GOLDENSOFTWARE

Surfer®

Powerful contouring, gridding & surface mapping system

Full User's Guide

Surfer® Registration Information

Your **Surfer** product key is located in the email download instructions and in your account at MyAccount.GoldenSoftware.com.

Register your **Surfer** product key online at www.GoldenSoftware.com. This information will not be redistributed.

Registration entitles you to free technical support, download access in your account, and updates from Golden Software.

For future reference, write your product key on the line below.

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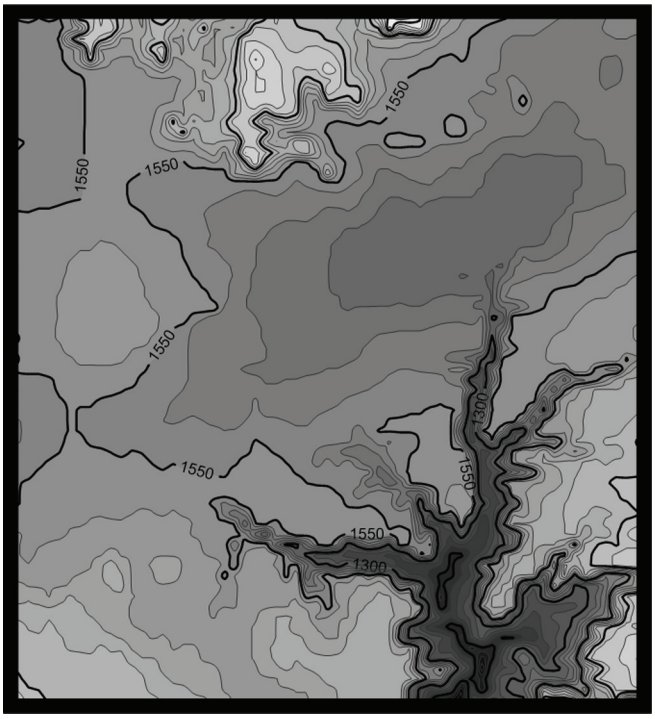
Surfer®

User's Guide

Contouring and 3D Surface Mapping
for Scientists and Engineers



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Chapter 1 - Introduction

Welcome to Surfer, a powerful contouring, gridding, and surface mapping package for scientists, engineers, educators, or anyone who needs to generate maps quickly and easily. Producing publication quality maps has never been quicker or easier. Adding multiple map layers and objects, customizing the map display, and annotating with text creates attractive and informative maps. Virtually all aspects of your maps can be customized to produce the exact presentation you want.

Surfer is a grid-based mapping program that interpolates irregularly spaced XYZ data into a regularly spaced grid. Grids may also be imported from other sources, such as the United States Geological Survey (USGS). The grid is used to produce different types of maps including contour, color relief, and 3D surface maps among others. Many gridding and mapping options are available allowing you to produce the map that best represents your data.

An extensive suite of gridding methods is available in **Surfer**. The variety of available methods provides different interpretations of your data, and allows you to choose the most appropriate method for your needs. In addition, data metrics allow you to map statistical information about your gridded data. Surface area, projected planar area, and volumetric calculations can be performed quickly in **Surfer**. Cross-sectional profiles can also be computed and exported.

The grid files can be edited, combined, filtered, sliced, queried, and mathematically transformed. For example, grids can be sliced to create cross-sectional profiles, or the **Grids | Calculate | Math** command can be used to create an isopach map from two grid files. Grids can be edited with an intuitive user interface in the grid editor.

Scripter

The **Scripter**™ program, included with **Surfer**, is useful for creating, editing, and running script files that automate **Surfer** procedures. By writing and running script files, simple mundane tasks or complex system integration tasks can be performed precisely and repetitively without direct interaction. **Surfer** also supports ActiveX Automation using any compatible client, such as Visual BASIC. These two automation capabilities allow **Surfer** to be used as a data visualization and map generation post-processor for any scientific modeling system.

New Features

The new features in **Surfer** are summarized:

- Online at www.GoldenSoftware.com/products/surfer
- In the web help at http://surferhelp.goldensoftware.com/#t=topics%2Fnew_features.htm
- In the program, click the help button  , and click on the *New Features* page in the *Introduction* book

Who Uses Surfer?

People from many different disciplines use Surfer. Since 1984, over 100,000 scientists and engineers worldwide have discovered Surfer's power and simplicity. Surfer's outstanding gridding and contouring capabilities have made Surfer the software of choice for working with XYZ data. Over the years, Surfer users have included hydrologists, engineers, geologists, archeologists, oceanographers, biologists, foresters, geophysicists, medical researchers, climatologists, educators, students, and more! Anyone wanting to visualize their XYZ data with striking clarity and accuracy will benefit from Surfer's powerful features!

System Requirements

The system requirements for **Surfer** are:

- Windows 7, 8 (excluding RT), 10 or higher
- 512MB RAM minimum for simple data sets, 1GB RAM recommended
- At least 500MB free hard disk space
- 1024x768 or higher monitor resolution with a minimum 16-bit color depth

Installation Directions

Installing **Surfer** requires Administrator rights. Either an administrator account can be used to install **Surfer**, or the administrator's credentials can be entered before installation while logged in to a standard user account. If you wish to use a **Surfer** single-user license, the product key must be activated while logged in to the account under which **Surfer** will be used. For this reason, we recommend logging into Windows under the account for the Surfer user, and entering the necessary administrator credentials when prompted.

Golden Software does not recommend installing **Surfer 15** over any previous versions of **Surfer**. **Surfer 15** can coexist with older versions (e.g. **Surfer 14**) as long as both versions are installed in different directories. By default the program installation directories are different. For detailed installation directions see the *Readme.rtf* file.

To install Surfer from a download:

1. Log into Windows under the account for the individual who will be licensed to use **Surfer**.
2. Download **Surfer** according to the emailed directions you received.
3. Double-click on the downloaded file to begin the installation process.
4. Once the installation is complete, run **Surfer**.
5. License **Surfer** by activating a single-user license product key or connecting to a license server.

Updating Surfer

To update your version of **Surfer**, open the **Surfer** program and choose the **File | Online | Check for Update** command. This will launch the Internet Update program which will check Golden Software's servers for any updates. If there is an update for your version of **Surfer** (e.g. **Surfer 15.0** to **Surfer 15.1**), you will be prompted to download the update.

You can also email your registered **Surfer** product key to surfersupport@goldensoftware.com and request to download the full product update. See the *Check for Update* topic in the help for additional information.

Uninstalling Surfer

To uninstall **Surfer**, follow the directions below for your specific operating system.

Windows 7

To uninstall **Surfer** go to the *Windows Control Panel* and click the *Uninstall a program* link. Select **Surfer 15** from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer**.

Windows 8

From the *Start* screen, right-click the **Surfer 15** tile and click the *Uninstall* button at the bottom of the screen. Alternatively, right-click anywhere on the *Start* screen and click *All apps* at the bottom of the screen. Right-click the **Surfer 15** tile and click *Uninstall* at the bottom of the screen.

Windows 10

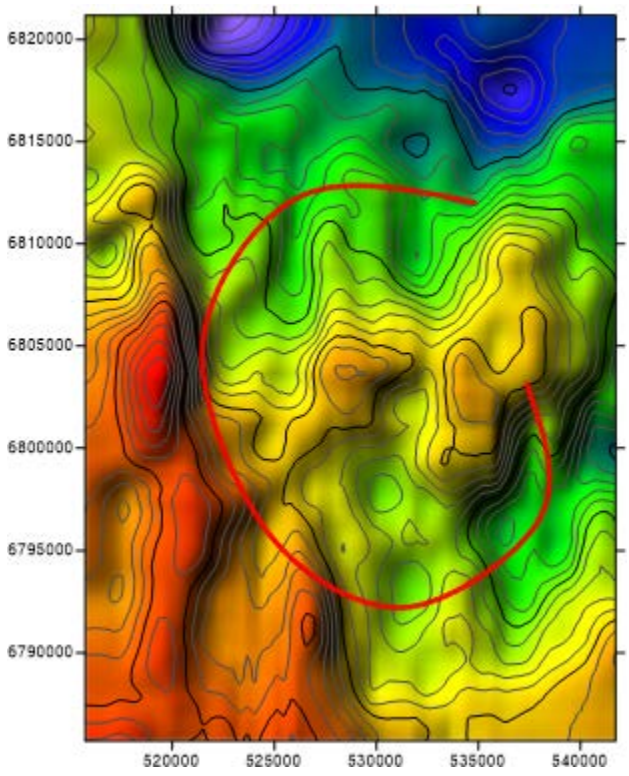
Select *Settings* in the **Start** menu. In *Settings*, select **System | Apps & features**. Select **Surfer 15** and then click *Uninstall*. To uninstall **Surfer** from the Windows Control Panel, click **Programs | Programs and Features**. Select **Surfer 15** and click *Uninstall*.

Surfer Trial Functionality

The **Surfer** trial is a fully functioning time-limited trial. This means that commands work exactly as the command works in the full program for the duration of the trial. The trial has no further restrictions on use. The trial can be installed on any computer that meets the system requirements. The trial version can be licensed by activating a product key or connecting to a license server.

Three-Minute Tour

We have included several sample files with **Surfer** so that you can quickly see some of **Surfer's** capabilities. Only a few files are discussed here, and these examples do not include all of **Surfer's** many map types and features. The Contents window is a good source of information as to what is included in each file.



To see the example files:

1. Open **Surfer**.
2. Click the File | Open command.
3. In the **Open** dialog, navigate to the **Surfer** Samples folder. The **Surfer** Samples folder is located in C:\Program Files\Golden Software\Surfer 15\ by default.
4. Select the sample .SRF file of interest and click *Open*. The sample file is now displayed. Repeat as necessary to see the files of interest.

Overview of Sample Surfer .SRF Files

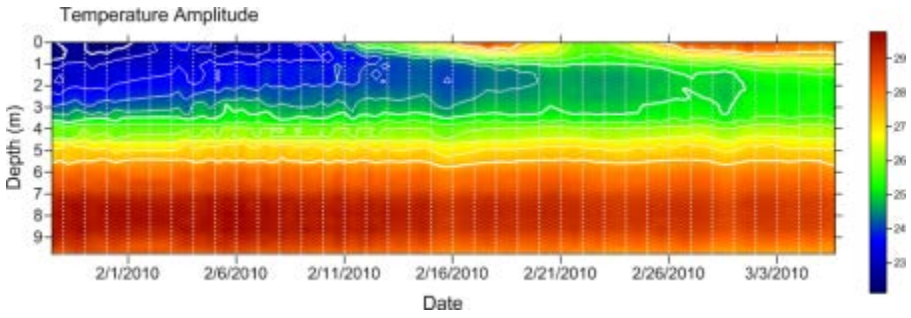
Click on the links below to see an image of the sample file and a brief explanation of what the sample file contains.

3DView.SRF

The *3DView.SRF* sample file includes contour and color relief layers, as well as a base (vector) layer that is used for a 3D view fly-through. Select the map and click **Map Tools | View | 3D View** to open a 3D view. Click **3D View | Fly-Through | Play** to view the example fly-through.

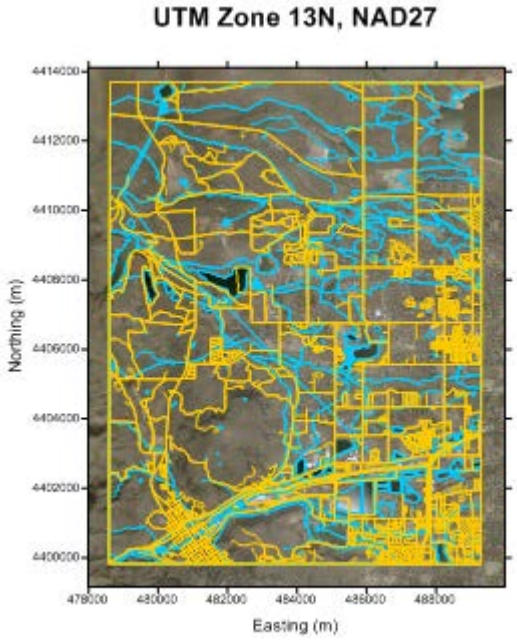
Axes.SRF

The Axes.SRF file contains a contour map layer and color relief map layer overlaid. The grid file used for the two map layers is the same and includes dates as the X values. The X Axis is displayed using date formatting.



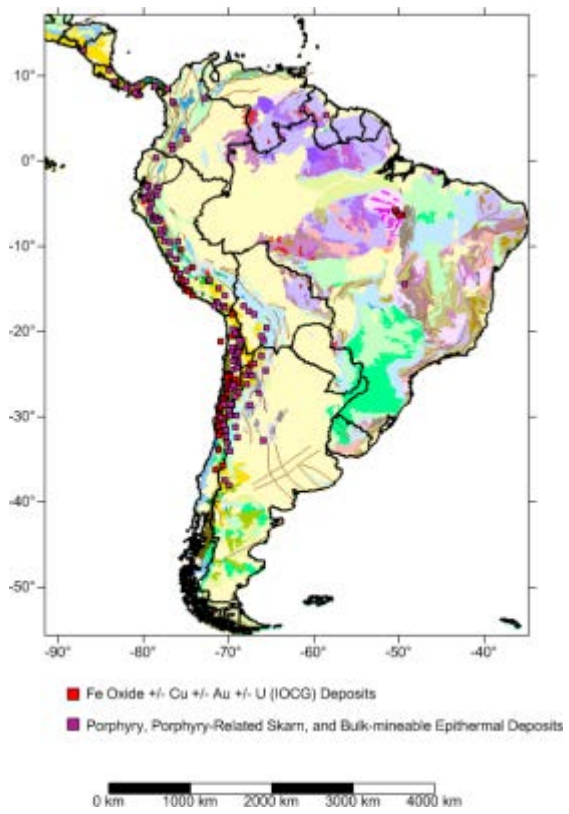
Base.SRF

The Base.SRF sample file displays three base map layers showing road transportation, stream hydrology, and a USGS urban area satellite image for Golden, Colorado, USA. The individual polygons and polylines that make up the base maps can be edited or deleted by expanding the base map layer in the **Contents** window.



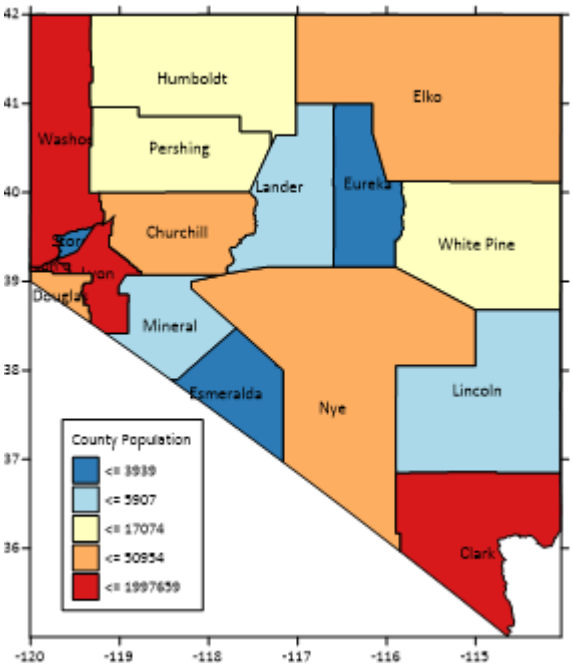
BaseMapFromServer.SRF

The BaseMapFromServer.SRF file contains five base maps of South America, showing Distribution of various minerals, national boundaries, and generalized geology. All base maps were created by downloading images from online servers.



BaseSymbology.SRF

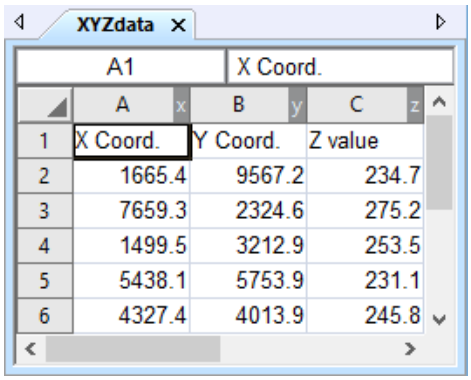
The *BaseSymbology.SRF* sample file includes a base (vector) layer with classed colors symbology applied to a map of Nevada. Counties are classified and colored by population. A legend is included to indicate the upper class values for each of the five classes.



Using Surfer

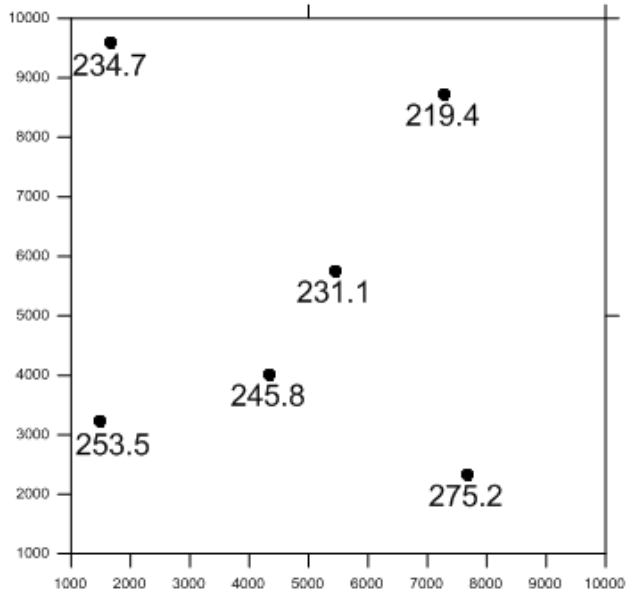
The most common application of **Surfer** is to create a grid-based map from an XYZ data file. The Grid Data command uses an XYZ data file to produce a grid file. The grid file is then used by most of the **Home | New Map** commands to produce maps. Post maps and base maps do not use grid files. The general steps to progress from an XYZ data set to a finished grid-based map are as follows:

1. Create an XYZ data file. This file can be created in a **Surfer** worksheet window or outside of **Surfer** (using an ASCII text editor or Microsoft Excel, for example).



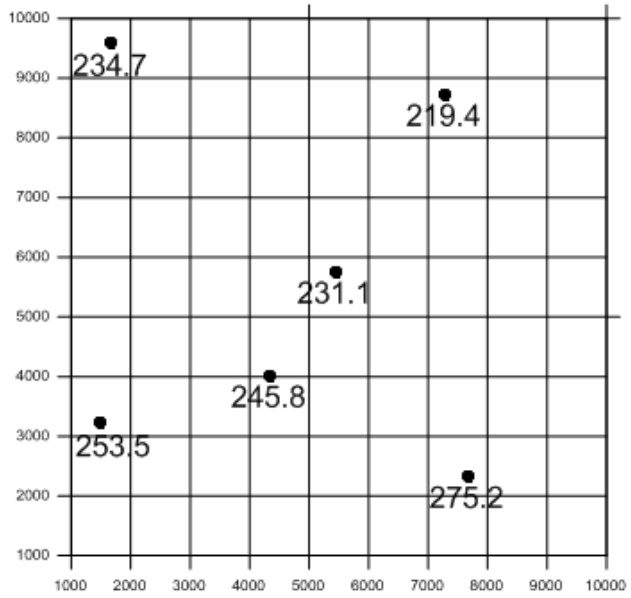
Start with irregular XYZ data in three columns.

2. To display the data points, click the **Home | New Map | Post** command.



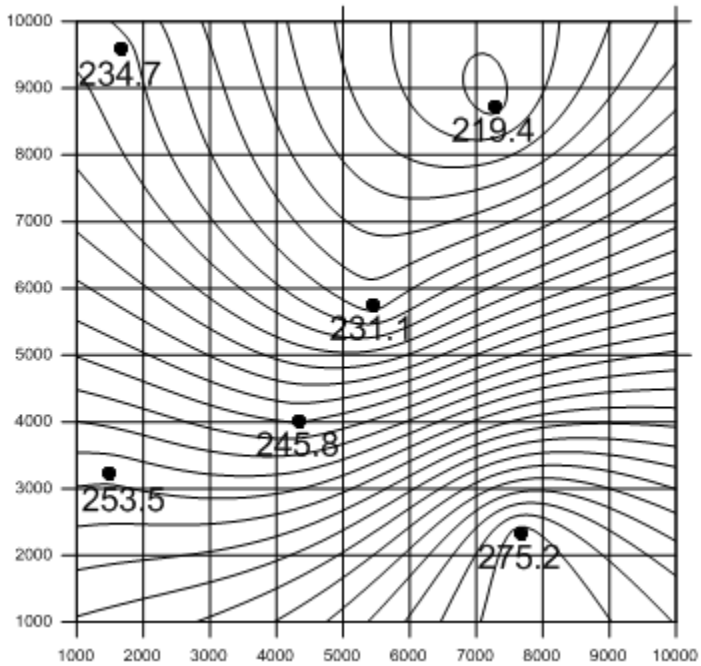
A post map displays the original XYZ data locations.

3. Create a grid file .GRD from the XYZ data file using the **Home | Grid Data | Grid Data** command.



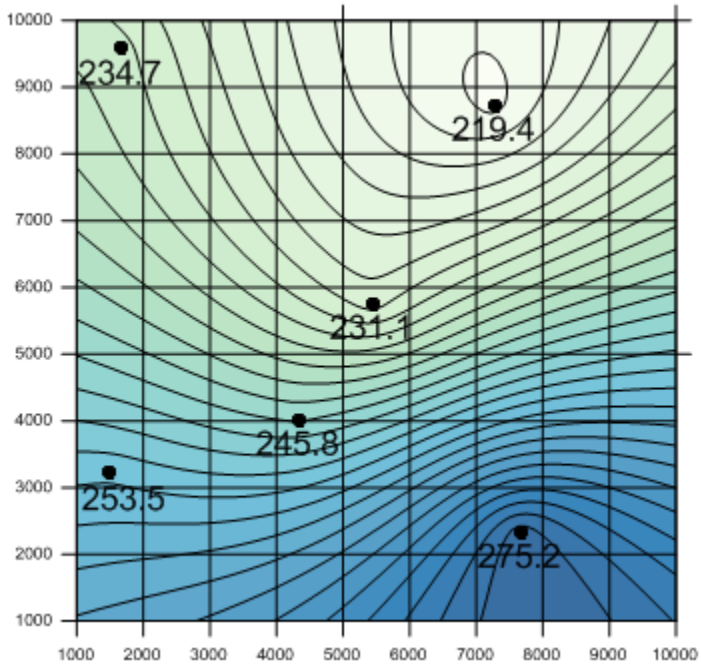
Gridding interpolates a Z value at the intersection of each row and column in the grid file. This fills the holes in the data. Here the rows and columns are represented by grid lines.

4. To create a map, select the map type from the **Home | New Map** commands. Select the grid file from step two. Grid-based maps include contour, 3D surface, 3D wireframe, color relief, shaded relief, vector, watershed, viewshed, and grid values maps.



The post map layer shows the original data points. The contour map layer shows the grid based contour map.

5. Click on the map to display the map properties in the **Properties** window where you can customize the map to fit your needs.

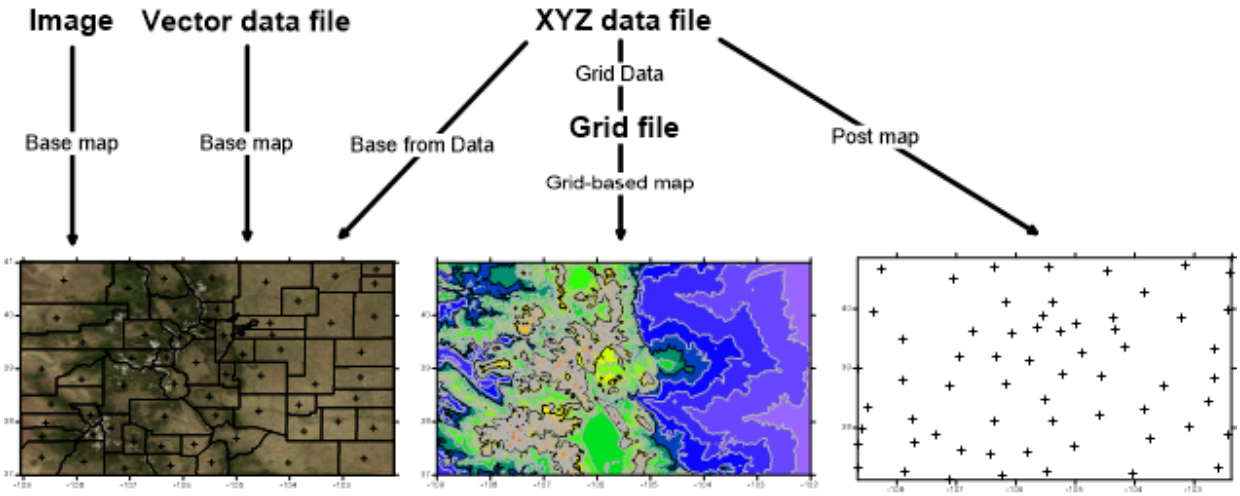


The contour map layer is filled with a gradational color fill.

6. Click the **File | Save** command to save the project as a Surfer .SRF file which contains all the information needed to recreate the map.

Surfer Flow Chart

This flow chart illustrates the relationship between XYZ data files, grid files, vector files, image files, and various maps. This example displays only one of the grid based maps, a contour map.



This flow chart illustrates the relationship between different data files and different map types.

Using Scripter

Tasks can be automated in **Surfer** using Golden Software's **Scripter** program or any ActiveX Automation-compatible client, such as Visual BASIC. A script is a text file containing a series of

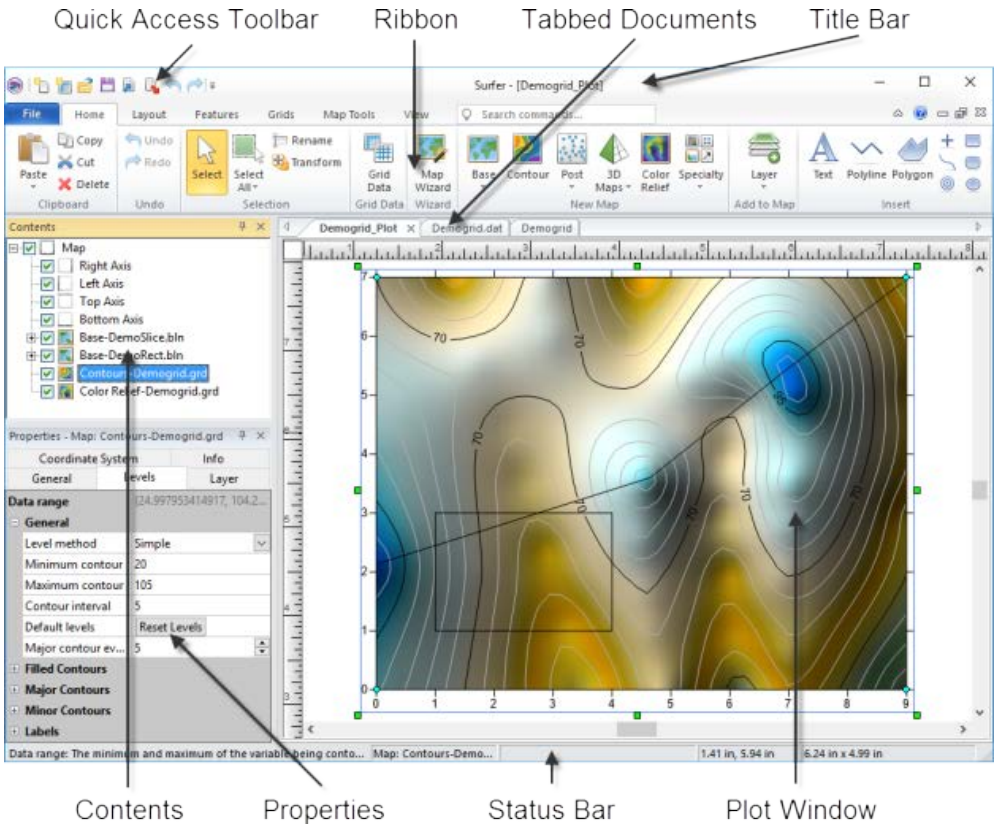
instructions for execution when the script is run. **Scripter** can be used to perform almost any task in **Surfer**. Scripts are useful for automating repetitive tasks and consolidating a sequence of steps. **Scripter** is installed in the same location as **Surfer**. Refer to the *Surfer Automation* help book for more information about **Scripter**. We have included several example scripts so that you can quickly see some of **Scripter's** capabilities.

To run a sample script file:

1. Open **Scripter** by navigating to the installation folder, C:\Program Files\Golden Software\Surfer 15\Scripter. If you are running a 32-bit version of **Surfer** on a 64-bit version of Windows, navigate to C:\Program Files (x86)\Golden Software\Surfer 15\Scripter. Right-click on the *Scripter.exe* application file and select **Run as administrator**.
2. Choose the **File | Open** command.
3. Select a sample script .BAS file. These are located in the C:\Program Files\Golden Software\Surfer 15\Samples\Scripts folder or, if you are running a 32-bit version of **Surfer** on a 64-bit version of Windows, the C:\Program Files (x86)\Golden Software\Surfer 15\Samples\Scripts folder.
4. Click the **Script | Run** command and the script is executed. Most sample scripts open **Surfer** and display a map in the plot window.

Surfer User Interface

Surfer contains four document window types: the plot document, worksheet document, 3D view, and grid editor. Maps are created and displayed in the plot document and 3D view. The worksheet document displays, edits, transforms, and saves data in a tabular format. The grid editor displays and edits Z values for the grid with various editing tools.



*This is the **Surfer** plot window with the **Contents** and **Properties** windows on the left and the worksheet and grid editor tabs on the top of the horizontal ruler.*

Surfer Layout

The following table summarizes the function of each component of the **Surfer** layout.

Component Name	Component Function
Title Bar	The title bar lists the program name plus the saved Surfer .SRF file name (if any). An asterisk after the file name indicates the file has been modified.
Quick Access Toolbar	All window types in **Surfer** include the quick access toolbar to the left of the title bar. The quick access toolbar contains buttons for many common commands. The quick access toolbar can be customized to add or remove buttons with the Customize Ribbon command.
Ribbon	The ribbon includes all of the commands in **Surfer**. Commands are grouped under the File menu and various tabs. Some commands and tabs are only available in specific views. For example, the **Features | Insert | Polyline** command is only available in the plot window. The ribbon commands can be modified and rearranged with the Customize Ribbon command.
Tabbed Documents	The plot, 3D view, worksheet, and grid editor windows are displayed as tabbed documents. The tabs may be reordered by clicking and dragging. When more than one window is open, tabs appear at the top of the document, allowing you to click on a tab to switch to a different window. When a document contains unsaved changes, an asterisk (*) appears next to its tabbed name.
Contents	The **Contents** window contains a hierarchical list of all the objects in a Surfer plot document, grid editor, or 3D view window displayed in a tree view. The objects can be selected, added, arranged, or edited. Changes made in the **Contents** window are reflected in the plot document, grid editor, or 3D view and vice versa. The **Contents** window is initially docked at the left side of the window.
Properties	The **Properties** window contains all of the properties for the selected object or objects. Changes made in the **Properties** window are reflected in the plot document, grid editor, or 3D view. The properties in the **Properties** window are grouped by page. The **Properties** window is initially docked below the **Contents** window.
Status Bar	The status bar displays information about the current command or activity in **Surfer**. The status bar is divided into five sections. The sections display basic plot commands and descriptions, the name of the selected object, the cursor map coordinates and units, the cursor page coordinates, and the dimensions of the selected object.

Opening Windows

Selecting the File | Open command opens any of the three window types, depending on the type of file selected. The File | New | Plot command creates a new plot window. The File | New | Worksheet command creates a new worksheet window. The Map Tools | View | 3D View command opens a 3D view of the selected map. The Grids | Editor | Grid Editor command opens a grid in the grid editor.

Chapter 2 - Tutorial

The tutorial is designed to introduce basic **Surfer** features and should take less than an hour to complete. After you have completed the tutorial, you will have the skills needed to create maps in **Surfer** using your own data. The tutorial can be accessed in the program by clicking the button and navigating to the *Tutorial* book or by clicking *Tutorials* in the Welcome to Surfer dialog.

If you find you still have questions after you have completed the tutorial, you should consider reviewing the material in **Surfer's** extensive in-program help. The help is also available on the web. The Golden Software website contains a knowledge base of questions and answers, an interactive forum, and training videos. Usually, the answers to your questions are found in one of these locations. However, if you find you still have questions, do not hesitate to contact Golden Software's technical support team. We are happy to answer your questions before they become problems.

Tutorial Overview

The following is an overview of lessons included in the tutorial.

Starting Surfer	shows you how to begin a new Surfer session and open a new plot window.
Lesson 1 - Viewing and Creating Data	opens and edits an existing data file and creates a new data file.
Lesson 2 - Using the Map Wizard	creates a grid file, the basis for most map types in **Surfer**, and a map with contour, post, and color relief layers.
Lesson 3 - Changing Layer Properties	edits the contour, post, and color relief layer properties.
Lesson 4 - Modifying an Axis	edits the axis tick labels and axis title properties.
Lesson 5 - Creating a Profile	creates a profile line on the contour map and displays the profile.
Lesson 6 - Saving a Map	saves your map and all the information it contains to a **Surfer** .SRF file.
Lesson 7 - Creating a 3D Surface Map	creates and edits 3D surface map.
Lesson 8 - Adding Transparency, Color Scales, and Titles	changes the transparency of various objects, adds a color scale, and adds a map title.
Lesson 9 - Creating Maps from Different Coordinate Systems	loads multiple map layers from different coordinate systems and sets the target coordinate system for the entire map.

Advanced (optional) Lessons

Optional Advanced Tutorial Lessons are available to demonstrate additional features of **Surfer**.

A Note about the Documentation

Various font styles are used throughout the **Surfer** quick start guide and online help. **Bold** text indicates commands, dialog names, tab names, and page names. *Italic* text indicates items within a dialog or the Contents or Properties windows such as section names, options, and field names. For example, the **Save As** dialog contains a *Save as type* list. Bold and italic text may occasionally be used for emphasis.

Also, commands appear as **Home | New Map | Contour**. This means, "click or scroll to the **Home** tab at the top of the plot window, then click on the **Contour** command within the **New Map** command group." The first word is always the menu or ribbon tab name, followed by the command group, and finally the command name within the menu list or on the ribbon.

Sample File Location

The sample files used in the tutorial lessons are located in the **Surfer** SAMPLES folder. The SAMPLES folder is located by default at C:\Program Files\Golden Software\Surfer 15\Samples. Note, if you are running the 32-bit version of **Surfer** on a 64-bit version of Windows, the SAMPLES folder is located at C:\Program Files (x86)\Golden Software\Surfer 15\Samples, by default.

Starting Surfer

To begin a **Surfer** session:

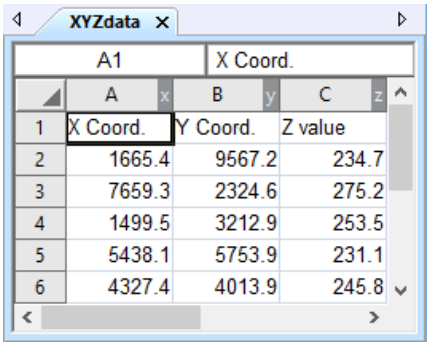
1. Navigate to the installation folder, which is C:\Program Files\Golden Software\Surfer 15 by default.
2. Double-click on the Surfer.exe application file.
3. The Welcome to Surfer dialog appears. Click *New Plot* to open a new blank plot window.
4. A new empty plot window opens in **Surfer**. This is the work area where you can produce grid files, maps, and modify grids.

If this is the first time that you have opened **Surfer**, you are prompted to license Surfer. Activate your Single-User product key, select a license server, or continue using the trial. Your product key is located in the download instructions email. You may also access your product key at your Golden Software My Account page.

If you have already been working with **Surfer**, open a new plot window before starting the tutorial. To open a new plot window, click the File | New | Plot command.

Lesson 1 - Viewing and Creating Data

An XYZ data file is a file containing at least three columns of data values. The first two columns are the X and Y coordinates for the data points. The third column is the Z value assigned to the XY point. Although it is not required, entering the X coordinate in column A, the Y coordinate in column B, and the Z value in column C is a good idea. **Surfer** looks for these coordinates in these columns by default. You can customize the default columns for XYZ data with the Assign XYZ Columns worksheet command. **Surfer** requires the use of decimal degree Latitude (Y) and Longitude (X) values when using Latitude and Longitude values.

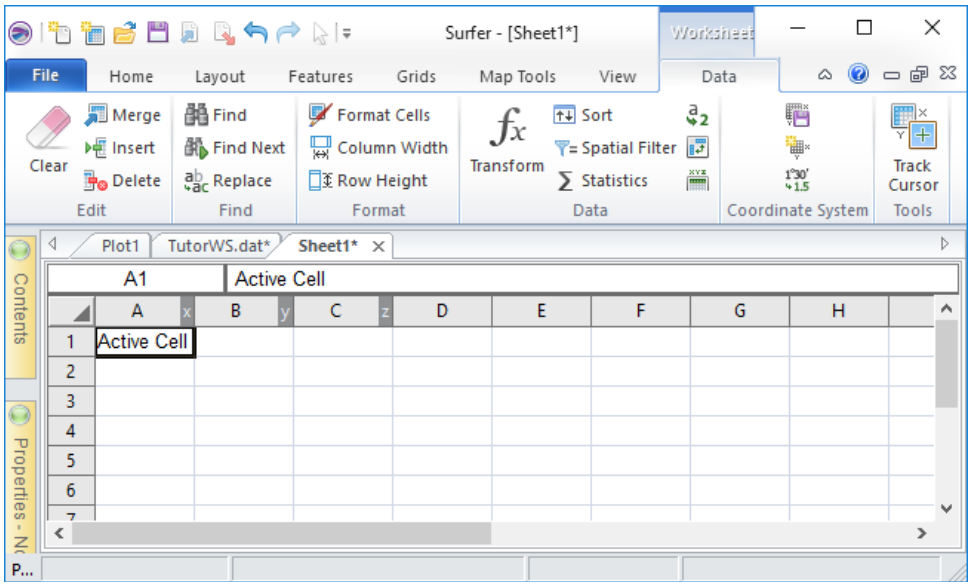


A simple XYZ data file. Notice that the X, Y, and Z data are placed in columns A, B, and C, respectively.

Creating a New Data File - Tutorial

The **Surfer** worksheet can also be used to create a new data file. To open a worksheet window and begin entering data:

1. Click the File | New | Worksheet command, click the  on the quick access toolbar, or press CTRL+W on the keyboard. A new empty worksheet window is displayed.
2. Data is entered into the active cell. The active cell is selected by clicking on the cell or by using the arrow keys to move between cells. The active cell is indicated by a heavy border and the contents of the active cell are displayed in the active cell edit box. The active cell location box shows the location of the active cell in the worksheet. Letters are the column labels and numbers are the row labels.
3. When a cell is active, enter a value or text, and the information is displayed in both the active cell and the active cell edit box.
4. The BACKSPACE and DELETE keys can be used to edit data as you type.
5. To preserve the typed data in the active cell, move to a new cell. Move to a new cell by clicking a new cell with the pointer, pressing one of the arrow keys, or pressing ENTER. Press the ESC key to cancel without entering the data.



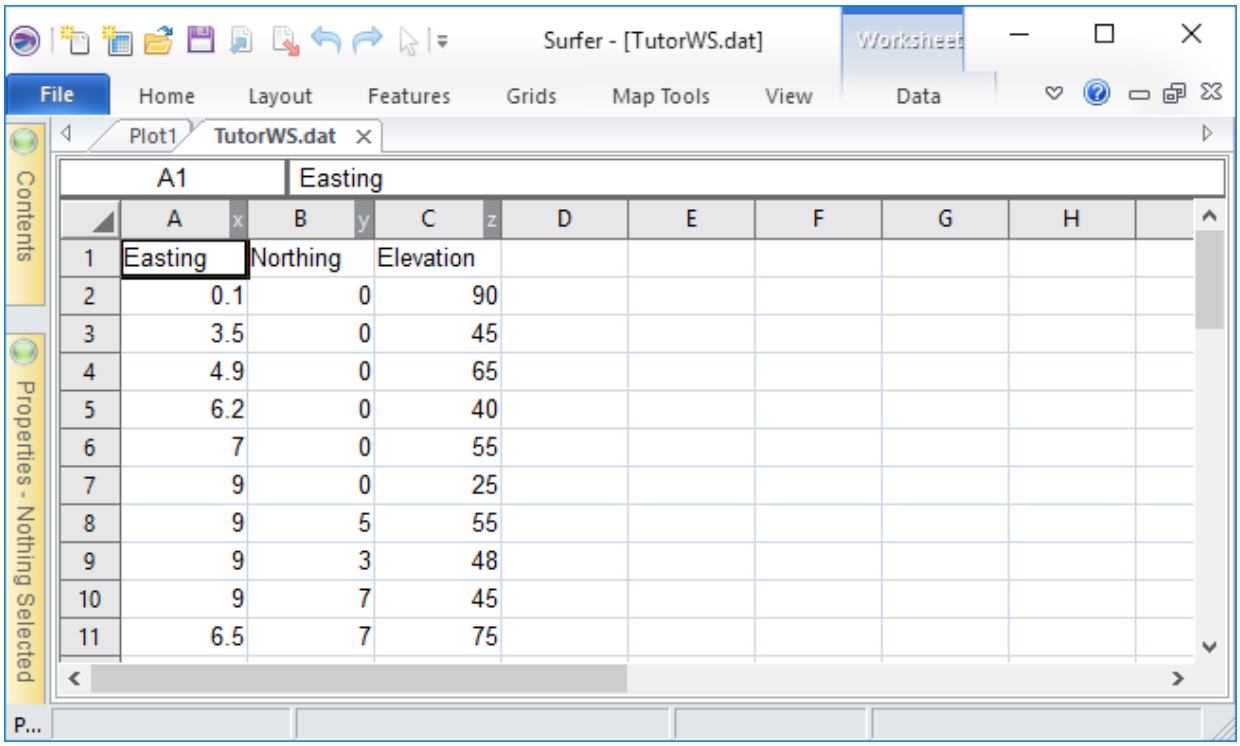
Data are entered into the active cell of the worksheet. Click on the text "A1" or "Active Cell" for the definition of the active cell, active cell location, and the active cell edit box.

Opening an Existing Data File - Tutorial

To look at an example of an XYZ data file, you can open any sample data file in a worksheet window:

1. Click the File | Open command, click the button on the quick access toolbar, or press CTRL+O on the keyboard to open the **Open** dialog.
2. If you are not in the *Samples* folder, browse to it. By default, the *Samples* folder is located in C:\Program Files\Golden Software\Surfer 15. In the list of files, click *TutorWS.dat*.
3. Click *Open* to display the file in the worksheet window.

Notice that the X coordinate (Easting) is in column A, the Y coordinate (Northing) is in column B, and the Z value (Elevation) is in column C. Although it is not required, row 1 contains header text, which is helpful in identifying the type of data in the column. When a header row exists, the information in the header row is used in the **Properties** window when selecting worksheet columns.



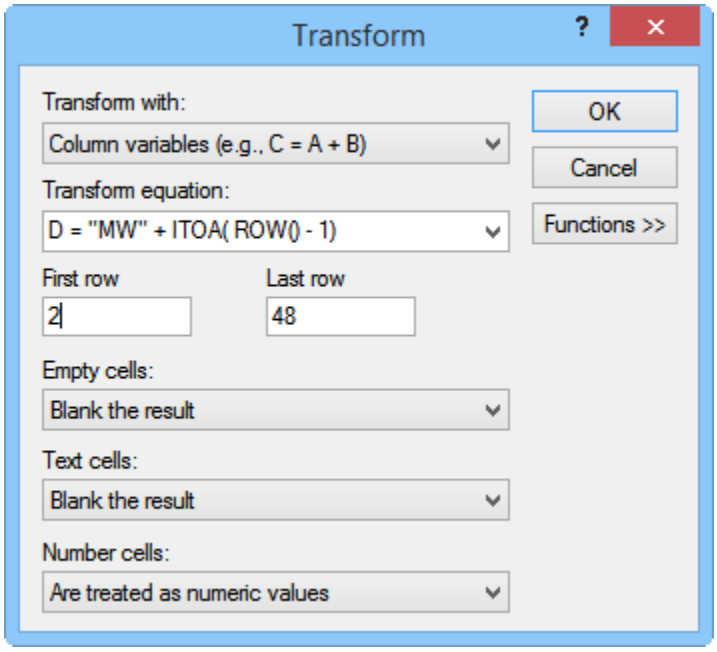
When a data file is displayed, the name of the file is shown in the title bar and in the worksheet tab. In this file, row 1 contains descriptive information about each column of data.

Adding New Data - Tutorial

To edit any value, click in the cell to select it. Type information and the existing value is overwritten. Data can be transformed, sorted, or filtered in this window. New columns can be added. For instance, an ID column can be added which labels each row with a unique identifier. To do this,

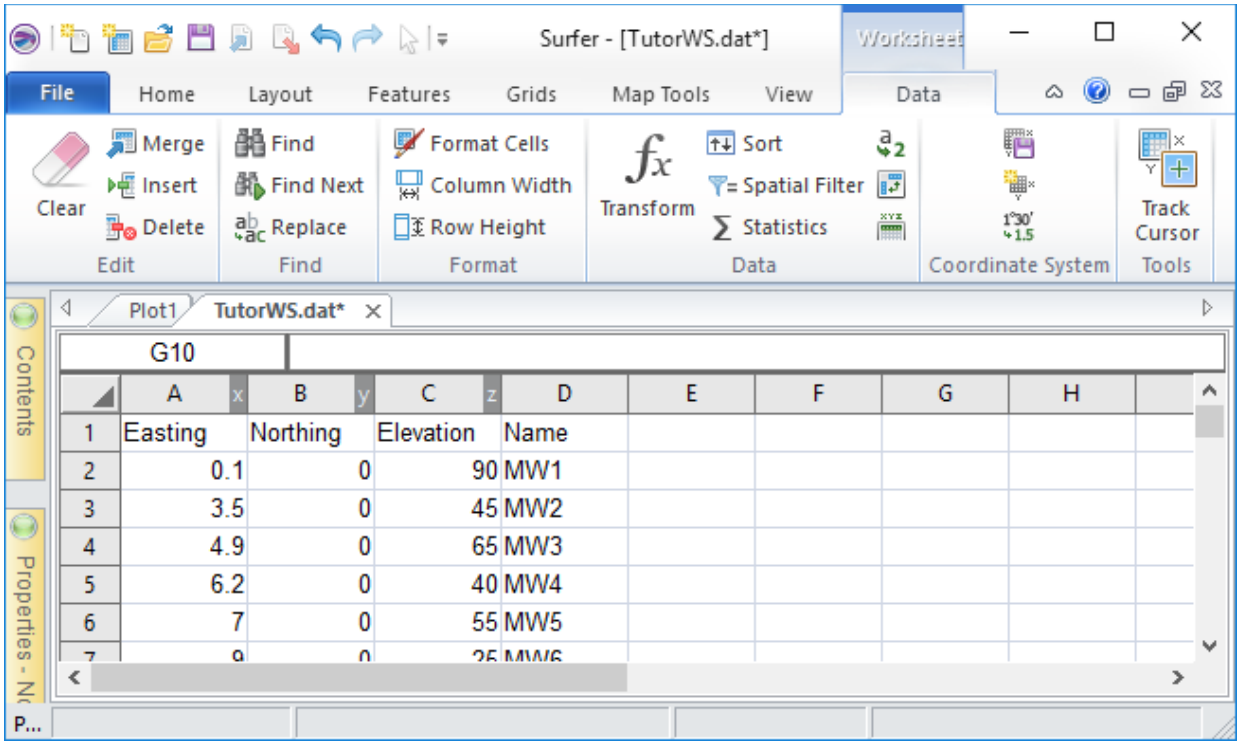
1. Click in cell D1.
2. Type the text *Name*.
3. Press ENTER to save the text and move the active cell to cell D2.
4. Click the Data | Data | Transform command.

5. In the **Transform** dialog, set the Transform with to Column variables (e.g., C = A + B).
6. Set the *Transform equation* to *D = "MW" + ITOA(ROW() - 1)*. This equation will use a prefix of "MW" before a number. The number is the row number minus 1 for each row. The ITOA function converts the ROW() -1 number to text.
7. Set the *First row* to 2.
8. Set the *Last row* to 48 (the last row in the worksheet).
9. Leave the *Empty cells*, *Text cells*, and *Number cells* set to the defaults.
10. Click *OK* and each row will have a unique identifier.



*Set the options in the **Transform** dialog as above to add a unique identifier to each row.*

The worksheet should now have a unique identifier column:



The new column contains a unique identifier for each row. This can be used for labels later in the tutorial.

Saving the Data File - Tutorial

When you have completed entering all of the data, the file can be saved.

1. Click the File | Save As command. The **Save As** dialog is displayed.
2. Navigate to the folder in which you wish to save the tutorial, for example the *Documents* folder.
3. In the *Save as type* list, choose the *DAT Data (*.dat)* option.
4. Type *Tutorial* into the *File name* box.
5. Click the *Save* button and the Data Export Options dialog opens.
6. Accept the defaults in the **Data Export Options** dialog by clicking *OK*.

The file is saved in the *Data .DAT* format as *Tutorial.dat*. The name of the data file appears in the title bar and on the worksheet tab.

Lesson 2 - Using the Map Wizard

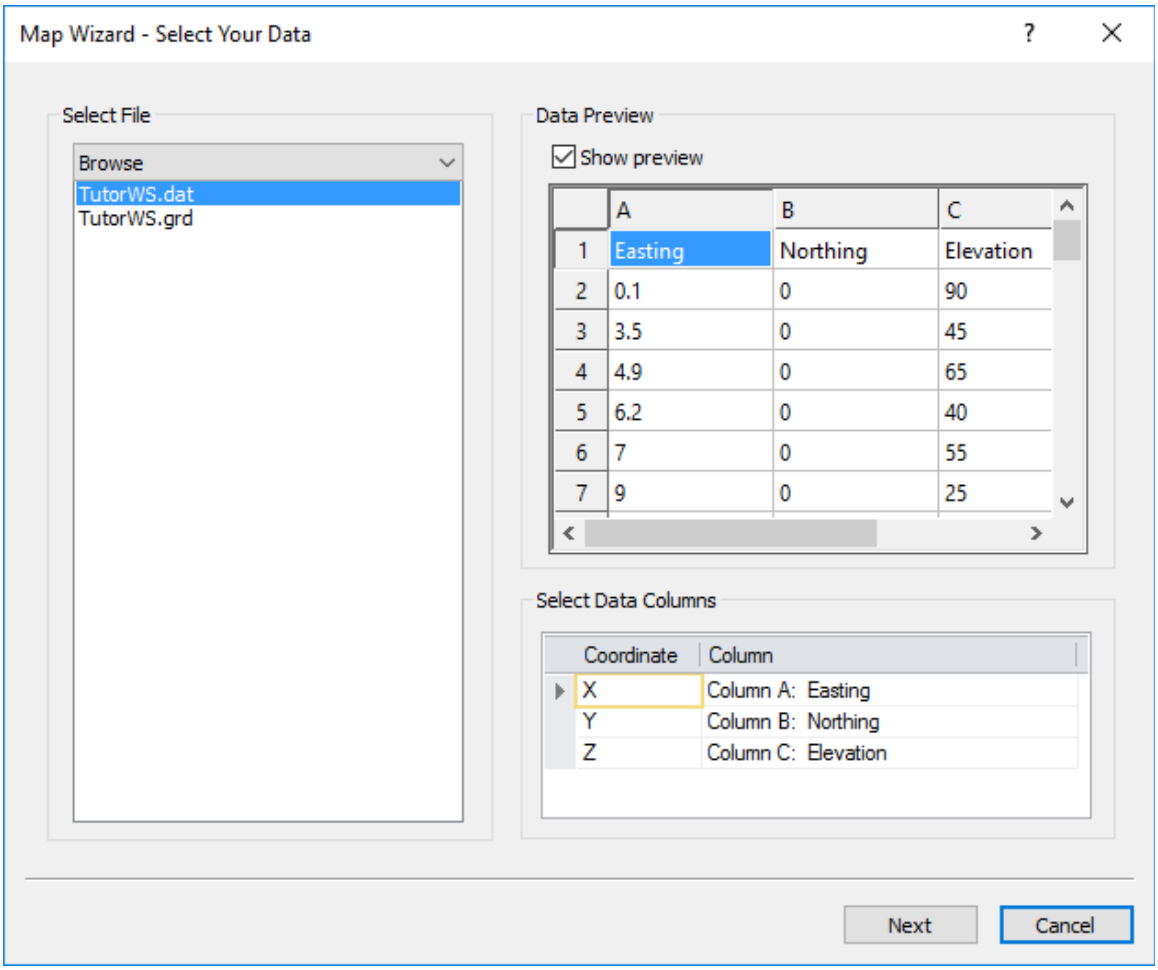
Now that we have saved the data file, we will use the Map Wizard to create a grid and a map with contour and post layers. The **Map Wizard** steps through the map creation process from raw data to a map with one or more layers. The **Map Wizard** is useful for creating multiple map types from a single data file. The **Map Wizard** can use a data, grid, or boundary file as an input file.

1. If you have the worksheet window open, click on the **Plot1** tab above the worksheet window. Alternatively, you can create a new plot window with the **File | New | Plot** command.
2. Click the **Home | Wizard | Map Wizard** command.

The **Map Wizard** opens to the first page, the Select Your Data page. The remaining topics in Lesson 2 will step through the pages of the Map Wizard.

Select Your Data - Tutorial

The first page in the Map Wizard is the **Select Your Data** page. Here you select the XYZ data, grid, vector data, or image file you wish to use to create your map.

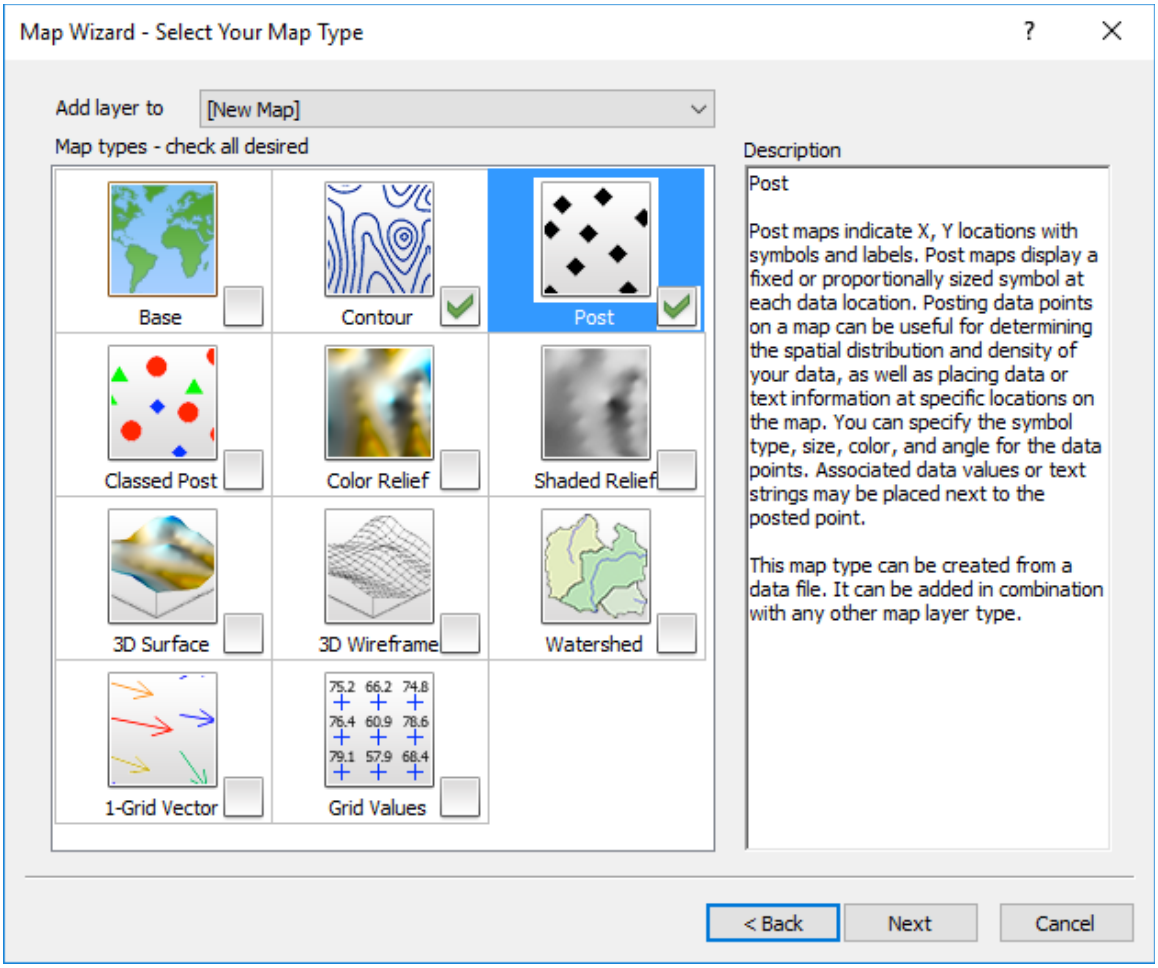


*Select the data file from Lesson 1 in the **Select Your Data** page.*

1. By default, the **Map Wizard** displays the sample files in the *Select File* list. Click *Sample files* and select *Browse* from the list. The Open dialog is displayed. You can also display *Recent files* and *Project files* in the *Select File* list.
2. In the **Open** dialog, navigate to the *Tutorial.dat* file you saved in *Lesson 1 - Saving the Data File*.
3. Select the *Tutorial.dat* file and click *Open*. The *Tutorial.dat* file is loaded in the *Data Preview* section. The column letters and header row information is displayed in the *Select Data Columns* list. By default the *X* coordinate is column A, the *Y* coordinate is column B, and the *Z* coordinate is column C. Any other valid input files in the folder are also displayed in the *Select File* list.
4. Click *Next* in the **Map Wizard**.

Select Your Map Type - Tutorial

Now that you have selected a data file and specified the data columns, we can select which map layers will be included in the map on the **Map Wizard - Select Your Map Type** page.



*Select the map layers you wish to create with the **Map Wizard**.*

XYZ data files are the most flexible input file type. All of the layers are available in the **Select Your Map Type** page after selecting an XYZ data file on the **Select Your Data** page. Some map types will be unavailable after choosing an image, vector, or grid file on the **Select Your Data** page. The data file type and the map type selections determine if a map is created after the **Select Your Map Type** page or if a grid must be created first.

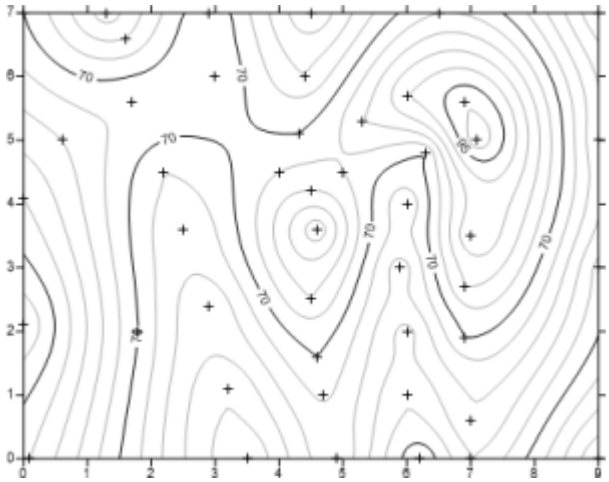
For this tutorial we will include a contour and post layer in our map:

1. Click the *Post* map in the *Map types - check all desired* list to select it. Notice a description is displayed in the *Description* field.
2. Click the *Contour* map in the *Map types - check all desired* list to select it. The *Finish* button changes to *Next*. This is because we must create a grid from the XYZ data file before we can create a contour map.
3. Click *Next*.

Select Gridding Parameters - Tutorial

Grid files are required to produce a grid-based map. Grid-based maps include contour, color relief, shaded relief, vector, viewshed, watershed, 3D wireframe, and 3D surface map layers. If necessary, grid files are created with the **Map Wizard**. Grid files can also be created at any time by using the Home | Grid Data | Grid Data command.

A grid must be created from the *Tutorial.dat* file to display a contour map. The **Map Wizard - Select Gridding Parameters** page controls the gridding options and output grid file name. The **Select Gridding Parameters** page displays a preview color relief map for you to quickly compare gridding methods. We will create a grid with the default gridding method and options.



A map is created with default contour and post layers.

1. Verify that the *Gridding method* is set to *Kriging*. If it is not, click the current gridding method and select *Kriging* from the list.
2. Verify that the Assign NoData outside convex hull of data option is not checked.
3. Verify that the *Output grid file* is named *Tutorial.grd* and in the desired directory, for example your *Documents* folder. If it is not, click and select the desired path for the created grid file.
4. Click *Finish*.

The grid is created and saved, and a map is created in the plot window with a contour and post layer. The map uses the default display properties. The **Map Wizard** is a useful tool for quickly creating maps and grids. However, it is not necessary to use the **Map Wizard**. Grids can be created with the **Grid Data** command, and maps and layers can be created with the **Home | New Map** and **Home | Add to Map | Layer** commands.

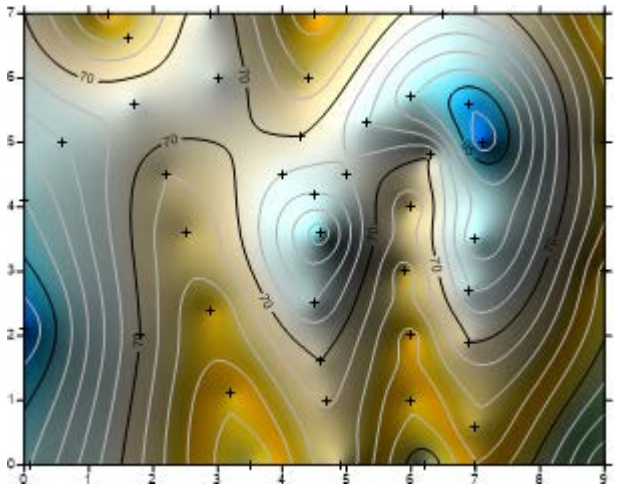
Adding a Color Relief Layer - Tutorial

Map layers allow you to add multiple maps to an existing map to create one map object displaying a variety of map types. The map uses a single set of axes and the map layers are positioned according to the target coordinate system. For example, if you have a contour map of weather data, you can add a post map layer displaying the location and station names of each data collection station.

Multiple map layers can be created at one time when using the **Map Wizard**. However, map layers can also be added to an existing map by selecting the map and using the **Home | Add to Map | Layer** command, by dragging an existing map layer from one map object to another, or by selecting all maps and using the **Map Tools | Map Tools | Overlay Maps** command. Now we will add a color relief layer to the map:

1. Click on the *Map* object in the Contents window, or click on the map in the plot window, to select it.
2. Click the **Home | Add to Map | Layer | Color Relief** command. The Open Grid dialog is displayed.

3. Navigate to the *Tutorial.grd* file you created in *Select Gridding Parameters* and select it.
4. Click *Open* to add the color relief layer to the map.

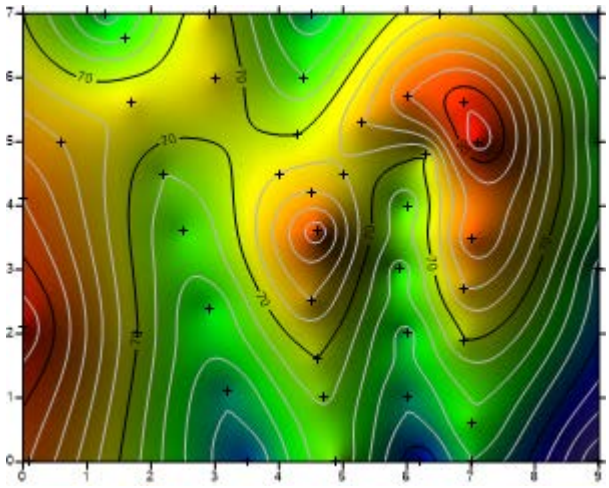


Now a color relief layer is also displayed in the map.

The color relief layer is added to the map and uses the default display properties. In Lesson 3, we will edit the appearance of the map by changing the color relief, contour, and post layer properties.

Lesson 3 - Changing Layer Properties

The map's appearance is mainly determined by the properties of the map layers. This lesson will demonstrate a few of the common properties for controlling the display of contour, post, and color relief layers. However, each map type has many properties and display options. A description and explanation is included for every property in the help.



This color relief layer uses the Rainbow colormap.

We will begin by changing the color relief layer's colors:

1. Click the *Color Relief-Tutorial.grd* layer in the Contents window to select it. When multiple layers are overlaid in a single map, it is often easier to select the desired layer in the

Chapter 3 - Data Files and the Worksheet

Data files contain the raw information used to create a grid file, perform residual calculations, or produce post maps. Each record in a data file occupies a single row and is comprised of at least two values (X, Y) for post maps and at least three values for gridding (X, Y, Z). The X, Y, and Z values are each placed in separate columns. The X and Y coordinates define the position of the point on the map, and the Z value defines the value assigned to the specific X, Y location. Common examples of X, Y coordinates include longitude and latitude, easting and northing, or UTM (Universal Transverse Mercator) coordinates. The Z data might be topographic elevation, water depth, chemical concentration, temperature, or any other quantity amenable to mapping.

Data files can be created in the **Surfer** worksheet, a text editor, or any program that can produce files in one of the supported file formats. Regardless of the program used to create your data files, you must save the file on disk prior to performing any **Surfer** operation requiring a data file, including the gridding operation. **Surfer** reads data only from a data file in one of the recognized formats.

It is not necessary to open a data file in the worksheet in order to use the data file for a command (i.e. **Grid | Data**). If you want to view or alter the data in a data file, you can use the **File | Open** command to gain access to the worksheet data.

Surfer requires the use of decimal degree values when using Latitude and Longitude data.

XYZ Data Files

XYZ data files contain the raw data **Surfer** interprets to produce a grid file. Before you create a grid file in **Surfer**, you must create an XYZ data file. XYZ data files must be organized in column and row format. By default, **Surfer** expects the X data to be contained in column A, the Y data in column B, and the Z data in column C. However, the data can be placed in any order in any column.

Portions of two simple data files are shown below. The order of the data in the file is not important. These examples contain descriptive headers in Row 1 of each column. Such information is helpful but not required by **Surfer** to create a grid file. When text appears in Row 1 of a column, this text appears in list boxes in various **Surfer** dialogs as column titles. If a number resides in Row 1, it is not incorporated into the dialogs, and instead, the column heading (such as column B) is displayed.

	A	B	C
1	0.1	0	90
2	3.5	0	45
3	4.9	0	65
4	6.2	0	40
5	7	0	55
6	9	0	25
7	9	5	55
8	9	3	48

This is a simple XYZ data file.

	A	B	C
1	Longitude	Latitude	Elevation
2	-109	39.205	1464
3	-108.965	39.337	1524
4	-108.93	39.389	1385
5	-108.895	39.526	1583
6	-108.86	39.588	1445
7	-108.825	39.795	1371
8	-108.79	40.003	1371

This is another example of an XYZ data file with header information in row 1 of each column in the data file.

Missing Entries

Rows with non-numeric entries (empty cells or text) in any of the X, Y, or Z columns are excluded when performing various tasks, including gridding or transforming data in the worksheet. If there is no Z information for a particular XY location, you can leave the Z cell blank for that row. In the example shown here, there are two data records without Z values. These records are not considered during the gridding operation.

	A	B	C
1	X Data	Y Data	Z Data
2	0.1	0	90
3	9	3	48
4	1.3	7	
5	4.7	1	66
6	1.7	5.6	75
7	6	1	
8	2.5	3.6	60

Blank Z column cells are ignored when gridding a data file.

Multiple Columns of Information for Additional Maps

Data files can contain up to one billion columns. Since you can specify the columns to be gridded, your X, Y, and Z values can occupy any three columns. This allows you to have columns containing other information particular to each point. The data file can contain several Z columns, so you can produce several contour maps using the same XY coordinates. For example, you might have concentrations of different contaminants at each sample location. All the contaminant concentration data can be placed in the same data file.

	A	B	C	D	E	F	G	H
1	X Coord	Y Coord	SS-A	SH-A	SLT-B	SH-B	SS-B	SA-C
2	4345	14005	1432	1478	1503	1593	1627	1645
3	4355	14015	1437	1483	1501	1589	1625	1640
4	4365	14025	1445	1479	1498	1592	1637	1638
5	4375	14035	1434	1466	1515	1586	1626	1635
6	4385	14045	1435	1476	1510	1597	1616	1637
7	4389	14055	1448	1475	1512	1601	1603	1638

This is an example of an XYZ data file containing several columns of Z data. You could use this file to create several different grid files, where each uses the same XY coordinates, but different Z data.

Additional Information in Data Files

Data files may contain information in addition to the X, Y, and Z values. For example, when posting data with the **Home | New Map | Post** command, additional columns can be used to specify the symbol, the rotation angle, the symbol color, labels, etc. The following is an example of such a data file. Columns A, B, and C contain the X, Y, and Z data used to produce a contour map of depth to the water table. Columns D, E, and F contain information used to create an overlaying post map.

Plot1* Sheet1.dat

B10 7

	A x	B y	C z	D	E	F
1	Easting	Northing	Elevation	Symbol set: index	Color	Angle
2	0.1	0	90	Arial:65	Red	45
3	3.5	0	45	Arial:66	green	30
4	4.9	0	65	Arial:67	blue	170
5	6.2	0	40	GSI Default Symbols:4	purple	18
6	7	0	55	GSI Default Symbols:8	majestic pu	145
7	9	0	25	GSI Default Symbols:14	Red	22

A data file used to create a post map or a classed post map can contain several columns of data. Each column can have a different effect on the posted data points.

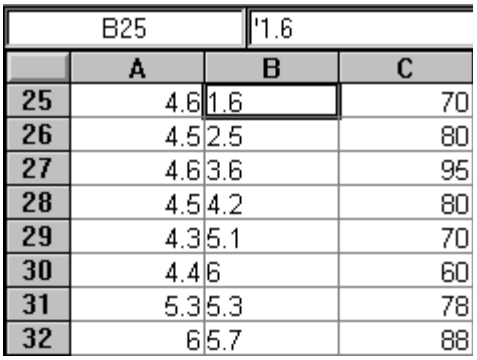
Data as Numbers or Text

Worksheet data are in one of two forms: numbers or text. Grid file creation, statistics, post maps, and other operations require data as numbers. Text data (even if it contains numeric digits) can be used for labels in **Surfer**, but it cannot be used to create grids or in any operation requiring numbers.

Numbers can consist of digits (0 - 9), decimal points (.), the letters "e," "d," "E," or "D" (indicating an exponent), and the plus (+) or minus (-) sign. If you type any characters other than these when entering a number (or type any of the special characters more than once), **Surfer** automatically converts the cell entry to text. For example, if your longitude data appears as 104.5 W in a worksheet cell, it is interpreted as text and cannot be used to grid data. To successfully read this data, use the -104.5 format to indicate a location 104.5 degrees west of the prime meridian. If a number has if formatted as text and should be formatted as a number, highlight the cell or group of cells to select them and click the Text to Number command.

You can also convert numeric data to text by typing a single quotation mark (') in front of the number. **Surfer** does not place the single quotation in the worksheet cell, however the single quotation is visible in the Active Cell Edit Box.

By default, numeric data is right justified in a cell, and text is left justified. Cell entries, whether numeric or text, can be justified by specifying the desired alignment using the options on the **Alignment** page of the Format Cells dialog. Use the Text to Number command to remove text formatting.



B25	'1.6	
	A	B	C
25	4.6	1.6	70
26	4.5	2.5	80
27	4.6	3.6	95
28	4.5	4.2	80
29	4.3	5.1	70
30	4.4	6	60
31	5.3	5.3	78
32	6	5.7	88

Notice that column B is left aligned. This means the numbers are formatted as text. When a cell is highlighted, an apostrophe appears in the active cell edit box, also indicating that the number is formatted as text.

Data File Formats

Surfer can import and export data in several data file formats. A variety of commands in the plot document, worksheet document, and grid node editor can be used to import and export data. The commands are summarized below:

Import Data File Formats

- File | Import in the plot document
- Data | Edit | Merge in the worksheet document
- File | Open in the plot, worksheet, or grid editor

Export Data File Formats

- File | Export in the plot document
- File | Save As in the plot document
- Grids | Edit | Convert in the plot document
- File | Save As in the grid editor
- File | Save As in the worksheet document

Date/Time Formatting

In addition to numbers and text, dates and times are format types in **Surfer**. Dates and times can be used to create a grid, as axis and plot labels, and to set axis limits.

Using Date/Time Formatting

To use dates and times in **Surfer**, the data need to be formatted as dates and times. One way to format data in **Surfer** is to use the worksheet. The worksheet can be accessed with the File | New | Worksheet or File | Open command. Highlight the column containing dates and times and select Data | Format | Format Cells to set the column as date/time in the worksheet. On the **Number** tab, select *Date/time* as the *Type*. Next, type the appropriate *Date/Time format* option, or click the ... button and select or create a date/time format in the Date/Time Format Builder dialog.

Once the formatting is set to date/time, you can use the date/time information just as you would use numbers in **Surfer**:

- you can create a post map of the data using date/time values
- you can set the map limits using date/time values
- you can grid date/time values

Date/time information can also be used as labels anywhere in the map layer or as axis tick labels.

Date/Time formats are made of combinations of year, month, day, hours, minutes, seconds, BC/AD or BCE/CE designation,and AM/PM designation. Years are shown as yy or yyyy. Months are shown as M, MM, MMM, MMMM, or MMMMM. Days are shown as d, dd, ddd, or dddd. Hours are shown as h, hh, H, HH, or [h]. Minutes are shown as m, mm, or [mm]. Seconds are shown as ss, ss.0, ss.00, ss.000, ss.0000, or [ss]. AM/PM designation is shown as tt or TT. BC/AD designation is shown as gg or GG. BCE/CE designation is shown as g, G, ggg, or GGG. See the Date Time Formats help topic for examples of date/time formats.

Date/Time Formatting Tips

- In the worksheet, save data files containing date/time formatting as Excel files to preserve the date time formatting as seen in the worksheet.
- You can save date/time-formatted data files as ASCII files (.DAT, .CSV, .TXT, .BNA, or BLN). Sometimes this is necessary if you exceed the Excel row or column limits. When opening the file in **Surfer's** worksheet, you can make the serial numbers appear as dates by using **Data | Format | Format Cells**.
- If you have formatted the data as date/time in another spreadsheet program such as Excel, the data are formatted as date/time in **Surfer**.
- Whenever possible, enter and display dates and times in one of the many calendar formats, e.g., "6/14/2009" or "14-June-2009", and let the software handle converting to/from internal numeric representations.
- When the recognized format is ambiguous (i.e. 10/7/12), the month, day, and year order is determined by the Windows locale. In some countries, this will be recognized as M/d/yy, in others as d/M/yy, and in others as YY/M/d. It is important to use non-ambiguous date/time formats when the Windows locale may change.
- The year 0 is defined, according to the ISO 8601:2004 standard.
- If dates/times occur before 1/1/0000, use the BC or BCE suffix after the date. So, Alexander III of Macedon's birthday would be listed as 20-July-356 BCE in the worksheet. Using AD or CE is not necessary and the worksheet will automatically remove these in dates after 1/1/0000.
- When a two digit year is input in the worksheet (00 to 99), it means the year in the current century. For instance, inputting 11/4/13, indicates that the year is 2013, not 0013. In order to have the year 0013, the full four digits (0013) must be input for the date. So, the date would be input as 11/4/0013 CE for November 4, 0013 CE or 11/4/0013 BCE for November 4, 0013 BCE.

Working with Date/Time Values

Date/time values can be displayed as labels on axes, map layers, and used in setting limits on maps. Below are some methods available to work with date/time formats.

Formatting Data as Date/Time

To format cells in the worksheet as date/time, open the worksheet and select all of the cells that should be date/time format. Click the **Data | Format | Format Cells** command. In the Format Cells dialog, select *Date/time* as the *Type* and type the date/time format string into the *Date/Time format* field. Click OK and the selected cell is formatted as date/time. Alternatively, click the  button to create the date/time format in the Date/Time Format Builder dialog. Save to a format, such as an Excel file, that accepts date/time formats to retain the date/time format.

Gridding Date/Time Values

Any worksheet column containing numbers, dates, or times can be used for gridding. When using date/time formats for any of the *Data Columns*, the values are stored in the grid as numbers, not in date/time format. To display date/time formats on the map, select the appropriate map part (axis, map layer, or map) and set the date/time label format.

Formatting Axes to Display Date/Time

Any axis can be changed to display dates or times for axis labels. To display date or time labels, click on the axis to select it. In the **Properties** window, click on the General tab. In the *Labels* section in the *Label Format* section, change the *Type* to *Date/time*. Then, set the *Date/Time format* to the desired label formats.

Formatting Contour Maps to Display Date/Time Labels

Any contour map label can be changed to display dates or times for axis labels. To display date or time labels, click on the contour map layer to select it. In the **Properties** window, click on the Levels tab.

For simple or logarithmic level methods: In the *Labels* section in the *Label Format* section, change the *Type* to *Date/time*. Then, set the *Date/Time Format* to the desired label formats.

For advanced level methods: Click the *Edit Levels* button next to the *Contour levels* command. In the **Levels for Map** dialog, click the *Label* button. Click the *Format* button to open the Label Format dialog. Change the *Type* to *Date/Time*. Then, set the *Date/Time Format* to the desired label formats. Click *OK* in all dialogs and the labels update.

Formatting Post or Classed Post Maps to Display Date/Time Labels

Any post map or classed post map label can be changed to display dates or times for axis labels. To display date or time labels, click on the post map layer or classed post map layer to select it. In the **Properties** window, click on the Labels tab. In the *Label Set 1* section, set the *Worksheet column* to the column that contains the date/time values. In the *Label Format* section, change the *Type* to *Date/time*. Then, set the *Date/Time Format* to the desired label formats.

Setting Map Limits with Date/Time

When using date/time formats for any of the axis labels, the minimum and maximum on the **Limits** tab are entered in date/time format. To change the map limits, click on the *Map* object to select it. In the **Properties** window, click on the Limits tab. Highlight the existing date/time value in any of the *xMin, xMax, yMin,* or *yMax* boxes and enter the minimum or maximum date/time value. For instance, 02/02/2014 12:00:00 AM can be entered into the *xMin* option. The map limits must be entered in M/d/yyyy hh:mm:ss TT format.

Grid Residuals

The Grids | Calculate | Residuals command takes an existing grid and an X,Y,Z column from a data file and computes the residuals at the locations specified in the data file. The residual value is written to a new column in the worksheet. If the input Z values in the worksheet are in date/time format, then the residuals are the difference between the Z grid value and the input date/time Z value. This is not a date/time format, but is rather the difference between the times, signifying a time duration. The units are days.

Date Time Formats

Date and time formats can be set from the worksheet, from labels, and from axes. In addition, date and time formats can be used for data columns when creating post maps or when gridding data. Date and time options are case sensitive.

When dates are parsed during input/import, the month and day of week names must match those of the local language as set in the Windows Control Panel, otherwise the entry will not be recognized as a valid date and will be treated as a text string.

Date/Time formats are made of combinations of locale, year, month, day, hours, minutes, seconds, BC/AD or BCE/CE designation, and AM/PM designation. Years are shown as yy or yyyy. Months are shown as M, MM, MMM, MMMM, or MMMMM. Days are shown as d, dd, ddd, or dddd. Hours are shown as h, hh, H, HH, or [h]. Minutes are shown as m, mm, or [mm]. Seconds are shown as ss, ss.0, ss.00, ss.000, ss.0000, or [ss]. AM/PM designation is shown as tt or TT. BC/AD designation is shown as gg or GG. BCE/CE designation is shown as g, G, ggg or GGG.

To add new date/time designations, use any combination of the following codes:

d	9	Single digit day, excluding leading zero
dd	09	Double digit day, including leading zero
ddd	Wed	Shortened day of week name
dddd	Wednesday	Full day of week name
M	7	Single digit month, excluding leading zero
MM	07	Double digit month, including leading zero
MMM	Jul	Shortened month name
MMMM	July	Full month name
MMMMM	J	First letter of month name
yy	98	Two digit year
yyyy	1998	Full year
g		Before Common Era designator - Includes space and bce or nothing if ce, lower case
gg	ad	BC/AD designator - Includes space and bc or ad, lower case
ggg	ce	Before Common Era designator - Includes space and bce or ce, lower case

G		Before Common Era designator - Includes space and BCE or nothing if CE, upper case
GG	AD	BC/AD designator - Includes space and BC or AD, upper case
GGG	CE	Before Common Era designator - Includes space and BCE or CE, upper case
h	6	Single digit hours - 1-12, excluding leading zero
hh	06	Double digit hours - 01-12, including leading zero
H	18	Hours - 0-23 military, excluding leading zero
HH	18	Hours - 00-23 military, including leading zero
[h]	1003914	Hours portion of total time, excludes leading zeros
m	45	Minutes - 0-60, excluding leading zero
mm	45	Minutes - 00 to 60, including leading zero
[mm]	45	Minutes portion of total time, includes leading zeros
ss	44	Seconds - 0-60, rounded to the nearest second
ss.0	44.1	Seconds - 0-60, rounded to the nearest tenth of a second
ss.00	44.12	Seconds - 0-60, rounded to the nearest hundredth of a second
ss.000	44.123	Seconds - 0-60, rounded to the nearest millisecond
ss.0000	44.12345	Seconds - 0-60, maximum precision
[ss]	44	Seconds portion of total time, includes leading zeros
tt	pm	am or pm designator, lower case
TT	PM	AM or PM designator, upper case
\		escape character - output next character verbatim
'...'		output ALL characters between single quotes verbatim, including escape character
[$-xxxx]	[$-409]	xxxx is an up to four hex digit representation of a locale ID

Custom Date/Time Example

mm/dd/yy h:mm:ss tt	Month double digits, Day double digits, Year double digits, Hour in standard format, Minutes, Seconds and AM/PM designation	04/14/09 6:45:44 PM

When dates are parsed during input/import, the month and day of week names must match those of the local language as set in the Windows Control Panel, otherwise the entry will not be recognized as a valid date and will be treated as a text string.

When the recognized format is ambiguous (i.e. 10/7/12), the month, day, and year order is determined by the Windows locale. In some countries, this will be recognized as M/d/yy, in others

as d/M/yy, and in others as YY/M/d. It is important to use non-ambiguous date/time formats when the Windows locale may change.

The tables below show many examples of date/time format strings.

Date Formats

All rows below use the date September 7, 1998 for the *Example*.

Date/Time Code	Example	Description
(None)		Date not displayed
M/d/yy	9/7/98	Single digit month and day, two digit year, separated with /
MM/dd/yy	09/07/98	Double digit month, day, and year, separated with /
M/d/yyyy	9/7/1998	Single digit month and day, full year, separated with /
MMM dd, yyyy	Sep 07, 1998	Shortened month name, double digit day, full year, separated with spaces and comma
MMMM dd, yyyy	September 07, 1998	Full month name, double digit day, full year, separated with spaces and comma
MMMM-d-yyyy	September-7-1998	Full month name, single digit day, full year, separated with -
d MMMM yyyy	7 September 1998	Single digit day, full month name, full year, separated with spaces
d-MMM-yy	7-Sep-98	Single digit day, shortened month name, two digit year, separated with -
dd-MMM-yy	07-Sep-98	Double digit day, shortened month name, two digit year, separated with -
d-MMM-yyyy	7-Sep-1998	Single digit day, shortened month name, full year, separated with -
d-MMM	7-Sep	Single digit day, shortened month name, separated with -
MMM-yy	Sep-98	Shortened month name, two digit year, separated with -
MMM-yyyy	Sep-1998	Shortened month name, full year, separated with -
MMMM-yy	September-98	Full month name, two digit year, separated with -
MMMM-yyyy	September-1998	Full month name, full year, separated with -
MM-dd-yy	09-07-98	Double digit month and day, two digit year, separated with -
yyyy	1998	Full year
yyyy gg	1998 ad	Full year with lowercase bc/ad designation

yyyy GGG	1998 CE	Full year with uppercase BCE/CE designation
yy	98	Two digit year
MMMMM	S	First letter of month name
MMMM	September	Full month name
MMM	Sep	Shortened month name
MM	09	Double digit month
M	9	Single digit month
MMMMM-yy	S-98	First letter of month name, two digit year, separated with -
MMM-d	Sep-7	Shortened month name, single digit day, separated with -
M/d	9/7	Single digit month and day, separated with /
dddd	Monday	Full day of week name
ddd	Mon	Shortened day of week name
dd	07	Double digit day
d	7	Single digit day
d/M/yy	7/9/98	Single digit day and month, two digit year, separated with /
d.M.yy	7.9.98	Single digit day and month, two digit year, separated with .
dd/MM/yy	07/09/98	Double digit day and month, two digit year, separated with /
dd/MM/yyyy	07/09/1998	Double digit day and month, full year, separated with /
yy/MM/dd	98/09/07	Two digit year, double digit month and day, separated with /
yyyy-MM-dd	1998-09-07	Full year, double digit month and day, separated with -

Time Formats

All rows below use the time 2:45:44.12 PM for the *Example*.

Date/Time Code	**Example**	**Description**
(None)		Time not displayed
h:mm tt	2:45 PM	Hour in 0-12 (standard format), two digit Minutes 00 to 60, then a space and AM or PM
h:mm	14:45	Hour in 0-23 (military time), two digit Minutes 00 to 60

hh:mm	14:45	Two digit Hour 00-23 (military time), two digit Minutes 00 to 60
h:mm:ss tt	2:45:44 PM	Hour in 0-12 (standard format), two digit Minutes 00 to 60
h:mm:ss	14:45:44	Hour in 0-23 (military time), two digit Minutes 00 to 60, two digit Seconds 00 to 60
hh:mm:ss	14:45:44	Two digit Hour 00-23 (military time), two digit Minutes 00 to 60, two digit Seconds 00 to 60
m:ss	45:44	Single digit Minutes 0 to 60, two digit Seconds 00 to 60
mm:ss	45:44	Two digit Minutes 00 to 60, two digit Seconds 00 to 60
m:ss.0	45:44.1	Single digit Minutes 0 to 60, two digit Seconds 00 to 60, fractional seconds rounded to the nearest tenth of a second
mm:ss.0	45:44.1	Two digit Minutes 00 to 60, two digit Seconds 00 to 60, fractional seconds rounded to the nearest tenth of a second
h:mm:ss.000	14:45:44.12	Hour in 0-23 (military time), two digit Minutes 00 to 60, two digit Seconds, 00 to 60, fractional seconds with full precision
m:ss.000	45:44.12	Single digit Minutes 0 to 60, two digit Seconds 00 to 60, fractional seconds with full precision
mm:ss.000	45:44.12	Two digit Minutes 00 to 60, two digit Seconds 00 to 60, fractional seconds with full precision
[h]:mm:ss	865094:45:44	Total hours (day value plus hour value), two digit Minutes 00 to 60, two digit Seconds 00 to 60. Example Explanation: Date value 865080 = September 7, 1998 Hour value = 14, added to 865080 = 865094

Opening a Worksheet Window

You can view, enter, or modify data in the worksheet document.

To open a blank worksheet window:

- Click the File | New | Worksheet command in the plot document, grid editor, or worksheet document.
- Click the  button in the toolbar.
- Press the CTRL + W keyboard command.

To view worksheet data:

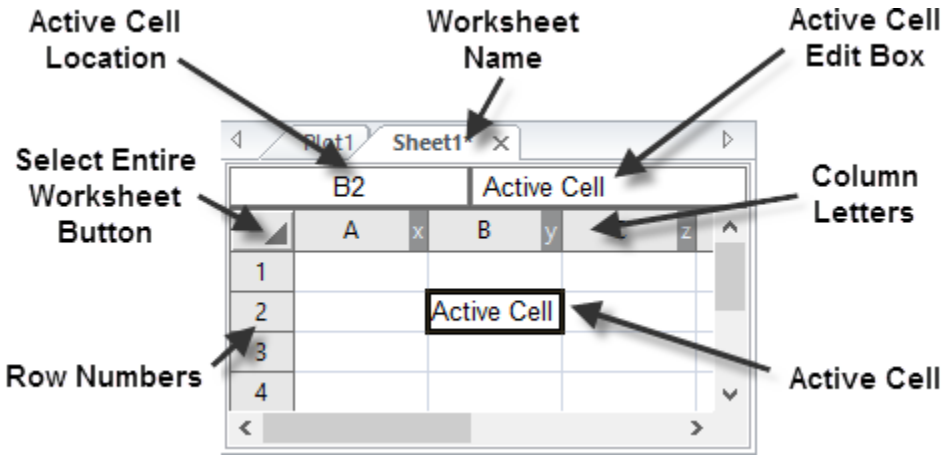
- Click the File | Open command in the plot document, grid node editor, or worksheet document and then select a data file.
- Click the  button in the toolbar. In the Open dialog, select a data file.
- Select the File | Open or File | Import command in the worksheet and then select a data file.
- If there is an open worksheet window, return to it at any time by clicking the desired worksheet tab.

To enter and modify worksheet data:

See Working with Worksheet Data for more information.

Worksheet Window

To enter data in a worksheet, click the File | Open command to open an existing data file or click the File | New | Worksheet command to create a blank worksheet. The components of the worksheet window are discussed below.

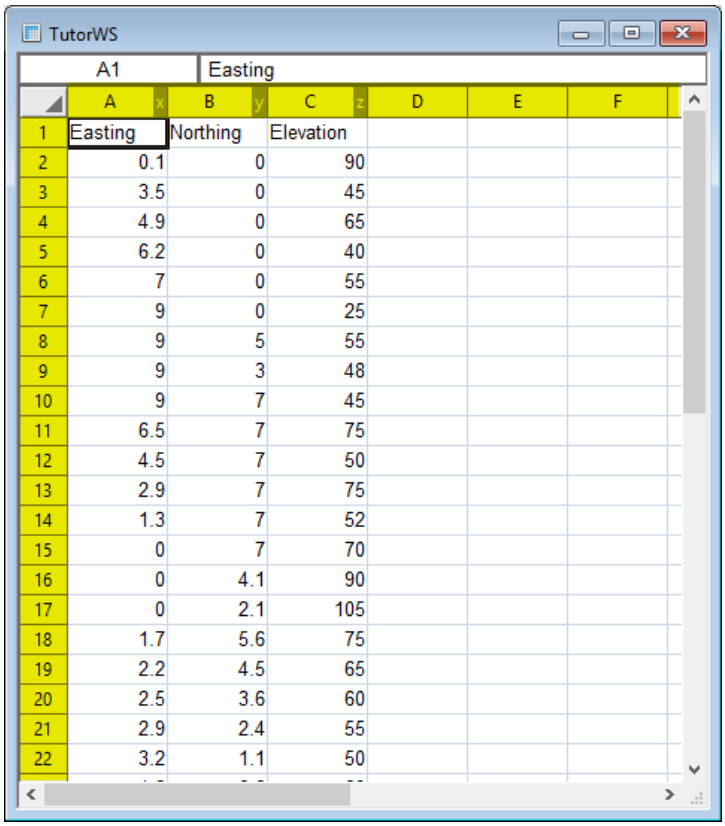


The components of a worksheet window shown above are described in the table below.

Component Name	Component Function
Column Letters	The letter that identifies a column of the worksheet.
Row Numbers	The number that identifies a row of the worksheet.
Active Cell	The cell highlighted with a bold outline. The active cell receives data input (numeric values or text strings) from the keyboard. Only one cell is active at a time.
Active Cell Location	The location of the active cell, specified by column letter and row number.
Active Cell Edit Box	The box displaying the data or text contained in the active cell. Data typed into an empty cell appears in both the edit box and the active cell.
Worksheet Name	The name of the data file displayed in the worksheet or the worksheet number prior to saving.
Select Entire Worksheet Button	The button used to select all cells in the worksheet. Located in the top left corner of the worksheet.

Row and Column Label Bars

The worksheet cells are located by column label bars (A, B, C…) or row label bars (1,2,3…). Click the label to select entire rows or columns, to change row height, to change column width, or to hide or unhide rows and columns. To select multiple rows or columns, drag the mouse over several adjacent labels.



	A	B	C	D	E	F
1	Easting	Northing	Elevation			
2	0.1	0	90			
3	3.5	0	45			
4	4.9	0	65			
5	6.2	0	40			
6	7	0	55			
7	9	0	25			
8	9	5	55			
9	9	3	48			
10	9	7	45			
11	6.5	7	75			
12	4.5	7	50			
13	2.9	7	75			
14	1.3	7	52			
15	0	7	70			
16	0	4.1	90			
17	0	2.1	105			
18	1.7	5.6	75			
19	2.2	4.5	65			
20	2.5	3.6	60			
21	2.9	2.4	55			
22	3.2	1.1	50			

The column and row label bars are highlighted in this example.

Active Cell

The active cell is displayed with a heavy border surrounding the cell. The contents of this cell are displayed in the cell edit box. You can enter or edit data in the active cell. To edit existing data, activate the desired cell and press the F2 key or highlight the information in the cell edit box.

Special Key Functions when editing the active cell include the following:

Keyboard Command	Action
ESC	ESC cancels edit mode and restores the original contents of the active cell.
ENTER	ENTER stores the contents of the cell edit box and then moves the active cell down one cell.
CTRL+ENTER	CTRL+ENTER completes the entry and keeps the current cell active.
ARROWS (left and right)	Left and right ARROWS move within the cell's text if the F2 key has been pressed. Otherwise, these keys store the contents of the cell edit box and then move the active cell to the left or right.
ARROWS (up and down)	Up and down ARROWS store the contents of the cell edit box in the active cell and move the active cell above or below.
DELETE	DELETE deletes the character to the right of the cursor if the F2 key has been pressed. Otherwise, pressing the delete key deletes the entire contents of the cell.
BACKSPACE	BACKSPACE deletes the character to the left of the cursor if the F2 key has been pressed. Otherwise, pressing the backspace key deletes the entire contents of the cell.
PAGE UP and PAGE DOWN	PAGE UP and PAGE DOWN store the contents of the cell edit box in the active cell and move one page up or down.
TAB and SHIFT+TAB	TAB and SHIFT+TAB store the contents of the cell edit box in the active cell and move the active cell to the right or left.

Active Cell Location Box

The active cell location box shows the location of the active cell in the worksheet. Letters are the column labels and numbers are the row labels.

C5 | 40

	A	B	C	D
1	Easting	Northing	Elevation	
2	0.1	0	90	
3	3.5	0	45	
4	4.9	0	65	
5	6.2	0	40	
6	7	0	55	

This example shows the active cell as cell C5. The name of the active cell "C5" is listed in the active cell location box in the upper left portion of the worksheet.

Active Cell Edit Box

The cell edit box is located at the top of the worksheet window just above the column letter bar. The cell edit box shows the contents of the active cell and is used for editing cells. Use the cell edit box to see the contents of a worksheet cell when the column is too narrow to display all of the cell contents.

To begin editing the selected cell, press the F2 key. Alternatively, highlight the contents of the cell edit box to edit the cell. To overwrite the current cell contents, simply begin typing without pressing F2. If the mouse is clicked on a new cell, the new cell becomes the active cell.

Right-click in the active cell edit box to access the following commands in the context menu:

Right to left Reading order	Toggles right to left reading order on or off.
Show Unicode control characters	Toggles the display of Unicode control characters on or off.
Insert Unicode control character	Select a Unicode control character from the list, and it is inserted in the active cell edit box at the cursor location.
Open/Close IME	When a user types a phonetic representation of a word, the IME displays a candidate list on the screen. The user can select the intended word or phrase from among several different possible representations in the candidate list, and the user's selection then replaces the phonetic representation in the document. This command toggles the IME on or off.
Reconversion	IME reconversion allows users who are typing in Japanese to convert back and forth between the phonetic spelling of a word (using the standard Western keyboard) and the Japanese character that represents the word.

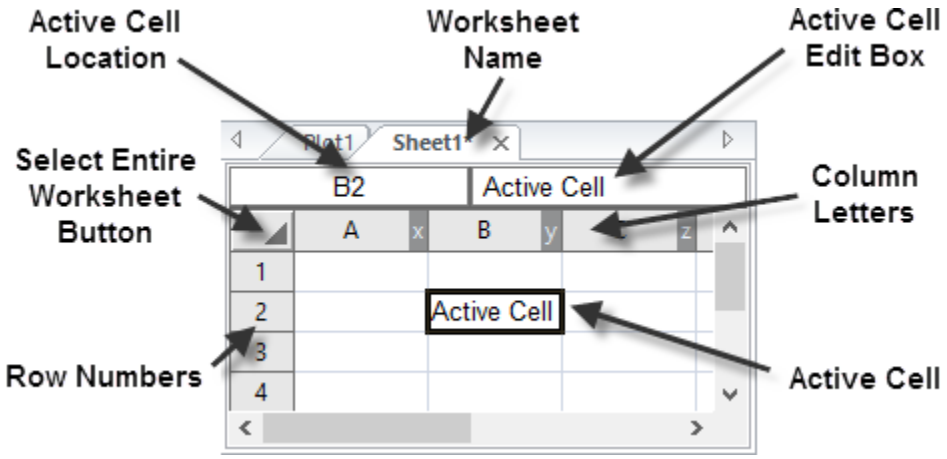
Special Key Functions when Editing the Active Cell:

Keyboard Command	Action

ESC	ESC cancels edit mode and restores the original contents of the active cell.
ENTER	ENTER stores the contents of the cell edit box and then moves the active cell down one cell.
CTRL+ENTER	CTRL+ENTER completes the entry and keeps the current cell active.
ARROWS (left and right)	Left and right ARROWS move within the cell's text if the F2 key has been pressed. Otherwise, these keys store the contents of the cell edit box and then move the active cell to the left or right.
ARROWS (up and down)	Up and down ARROWS store the contents of the cell edit box in the active cell and move the active cell above or below.
DELETE	DELETE deletes the character to the right of the cursor if the F2 key has been pressed. Otherwise, pressing the delete key deletes the entire contents of the cell.
BACKSPACE	BACKSPACE deletes the character to the left of the cursor if the F2 key has been pressed. Otherwise, pressing the backspace key deletes the entire contents of the cell.
PAGE UP and PAGE DOWN	PAGE UP and PAGE DOWN store the contents of the cell edit box in the active cell and move one page up or down.
TAB and SHIFT+TAB	TAB and SHIFT+TAB store the contents of the cell edit box in the active cell and move the active cell to the right or left.

Select Entire Worksheet

Clicking on the small box above the row labels and to the left of the column labels selects the entire worksheet.



The Select Entire Worksheet button is located to the left of column A and above row 1.

Working with Worksheet Data

There are three ways to enter data into the worksheet. Data are entered into the worksheet by using File | Open and opening a data file, by typing data directly into the worksheet, or by copying

the data from another application and pasting it into the worksheet. Use the Data menu commands to sort the data, filter the data, view statistics, transform the data using mathematical functions, assign default columns for coordinate data, assign a coordinate system to the data, and project coordinates.

There are two basic modes in the worksheet. Normal mode is when the active cell can be moved throughout the worksheet, and edit mode allows the contents of a single cell to be edited in the active cell edit box. Only one mode may be active at a given time. ESC, ENTER, or clicking on another cell can be used to exit edit mode and return to normal mode.

Entering Data Into a Cell

Edit the contents of a cell by making it the active cell. The active cell is positioned by clicking on a cell with the mouse, by using the ARROW keys, PAGE UP, PAGE DOWN, TAB, HOME, END, and SHIFT+TAB. Press the F2 key or highlight the contents of the cell edit box to edit the contents of the cell.

To enter new data and delete the old, position the active cell and begin typing. Edit mode is entered automatically and the old data is deleted. Pressing the ENTER, Up or Down ARROWS, TAB, SHIFT+TAB, PAGE UP, or PAGE DOWN keys causes the edit changes to be recorded permanently in the cell. After pressing F2 or highlighting the cell edit box use the HOME, END, BACKSPACE, DEL, and ARROW keys to edit the cell. Pressing ESC while editing a cell cancels the changes and restores the original data.

Moving the Active Cell

You can designate any worksheet cell as the active cell by left-clicking on it with the mouse. The active cell can also be repositioned by using keyboard commands. The active cell is the cell with a thick border drawn around it.

Keyboard Command	Action
ARROW keys (Up, Down, Left, Right)	The ARROWS move the active cell to an adjacent cell.
PAGE UP/PAGE DOWN	Press the PAGE UP or PAGE DOWN to move the active cell up or down by the number of rows visible in the window.
HOME	Press HOME to move the active cell to the first occupied cell in the current column. Press HOME again to move the active cell to the top row in the current column.
END	Press END to move the active cell to the last occupied row in the current column. Press END again to move the active cell to the bottom row of the worksheet.
ENTER	Press ENTER to move the active cell down one row and end "edit mode."
TAB	Press TAB to move the active cell right one column and end "edit mode."
SHIFT + ENTER	Press SHIFT+ENTER to move the active cell up one row and end "edit mode."
SHIFT + TAB	Press SHIFT+TAB to move the active cell left one column and end "edit mode."

CTRL+HOME	Press CTRL+HOME to move the active cell to the top cell of the left most column in the worksheet (A1).
CTRL+END	Press CTRL+END to move the active cell to the bottom occupied row of the last occupied column in the worksheet.
CTRL+LEFT ARROW	The CTRL+LEFT ARROW behavior depends on the position of the active cell. If the active cell is to the right of the last occupied column in the current row, it moves the active cell to the last occupied column in the current row. If the active cell is in or to the left of the last occupied column in the current row, but to the right of the first occupied column in the current row, it moves the active cell to the first occupied column in the current row. Otherwise, CTRL+LEFT ARROW moves the active cell to the first column in the current row.
CTRL+RIGHT ARROW	The CTRL+RIGHT ARROW behavior depends on the position of the active cell. If the active cell is to the left of the first occupied column in the current row, it moves the active cell to the first occupied column in the current row. If the active cell is in or to the right of the first occupied column in the current row, but to the left of the last occupied column in the current row, it moves the active cell to the last occupied column. Otherwise, CTRL+RIGHT ARROW moves the active cell to the last column in the current row.
CTRL+UP ARROW	The CTRL+UP ARROW behavior depends on the position of the active cell. If the active cell is below the bottom occupied row in the current column, it moves the active cell to the bottom occupied row in the current column. If the active cell is below the top occupied row in the current column, but in or above the bottom occupied row in the current column, it moves the active cell to the top occupied row in the current column. Otherwise, CTRL+UP ARROW moves the active cell to the first row in the current column.
CTRL+DOWN ARROW	The CTRL+DOWN ARROW behavior depends on the position of the active cell. If the active cell is above the top occupied row in the current column, it moves the active cell to the top occupied row in the current column. If the active cell is above the bottom occupied row in the current column, but below the top occupied row in the current column, it moves the active cell to the bottom occupied row in the current column. Otherwise, CTRL+DOWN ARROW moves the active cell to the last row in the current column.
ENTER, TAB, SHIFT+ENTER, and SHIFT+TAB	If a block of cells is selected, the ENTER, TAB, SHIFT+ENTER, and SHIFT+TAB keys move the active cell within a group of selected cells without canceling the selection.

Moving the Active Cell Within Selections

The ENTER, TAB, SHIFT+ENTER, and SHIFT+TAB keys move the active cell within a group of selected cells without canceling the selection.

Pasting Data

If data are copied to the clipboard from another software application, the contents of the clipboard can be pasted into the worksheet. If the source application is Microsoft Excel, some formatting information is retained. When pasting data into the worksheet, select a cell and use Home | Clipboard | Paste (CTRL+V). Any data to the right or below the active cell is overwritten, so be sure to locate the active cell carefully. When data are copied to the clipboard, special formatting

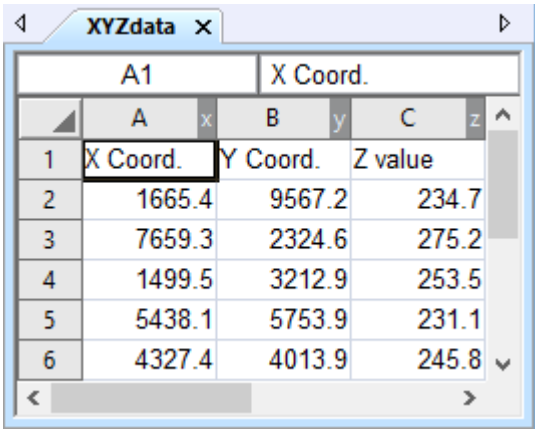
Chapter 4 - Creating Grid Files

Contour maps, color relief maps, shaded relief maps, vector maps, watershed maps, 3D surfaces, and 3D wireframes all require grids for their creation in **Surfer**. A grid is a regular, rectangular array of values. The Home | Grid Data | Grid Data command provides you with several methods for generating a **Surfer** .GRD grid file from your XYZ data. In addition to the grid files that **Surfer** creates, it can also read many common grid file formats directly. A grid with all NoData nodes cannot be saved.

A Gridding Example

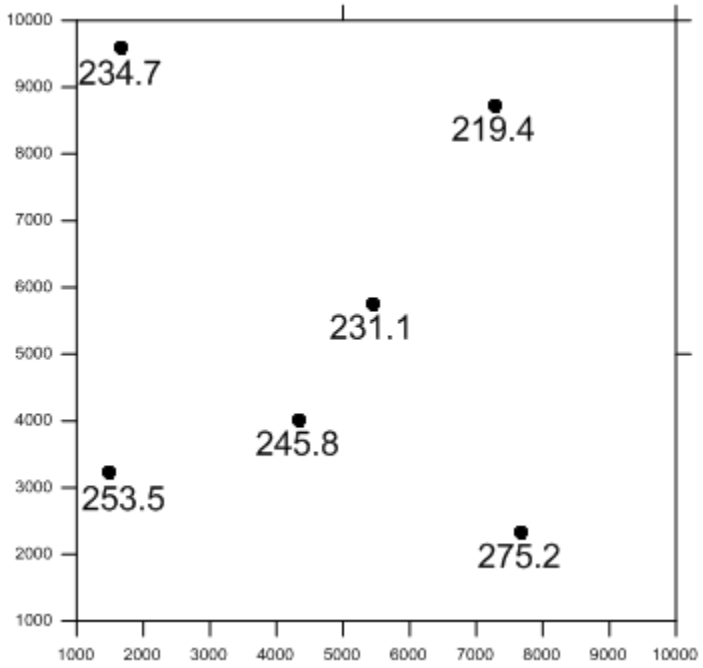
Consider the scenario of producing a contour map of water table depth given well data collected over a region. The well locations are not regularly spaced over the area of interest. If you provide **Surfer** with the locations of the wells (the XY coordinates) and the depth to the water table (the Z value) in the form of an XYZ data file, **Surfer** can produce a grid file from the original data and a grid-based map from the gridded data. The following series of figures show the normal progression from a data file, to a grid file, to a contour map.

1. In a worksheet window, define well locations (X and Y coordinates) and water table depth (Z value) at each location in an XYZ data file.



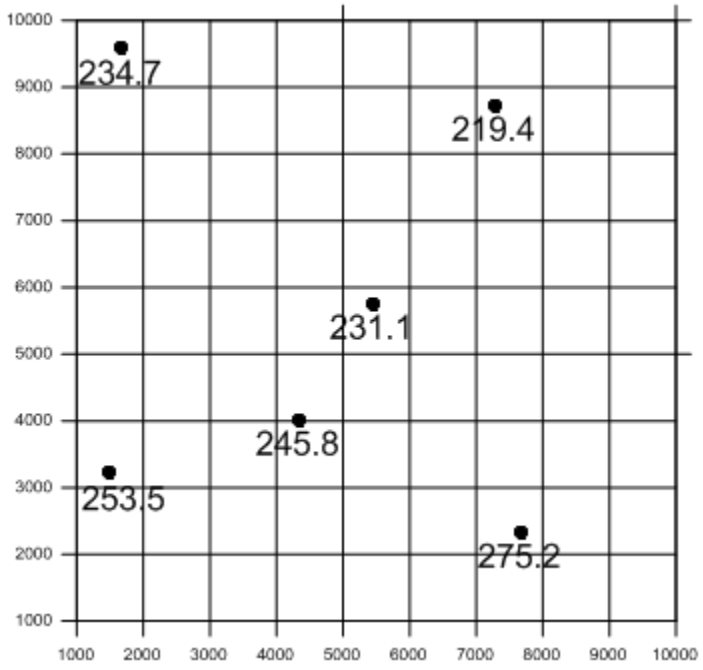
This is the XYZ data file that defines the well locations and water table depth at each location.

2. In the plot window, click the **Home | New Map | Post** command. Select the data file created in step 1and click *Open* to create a post map displaying the data locations with Z value labels. This step is to show the irregularly spaced data across the map.



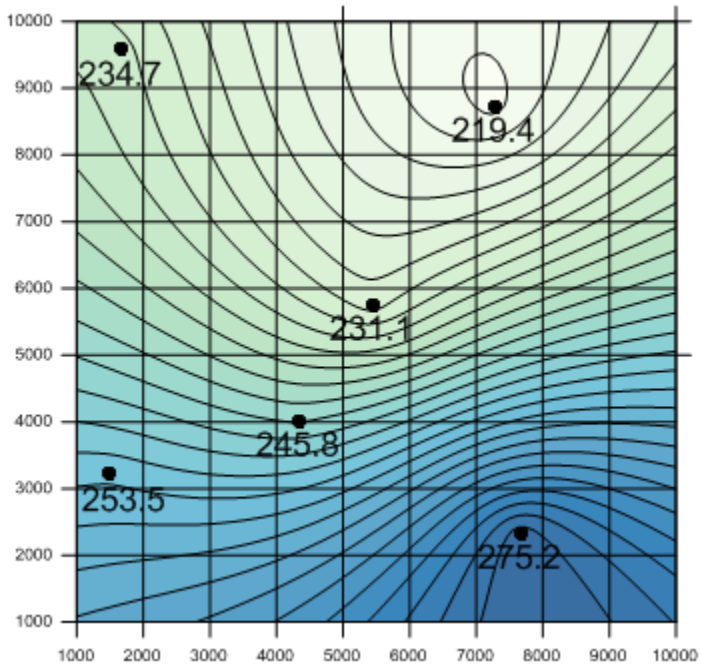
This is a post map displaying the data locations. The well locations are irregularly spaced over the map in this example. There are many "holes" where no data exists.

3. Click the **Grids | New Grid | Grid Data** command to create a regularly spaced grid .GRD file from the irregularly spaced XYZ data file. Use the default values in the Grid Data dialog and click *OK* to create the .GRD file.



Gridding interpolates a Z value at the intersection of each row and column in the grid file, thereby filling holes in the data. Here the rows and columns are represented by grid lines drawn across the map.

4. Click once on the post map to select it. Click the **Home | Add to Map | Layer | Contour** command to add a contour map of the grid file to the post map of the data file.



The irregularly spaced data points are used to interpolate grid node values. These interpolated values are written to a grid file. The grid file is used to produce the contour map. This figure shows the filled contour map, the posted data points, and the layout of the grid.

Grid Data

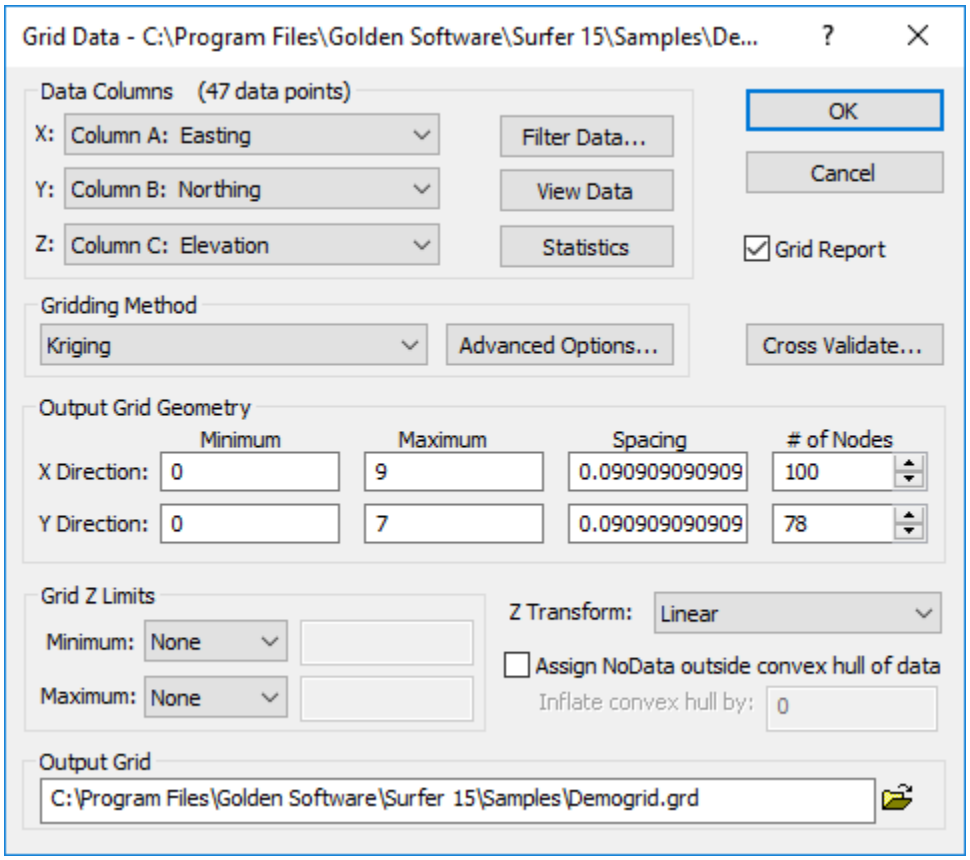
Grid files are necessary in **Surfer** to create grid-based maps types. Data files are typically randomly spaced files, and this data must be converted into an evenly spaced grid before using many of **Surfer's** features. Grid files are produced from XYZ data using the **Home | Grid Data | Grid Data** or the **Grids | New Grid | Grid Data** command. With this command, you can specify the parameters for the particular gridding method and the extents of the grid. The gridding methods define the way in which the XYZ data are interpolated when producing a grid file. Refer to the tutorial for more information on data and gridding data.

When creating a grid file you can usually accept all of the default gridding parameters and generate a grid file that represents your data well. Under most circumstances, the recommended gridding method is kriging with the default linear variogram. This is the selected default gridding method because it gives good results for most XYZ data sets.

There are several gridding parameters you can set when producing a grid file. Refer to the gridding method for more information on specific parameters. Most gridding methods require at least three non-collinear data points. The *Inverse Distance*, *Nearest Neighbor*, *Moving Average*, and *Data Metrics* methods require at least three data points, collinear or not. Some methods require more data points. For example, a higher-order polynomial fit needs more than three data points; there must be at least as many data as there are degrees of freedom. When the *Z Transform* is set to *Log, save as log* or *Log, save as linear*, at least three data points must contain Z values that are non-negative and non-zero. Click the **Grids | New Grid | Grid Data** or **Home | Grid Data | Grid Data** command to choose the data to be used in the gridding process.

Grid Data Dialog

Click the **Grids | New Grid | Grid Data** or **Home | Grid Data | Grid Data** command to display the Open Data dialog. Select a data file and click *Open*. The **Grid Data** dialog is displayed.



*Gridding options are set in the **Grid Data** dialog.*

Data Columns

Individually specify the columns for the X data, the Y data, and the Z data in the *Data Columns* section. **Surfer** defaults to *X: Column A*, *Y: Column B*, and *Z: Column C*. However, your data can be in any three columns. Click the down arrow on each box and select the appropriate column for each variable. If the data file was selected from the *Open worksheets* list in the **Open Data** dialog, assigned XYZ columns (if any) will populate the appropriate columns in the *Data Columns* group. Columns containing dates or numbers can be selected.

Note: When using date/time formats for any of the *Data Columns*, the values are stored in the grid as numbers, not in date/time format. To display date/time formats on the map, select the appropriate map part (axis, map layer, or map) and set the date/time label format.

Filter Data

You can filter the data before gridding based on a predefined filter or based on a user-defined equation by clicking the Filter Data button.

View Data

If you are unsure of which columns contain your XYZ data, click the *View Data* button to see the data file in a worksheet format. If you get an *Insufficient data (3 or more XYZ triplets required)* error, use *View Data* to check the layout of the data. One common reason for this warning is that the data is not numeric or date/time format. After clicking *View Data*, make sure that all three columns of data are right aligned. If one of the columns is left aligned, the data are text, not numbers. You can use the data view to determine the appropriate columns for the X, Y, and Z values.

Statistics

Click the *Statistics* button to display statistics based on the selected X, Y, and Z columns.

Grid Report

Check the box next to the *Grid Report* option to create a gridding report that includes all the gridding parameters used to generate a grid. This report also includes statistics about the grid. You can also access the grid statistics by creating a grid information report. Create a grid information report in the Grid Editor by clicking the Grid Editor | Options | Grid Info command or by clicking the Grids | Info | Grid Info command from any document window.

Gridding Method and Advanced Options

Surfer has several different gridding methods. These gridding methods define the way in which the XYZ data are interpolated when producing a grid file. Choose the *Gridding Method* and gridding options (*Advanced Options* button) in the *Gridding Method* group. Refer to the gridding methods help topics for more information on the options.

Cross Validate

Click the *Cross Validate* button to perform cross validation on your data. Cross validation is an objective way of assessing the gridding parameters for your data set. Cross validation is always performed on the linear Z values, not the transformed Z values.

Output Grid Geometry

The *Output Grid Geometry* section defines the grid limits and grid density. The *Output Grid Geometry* section also controls whether grid nodes outside the data are automatically assigned the NoData value.

Minimum and Maximum X and Y Coordinate (Grid Limits)

Grid limits are the minimum and maximum X and Y coordinates for the grid. **Surfer** computes the minimum and maximum X and Y values from the XYZ data file. These values are used as the default minimum and maximum coordinates for the grid.

Grid limits define the X and Y extent of the output grid. The extents of the grid define the extents of contour maps, color relief maps, shaded relief maps, vector maps, 3D wireframes, and 3D surfaces created from grid files. When creating a grid file, you can set the grid limits to the X and Y extents you want to use for your map. Once a grid file is created, you cannot produce a grid-based map larger than the extent of the grid file. If you find you need larger grid limits, you must regrid the data. You can, however, read in a subset of the grid file to produce a map smaller than the extent of the grid file.

When either the X, Y, or Z value is in a date/time format, the date/time values are converted and stored in the grid as numbers.

Spacing and # of Nodes (Grid Density)

Grid density is usually defined by the number of columns and rows in the grid, and is a measure of the number of grid nodes in the grid. The *# of Nodes* in the *X Direction* is the number of grid columns, and the *# of Nodes* in the *Y Direction* is the number of grid rows. The direction (*X Direction* or *Y Direction*) that covers the greater extent (the greater number of data units) is assigned 100 grid nodes by default. The number of grid nodes in the other direction is computed so that the grid nodes *Spacing* in the two directions are as close to one another as possible.

By defining the grid limits and the number of rows and columns, the *Spacing* values are automatically determined as the distance in data units between adjacent rows and adjacent columns.

Note on High Density Grid Files

Higher grid densities (smaller *Spacing* and a larger *# of Nodes)* increase the smoothness in grid-based maps. However, an increase in the number of grid nodes proportionally increases the gridding time, drawing time, and the grid file size. You can have up to 2,147,483,647 rows and columns in a grid file. It is likely your computer will run out of memory before reaching the maximum grid size. The primary use for the large grid size maximum is to allow grids with extreme aspect ratios to be created.

The larger the density of grid nodes in the grid, the smoother the map that is created from the grid. Contour lines and XY lines defining a wireframe are a series of straight-line segments. More X and Y grid nodes in a grid file result in shorter line segments for contours or wireframe maps. This provides a smoother appearance to contour lines on a contour map or smoother appearing wireframe.

Although highly dense grid files can be created, time and space are practical limits to the number of grid nodes you may want to create in a grid file. The grid density limit is based on the amount of available memory in your computer and the size of the data file used to create the grid. Limited memory, very large data files, very dense grids, or any combination of these factors can greatly increase gridding time. When gridding begins, the status bar provides you with information about the estimated gridding time to complete the task. If gridding time is excessive, click in the plot window to cancel the gridding operation.

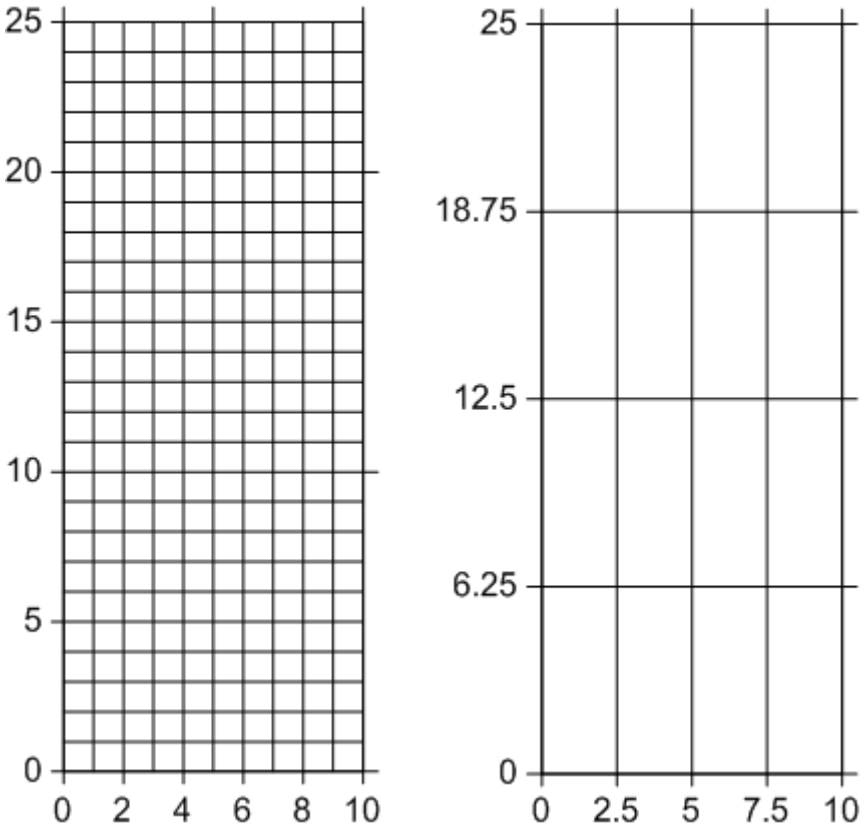
Some examples of the amount of memory needed to grid large files:

- A 10,000 x 10,000 grid requires 10000*10000*8 = 763MB.
- A 15,000 x 15,000 grid requires 1.7GB.
- A 20,000 x 20,000 grid requires 3GB which is more than a 32-bit OS can address (although it is possible on an 64 bit OS)
- A 2,147,483,647 x 2 grid requires 32GB of contiguous RAM (most computers contain a maximum of 16GB RAM stored noncontiguously)

You can also increase or decrease the grid density by using the Grid | Spline Smooth, Grid | Extract, or Grids | Resize | Mosaic commands.

Output Grid Geometry Example

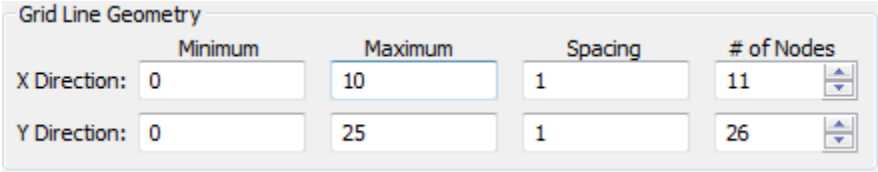
Consider these examples. The data range from 0 to 25 in the Y dimension and 0 to 10 in the X dimension. The two examples use different numbers of grid nodes, or grid spacing, during gridding.



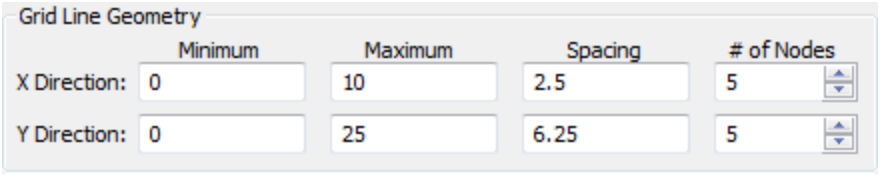
Two different Grid Line Geometry examples are shown here. These are based on the same data file. The coordinates range from zero to 10 in the X direction and zero to 25 in the Y dimension.

In the example on the left above, the grid *Spacing* is set approximately equal in the X and Y dimensions (one unit each). This results in a different number of grid nodes in the X and Y dimensions. In the example on the right above, the same *# of Nodes* are specified in the two dimensions. This results in an unequal spacing in data units in the two dimensions.

The *Output Grid Geometry* information specified in the **Grid Data** dialog for each of the examples is displayed below.



This shows the Output Grid Geometry information for the 11 by 26 grid. The grid node spacing values are set to one, resulting in a different number of grid nodes in the X and Y dimensions.



This shows the Output Grid Geometry information for the 5 by 5 grid. The number of nodes is equal, resulting in different spacing in the X and Y dimensions.

Grid Z Limits

In some cases, the gridding interpolation and extrapolation can result in undesired values, for example negative numbers in cases where negative values are physically impossible. The *Grid Z Limits* options clamp the grid output to specific minimum and maximum values.

The *Grid Z Limits* are applied after the interpolation operation. After the grid interpolation is performed, **Surfer** locates any grid values less than the *Minimum* and replaces them with the *Data min* or *Custom* value. **Surfer** locates any grid values greater than the *Maximum* and replaces them with the *Data max* or *Custom* value.

To clamp the output to a specific minimum value, click the current selection next to *Minimum*, and select *None*, *Data min*, or *Custom* from the list. If *Data min* is selected, the data minimum will be displayed in the field to the right of the *Minimum* list. Select *Custom* and type a value in the input box to use a user-defined *Minimum*.

To clamp the output to a specific maximum value, click the current selection next to *Maximum*, and select *None*, *Data max*, or *Custom* from the list. If *Data max* is selected, the data maximum will be displayed in the field to the right of the *Maximum* list. Select *Custom* and type a value in the input box to use a user-defined *Maximum*.

Convex Hull of Data

The convex hull of a data set is the smallest convex polygon containing all the data. The convex hull can be thought of as a rubber band that encompasses all data points. The rubber band only touches the outside points. So, areas inside the convex hull without data are still gridded.

Assign NoData Outside Convex Hull

Check the box next to the *Assign NoData outside convex hull of data* to automatically assign the NoData value to the grid nodes outside the convex hull of the data. Leave the box cleared to extrapolate the data to the minimum and maximum grid limits, regardless of whether data exists in these areas.

Inflate Convex Hull

The *Inflate convex hull by* option expands or contracts the convex hull. When set to zero, the boundary connects the outside data points exactly. When set to a positive value, the area assigned the NoData value is moved outside the convex hull boundary by the number of map units specified. When set to a negative value, the area assigned the NoData value is moved inside the convex hull boundary by the number of map units specified.

To change the value, highlight the existing value and type the desired value. Values are in horizontal (X) map units. If the value is set to a large positive value, the grid values may extend all the way to the minimum and maximum X and Y limits of the grid, essentially overriding the *Assign*