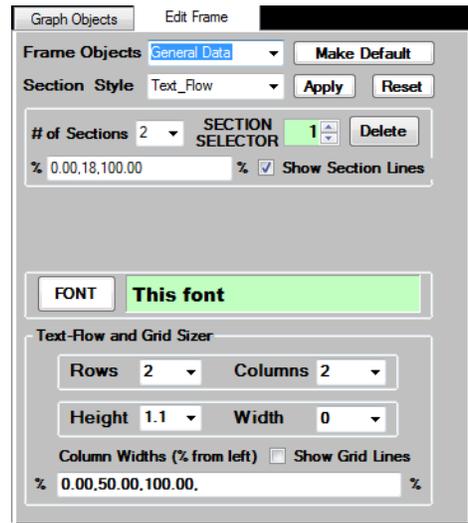


EDITING FRAMES: Once a frame has been created, you can use the “Frame” submenu to edit its CORE



properties. (For more fine-tuning, you will click the “Edit Frame” tab on the top left). Use the radio buttons to pull up their corresponding options dialogues: background color, font color and frame color. You may toggle whether a colored frame outlines the frame itself by toggling the “Show Frame” box. You may also toggle “Section Lines,” which will show if there is more than one column in the frame itself. Frame size and width is also controlled in this sub-panel, as is the font properties found in the header. Click “Font” to pull up the font properties. The Outer Scale meter will automatically resize the frame, font and all. Click “Save” to save all the current settings to default for future frames of that type.

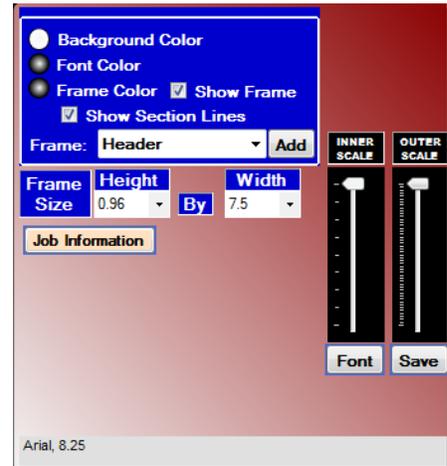
EDIT FRAME TAB: The other tab in the main control panel of the Plot Designer is the Edit Frame panel. It is used for more fine-tuning of any given frame. The first step is to select the object to be edited from the Frame Objects drop-down menu. This will dictate the kinds of options that will be available in the rest of the panel.



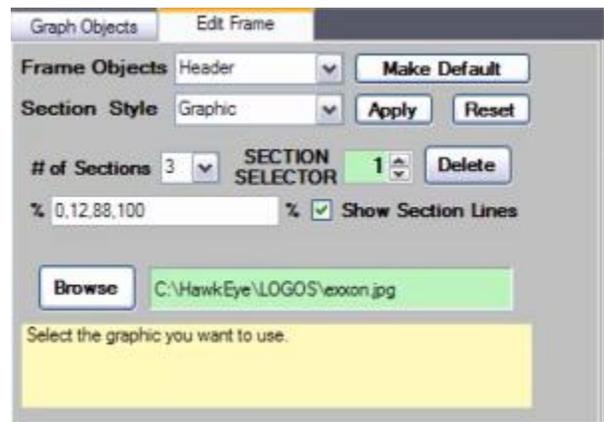
Thus there are two levels in which to edit plot frames in HawkEye™ and they are each found in their own tab of the main control panel of the plot designer. The colors, fonts and outer scale is edited under the “Graph Objects” tab, where such frames can also be added. Under the “Edit Frame” tab, specific spacing parameters can be entered, as well as section divides and section styles.

2. Header

The first step in creating a presentation plot from a blank slate is to add a header. To do that, click the “Add Frame” button from the main panel, then in the “Frame” drop-down menu select “Header.” A standard header will appear at the top of the plot with graphical logo on the left and seven lines of header text to the right of the logo. You may edit the basic characteristics of the header frame as described above, but you may also click the “Job Information” button to edit the actual information found in the header.



To edit a header more closely, select the “Edit Frame” tab on the top left. Then select “Header” from the “Frame Objects” drop-down menu. You will now see the breakdown of how the header is built in this panel. By default the header is composed of three sections, which can be changed. To change the relative widths of each section, you will **manually enter the ratio** in the “%” field. Each of these numbers represents the percentage of the total width of the header at each section divider.



So in the following example, the ratio of “0, 12, 88, 100” divides a header that looks like so:



The three sections are 1) the graphic section, 2) the “text flow” section and 3) another graphics section. The dividers come at 0% width, 12% width, 88% width and at the end at 100% total width. The next picture shows a ratio of 1,9,91,100:

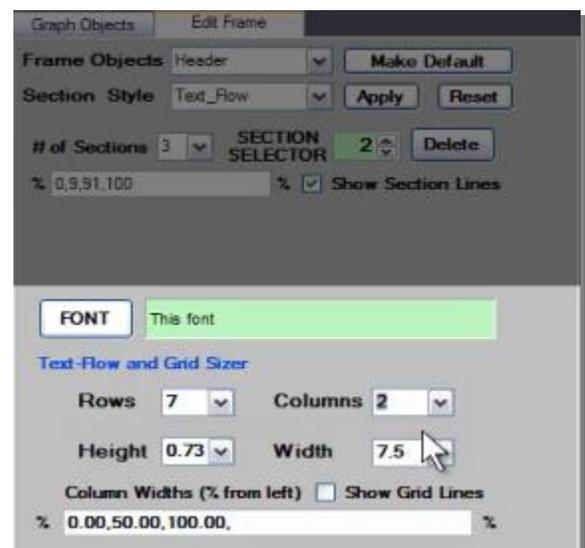


To edit any of these sections, use the “SECTION SELECTOR” to move the number up and down. Sections are numbered from left to right, so the first graphic section above would be “1.” It is characterized under the “Section Style” drop-down menu as a “Graphic.” To change this particular graphic, make sure the Section Selector is on “1,” then click “Browse” to select a different graphic for that section.

NOTE: Any graphic located within a folder path that contains special characters such as “&” will not load into the SVG environment!

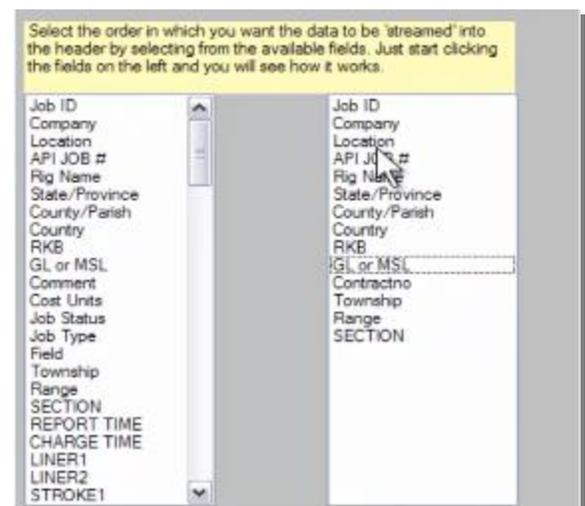
Hit “Apply” after selecting any new graphic or making any changes.

To edit a “Text Flow” section, use the Section Selector to select it. In this case it would be “2.” Once selected, the entire panel will change to display all the text flow options. The most salient options are the number of rows and columns. Just like with section width ratios, the spacing of these columns are controlled by manually entering ratios. However, notice that the ratios are specified by default as decimals up to the hundredth power, so mind the punctuation in this field.



ADDING DATA COLUMNS: Further below in text flow editing panel are the data type selection columns. There you can choose which kinds of data will appear in the text flow section. On the left are all the available data types that can be added.

To add one, left-click on it, and it will appear at the bottom of the right-hand column. The right-hand column, likewise, displays in order from top down which data types are displayed from left to right on the plot (restarting from top left on subsequent rows and columns).

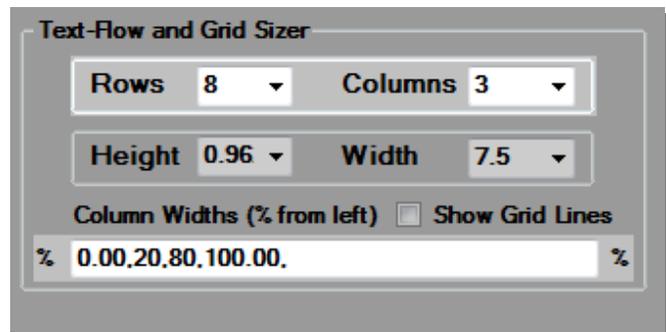


To remove a data type, left-click and then right-click on the word. To re-order the data, you must remove each of them and re-stack them in the desired order.

In the following example, there are 14 data types, 7 rows and 2 columns. The columns are given width ratios of 0,50,100. Remember that the width ratios within a text flow area only apply to that section, not the entire frame.



Here is another example. The text flow section is given three columns, with 8 rows per column. But the width breakdown is a little different: 0,20,80,100.

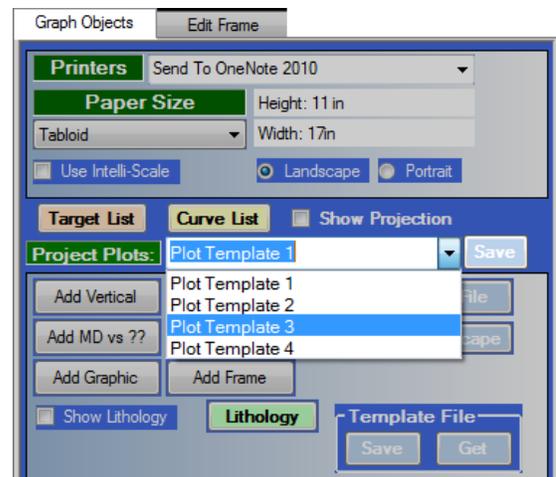


This creates columns within the text flow section that are not symmetrical, which is what the user may want:



MAKE DEFAULT: Once all changes have been made to spec, be sure to click “Make Default” at the top of the Edit Frame panel.

SAVE AS TEMPLATE: To save any component or frame settings in one of the four template slot/wellheads, just click the Graph Objects tab at the top, then use the pulldown menu to select which slot/wellhead you want to save under, then click the “Save” button to the right. Remember, saving in a slot/wellhead will erase the old template in that slot/wellhead, so keep track of your templates.



3. Lithology, Casing and Targets Lists

The lithology, casing and targets frames are the kinds found under the general frames list, so to add them to a plot, just click “Add Frame” in the main control panel on the left side of the Plot Designer. A “Frame” sub-panel will appear, and from the “Frame” drop-down menu, select Lithology. It will automatically appear. Don’t click the “Add” button unless you want a *second* frame of that type.



SAME PROCESS: This creation process is the same for casing and targets, and all of the controls described below are also identical.

PROXY CONTROL: Once the lithology frame has been created, it will appear on the plot. Below the plot will also appear a proxy control. This proxy control emulates the selected frame (select any frame by clicking on its sub-panel on the left) and allows the user to resize columns by clicking and dragging borders. So when a column width is resized in the proxy control, its respective frame is resized.

LITHOLOGY		
Description	Top	Bottom
L1	0.00	2000.00
L2	2000.00	4000.00
L3	4000.00	7000.00
L4	7000.00	7500.00
L5	8000.00	8010.00

Description	Top	Bottom
L1	0	2000
L2	2000	4000
L3	4000	7000
L4	7000	7500
L5	8000	8010

Certain frames like lithology, casing and targets have a proxy control that appears below the plot, where by adjusting the proxy chart column widths, the frame’s column widths are adjusted.

All the characteristics besides column width are controlled in the frame's sub-panel. Click on the radio button to pull up each respective dialogue.

NOTE: To trigger changes made to the frame here, sometimes another change must be made. The easiest way to do this without making unwanted changes is to check the "Show Frames" box twice.

ANCHOR CONTROL: The 9-circle grid on the top right of the panel is an anchor control which delineates which quadrant of the plot the frame will be placed. Sometimes the frame will not be placed in the absolute corner of a plot when told to do so because of the spacing priority logic of previously placed frames or objects. But this anchoring control is only for rough placement anyway. All final placements on a plot are done in InkScape™. (To get to InkScape™, just click "Edit w/ InkScape™" at the top of the main control panel).



TARGETS					
NAME	Easting	Northing	TVD	EW	NS
FBH - 7947.64	99614.04	737335.40	7947.64	2980.74	-1840.00
Way Point - 305° 88	994006.40	740145.63	8054.55	617.60	968.28
FBH - 9671.06	912297.19	739039.11	9671.06	1798.05	-5540.74
DBH - 10000.01	994300.66	746294.95	10000.00	745.05	1104.60

CASING						
Size	Weight	ID	OD	Weight Rgm	Top Depth	Set Depth
20	94.00	18.12	21.00	0.00	0.00	300.00
13.50	88.00	12.30	14.38	0.00	300.00	2000.00
9.50	53.50	8.54	10.63	0.00	2000.00	3000.00
7.50	33.70	6.77	8.58	0.00	3000.00	4000.00

LITHOLOGY		
Description	Top	Bottom
L1	0.00	2000.00
L2	2000.00	4000.00
L3	4000.00	7000.00
L4	7000.00	7500.00
L5	8000.00	8010.00

Frames are placed via the 9-circle grid of their respective subpanels. However, they will be stacked on top of other frames if the spot is already taken. This is because the anchor is only for approximate placement. All final placements of frames and objects are done in InkScape where they can also be warped, resized, drawn and commented on.

4. Targets List

Further editing of a grid-style section can be done under the “Edit Frame” tab, selected from the top of the main control panel in the Plot Designer. Changing a frame without making it a default will have the changes only apply to the current plot. Once Make Default is selected then the changes will be reflected in all newly generated plots. One of the most common grid style sections in plots is the Target List. To fine-tune edit such a list once it has been created in the plot, just click the “Edit Frame” tab, then select “Targets” from the “Frame Object drop-down menu. Then be sure to select “Grid” from the “Section Style” drop-down list.

OTHER GRID-STYLE FRAMES: Lithology and Casing lists are also grid-style lists, so they can be fine-tune edited under this tab by selecting them under Frame Objects drop-down menu and selecting “Grid” for the section style.



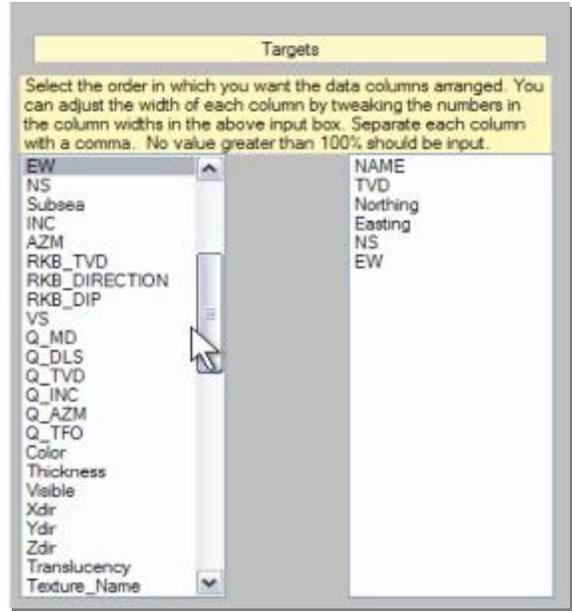
The font, number of columns and overall width of the frame is controlled in this panel. Check the “Show Grid Lines” box to display the lines along each of the columns.

COLUMN WIDTHS: The column width field allows the user to define widths by percentage from the left. The number of percentage values given depends on the number of columns in the frame. Each value defines where a column division is placed, with the first and last values (0 and 100) representing the outer edges of the frame. The following target list has 6 columns with a column width percentage of 0, 16.67, 33.33, 50, 66.67, 83.33, 100:

TARGETS					
NAME	TVD	Northing	Easting	NS	EW
INTERSECTION POINT	5601.96	622187.73	2868031.68	1699.47	646.74
K BISC Target	8000.00	623943.26	2868784.94	3455.00	1400.00
Target2	9000.00	625019.80	2869498.03	4531.54	2113.09

The column width percentages will automatically generate to equal spacing when a new number of columns is selected for the frame.

ADDING DATA COLUMNS: Further below in text flow editing panel are the data type selection columns. There you can choose which kinds of data will appear in the text flow section. On the left are all the available data types that can be added. To add one, left-click on it, and it will appear at the bottom of the right-hand column. The right-hand column, likewise, displays in order from top down which data types are displayed from left to right on the plot (restarting from top left on subsequent rows and columns). To remove a data type, left-click and then right-click on the word. To re-order the data, you must remove each of them and re-stack them in the desired order.

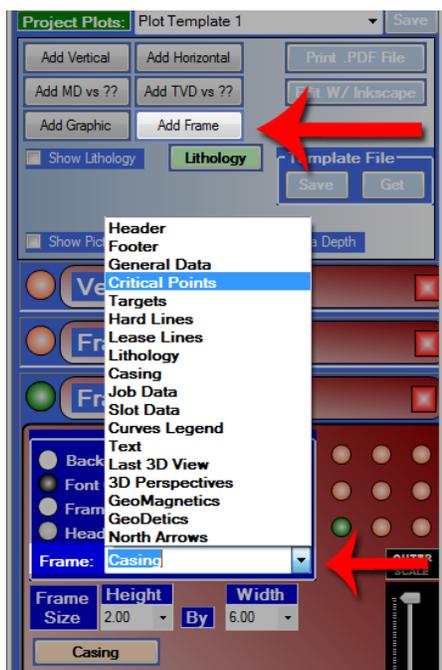


APPLY/MAKE DEFAULT: Be sure to click the “Apply” button after making each change to the frame so that it will appear in the plot. Once all the parameters of a given frame type have been set up to personal spec, then click the “Make Default” button to save them as such.

5. Critical Points List

Critical points frames are the kind found under the generic “Add Frame” button in the main control panel.

To add a critical points list to the plot, click the “Add Frame” button, which will create a new sub-panel below labeled “Frame.” From its “Frame” drop-down menu, select “Critical Points.” This creates the frame in the plot.



RESIZING: Resizing the critical points list is done in two ways: either selecting a width in the sub-panel width drop-down menu (height is determined by the content of the list itself), or by sliding the “Outer Scale” slide control on the right. In addition, a frame’s column widths may be altered with the proxy grid just below the plot window.

RESOLVING TEXT OVERLAP: The critical points list, like many of the other informational list-based frames in the Plot Designer, may display overlapping text and numbers when initially placed. This is resolved in three ways:

- Resize and/or change the font by clicking the “Font” button.
- Enlarge the frame by increasing width in the sub-panel.
- Resize the frame and/or its components in InkScape™:

InkScape™ allows each of the elements in a frame to be resized and manipulated, so resolving individual instances of text overlap is as easy as clicking on the trouble line and resizing it.

CRITICAL POINTS - PROP3					
Comment	MD	Inc	Azm	T	
Surface location @ 503358.60 Ft Easting, 739180.00 Ft Northing	0.00	0.00	0.00	0.00	
Begin Build @ 5000.00MD, 2.50°/ 100 Ft	5000.00	0.00	1.54	500	
Begin Build @ 0.00°/ 100 Ft	5980.00	24.50	34.00	595	
Begin Hold @ 25.00°, 34.00° Azm	6000.00	25.00	34.00	596	
Begin Drop @ -2.00°/ 100 Ft	8009.50	25.00	34.00	778	
Begin Hold @ 0.00°, 188.13° Azm	9259.51	0.00	188.13	900	
PBHL @ 10000.51 Ft TVD	10259.50	0.00	188.13	1000	

NOTE: InkScape™ will not alter the actual information itself. Such changes must be made in the project itself in HawkEye’s main interface or in the Plot Designer editing field below the preview window.

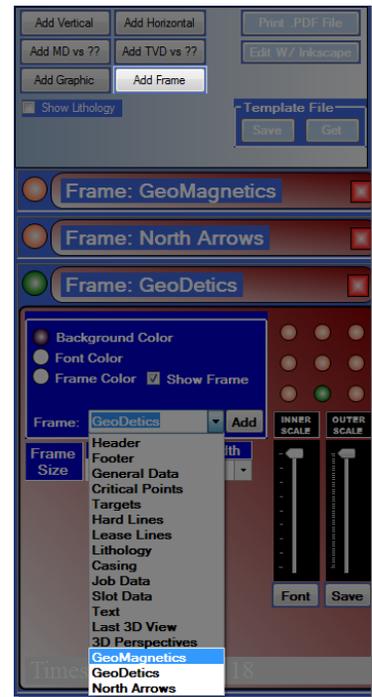
CRITICAL POINTS - PROP3					
Comment	MD	Inc	Azm	T	
Surface location @ 503358.60 Ft Easting, 739180.00 Ft Northing	0.00	0.00	0.00	0.00	
Begin Build @ 5000.00MD, 2.50°/ 100 Ft	5000.00	0.00	1.54	500	
Begin Build @ 0.00°/ 100 Ft	5980.00	24.50	34.00	595	
Begin Hold @ 25.00°, 34.00° Azm	6000.00	25.00	34.00	596	
Begin Drop @ -2.00°/ 100 Ft	8009.50	25.00	34.00	778	
Begin Hold @ 0.00°, 188.13° Azm	9259.51	0.00	188.13	900	
PBHL @ 10000.51 Ft TVD	10259.50	0.00	188.13	1000	

6. Geodetics, Magnetics and a North Arrow

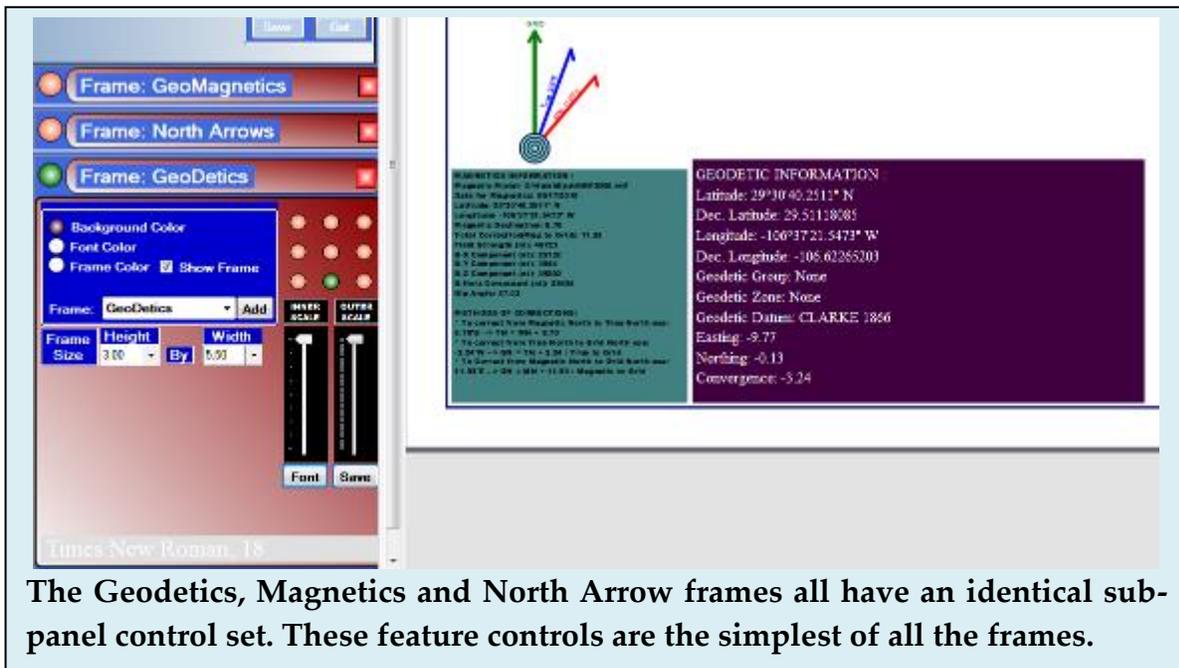
The Geodetics, Magnetics and North Arrow frames all have identical sub-panel controls, and they are among the simplest of all the frames that can be added to a plot.

ADD THE FRAME: To add any of these frames, click the “Add Frame” button in the main control panel of the Plot Designer, then select any of the bottom three selections from the “Frame” drop-down menu in the sub-panel.

FRAME FEATURES: The user may control background, font and frame color, as well as height and width of the frame. If a font size or type becomes larger than the background of the frame itself, there may be clipping. This is resolved by increasing the dimensions of the frame size. The Inner Scale slider is inert, but the Outer Scale slide controls the overall size of the frame. Click “SAVE” to save the current settings to the default for that particular kind of frame.



RESIZING AND PLACING: Although resizing is mostly done in the Plot Designer, fine-tune resizing and placement is done in InkScape™. (“Edit w/InkScape™” button).



The Geodetics, Magnetics and North Arrow frames all have an identical sub-panel control set. These feature controls are the simplest of all the frames.

g. Add Frames: Screenshots

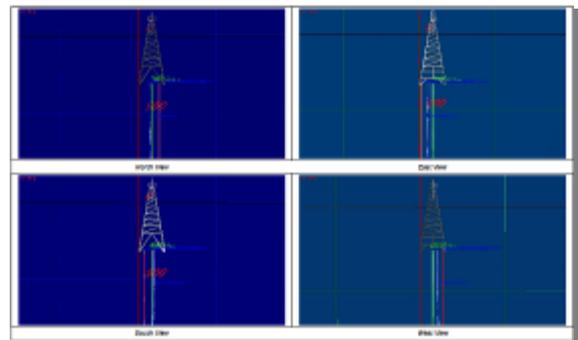
There are two special frames that can be added to the plot which take images from the 3D space. The Multishot will take four screenshots of a single point, and the Last 3D View will take the very last 3D view that you see before the Plot Designer is opened.

1. 3D Perspectives (Multishot)

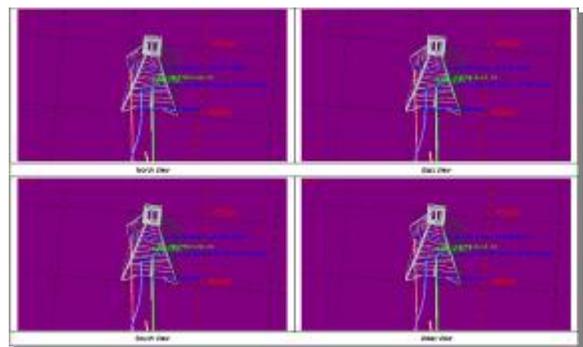
HawkEye™ can take four snapshots of the same 3D space from the four cardinal directions and place them in a plot. To do this, the user must align the 3D window view to the desired portion of the curve to be captured. Once the Look-at Point is positioned to the desired place, select the snapshot mode in the “Mode” drop-down menu just under the 3D window. The choices are Vertical M.S., Custom M.S. or Snapshot.



VERTICAL M.S.: This mode takes four screenshots of the current Look-at Point from a flat angle, looking straight across. It is essentially a 3D vertical section view of the Look-at Point from 0, 90, 180 and 270 degrees azimuth.

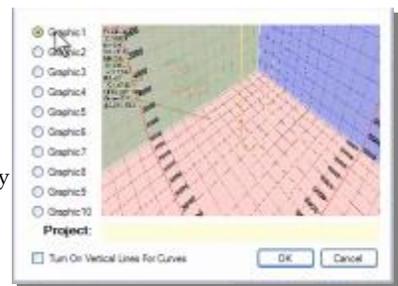


CUSTOM M.S.: This mode will take four screenshots of the current Look-at Point, but from any inclination up or down that the POV is currently positioned at. The shots are still taken with the north, south, east and west direction.



SNAPSHOT: This mode allows the user to take a single screenshot of the currently displayed view in the 3D window to later load as a graphic in the Plot Designer. When taken, it requires the user to enter a file name for the snapshot.

TAKE THE SHOTS: Once the multishot mode is selected, click the Snapshot icon to the right of the drop-down menu.



 This will take the four shots in the case of the Vertical and Custom M.S. and the single shot if the Snapshot mode is selected.

SELECT THE SET: For Vertical M.S. and Custom M.S. modes, up to ten different sets of shots can be saved. After taking the shot, the Graphics Set prompt will appear. Choose the slot/wellhead to save the current set to, from 1 to 10. This set of screenshots is later chosen in the 3D Perspectives sub-panel before loading into the plot.

Vertical Lines (droplines) can also be added here to each of the curves with the checkbox at the bottom. They would be generated here and saved permanently in the screenshots.

3D PERSPECTIVES FRAME: Launch the Plot Designer  from the top left of the main screen.

The Multishot frame is treated as a generic frame, so to add it, just click “Add Frame” in the main control panel. Then select “3D Perspectives” from the “Frame” drop-down menu. This will immediately generate the multishot frame in the plot window on the right.

The frame is called “3D Perspectives” because the sub-panel allows for the multishots as well as a snapshot to be loaded into the plot.



Once the frame is created, the multishot sub-panel will allow for certain setting adjustments. The colors can be adjusted by clicking the circle to the left of the color labels.

PLACEMENT: The 9-circle grid on the top right will control the general placement of the graph. However, for fine-tune placement (as well as resizing), InkScape™ is used. This grid is only for rough draft placing.

RESIZING: The Width drop-down menu is the primary way to resize the multishot frame, whereas height does not control the size nearly as much. The Outer Scale slider control will shrink the frame while keeping aspect ratio. To further resize this

screenshot frame, launch InkScape™ by clicking the “Edit w/ InkScape™” button in the main control panel above.

LAYOUT: Select “Horizontal” to line the four screen shots in a row on the plot. “Vertical” will stack them in a column. “Rectangle” is the default and will arrange them in a 2x2 orientation.

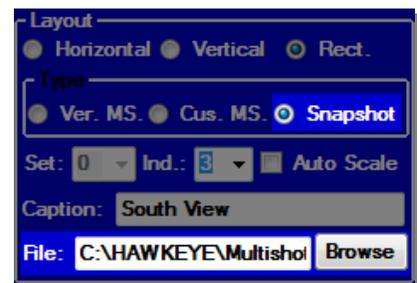
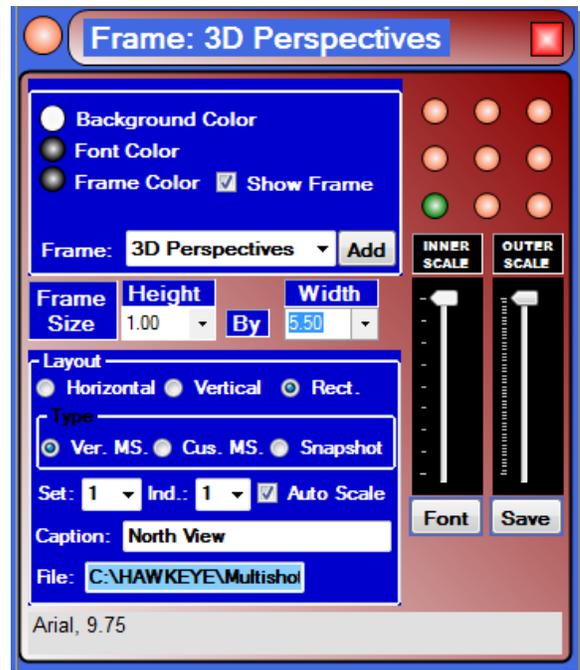
TYPE: Select either Ver. MS, Cus. MS or Snapshot in order to instantly change the set of screenshots displayed in the frame. HawkEye™ will pull the set from the type as they were captured in the 3D space. There will be no changes to the frame if a screenshot set for that type has not been taken yet.

SET: This drop-down menu allows the user to select the graphic index 1 through 10, loading the respective index into the frame itself. These indexes are available for Vertical M.S. and Custom M.S. and the prompt to choose the index always appears after taking the shot in the 3D space.

IND AND CAPTION: This drop-down menu selects the “index” from 1 to 4, selecting the caption field to be edited. The captions under each screenshot can be edited by selecting a number from this menu and then editing the text in the “Caption” field. (The default is: 1 -“North View,” 2- “East View,” 3- “South View,” and 4- “West View.”) Click on the “FONT” button to edit the font characteristics of the captions.

AUTO SCALE: Checking this box will attempt to resize the SNAPSHOT, if there is one loaded in the plot, into a size comparable to surrounding loaded screenshots.

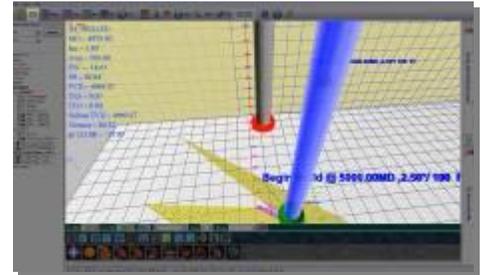
FILE: This field becomes active when the “Snapshot” Type is selected. Click the “Browse” button to load either the snapshot taken from the 3D space or ANY graphic file to load. NOTE: To load custom graphic files, the “Add Graphic” button in the Plot Designer main control panel will launch a dedicated picture frame sub-panel.



SAVE: Click the “Save” button to lock in the current settings as default for every time a new 3D Perspectives (“multishot views”) frame is created in the Plot Designer.

2. Last 3D View

Any time the Presentation Plot Designer is launched from the main screen, it grabs the last 3D view that is being displayed in the 3D window. To customize the screenshot itself before launching the Plot Designer, the user simply resizes the window and calibrates the 3D view itself to reflect whatever view is desired. Once set up, just click the Presentation Plot icon at the top.



The next step, once inside the Plot Designer, is to click “Add Frame” and select “Last 3D View” from the “Frame” drop-down menu of the new sub-panel. This will automatically drop the 3D screenshot into the plot.

TEMPLATE: In order to always have the Last 3D View dropped into a plot, just add this frame to a plot and save as a template. The Plot Designer will treat that space as any other template-designed frame and fill it in with the actual last 3D view displayed.

RESIZING: Height and width can be changed with the drop-down menus. The “Outer Scale” slide control will resize the graphic as a whole. Further fine-tune resizing can be done in InkScape™. (Launch InkScape™ by clicking the “Edit w/ InkScape™” button in the main control panel on the top left quadrant of the Plot Designer).



PLACEMENT: The 9-circle grid on the top right will control the general placement of the graph. However, for fine-tune placement (as well as resizing), InkScape™ is used. The grid is only for rough draft placing.

2. Finishing With Inkscape™



The Inkscape™ program is installed with HawkEye™ as a companion program which acts as an empowered module for extremely professional plot layouts. The program installs with HawkEye™, and **it is advised that this version of Inkscape is used rather than the latest versions which can be downloaded at the Inkscape website.**

WHAT IS INKSCAPE?

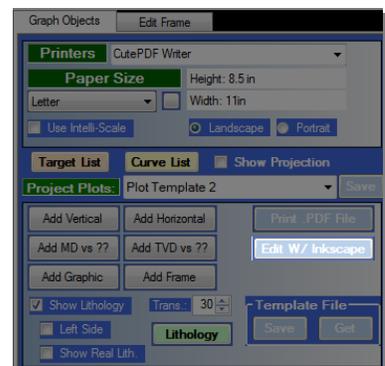
Inkscape is an open source vector graphics editor, with capabilities similar to Illustrator, CorelDraw, or Xara X, using the W3C standard Scalable Vector Graphics (SVG) file format.

Inkscape supports many advanced SVG features (markers, clones, alpha blending, etc.) and great care is taken in designing a streamlined interface. It is very easy to edit nodes, perform complex path operations, trace bitmaps and much more. Its creators also aim to maintain a thriving user and developer community by using open, community-oriented development. As such, it has become an extremely polished SVG editor that is the product of tens of thousands of dedicated manhours over the course of ten years.

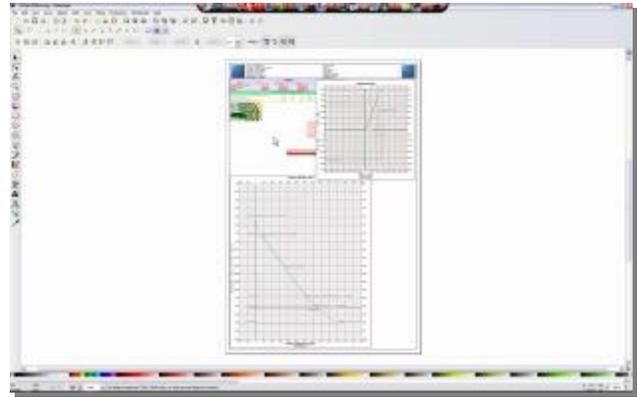
a. Primary Functions

Inkscape™ is used in HawkEye™ primarily to RESIZE plot frames and the alphanumeric elements within, as well as PLACE those frames in exact positions for a fine-tuned plot layout.

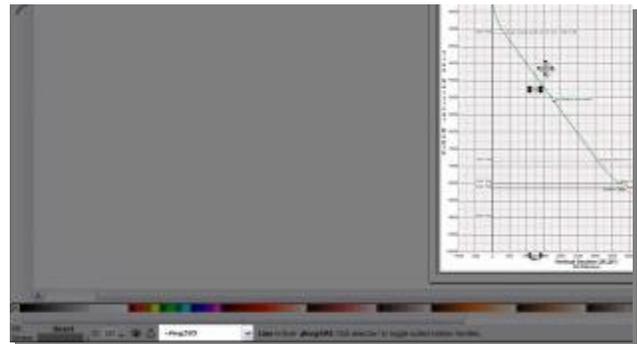
OPENING INKSCAPE™: You can open Inkscape™ at any time from the Plot Designer by clicking on the “Edit w/ Inkscape™” button. This will launch Inkscape™, but make sure to have all frames of the plot already placed. Such elements can only be added in the Plot Designer. Inkscape™ allows for the adding of additional graphics and comments, as well as editing text and numbers, but is not integrated with the database information of a project in HawkEye™.



When InkScape™ opens, all of the elements that have been placed in the Plot Designer will appear in the same paper size but in SVG layers. Although it may appear a jumble, now each of the elements can be moved about freely and precisely. If the plot in InkScape™ appears small, hit “5” to automatically fit the plot to screen width and height.



LAYERS: The SVG elements (plot frames and graphics) in InkScape™ are treated as sets of layers, which can be selected individually, in groups or even linked together. Select a layer by double-clicking on it in the graphic window. By double-clicking again and again on an element, different layers within that element are selected. Double-click on any blank space in the graphics window to get back to the root layer. The layer indicator appears at the bottom left of the screen.

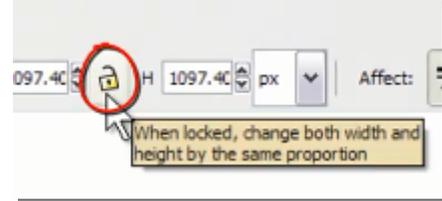


ZOOM: Select the magnifying glass icon on the left side of the screen to go into zoom mode and simply draw a box over any portion of the graphics window to zoom into that area. To get back to the whole page view, hit “5” on the keyboard. Advanced zoom preferences can be explored in the Preferences panel (File>Preferences or Shift+Ctrl+P) which allow for things like zooming with the scroll wheel.

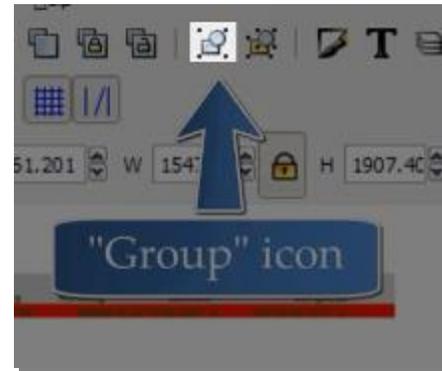
MOVING OBJECTS: To move an object, it must be selected. Since InkScape™ works in SVG, there are often multiple layers to each object. A singular element may be selected when trying to move an entire object, resulting in fragmentation. When this occurs, simply hit Ctrl+Z to undo the move, then double-click on the object until it is selected in its entirety. After a little practice, this becomes second nature. And sometimes particular layers of a list or grid will need individual nudging, so it’s a valuable tool. One hint is to keep an eye on the layer name at the bottom and get accustomed to how the layers are labeled.



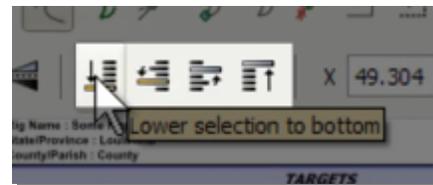
RESIZING: When an object is selected, arrows will appear at its corners and sides. These are “handles” which can be clicked on and dragged to resize the object. One major issue with resizing an object is the aspect ratio. (Ctrl+Z to undo unwanted resizings). InkScape™ has two methods of retaining aspect ratio when resizing an object. 1) Hold down SHIFT while dragging a corner handle of an object, or 2) Click the “Lock” icon at the top while the object is selected. This will permanently lock the aspect ratio for that selected object. Be sure that the entire object is selected and not just one layer in it.



GROUPING: Two or more objects can be “grouped” or locked in an orientation and moved as one object. This is useful for when getting graphs placed on top of each other and not wanting to re-place the graphs when moving them around the plot. To group objects, they must all be first selected at once. To select multiple objects, select one then HOLD SHIFT while selecting another. Or draw a box over all the objects to be selected with the black arrow selector tool and they will be simultaneously selected. Then as a final step, click the “Group” icon at the top of the page to marry all the objects together. Any group will be moved and resized as if it were one object.



SENDING LAYERS TOP AND BOTTOM: Since all objects are layers, they are stacked from front to back, or “top” to “bottom.” Layers that are closer to the top are displayed when overlapping any layers that have a lower status or designation. In laying out a complex plot, there will be objects that overlap each other and usually the smaller elements will need to be on top so that they are not covered by the larger ones. To control the layer status of an object, just select it, then go to the four icons at the top of the screen. They will either 1) Lower selection to bottom, 2) Lower selection down one level, 3) Lower selection up one level, or 4) Lower selection to top.



ADDING TEXT AND NUMBERS: InkScape™ allows for the adding of comments, as well as the editing of text fields within lists that have been added from HawkEye’s



Plot Designer. The first step is to set up the font and size settings. Do this by clicking on the Text and Font panel box at the top of the page or hit Shft+Ctrl+T. Click “Set as default” in the panel to make those settings permanent.

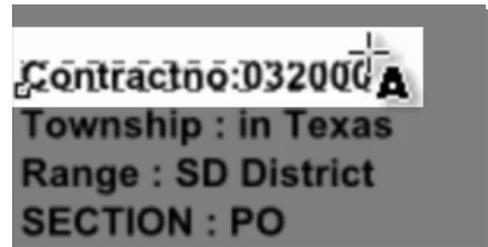
Then select the Text Tool on the bottom of the left side (or hit F8). As with all specialized tools in InkScape™, the cursor will change to indicate which mode the user is in. Here the cursor is a crosshair with the letter “A.” Use the Text cursor to draw a box on the graphics window. This will create a text box in which text can be entered.



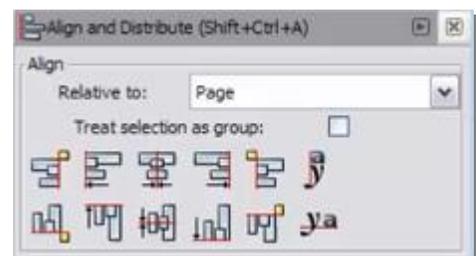
PASTING TEXT: Once this text box is drawn, simple text can also be pasted into the box from other programs. But note, InkScape™ will only display simple text and none of the more complex formats. Any changes to font, size and color must be done after pasting into the textbox.

Color of the text can easily be changed by 1) selecting the text box itself, then 2) clicking on a color along the color palette bar that stretches along the bottom of the screen.

Editing the text field within a list is as simple as clicking on that field and typing in or deleting whatever data is there. But remember that InkScape™ is not integrated with the project database information itself, so whatever data changes are made in InkScape™ are neither saved to the project nor verified by HawkEye™ in any way.



ALIGN TOOLS: To make sure that any or all objects are aligned correctly, select any or all objects and click one of the alignment options found on the right-hand side of the screen. If the options are not displayed, then hit Shift+Ctrl+A for them to appear.



PRINTING: The recommended way to print the final plot is to first SAVE AS A PDF (File>Save As, then select “Portable Document File” as filetype). After saving the file as such, open it with Adobe Reader, which is free and should be installed on any computer, and select print options from there.

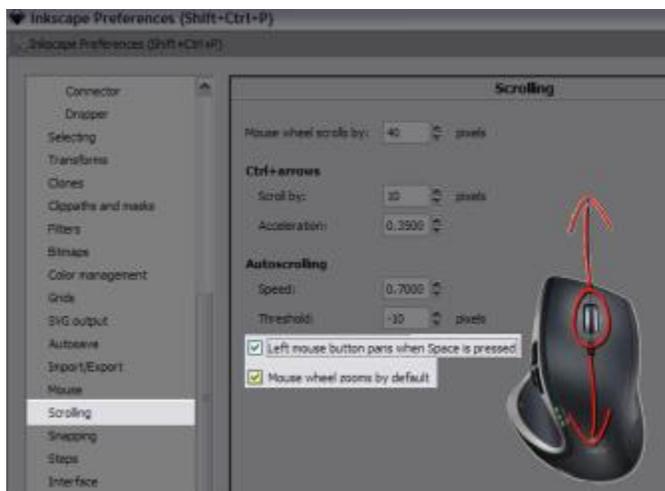
b. Tips and Tricks

1. Setup Tips

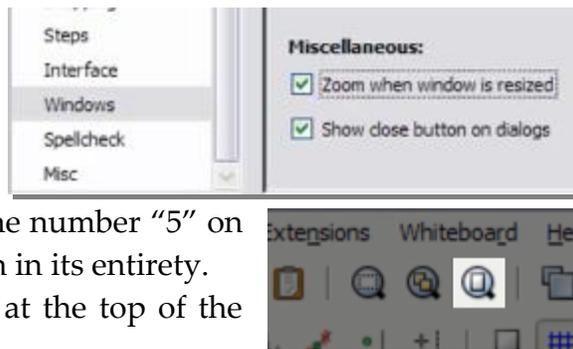
As with HawkEye™, spending a little time to explore InkScape™ will pay back in spades. In the case of InkScape™, the better one is with its interface, the more advanced and professional-looking a plot will have the potential to be. There are many great tutorials online for InkScape™. A basic starter is found at <http://InkScape™.org/doc/basic/tutorial-basic.html>. There are certain preferences and tricks in InkScape™ which grease the wheels navigation and of enhancing plot-design. Here are a few setup tricks:

SCROLL ZOOM: Zooming in and out with a scroll wheel is convenient and can save a lot of time with large plots. Since HawkEye™ users should be using a hyperscroll mousewheel, the zooming can become a convenient second-nature activity. But the option needs to be turned on.

All preferences are found under File>Preferences (Shift+Ctrl+P), and each of them is divided into categories on the left column in the preferences panel. To turn on the Scrollwheel Zoom feature, click on “Scrolling” in the Preferences window. Then check “Mouse wheel zooms by default.” Another useful option to turn on here is LEFT MOUSE BUTTON PANNING. Just check the box labeled “Left mouse button pans when Space is pressed.” This option will do just that.



FIT TO PAGE: Set InkScape™ to always fit to page when opening by going to File>Preferences (or Shift+Ctrl+P), then in the Preferences scroll down the left column to “Windows” and check the “Zoom when window is resized” box. Also remember, hit the number “5” on the keyboard to autofit everything to the screen in its entirety. You may also click on the “Fit to Page” icon at the top of the screen.



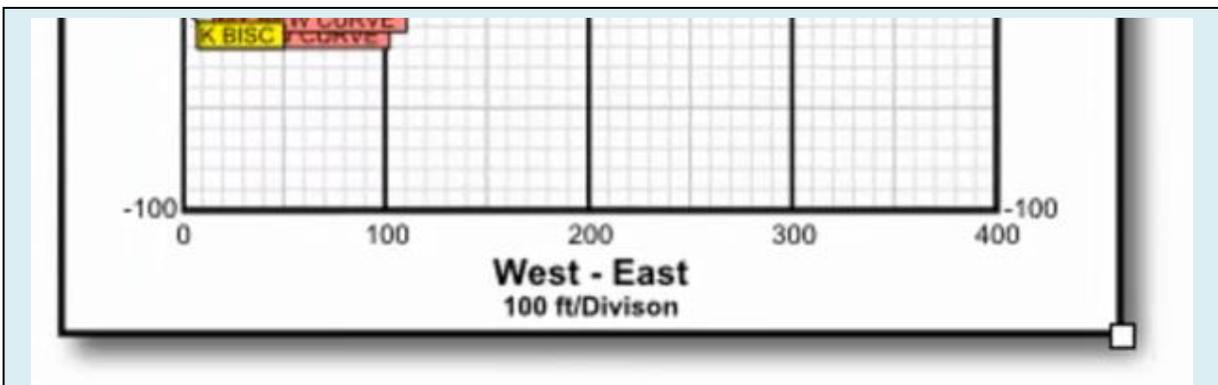
2. Drop Shadows

Adding graphical flourishes to plot objects is the whole point of Inkscape™ in HawkEye™. One essential such embellishment is the drop shadow, which gives a frame a sense of depth.

To add shadow to a frame, first select the frame by clicking on the Rectangle Selector, then with the plus-rectangle cursor, click on the frame.



Once the frame is selected, go to Filters>Shadows and Glows>Drop Shadows. This opens the Drop Shadow dialogue in which the shadow can be highly customized. But the default drop shadow is a fairly decent as it is. Click “Apply” and the drop shadow will appear “behind” the frame. It is actually part of the layer and will move/resize with it. To edit this effect, just select the frame and go back to the Drop Shadow dialogue.

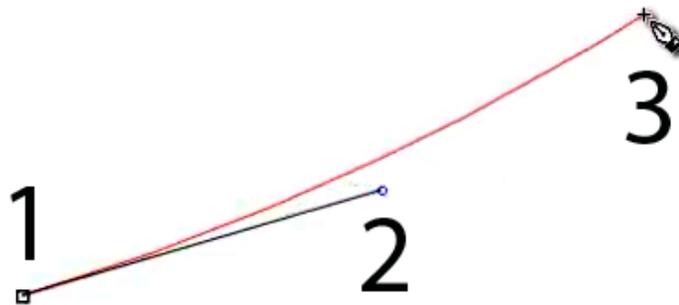


Drop shadows will add a sense of depth to any frame, enhancing the plot with a 3D feel. Many other effects are found under the “Filters” menu in Inkscape.

3. Arrow Pointers

Complex parametric curves (Bezier curves) can be dropped onto a plot in InkScape™ as arrows to simulate the organic look of handwritten marker notation. This effect is useful for callouts and has the advantage over actual marker notations because the arrow and comments are both cleanly defined and editable before printing.

To make such an arrow pointer, first select the Bezier Drawing Tool on the left side of the screen. Once selected, click on the screen once (1) with the tool to set the first point, then click a second time (2) to place the Bezier pivot point. Finally click a third time (3) after bending the hypothetical curve to create the end point. The straight line will disappear and only the curve will remain.



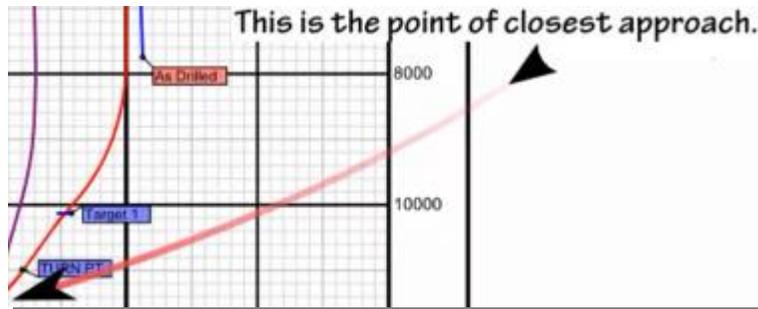
Once the curve is created, its style can be edited in the Fill, Stroke Paint and Stroke Style panels on the top right corner of the screen. This panel is available for many objects in InkScape™ and provides a wide array of customization options. Select the color under the Stroke paint tab.



To make the curve an arrow pointer, it is simply a matter of selecting a “Start Marker” and “End Marker” under the Stroke style tab. The choices are many under these drop-down menus and just by changing the endings a curve can transform into many different objects.

EDIT THE CURVE: Click on the “Edit Path Nodes” icon just below the black arrow icon on the top left of the screen, or hit F2 to go into “Edit Path Nodes” mode in order to reactivate the draw nodes of the curve. Now by dragging the nodes around, the arrow is re-drawn on the fly, but will retain its start and end markers. This is necessary for precision placement on a plot.

ADD TEXT: To add a text box, click on the “Text” icon on the bottom left, or hit F8 to go into Text Mode. Then draw a box onto the graphics window and type in any desired comments. This box can be placed at the end of the pointer to create a callout.



SAVE THE ARROW POINTER: Select the entire arrow, then go File>Save As and save the arrow as a .SVG file. This will save the arrow as an importable object that can later be added to other plots.

To **IMPORT** the arrow, just go File>Import... (Ctrl+I), then select the file from wherever it was saved. Editing the direction of the arrow in new plots simply requires hitting the F2 button to activate the Edit Nodes mode and then dragging those nodes around until it is shaped just right.

10.

VII. THE WELL PLANNING MODE

TWO MODES: There are two overall modes in HawkEye. The Field Mode is default and available in both versions. It is used for directional drillers who are not creating much in the way of complex proposals or well plans. Whereas the Well Planning Mode, available only in the Well Planning Version, is used to create complex well plans.

To get into the Well Planning Mode, you need the Well Planning Version of HawkEye.

VERSION OF HAWKEYE	MODES AVAILABLE	
	Field	Well Planning
Field Version		
Well Planning Version		

TWO DIFFERENCES BETWEEN THE TWO VERSIONS

1. **PRINTING PLOTS:** The difference between the Field Version and Well Planning Version of HawkEye™ with plotting is that only in the Well Planning Version will the larger wall plot sizes be available for printing and exporting. Only the smaller paper sizes are available in the Field version since it is assumed that users of the Field Version will not need a plot printout larger than A3.

Exclusive Well Planning Version print sizes include: A4, A2, 11x17, ISO A0-2, ISO B1, B1-B4(JIS), ARCH A-E1, Folio [8.5x13in], 22x36in, 24x48in, 24x60in, 24x72in, 24x84in, 24x96in, 24x108in, 36x42in, 36x60in, 36x72in, 36x84in, 36x96in, 36x108in and PostScript Custom.

2. **EDITING PROJECTIONS:** The principle difference to keep in mind between the Field Version and Well Planning Version of HawkEye™ is that, although they both have the same arsenal of projections which can be appended end to end, **only in the Well Planning Version can a projection be edited at any segment and have the whole plan recalculate.**

In other words, in the Field Version, only the last appended projection can be edited, so that in order to edit a part further up the curve, the user must delete all appended parts of the curve made subsequent to that higher up part before editing it. In Well Planning, the proposal is “poseable,” a model with hundreds of points of articulation.

7. Well Planning Control Panel

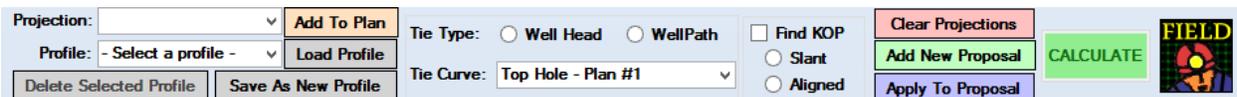


OPENING THE WELL PLANNING MODE: The Well Planning Mode is activated by clicking on the compass-and-protractor icon on the far right end of the “Home” tab. (This Icon does not appear in the Field Version of HawkEye™.)



The Control Panel that appears just below the projection icons contains a number of powerful tools, most of them centered around profiles that contain sets of projections. When this subpanel is activated this is what is referred to as being in the “Well Planning Mode” as opposed to being in the Field Mode. In the “Well Planning Mode,” the curve you are working with is a temporary curve that is not committed to the current Proposal Curve until “Apply To Proposal.”

In order to commit this curve as the proposal curve it is necessary to click the “Apply to Proposal” button. The ‘temporary’ curve that constitutes the projection segments is saved to the database so that should you desire to make changes at a later time you can return to the Well Planning Mode and alter what you want. Once you click the “Clear” button, however, this segmented curve is erased permanently.



ADD A PROJECTION: The “Add to Plan” button is tied to the “Projection” drop-down menu, allows for individual projections to be appended to the end of the current plan. Select from MD, TVD, Nudge (stilled called Quija here), Slant, Aligned or Horizontal, and the respective panel for that projection will appear below in the list of active projections.

DEFAULT PROFILES: The special controls of the Well Planning version allow the user to load well profiles, as well as save new ones. The default profiles under the “Profile” dropdown menu are the most common type of profiles and are designed so that all the user need do is load the profile and fill in the white background grid cells, perhaps select a target if it isn’t already selected, and have a solution.

The “Profile Name” drop-down menu contains several default profiles to choose from, and will also contain any saved user-created profiles. The default profiles are:

- **Simple 2D S-well** (w/special profiler tool)
- **Simple 2D Slant** (w/special profiler tool)
- **Find KOP S-well**
- **Find KOP Slant**
- **Default Slant**
- **Default Aligned**
- **Default Horizontal**

Once a profile is selected from the drop-down menu, click “Load Profile” to the right of the menu.

If a “targeted” projection (Slant, Aligned, BOT and Horizontal) is selected, then HawkEye™ needs a First Target. Designate a target as First Target by right-clicking on one in the Data Tree and select “Set as the First Target,” or by selecting it from the dropdown list in the “Home” tab. Then click “Load Profile” again.

WELL PLANNING LIST PANEL: Normally in the Field Mode the window at the bottom of the main screen lists curve data (surveys, critical points, comments, etc.). But in the Well Planning Mode, the Well Planning list tab appears, allowing the **display of each projection of a curve in a list**. For each projection type, there are a number of columns of information in which the WHITE cells can be edited independently of other parameters.

No	Projection	Target
1	Tie in	N/A
2	MD	N/A
3	Slant	N/A
4	Slant	Target3

The parameters for each projection in the well planning list are:

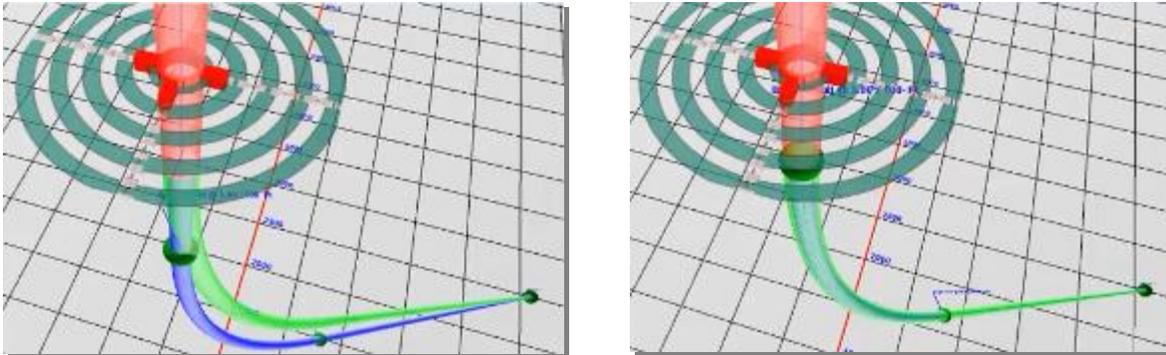
- | | | |
|---------------------|-----------|------------------------|
| • Projection (type) | • Azm Deg | • Northing |
| • Target | • EVD | • TVD |
| • MD | • NS | • DLS |
| • CL | • EW | • TFA ⁺ Deg |
| • Inc Deg | • Easting | • Comment |

⁺TFA stands for Tool Face Angle and is the same as TFO

MAKE CHANGES: When a profile is loaded, it will have with it default values for KOP and DLS as well as other parameters. Any of these projections can be changed or nudged by finding the parameter in the Well Plan List Panel at the bottom of the screen, clicking on the field in question, and changing the number right there in the field.

NOTE: Only cells in white can be changed. Changes to the projection are usually instantaneous, but are not automatically applied to the proposal. (For aligned projections, you must click “CALCULATE” after each change). After changes are made here, but before they are applied, they are still in the status of a projection.

APPLY TO PROPOSAL: When it is decided that any changes made to a proposal are acceptable, click “Apply to Proposal” to integrate changes to the current proposal curve.



No.	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	TVD (Ft)	N6 (Ft)	EW (Ft)	Easting (Ft)	Northing (Ft)	VS (Ft)	DLS '1000 (Ft)	TFA Deg
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3455231.48	810940.54	0.00	0.00	90.00
2	MD	N/A	2000.00	2000.00	0.00	0.00	2000.00	0.00	0.00	3455231.48	810940.54	0.00	0.00	0.00
3	Aligned	N/A	3253.46	3253.46	37.54	46.70	3163.80	273.28	287.87	3455518.35	811213.82	395.55	3.00	0.00
4	Aligned	N/A	5578.13	2326.67	37.54	46.70	5088.59	1243.63	1319.70	3456251.18	812184.17	1813.35	0.00	180.00
5	Aligned	PBHL	9332.49	3754.38	0.00	0.00	8500.00	2057.46	2183.32	3457414.80	812998.00	3000.00	1.00	0.00

After a profile is loaded, click on any projection in the List Panel at the bottom and its respective control panel will appear. Parameters in white may be changed in the special panel or in the List Panel. Click “Apply to Proposal” to lock in changes.

In the example above, a change in KOP is made higher up the curve, resulting in the green projection deviating from the proposal in blue. By clicking “Apply to Proposal,”

the changes made will become the new proposal and override the old one. In this fashion the Well Planner controls allow for quick fine-tuning of proposals.

ADD NEW PROPOSAL: Clicking this button on the far right of the Well Planning Panel will launch the “Add New Curve” dialogue. It will create either a Proposal or Survey curve under the current slot/wellhead, and that curve can be assigned to any jobs from the database. The “Job” button here will launch the Jobs dialogue in which job information can be added and edited.

Any new Proposal Curve added from the Well Planning panel will automatically become the Current Proposal Curve, and projections, if applied, will be added to this particular curve.

SAVE AS NEW PROFILE: Click the “Save As New Profile” button to save the current projection set, as displayed in the 3D and List Panel at the bottom of the screen, as a profile that can later be conveniently invoked as a whole. Any new profiles are saved to the current database, and they become available in the “Profile Name” drop-down menu. (This process is described in further detail in the subsection “Build a Custom Template” below.)

TIE TYPE and CURVE: A Tie In can be added with this toolset, either from the Well Head or a Well Path. (This process is described in further detail in the subsection “Tie Ins” below.)

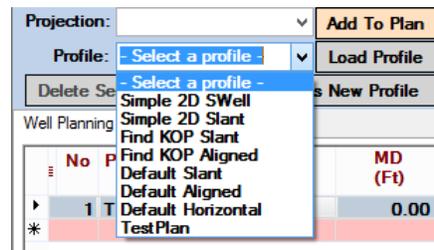
KOP: This turns on the search for KOP flag for either the Aligned well, or the Slant well. Be aware that this can be a time consuming process, particularly with an Aligned well since there is a great deal of iteration that the computer does in order to find a solution.



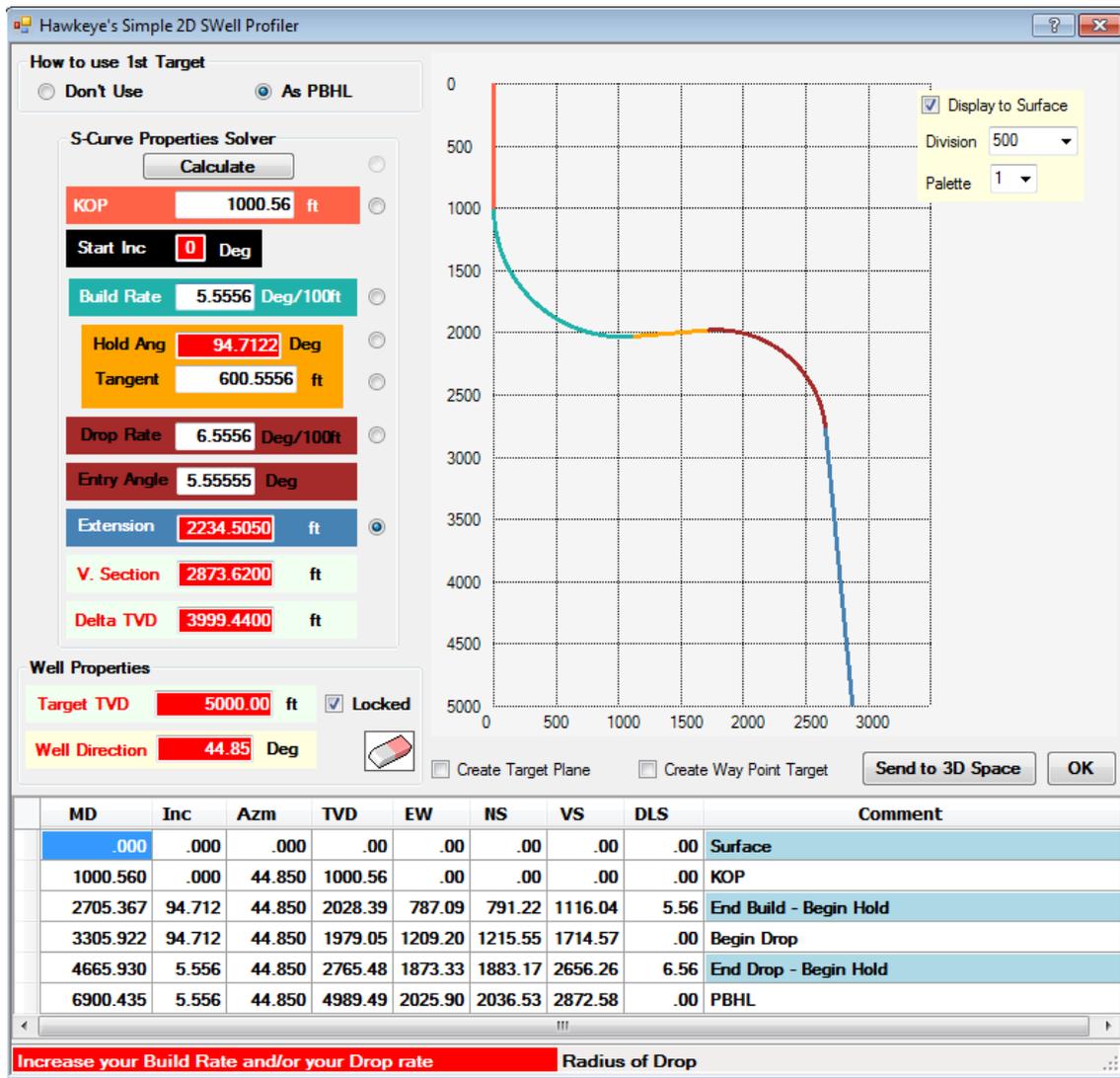
Field Mode View: This closes the Well Planning control panel and brings HawkEye™ back into the default Field Mode.

a. Simple 2D S-Well Profiler

Within the Well Planning Control Panel, selecting the “Simple 2D S-Well” from the “Profile Type” pulldown menu will invoke the dedicated profiler for this well type.



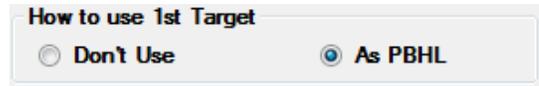
The “Simple 2D SWell Profiler”:



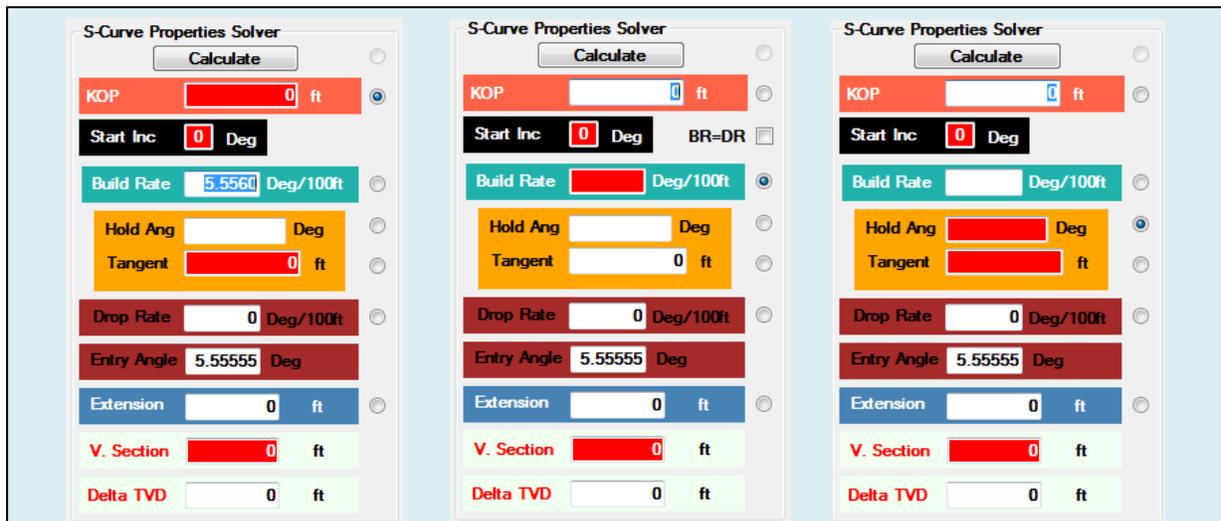
FIRST TARGET: Since S-wells are “targeted projections,” a first target must usually be set. If a first target has not been set yet, find the target to be set either in the Data Tree, 3D space, right-click on it and select “Set as First Target.”

Or set it from the Target Selector pulldown labeled “First Target” under the “Home” tab.

HOW TO USE 1ST TARGET: The top left option in the Profiler allows the user to either ignore First Target (for when creating an open plan) or treat it as the PBHL (Proposed Bottom Hole Location). When “Don’t Use” is selected, the profiler will create a target where the projection ends and call it “PBHL” by default.



S-CURVE PROPERTIES SOLVER: Throughout this colorful list of parameters, the important rule of thumb to keep in mind is that the fields in red cannot be changed, whereas the fields in white can be changed. These fields change depending on which solve mode is selected.



In the Solver, different fields are editable depending on which solve mode is selected (from the 6 radio buttons on right). Red fields are uneditable while white fields are editable. Click “Calculate” to register parameter changes.

The Solver has 10 different parameters which shape the S-Well. The properties are:

- **KOP-** The depth at which the first build in the S-Well begins.

- **Start Inc-** The starting inclination. It is always set to '0' and can't be changed for this type of plan.
- **Build Rate-** The degree of turn per 100 ft along the first turn.
- **Hold Angle-** Angle in degrees of the tangent / hold section.
- **Tangent-** Length of the tangent / hold section between the upper and lower curves. **If this is set to 0 and the radio button to the right is set, then the program will solve for a kick off point.**
- **Drop Rate-** Drop rate in degrees per 100ft or degrees per 30 meters. Note that this does not have to drop, it can also build if it is a horizontal well.
- **Entry Angle-** Degree at which the second turn ends. 0 degrees will make the curve going straight down at the end of the second turn.
- **Extension-** This is the distance of straight extension BEFORE the target and at the end of the drop of the second curve.
- **V. Section-** This is the closure distance or vertical section distance of the target point at the end of the proposal This can be a locked parameter with the "Locked" checkbox of the Well Properties just below the Solver. When this is locked it is in essence defining the target point, as opposed to an open solution in which the target pt would be defined by the solution.
- **Delta TVD-** Difference between the KOP and the Target TVD.

As changes and solutions are made, they are displayed in the vertical section view immediately to the right of the Solver, all color coded to the background color of the various solver parameters.

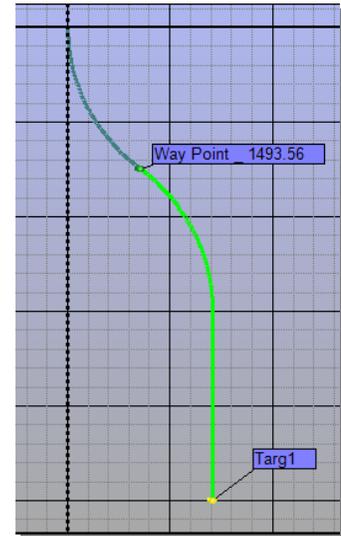
In addition, critical points data is displayed in spreadsheet format in the list panel at the bottom of the profiler. This allows the user to see details of the curve that are not always apparent in either the in-profiler VS View or Solver fields.

MD	Inc	Azm	TVD	EW	HS	VS	DLS	Comment
.000	.000	.000	.00	.00	.00	.00	.00	Surface
2000.000	.000	22.060	2000.00	.00	.00	.00	.00	KOP
3384.149	41.525	22.060	3266.12	180.28	444.86	430.00	3.00	End Build
5460.373	.000	22.060	5165.31	450.69	1112.15	1200.00	2.00	End Drop - Begin Hold
8295.068	.000	22.060	8000.00	450.69	1112.15	1200.00	.00	PBHL

WELL PROPERTIES: The "Target TVD" and "Well Direction" fields under this heading will only be activated if no target is used. To NOT use a target, just select "Don't Use" at the top left of the profiler where it says "How to Use 1st Target." The "Locked" checkbox will lock these parameters into place even other parameters are changed.

CREATE TARGET PLANE: Check this box in the Profiler to turn on a target plane in the 3D space. When the profile you make is sent to the 3D space, it will generate a target plane along the first straight tangent section. This target plane will remain even if the profile is cleared away.

CREATE WAY POINT TARGET: Check this box to automatically generate a target (default name: “Way Point”) at the beginning of the first turn in the S-Well. This target will remain even if the profile is cleared away. Example at right.



SEND TO 3D SPACE: This button acts as an “APPLY” button, porting all of the S-Well changes made in the Profiler into the 3D space. This option will be a prompt when clicking “OK” just in case the user forgets. When an S-Well is sent into the 3D space from the Well Planning Profiler, a Nudge projection is inserted for the first half of the first build.

This feature provides a sort of hinge, allowing the user to nudge the Quija (Nudge) portion of the s-well and redirecting the entire curve left or right while retaining all features below the first turn. To tweak the Quija (Nudge) component or any other part of the well, return to the Well Planner Mode, then click on the desired projection in the List Panel at the bottom of the screen.

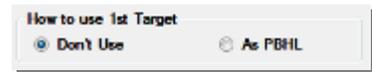
No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	RKB TVD (Ft)	NS (Ft)	EW (Ft)	Easting (Ft)	Northing (Ft)	VS (Ft)	DLS */100 (Ft)	TFA Deg
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.00
2	MD	N/A	4322.38	4322.38	0.00	0.00	4322.38	0.00	0.00	-26.47	-37.43	0.00	0.00	0.00
3	Quija	N/A	5092.37	769.99	42.78	44.84	5022.80	194.51	193.46	166.99	157.08	274.34	5.56	0.00
4	Slant	N/A	5862.31	769.94	85.55	44.85	5350.56	674.54	670.87	644.40	637.11	951.35	5.56	0.00
5	Slant	USB-446	7790.38	1928.07	85.55	44.85	5500.00	2037.43	2026.47	2000.00	2000.00	2873.62	0.00	0.00

When the Quija (Nudge) row is clicked, its special control panel appears for editing. If the Tool Face, for example, is changed in this Quija (Nudge) section, then the entire curve will be redirected yet maintain its build characteristics. You can edit any parameters directly in the List Panel which have a white background.

1. S-Well Defined Without Targets

The first three steps to creating an S-Well without targets is to:

1) Select “Don’t Use” at the top left of the Profiler, then



2) Check “Extension” to solve for extension.



3) Uncheck the “Lock” checkbox at the bottom in Well Properties in order to allow for the editing of the V. Section field. It may also be a good idea to click the Erase icon to clear all the fields.



From there, in the Solver, enter a KOP, Build Rate, Tangent, V.Section (Vertical Section) and Delta TVD. After the last two parameters are entered, the Profiler will solve for a Target TVD. The final step is to enter a desired Well Direction at the bottom.

Create the target points by checking “Create Target Plane” and “Create Way Point Target” at the bottom under the graph.

Then click “OK” and make sure to “Send to 3D Space” when prompted.



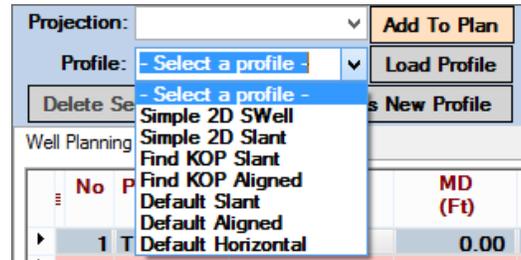
The curve will appear in the 3D space going through two targets and along a target plane. Just as with the targeted S-Well made from the Profiler, this S-Well contains a Nudge projection near the top that allows for powerful nudging options which preserve the S-Well’s characteristics. Any of the projection components of the well can be accessed and edited by clicking on the projection in the List Panel at the bottom of the screen.

Once the curve is nudged and adjusted, click “Apply to Proposal” in the Well Planning Control Panel and it will make this curve a proposal curve.

Click the “Field” Mode to get back to the main HawkEye™ module and the S-Well will be displayed as a proposal curve along with the targets generated and listed.

b. Simple 2D Slant Profiler

Within the Well Planning Control Panel, selecting the “Simple 2D Slant” from the “Profile Type” drop-down menu will invoke the dedicated Profiler for these well types. The parameter set for both slant wells and horizontal wells are identical since both consist of a single turn.



You will open up the “Simple 2D Slant / Horizontal Profiler:

The screenshot shows the 'Hawkeye's Simple 2D Slant / Horizontal Profiler' window. It features a 'How to use 1st Target' section with radio buttons for 'Don't Use', 'As Landing', and 'As PBHL' (selected). A 'Radius = 1031.32' is displayed. The 'Curve Properties Solver' section includes input fields for KOP (3822.378 ft), Build Rate (5.5556 Deg/100ft), Start Inc (0 Deg), End Inc (85.5556 Deg), Landing Disp (951.3974 ft), Delta TVD (1028.2146 ft), Delta MD (1539.9884 ft), Dip Angle (4.44445 Deg), and Above Dip (954.2661 ft). The 'Well Properties' section includes Landing TVD (4850.593 ft), Well Direction (44.845 Deg), and Extension (1928.022 ft). A graph on the right shows a blue curve representing the well path. At the bottom, there are checkboxes for 'Create Target Plane' and 'Create Way Point Target', and buttons for 'Send to 3D Space' and 'OK'. A data table is shown at the bottom of the window.

MD	Inc	Azm	TVD	EW	NS	VS	DLS	Comment
.00	.00	.00	.00	.00	.00	.00	.00	Surface
3822.38	.00	44.85	3822.38	.00	.00	951.40	.00	KOP
5362.37	85.56	44.85	4850.59	670.92	674.56	951.40	5.56	Begin Hold
7290.39	85.56	44.85	5000.00	2026.45	2037.45	2873.62	.00	PBHL

FIRST TARGET: Since Both Slant and Horizontal projections are “targeted projections,” a first target must usually be set. If a first target has not been set yet, find the target to be set either in the Data Tree, 3D space, right-click on it and select “Set as First Target.”

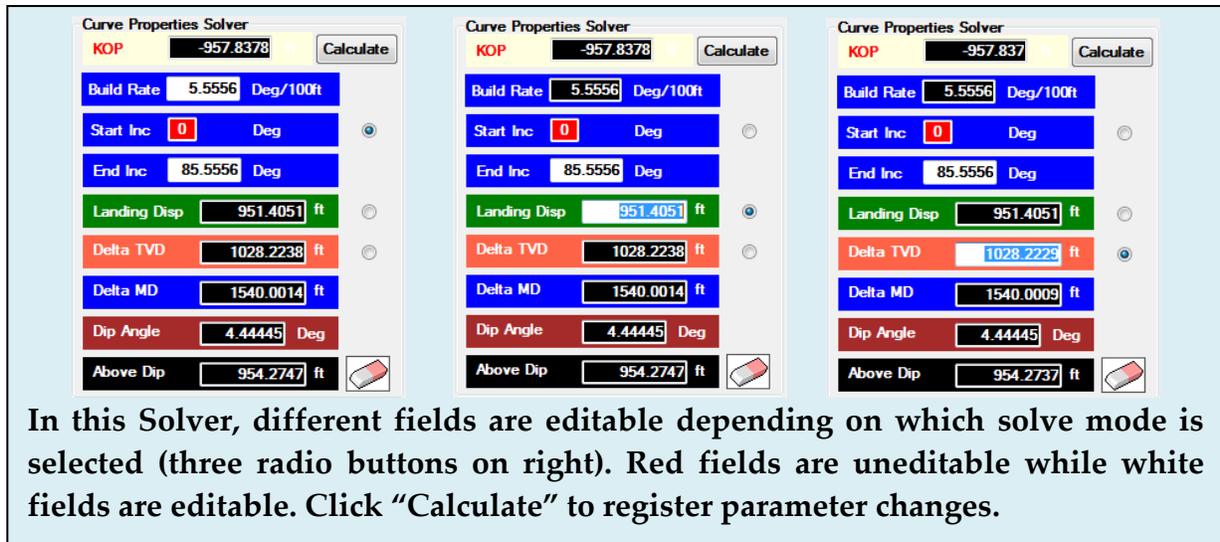
Or set it from the “First Target” dropdown under the “Home” tab at the top of the screen.

HOW TO USE 1ST TARGET: Choose from the top left box in the Profiler how to build the profile around the target.



- **Don't Use-** This option allows the user to make the Profiler determine where a target should be after providing certain parameters. **When “Don't Use” is selected, the profiler will *create* a target where the projection ends and call it “PBHL” by default.**
- **As Landing-** This means set the target to the landing point which is another way of saying: “Solve for the minimum build rate that is required to achieve the desired inclination at the landing point. The KOP will be determined as a function of that.”
- **As PBHL-** Treating the target as a Proposed Bottom Hole Location is the default method of target utilization, with the target acting as the end point designation for the curve.

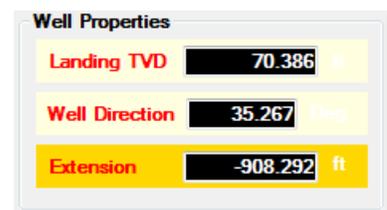
CURVE PROPERTIES SOLVER: As with the S-Well Properties Solver (found in the S-Well Profiler), the rule of thumb is that the fields in red cannot be changed, whereas the fields in white can be changed. These fields change depending on which solve mode is selected. Select for a solve mode by clicking on one of the three radio buttons on the right.



The Solver for Slant/Horizontal wells has 8 different parameters which define the well. The properties are:

- **KOP**- The depth at which the first turn in the S-Well begins, usually after the initial straightaway from the surface.
- **Build Rate**- The degree of turn per 100 ft along the first turn.
- **Start Inc**- This is the initial inclination, which is always zero for this type of plane
- **End Inc**- The landing inclination
- **Landing Disp**- Displacement in feet or meters to the landing point, illustrated by the **Dark Green** upper line in the diagram
- **Delta TVD**- The change in True vertical depth on the curve. The **Red Line** illustrates this distance.
- **Delta MD**- The change in measured depth from the beginning of the curve to the end of the curve. The **Blue Line** represents where this distance is calculated.
- **Dip Angle**- The dip angle is calculated as 90-Landing Inc. So a curve that has a landing angle of 88 degrees would have a 2 degree dip. The **Maroon Line** represents where this angle is calculated, relative to an imaginary horizontal line.
- **Above Dip**- The Above dip distance is represented by the **Black Line** on the left. This is the distance above the formation at the beginning of the kick off.

WELL PROPERTIES: Unlike the S-Well Profiler, the "Well Properties" fields are uneditable regardless of which solve mode is selected. These fields merely indicate the figures shown. These parameters indicate several crucial bits of information:

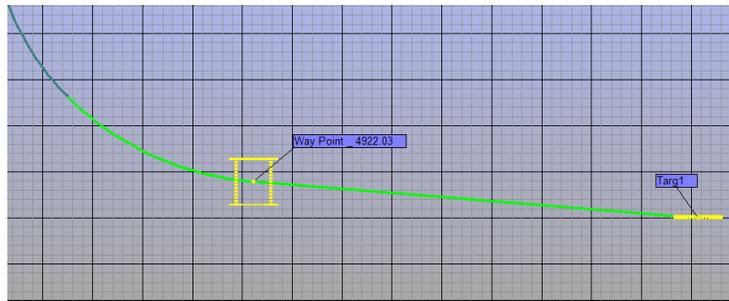


- **Landing TVD-** The Target TVD
- **Well Direction-** The azimuth direction in which the well is being planned.
- **Extension-** The extension is the amount of tangent Measured Depth *before* reaching the Landing TVD, aka. the Target.

CREATE TARGET PLANE: Check this box in the Profiler to turn on a target plane in the 3D space. Target Planes in the 3D space are a very useful visual tool. They can easily be created within the 3D space by selecting a tangent section on a curve that the right-clicking for the context menu and then selecting ‘Create Target Plane’. But, if you know you want to have a target plane then it is even easier to have one automatically created

CREATE WAY POINT TARGET:

Common practice in directional drilling is to have the point at the end of the build section identified as a target. This is more commonly referred to as a waypoint. Selecting this option will have the program automatically create a waypoint target at the end of the first turn in the curve. The target will be named “Way Point” with its TVD by default.



SEND TO 3D SPACE: This button acts as an “APPLY” button, porting all of the Slant/Horizontal well changes made in the Profiler into the 3D space. This option will be a prompt when clicking “OK” just in case the user forgets.

COMES WITH A NUDGE INSTALLED: Just like the S-Well, when a Slant/Horizontal well is sent into the 3D space from the Well Planning Profiler, it is equipped with a Nudge projection at the first turn.

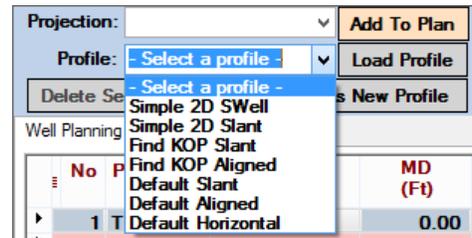
This feature acts as a sort of hinge, allowing the user to nudge the Nudge portion of the well and redirecting the entire curve elsewhere while retaining all features below the first turn. To tweak the Nudge component or any other part of the well, return to the Well Planner Mode, then click on the desired projection in the List Panel at the bottom of the screen.

When the Nudge row is clicked, its special control panel appears for editing. If the Tool Face, for example, is changed in this Nudge section, then the entire curve will be redirected yet maintain its build characteristics.

c. Find KOP Slant

The “Find KOP Slant” is the first of the profiles to not have a dedicated profiler tool. It is styled like all the remaining profiles in that it gives you a series of projections with which you can tweak, add to or take projections out of. This profile will look for the optimal KOP given the parameters that you enter into your slant projection panel.

LOAD PROFILE: This profile does not have a dedicated profiler tool pop up when you select it. Remember to click “Load Profile” after selecting this and all profiles below this one.



SET FIRST TARGET: Since the Slant projection is a targeted projection, a First Target must be set. If a first target has not been set yet, find the target to be set either in the Data Tree, 3D space, right-click on it and select “Set as First Target.”

Or set it from the “First Target” dropdown under the “Home” tab at the top of the screen.

CHANGE INCLINATION FROM THE LIST PANEL: If the resulting proposal curve is not exactly what is needed, any of the projections composing the curve can be edited. The fields in white can be edited directly in the List Panel. To change other parameters of a given projection, click on the name of the projection and its own control panel will appear.

Below is the projection series created by the “Find KOP S-Well,” with “Target1” set as the First Target. The inclination of the first slant can be changed to affect the KOP:

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	RKB TVD (Ft)	NS (Ft)	EW (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	MD	N/A	2038.60	2038.60	0.00	0.00	2038.60	0.00	0.00
3	Slant	N/A	3038.53	999.93	30.00	45.00	2993.47	180.91	180.91
4	Slant	Target1	5355.42	2316.89	30.00	45.00	5000.00	1000.00	1000.00

Changes are updated instantaneously to the 2D and 3D space. To the right is a typical “Find KOP Slant” profile, with the parameters from the previous List Panel screenshot.

Here, the KOP is seen in the List Panel as 2038.6 feet. The build is at 30 degrees inclination and 45 degrees azimuth.

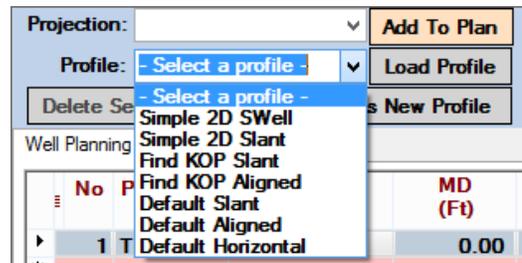
APPLY TO PROPOSAL: Remember that any list of projections that you create in the Well Planning Mode will not appear in the Field Mode and become a part of your Proposal Curve until you click “Apply to Proposal.”



d. Find KOP Aligned

The “Find KOP Aligned” is a standard style Well Planning profile in that it gives you a series of projections with which you can tweak, add or take projections out of. This profile will look for the optimal KOP given the parameters that you enter into your aligned projection panel.

LOAD PROFILE: This profile does not have a dedicated profiler tool pop up when you select it. Remember to click “Load Profile” after selecting this and all profiles below this one.



SET FIRST AND SECOND TARGET: Since the Aligned projection is a targeted projection, a First Target must be set. Additionally, it is the only projection which uses the Second Target. If a first and second target has not been set yet, find the target to be set either in the Data Tree, 3D space, right-click on it and select “Set as First Target.”

Or set it from the “First Target” and “Second Target” dropdown under the “Home” tab at the top of the screen.

EXTEND TO NEXT TARGET: With the Aligned projection, *if you want* to hit two targets you will need to open up the Aligned Projection control panel by clicking on the aligned projection in the List Panel below.

Once the control panel is open, check the “Use Vector to Second Target” and “Extend to Next Target” boxes. This will ensure that the projection is calculated to pass through the First Target and end at the Second Target.

NOTE: With the Aligned projections, always remember to hit the “Calculate” button, either in the small control panel or the Well Planning Control Panel on the far right.



CHANGE INCLINATION FROM THE LIST PANEL: If the resulting proposal curve is not exactly what is needed, any of the projections composing the curve can be edited.

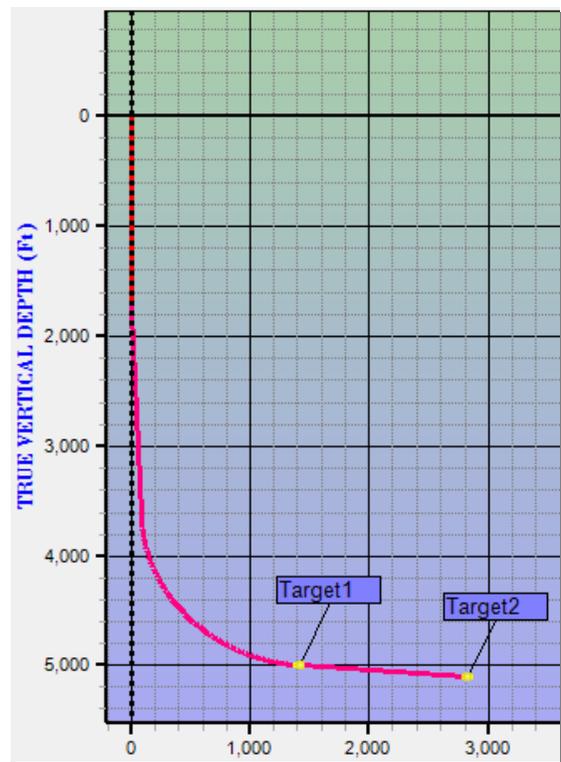
Below is the projection series created by the “Find KOP Aligned,” with “Target1” set as the First Target and “Target2” set as Second Target:

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	RKB TVD (Ft)	NS (Ft)	EW (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	MD	N/A	1731.84	1731.84	0.00	0.00	1731.84	0.00	0.00
3	Aligned	N/A	1774.52	42.68	2.56	45.00	1774.50	0.67	0.67
4	Aligned	N/A	3637.03	1862.52	2.56	45.00	3635.16	59.51	59.52
5	Aligned	Target1	5722.02	2084.98	85.96	45.00	5000.00	1000.00	1000.00
6	Aligned	Target2	7139.76	1417.74	85.96	45.00	5099.88	2000.01	2000.00

The fields in white in the List Panel can be edited directly. To change other parameters of a given projection, click on the name of the projection and its own control panel will appear. In the example above, since the “Find KOP” box is checked under our “Find KOP Aligned” profile, we can directly change the Inclination on the first aligned projection. This will cause the KOP to be recalculated.

MUST CLICK “CALCULATE”: For profiles containing aligned projections such as this one, changes are updated to the 2D and 3D space after clicking “Calculate.”

To the right is the vertical section view of a typical “Find KOP Aligned” profile, with the parameters from the List Panel above. Here, the KOP is seen in the List Panel as 1731.84 feet. The DLS values are at 6 and 4, according to the Aligned Projection control panel. The curve hits Target1 and extends in a straight tangent for 1417.74 feet to hit Target2.

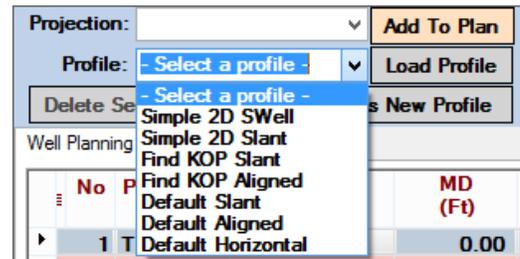


APPLY TO PROPOSAL: Remember that any list of projections that you create in the Well Planning Mode will not appear in the Field Mode and become a part of your Proposal Curve until you click “Apply to Proposal.”

e. Default Slant

The Default Slant profile is similar to the Find KOP Slant profile except that it is not solving for a KOP given a user-provided inclination. Instead, a KOP must be provided, as well as DLS and Hold Angle numbers for the slant projection portions.

LOAD PROFILE: This profile does not have a dedicated profiler tool pop up when you select it. Remember to click “Load Profile” after selecting this and all profiles below this one.



SET FIRST TARGET: Since the Slant projection is a targeted projection, a First Target must be set. If a first target has not been set yet, find the target to be set either in the Data Tree, 3D space, right-click on it and select “Set as First Target.”

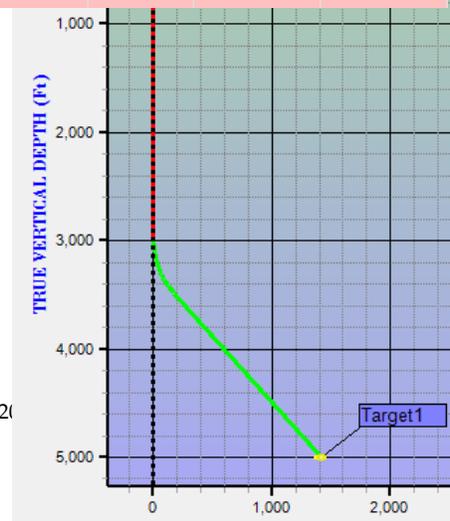
Or set it from the “First Target” dropdown under the “Home” tab at the top of the screen.

CHANGE KOP FROM THE LIST PANEL: If the resulting proposal curve is not exactly what is needed, any of the projections composing the curve can be edited. The fields in white can be edited directly in the List Panel. To change other parameters of a given projection, click on the name of the projection and its own control panel will appear.

Below is the projection series created by the “Default Slant,” with “Target1” set as the First Target. The KOP can be changed:

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	RKB TVD (Ft)	NS (Ft)	EW (Ft)	Easting (Ft)	Northing (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3455231.48	810940.54
2	MD	N/A	3000.00	3000.00	0.00	0.00	3000.00	0.00	0.00	3455231.48	810940.54
3	Slant	N/A	3540.26	540.26	27.01	79.30	3520.46	23.22	122.84	3455354.32	810963.76
4	Slant	Target1	4214.33	674.07	27.01	79.30	4121.00	80.07	423.67	3455655.15	811020.61

Changes are updated instantaneously to the 2D and 3D space. To the right is a typical “Default Slant” profile,



with the parameters from the previous List Panel screenshot.

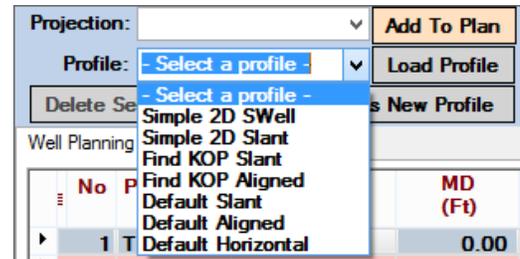
Here, the KOP was defined in the List Panel as 3000 feet. The build is at 27.01 degrees inclination and 79.30 degrees azimuth. The DLS for this curve is 5 degrees per hundred feet, and that could be reduced by decreasing the user-defined KOP.

APPLY TO PROPOSAL: Remember that any list of projections that you create in the Well Planning Mode will not appear in the Field Mode and become a part of your Proposal Curve until you click “Apply to Proposal.”

f. Default Aligned

The “Default Aligned” is a standard style Well Planning profile in that it gives you a series of projections with which you can tweak, add to or take projections out of. This profile will allow you to change your KOP as well as your inclination and azimuth upon reaching the first target.

LOAD PROFILE: This profile does not have a dedicated profiler tool pop up when you select it. Remember to click “Load Profile” after selecting this and all profiles below this one.



SET FIRST AND SECOND TARGET: Since the Aligned projection is a targeted projection, a First Target must be set. Additionally, it is the only projection which uses the Second Target. If a first and second target has not been set yet, find the target to be set either in the Data Tree, 3D space, right-click on it and select “Set as First Target.”

Or set it from the “First Target” and “Second Target” dropdown under the “Home” tab at the top of the screen.

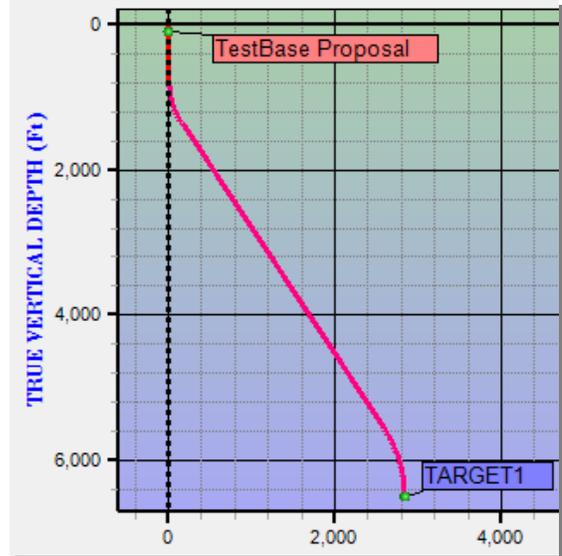
CHANGE KOP AND INC/AZM AT FIRST TARGET: If the resulting proposal curve is not exactly what is needed, any of the projections composing the curve can be edited. Below is the projection series created by the “Default Aligned,” with “Target1” set as the First Target:

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	RKB TVD (Ft)	NS (Ft)	EW (Ft)	Easting (Ft)	Northing (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3455231.48	810940.54
2	MD	N/A	781.64	781.64	0.00	0.00	781.64	0.00	0.00	3455231.48	810940.54
3	Aligned	N/A	1381.57	599.93	30.00	45.00	1354.54	108.53	108.53	3455340.01	811049.07
4	Aligned	N/A	6220.33	4838.76	30.00	45.00	5545.17	1819.11	1819.11	3457050.59	812759.65
5	Aligned	TARGET1	7220.21	999.88	0.00	0.00	6500.00	2000.00	2000.00	3457231.48	812940.54

The fields in white, here the KOP and Inc/Azm at First Target, can be edited directly. To change other parameters of a given projection, click on the name of the projection and its own control panel will appear.

MUST CLICK “CALCULATE”: For profiles containing aligned projections such as this one, changes are updated to the 2D and 3D space after clicking “Calculate.”

To the right is the vertical section view of a “Default Aligned” profile, with the parameters from the List Panel above. Here, the KOP was set in the List Panel at 781.64 feet. The curve hits Target1 at 0 degrees inclination and azimuth, or in other words straight down from the top.



EXTEND TO NEXT TARGET: With the Aligned projection, *if you want* to hit two targets you will need to open up the Aligned Projection control panel by clicking on the aligned projection in the List Panel below.

Once the control panel is open, check the “Use Vector to Second Target” and “Extend to Next Target” boxes. This will ensure that the projection is calculated to pass through the First Target and end at the Second Target.

NOTE: With the Aligned projections, always remember to hit the “Calculate” button, either in the small control panel or the Well Planning Control Panel on the far right.

ALIGNED PROJECTION ✕

Calculate

Turn On Projection

DLS1	10.000	🔒
DLS2	10.000	🔒
Inc @ Target	90	
Azm @ Target	182	

Set DLS1 = DLS2

Tangent 9994.91

Line up to hit 2nd Target

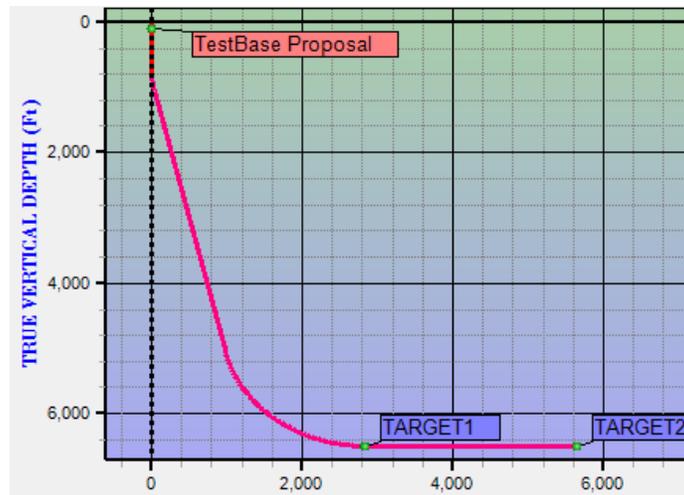
Extend Before	0
Extend After	0

Extend to 2nd Target

Color

When extending to the next target, the program will recalculate the aligned projection to automatically hit Second Target from the First Target. In the example below, once the projection was told to use vector to second target, it calculated that it needed to hit First Target at 90 degrees inclination and 45 degrees azimuth:

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	DLS °/100 (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00
2	MD	N/A	781.64	781.64	0.00	0.00	0.00
3	Aligned	N/A	1046.88	265.24	13.26	45.00	5.00
4	Aligned	N/A	5139.79	4092.91	13.26	45.00	0.00
5	Aligned	TARGET1	7697.72	2557.93	90.00	45.00	3.00
6	Aligned	TARGET2	10526.15	2828.43	90.00	45.00	0.00

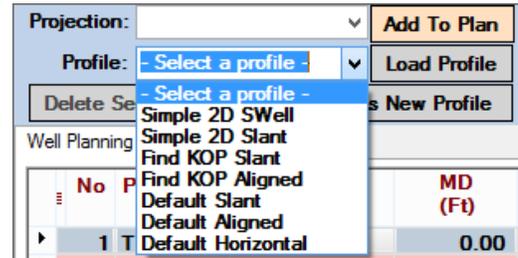


APPLY TO PROPOSAL: Remember that any list of projections that you create in the Well Planning Mode will not appear in the Field Mode and become a part of your Proposal Curve until you click “Apply to Proposal.”

g. Default Horizontal

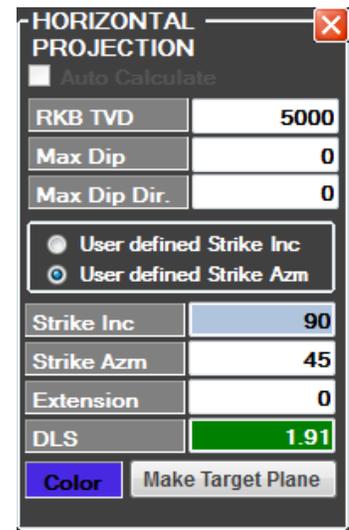
The “Default Horizontal” profile contains the horizontal projection, which is a targeted projection but will not use First or Second Target. Instead, just like when making a horizontal projection in the Field Mode, you must define a target plane from within the control panel.

LOAD PROFILE: This profile does not have a dedicated profiler tool pop up when you select it. Remember to click “Load Profile” after selecting this and all profiles below this one.

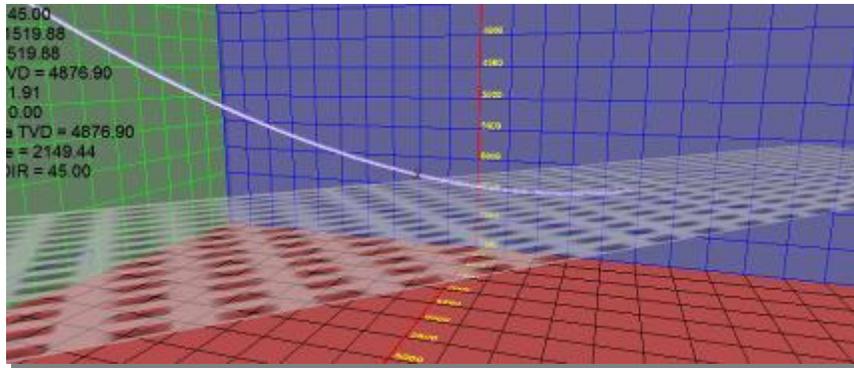


DEFINE YOUR TARGET PLANE: Just as in the Field Mode, the Horizontal Projection **can only be calculated upon defining the target plane** which it is supposed to hit. So when the “Default Horizontal” profile is loaded, you must click on the “Horizontal” projection in the List Panel below and enter some parameters into the control panel that pops up.

Here, we have defined a plane that sits at 5000 feet RKBTV D, with no dip in any direction, and we want the curve to strike the plane at a 90 degree angle (flat), at a direction of 45 degrees, with no extension. The program calculates that this will require a low 1.91 DLS.



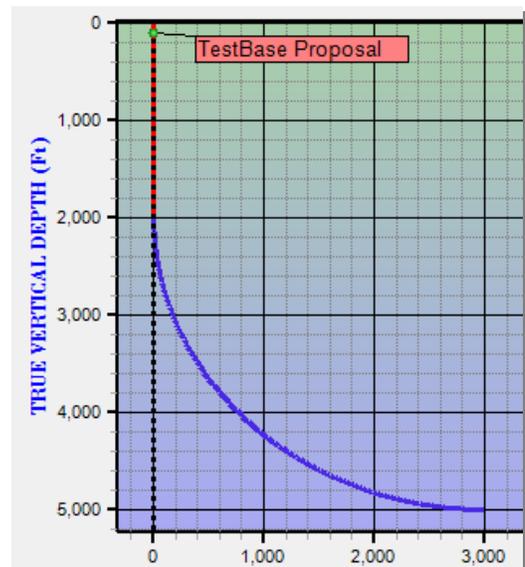
MAKE TARGET PLANE: By clicking the “Make Target Plane,” this projection will automatically generate a target plane in the 3D space that will be associated with your current platform/pad. Generating the target plane may help to visualize how and where the curve strikes the plane.



MAKE CHANGES IN THE LIST PANEL: As is the case with all data in the Well Planning Mode's List Panel, white fields are editable. Taking a look at the List Panel below. Here, we can change the KOP, strike azimuth and total depth of the plane itself:

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	RKB TVD (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00
2	MD	N/A	2000.00	2000.00	0.00	0.00	2000.00
3	Horizontal	N/A	6712.39	4712.39	90.00	45.00	5000.00
*							

As can be seen in the vertical section view to the right, the Horizontal projection profile can be used to make a smooth "landing" with a low DLS.



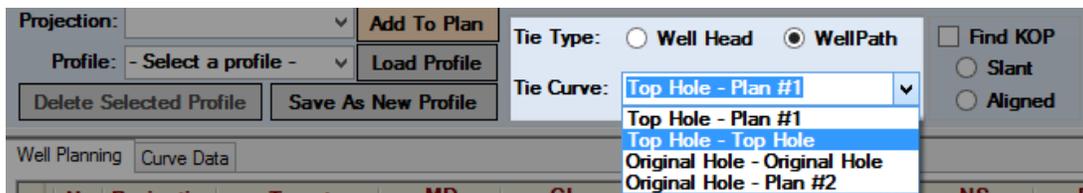
APPLY TO PROPOSAL: Remember that any list of projections that you create in the Well Planning Mode will not appear in the Field Mode and become a part of your Proposal Curve until you click "Apply to Proposal."

h. Tie-Ins

Adding tie-ins in the Well Planning Mode is conceptually the same as doing it in the Field Mode. The advantage here is that it can be nudged and modified by any parameter at any point, which is the general advantage of working in the Well Planning Mode.

TIE TYPE: To create a tie-in from the Well Planning Control Panel, DON'T select a profile. Instead, first select the type of tie-in to be created from the "Tie Type" drop-down menu. The choices are Well Head or Well Path. In the following example, the tie-in will be off of the well path.

TIE CURVE: When "WellPath" is selected as the tie-in type, the "Tie Curve" drop-down menu is activated and a curve from which to tie in can be selected. Keep in mind that you cannot launch a tie-in from the current curve that you are on: it must be from either the survey curve or another proposal.



Once a tie-in base curve is selected, by default, the tie-in will start at the END of the selected tie-in base curve. This entry appears in the List Panel as "Tie in." Change where the tie-in starts by changing the MD in the List Panel.

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	TVD (Ft)	NS (Ft)
1	Tie in	N/A	2050	0.00	87.00	78.00	2683.18	726.69

ADD PROJECTION: The next step is to select a projection type to use as the tie-in curve from the "Add Projection" drop-down menu. When any projection is selected, its special control panel appears inside of the 3D window, where it always normally appears.

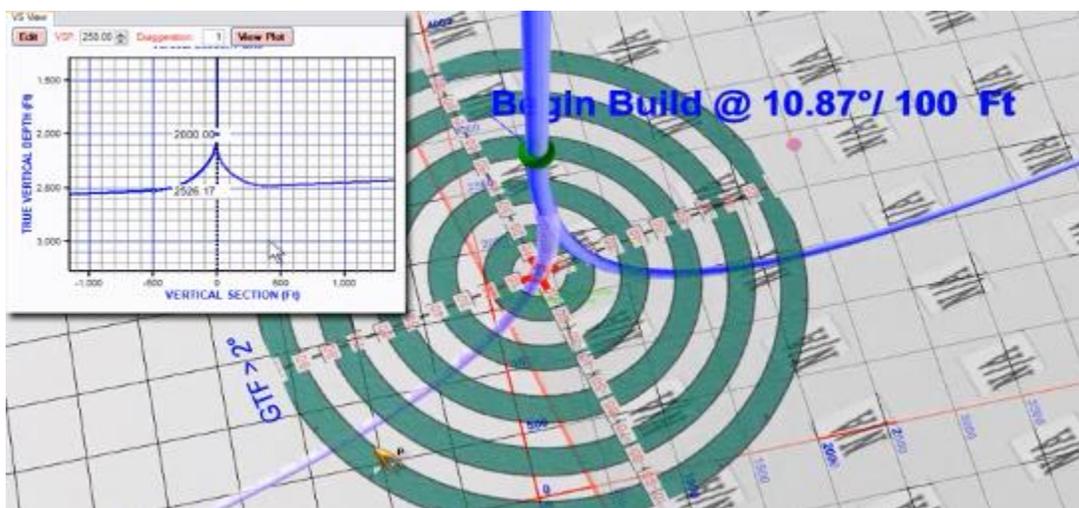
In this example, a horizontal projection is used as the tie-in off of horizontal proposal. When a horizontal projection is made, a target plane must be defined and this is done in the Horizontal Projection panel. It is defined by its RKBTV D, Max Dip and Max Dip Direction. In this case, the target plane is contacted 2500 feet below the surface location, its maximum dip angle is 3 degrees and its direction is 78 degrees.

For the tie in, the strike inclination is defined as 93 degrees, and the strike azimuth is 258 degrees, which is exactly 180 degrees opposite the proposal’s azimuth. The tie-in is also given an extension of 3000 feet and the DLS is automatically calculated at 14.61 in order to accommodate these parameters.

ADD: The next step is to click the “Add” button. This will create the curve and it will appear both in the 3D space as a translucent projection as well as the next projection entry in the Well Planning List Panel (just below “Tie in). (See 9.1.8 video for reference)

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	TVD (Ft)	NS (Ft)	EW (Ft)	East (Ft)
1	Tie in	N/A	2050.00	0.00	5.44	78.00	2049.92	0.49	2.32	34552
2	Horizontal	N/A	2723.57	673.57	93.00	258.00	2478.60	-84.92	-399.50	3454
3	Horizontal	N/A	5723.57	3000.00	93.00	258.00	2321.59	-707.80	-3329.92	3451

The new tie-in is also reflected in the 2D and 3D space as a translucent projection.



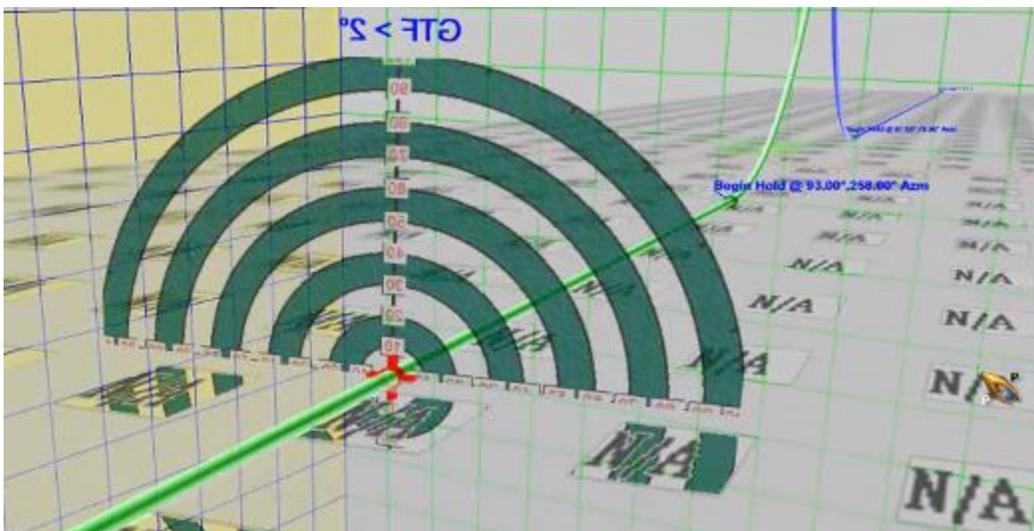
By changing the “MD” value of the Tie-in in the List Panel, the actual tie-in point can be manipulated. Notice that when the tie-in’s MD (tie-in point) is changed from 2050 to

2100, it starts lower off of the base curve and ultimately adopts a more severe dogleg severity to attain its assigned strike inclination.



To get the exact desired dogleg severity, the user can keep changing the MD until the right DLS value is generated. Such “what-if” games can be played in the Well Planning version for all sorts of parameters in order to create an optimal curve.

When the tie-in curve has been articulated to user spec, click “Apply to Proposal” and it becomes part of a multilateral proposal curve. Click the Field Mode icon  to get back to the main HawkEye™ interface and see the proposal curve.



3. Build a Custom Well Planning Template

Once the Well Planning Control Panel has become familiar, creating customized profiles is straightforward. The principle tools are the “Add” button and the List Panel. Custom profiles can also be based on existing default profiles. Any sequence of projections that is currently displayed in the List Panel can be saved as a new user-created profile, making this aspect of the Well Planning Mode a potent time saving device.

ADD FIRST PROJECTION: When creating a profile from scratch, first click the “Clear” button in the Well Planning panel. Then add a projection at the top of the curve by selecting the type in the “Add Projection” drop-down menu. The special control panel for any of the projections appear where they normally do, just inside the 3D window. Edit the main parameters in this panel.



Then click the “Add” button. The projection as defined will appear in the List Panel below as well as the 3D space above. All parameters can be further edited in the List Panel by clicking on the projection row, or in the special control panel.

ADD ANOTHER PROJECTION: The next step in building a profile is to stack on a second projection. A common and useful second projection for ample customization room down the road is a Nudge projection since it acts as a flexible control point for any template. Select “Nudge” from the “Add Projection” drop-down menu and click “Add.” This will place a Nudge projection just after the first one.

No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	TVD (Ft)	NS (Ft)	EW (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	MD	N/A	2000.00	2000.00	0.00	0.00	2000.00	0.00	0.00
3	Quija	N/A	2300.00	300.00	9.00	90.00	2298.77	0.00	23.51

ADD TARGETED PROJECTIONS: Add targeted projections in the same manner as targetless, but keep in mind that a target will need to be set as First Target when adding the former. Set a target as First Target by right-clicking on it in the 3D window and

selecting “Set as the First Target.” When loading the profile for later projects, the targeted sections of the profile will adjust to whichever current First Target is set.

MAKE FINAL CHANGES: Any tweaks to the projections can be made in the List Panel before saving by clicking on the parameter in question.

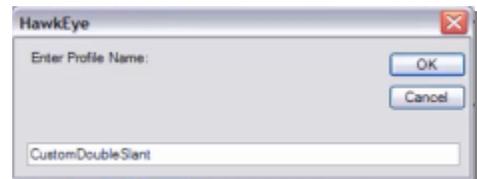
No	Projection	Target	MD (Ft)	CL (Ft)	Inc Deg	Azm Deg	TVD (Ft)	NS (Ft)	EW (Ft)	Easting (Ft)
1	Tie in	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	606983.89
2	MD	N/A	2000.00	2000.00	0.00	0.00	2000.00	0.00	0.00	3455231.48
3	Quija	N/A	2300.00	300.00	9.00	90.00	2298.77	0.00	23.51	3455254.99
4	MD	N/A	2600.00	300.00	9.00	90.00	2595.07	0.00	70.44	3455301.92
5	Slant	N/A	3340.42	740.42	27.71	44.95	3297.29	123.39	252.29	3455483.77
6	Slant	1st Target	9217.31	5876.31	27.71	44.95	8500.00	2057.46	2183.32	3457414.80
7	MD	N/A	9717.31	500.00	27.71	44.95	8942.66	2222.00	2347.58	3457579.06
8	Slant	N/A	10303.26	585.95	40.04	67.87	9430.15	2390.75	2620.57	3457852.05
9	Slant	2nd Target	11047.61	744.35	40.04	67.87	10000.00	2571.15	3064.18	3458295.66

Changes are reflected instantly in the 3D window above the List Panel.

SAVE AS NEW PROFILE: Once a list of projections has been compiled, they may all be saved as a template for future use.



Name the new profile when prompted, and it will be available in the “Profile Name” drop-down menu along with all the default profiles.



APPLY TO PROPOSAL: Anything created and displayed in the Well Planning Mode must be actively pushed over into the Work Space in order for it to become part of a proposal curve. To do that, just click “Apply to Proposal.” Then click the “Work Space” view button (hardhat) to return to the main HawkEye™ screen.

CHANGING THE TEMPLATE: Anytime a template needs to be altered, first get back to the Well Planning panel and load the profile. Then make the desired changes in the List Panel and individual control panels for any of the curves. Finally save as new profile again, naming it the same or something different.

VIII. Torque and Drag

The Torque and Drag Program

The Softdrill NL Torque and Drag module is a program offered with an additional charge for those ordering the Field Version of HawkEye™, or simply included in the Well Planning Version.

Performance Drilling Technology has enlisted Softdrill NL to embed its torque and drag program within HawkEye™ as an optional component module. T&D is an important component of many drilling operations and the ability to create useful T&D analysis quickly and accurately is important.

To this end, HawkEye™ passes survey information to the torque and drag program which provides the interface for setting up the calculation parameters for torque and drag, and also provides the reports and graphs. The following pages explain how to operate the Torque and Drag program.

1. Overview

Softdrill NL Torque & Drag can be used for a variety of engineering applications:

- Optimizing well path design and prediction of operational scenarios
- Drillstring design and prediction of expected tension and torque values exerted on drillstring elements
- Analysis of normal forces (predicting casing wear)
- Analyzing drilling problems (string “hang up”)
- Prediction of hook loads while tripping in or out of the hole and early detection of cuttings build up by comparing actual hook loads (“diverge/converge” method).

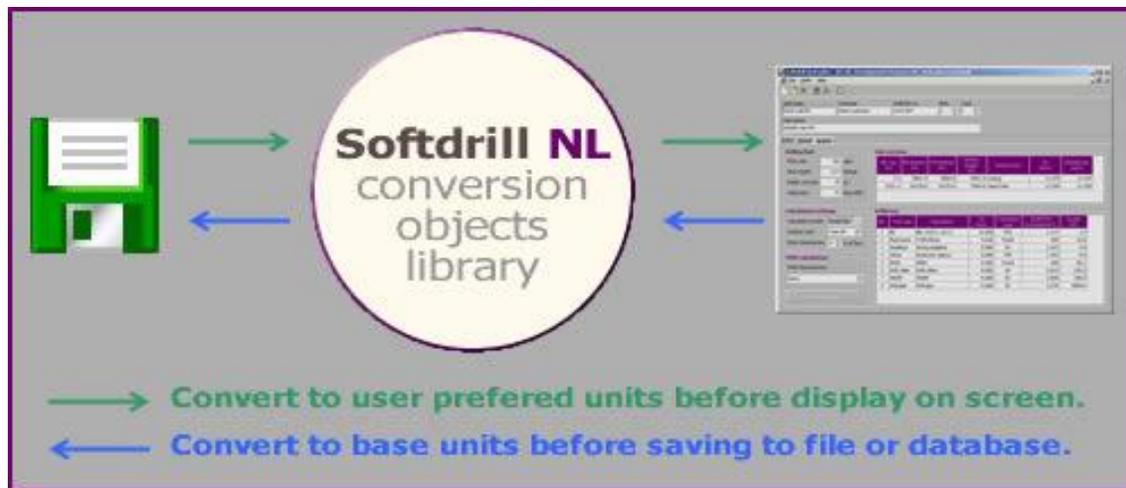
Each of these applications of the software will be introduced and described in this document.

NOTE: This manual has been written for the stand-alone version of Torque & Drag, which allows multiple calculation models to be opened simultaneously (multiple document interface). The Torque & Drag version embedded in Performance Drilling

Technology's HawkEye™ consists of a single document interface, but functionality of the software is similar to the stand-alone version. Please refer to section "Hawkeye™ Embedded Version" later in this chapter for further details.

a. Units of measurement

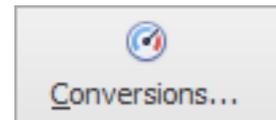
Common to all **Softdrill NL** applications, the Torque & Drag program has full flexibility with regards to the units of measurement used for input and output. All numeric data is stored in a consistent set of units (imperial) when it is saved in a file or stored in a database. This is schematically depicted in the figure below.

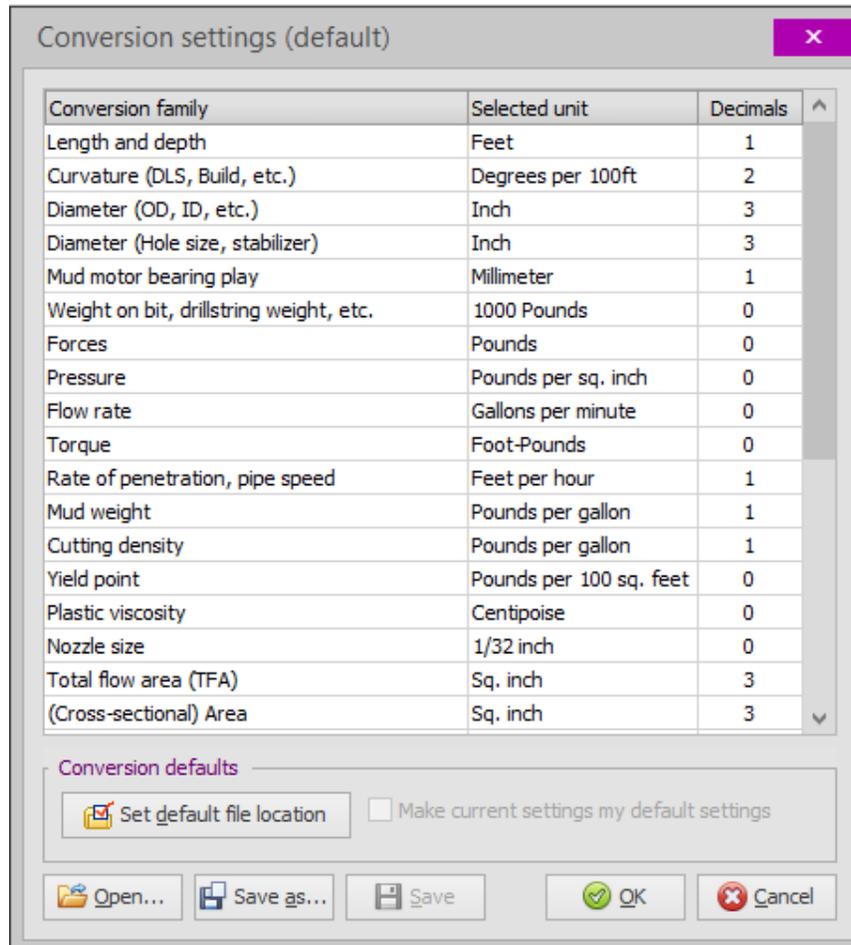


Conversion of units of measurement

The conversion mechanism is fully transparent to the user and allows the program(s) to function fully independently of the selected units. The advantage of this is two-fold: every user can work in his preferred units while working with the program and change to the required units just prior to printing the report(s) to be presented.

To access a variety of functions related to the selected units of measurements, click the "Conversions" button at the top of the main screen. This opens the dialog window as displayed below in the next figure:





This dialog window presents the user with several options related to units of measurement:

- The conversion families (or: groups of units) are sorted in the most logical manner in the context of an engineering application. However, you may choose to sort this list by Conversion Family by clicking on the column header (continued clicking will toggle between ascending and descending sort order).
- For each conversion family, you may select your preferred unit from the drop-down box in the Selected Unit column.
- The button [Set default file location] allows the user to define a folder (directory) where all conversion files will be saved. Typically this is My Documents\Softdrill NL data for the current user, but it may be changed to any folder. This folder's path is saved to the registry and becomes the default location when storing your settings. (This can still be overridden because the user is asked for a storage location prior to opening or saving a settings file). Note that it is probably not a good idea to set a network location as the default.

Specifically with a laptop computer, you may not be connected to the network and problems will occur when attempting to retrieve you default settings.

- If you check the checkbox labeled ‘Make current settings my default settings’, the currently selected settings will become the default (on startup) of all **Softdrill** NL applications installed on your computer.
- Click “OK” to keep your selected settings or “Cancel” to undo all changes and keep things as they were.

b. The Torque & Drag Toolbar



The following shortcut buttons are available on the top toolbar in the main window:

Open

Open existing (saved) calculation model. Alternatively you can use this to open an existing model, input the required changes and save it under a new name using [File] – [Save As...] from the main menu. This is particularly useful in situations where several cases for similar situations must be calculated (e.g. only minor changes to BHA, various bit depths, different mud weights, etc.). Please note that specifically for this purpose the Case No. and Description input fields were added to allow easy distinction between several different cases.

Save

Save changes to currently opened calculation model.

Save as template...

Saves the current configuration of entered parameters as a special .tdt file that can be later loaded from the “Open” option.

Calculate

Calculate currently opened calculation model. This takes you to the resulting graph screen on completion of the calculation. The same function is executed when the [F9] key is pressed.

Print

Print Torque & Drag report complete with selected graphs. This function prints to a preview window first, allowing the user to review the report prior to printing the actual hardcopy.

When you print the report from the preview window (click on printer icon), the print dialog opens where you can select and adjust the printer you want to use to print the report. Optionally you can print to a PDF file directly by checking the 'Print to file' checkbox and selecting 'PDF' from the combo-box.

Conversions

Edit conversion settings (units of measurement) as described above.

2. Input screens

a. General data

The main screen of the currently selected model window gives you access to the following general input data:

Most data input in this section is self-explanatory but the following may require some additional explanation:

- **Case no.**- Allows distinction between models for the same BHA on the same well (use in conjunction with 'Description' field).
- **Step length**- The torque and drag is calculated cumulatively for various depths along the drillstring (from the bit upwards). These depths are calculated using the specified step length. Typically this value is set to 100 feet (or 30 meters). Different step lengths will yield different results but will also impact calculation time.
- **Safety factor**- This factor is used to adjust the tension and torsional yield curves for the operational scenario graph. The absolute yield values are divided by the

safety factor to calculate the yield curve values on the graph. For example, a safety factor of 1.25 results in a graph value being plotted at $1 / 1.25 = 0.80 = 80\%$ of the absolute value

- **M.O.P.**- The margin of overpull applied in the calculation of the model.
- **Stiff string**- By default the model is calculated as 'Soft string' whereby additional forces, resulting from bending the drillstring elements, are not taken into account. Selecting this option will alter the calculation model where these additional forces will be taken into account. See the 'Calculation theory' section further in this document for further explanation.
- **Helical buckling**- Allows the user to select the applied method for calculation of the helical buckling force. The available options are 'Chen & Cheatham' and 'Wu & Juvkam-Wold', where 'Chen & Cheatham' is considered the most reliable and the default value.
- **Calculation mode**- Available options are: *Scenario* (also known as 'single depth analysis'), *Trip Log* (surface hook load vs. bit depth) and *Friction Factor* (back-calculates friction factor from known surface loads; used for post run analysis and in-field optimization of models).

b. Drilling parameters

Drilling parameters	Hole sections	Drillstring	Survey data			
Operational Mode	WOB [kbs]	RPM	Pipe speed [ft/hr]	BHA Drag [lbs]	BHA Torque [ft.lbs]	Bit Torque [ft.lbs]
Pick up without rotation			60.0	3000		
Pick up with rotation		120	60.0	3000	2000	
Slack off without rotation			60.0	3000		
Slack off with rotation		120	60.0	3000	2000	
Rotating off bottom		120			2000	
Rotary drilling	10	120	60.0	3000	2000	2000
Oriented drilling	10		60.0	3000		

This grid allows input of various (drilling) parameters for each operational mode. The operational modes are defined as shown in the left-most column. Cells for non-applicable values are grayed out and disabled.

Bit torque and BHA torque define the starting values for calculating torque values along the drillstring. These values are increased as a result of an increasing weight (and bending force in the case of stiff string models) along the drillstring. BHA Drag serves as a start value for calculation of tension along the drillstring.

Other data is considered to be self-explanatory.

c. Hole sections

Drilling parameters	Hole sections	Drillstring	Survey data		
MD Top [ft]	MD Bottom [ft]	Section Type	Hole Size [inch]	Friction Factor	
0.0	300.0	Casing	8.630	0.27	
300.0	15547.0	Open Hole	8.750	0.38	

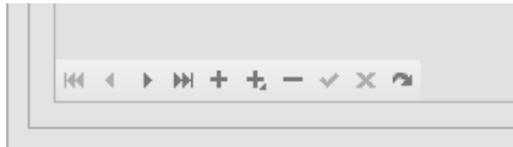
When selected, the hole size column will display an ellipsis button (...). If the Section Type column is defined as *Casing* or *Liner*, the clicking the button displays a casing catalog from which the user can choose the applicable specifications.

The friction factor is a crucial parameter in the torque & drag calculation that allows modeling of a variety of surface-to-surface interactions resulting in drag and torsional friction. The actual value of the friction factor used in a particular situation is a combination of several factors, including:

- Material and condition of cased hole sections and formation type in open hole sections
- Drilling fluid type and composition
- Tool joint material and condition
- Additional borehole tortuosity not correctly reflected by the survey data (i.e. 'micro doglegs').

At a specific point in time, the borehole tortuosity, drillstring composition, drillstring characteristics and mud type will be constant, but several sections of cased and open hole may exist. In most cases it will therefore be necessary to specify multiple friction factors.

Add, Insert and Delete hole sections on this grid with the little buttons found at the bottom of the window:



d. Drillstring

Drilling parameters		Hole sections		Drillstring		Survey data				
Type	Description	OD [inch]	Torque OD [inch]	ID [inch]	Length [ft]	Nom. Wt. [lbs/ft]	Act. Wt. [lbs/ft]	Tension Limit [lbs]	Torsion Limit [ft.lbs]	Make-up [ft.lbs]
▶ Drill Pipe	6 3/4 x 2 13/16 in. 101.0 lbs/ft	6.750	6.750	29.400	29.4	101.0	101.0	0	0	0
HWDP	5" HWDP	5.000	5.000	3.000	213.6	49.3	49.3	691185	56495	29400
Drill Pipe	5" DP-S	5.000	5.000	4.276	9757.0	19.5	22.6	560764	74100	28381

Type. Specify element type. Currently three values are valid: *Drill Collar*, *HWDP* and *Drill Pipe*.

Description. Self-explanatory, but selecting this column (As shown in figure 6 above) will reveal a button that – when clicked - allows the user to select the element from a catalog.

Actual weight is nominal pipe weight corrected for tool joints and used in actual calculation.

Tension limit, torsion limit and make-up torque are used for calculating the various yield curves in the result graphs (taking safety factor and margin of overpull into consideration).

e. Survey data

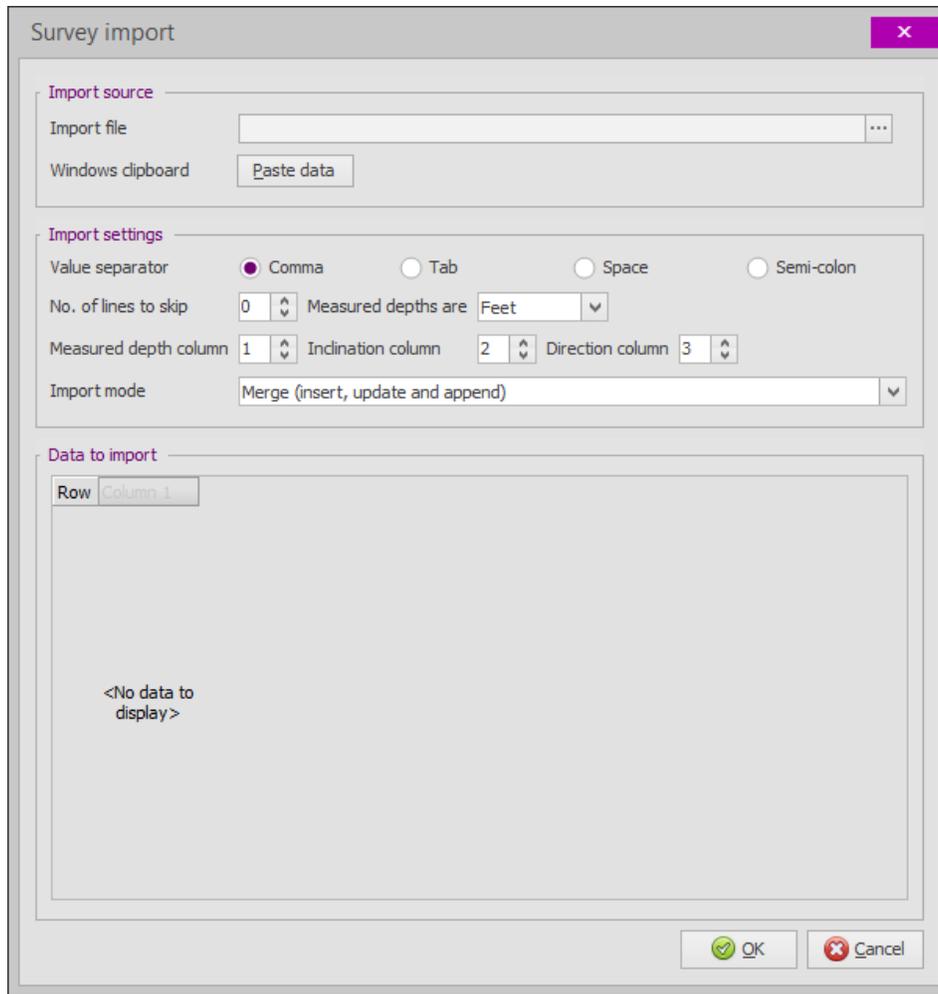
Drilling parameters		Hole sections		Drillstring		Survey data		
MD [ft]	▲	Inc. (deg)	Dir. (deg Az)	Build Rate [°/100ft]	Walk Rate [°/100ft]	DLS [°/100ft]	Radius [ft]	Comment
0.0		0.0	0.0	0.0	0.0	0.0	0.0	
100.0		0.0	0.0	0.0	0.0	0.0	0.0	
9873.9		0.0	0.0	0.0	0.0	0.0	0.0	
9883.9		0.8	160.0	8.4	1600.0	8.4	686.6	
9893.9		1.7	160.0	8.4	0.0	8.4	686.5	
9903.9		2.5	160.0	8.4	0.0	8.4	686.5	
9913.9		3.3	160.0	8.4	0.0	8.4	686.5	
9923.9		4.2	160.0	8.4	0.0	8.4	686.5	
9933.9		5.0	160.0	8.4	0.0	8.4	686.5	
9943.9		5.8	160.0	8.4	0.0	8.4	686.5	
9953.9		6.7	160.0	8.4	0.0	8.4	686.5	
9963.9		7.5	160.0	8.4	0.0	8.4	686.5	
9973.9		8.3	160.0	8.4	0.0	8.4	686.5	
9983.9		9.2	160.0	8.4	0.0	8.4	686.5	
9993.9		10.0	160.0	8.4	0.0	8.4	686.5	

Survey (or wellplan) data is pulled from the current curve in HawkEye or can be imported from a text file (with the “Import surveys” button on the top right of the main screen).

Surveys can also be manually input. For wellplans, only critical points (KOP, end of build, start of drop, etc.) have to be entered since intermediate points will be interpolated as required.

If the first section of a wellplan is vertical down to the kick off point (KOP), the resultant torque and drag values will be zero due to the absence of any inclination (theoretical absence of wall contact). To model a real-time situation it is recommended to adjust the inclination in the KOP to 1.00° (for example). Optionally, intermediate stations with low inclination and random direction can be entered to simulate borehole tortuosity in this section.

Click the “Import surveys” button at the top right of the screen to open the dialogue:



Click the “...” button to select a *.txt or *.csv (Excel comma separated) text file. The ‘Value separator’ radio buttons specify which token to use a field separator when reading data.

Under ‘Import settings’ you can specify how many lines should be ignored before reading data (skip comment lines), what measurement units were used for measured depth values (feet or meters) and which columns contain measured depth, inclination and direction data. Specific attention should be given to the definition of the units used for the depth column to ensure correct conversion upon import of the data.

3. How to Use this Torque and Drag module

Data required to calculate torque and drag:

- A. Surveys
- B. Drillpipe
- C. heavyweight drillpipe
- D. drill collars
- E. Casing

Here's how all that information is entered:

1. Select or design a well (drillstring) in the main HawkEye program. You'll need the surveys from this well.
2. Enter [casing](#) for the string in the main HawkEye program.
3. Open the Torque and Drag module. Enter the basic information at the top:

The screenshot shows the top section of the software interface. It features a toolbar with icons for Open..., Save..., Save as template..., Calculate, Print..., Conversions..., Settings..., and Import surveys... Below the toolbar is a form with the following fields: Well name (containing "#3H Proposal"), Operator (containing "ABC Oil, Inc."), Well / Job No. (containing "1"), BHA (containing "0"), and Case no. (containing "1"). There is also a Description field which is currently empty.

4. Click "Save" at the top and name this torque and drag profile in a folder you will remember.
5. Click on "Hole Sections" to confirm the casing information that you entered:

The screenshot shows a table with the following data:

MD Top [ft]	MD Bottom [ft]	Section Type	Hole Size [inch]	Friction Factor
0.0	984.2	Casing	9.063	0.27
984.2	6017.0	Casing	6.456	0.27
6017.0	7975.7	Casing	5.524	0.27
7975.7	7975.9	Open Hole	8.750	0.38

6. Click on "Survey Data" to confirm the survey information that was pulled from your current curve before launching the T&D module.
If it's not the curve that you want, save your T&D profile, then close the module.
In HawkEye, right-click on the curve you want in the Data Tree and select "Set

As Current Work/Proposal Curve.” Or switch Proposal/Work Mode with the P/W button at the top left of the main screen.

- In the T&D module, click “Drillstring.” Here you will add the drillpipe and drill collars. Click on the Plus-Arrow button highlighted below to add items to the table:

Drilling parameters											
		Hole sections		Drillstring		Survey data					
Type	Description	OD [inch]	Torque OD [inch]	ID [inch]	Length [ft]	Nom. Wt. [lbs/ft]	Act. Wt. [lbs/ft]	Tension Limit [lbs]	Torsion Limit [ft.lbs]	Make-up [ft.lbs]	
DC	Test Element	5.000	5.000	3.000	31.2	10.0	100.0	200000	8000	0	



In this step, make sure to have drillpipe, HWDP and drill collars (DC) with weight values included. These are essential to the calculations.

- Go ahead and save again after putting in all that data. You can even “Save as Template.”
- Click “Calculate” at the top of the module. Your reports will be generated. To tweak the results, visit the “Drilling Parameters” section:

Drilling parameters						
		Hole sections		Drillstring		Survey data
Operational Mode	WOB [kbs]	RPM	Pipe speed [ft/hr]	BHA Drag [lbs]	BHA Torque [ft.lbs]	Bit Torque [ft.lbs]
Pick up without rotation			60.0	3000		
Pick up with rotation		120	60.0	3000	2000	
Slack off without rotation			60.0	3000		
Slack off with rotation		120	60.0	3000	2000	
Rotating off bottom		120			2000	
Rotary drilling	10	120	60.0	3000	2000	2000
Oriented drilling	10		60.0	3000		