

# Surfer<sup>®</sup>

Powerful contouring, gridding & surface mapping system

## Quick Start Guide

## Surfer® Registration Information

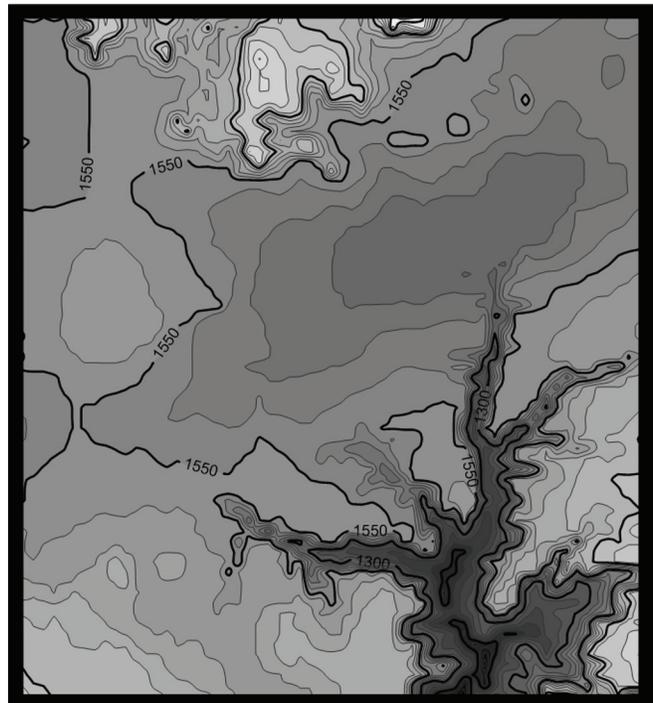
Your **Surfer** product key is located in the email download instructions and in your account at [MyAccount.GoldenSoftware.com](http://MyAccount.GoldenSoftware.com).

Register your **Surfer** product key online at [www.GoldenSoftware.com](http://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.

---



## COPYRIGHT NOTICE

Copyright Golden Software, LLC 2017

The **Surfer**<sup>®</sup> program is furnished under a license agreement. The **Surfer** software, quick start guide, and user's guide may be used or copied only in accordance with the terms of the agreement. It is against the law to copy the software, quick start guide, or user's guide on any medium except as specifically allowed in the license agreement. Contents are subject to change without notice.

**Surfer** is a registered trademark of Golden Software, LLC. All other trademarks are the property of their respective owners.

# Table of Contents

Introduction to Surfer .....	1
Scripter .....	1
New Features .....	1
Who Uses Surfer?.....	1
System Requirements .....	2
Installation Directions .....	2
Updating Surfer .....	2
Uninstalling Surfer.....	2
Surfer Trial Functionality .....	3
Three-Minute Tour.....	3
Using Surfer .....	4
Using Scripter.....	5
Surfer User Interface .....	5
Surfer Layout .....	6
Opening Windows.....	6
Changing the Layout.....	7
Menu and Tab Commands.....	8
Status Bar .....	9
Contents.....	10
Properties .....	11
Worksheet Document.....	13
Grid Editor .....	14
File Types .....	17
Data Files .....	17
Grid Files .....	18
Base Map Files.....	18
Surfer Files .....	18
Gridding Overview .....	18
What is a grid? .....	18
What is gridding? .....	18
Gridding Methods .....	18
General Gridding Options.....	19
Grids Tab Commands.....	19
Grid Data .....	19
Breaklines.....	22
Faults.....	22
Map Types .....	23
Map Layers .....	25
Coordinate Systems .....	25

## Table of Contents

Source Coordinate System - Map Layer.....	26
Target Coordinate System - Map.....	26
Tutorial .....	27
Tutorial Overview.....	27
Starting Surfer.....	28
Lesson 1 - Viewing and Creating Data.....	28
Lesson 2 - Using the Map Wizard .....	31
Lesson 3 - Changing Layer Properties .....	34
Lesson 4 - Modifying an Axis .....	43
Lesson 5 - Creating a Profile .....	44
Lesson 6 - Saving a Map .....	45
Lesson 7 - Creating a 3D Surface Map .....	46
Lesson 8 - Adding Transparency, Color Scales, and Titles.....	49
Lesson 9 - Creating Maps from Different Coordinate Systems .....	54
Tutorial Complete.....	57
Printing the Online Help .....	58
Getting Help.....	58
Context-Sensitive Help.....	58
Internet Help Resources .....	59
Technical Support .....	59
Index.....	60

# Introduction to Surfer

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 in 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 14** are summarized:

- Online at: [www.GoldenSoftware.com/products/surfer](http://www.GoldenSoftware.com/products/surfer)
- In the web help at [http://surferhelp.goldensoftware.com/#t=topics%2Fnew\\_features.htm](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 Vista, 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.

Golden Software does not recommend installing **Surfer 14** over any previous versions of **Surfer**. **Surfer 14** can coexist with older versions (e.g. **Surfer 13**) 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 the account for the individual who will be licensed to use **Surfer**. Log in at <http://myaccount.goldensoftware.com>.
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 14.0** to **Surfer 14.1**), you will be prompted to download the update.

## Uninstalling Surfer

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

### Windows Vista

To uninstall **Surfer** when using the *Regular Control Panel Home*, click the *Uninstall a program* link. Select **Surfer 14** from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer**. To uninstall **Surfer** when using the *Classic View*, go to the Control Panel and double-click on *Programs and Features*. Select **Surfer 14** from the list of installed applications. Click the *Remove* button to uninstall **Surfer**.

### Windows 7

To uninstall **Surfer** go to the *Windows Control Panel* and click the *Uninstall a program* link. Select **Surfer 14** from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer**.

## Windows 8

From the *Start* screen, right-click the **Surfer 14** 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 14** 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 14** and then click *Uninstall*. To uninstall **Surfer** from the Windows Control Panel, click **Programs | Programs and Features**. Select **Surfer 14** and click *Uninstall*.

## Surfer Trial Functionality

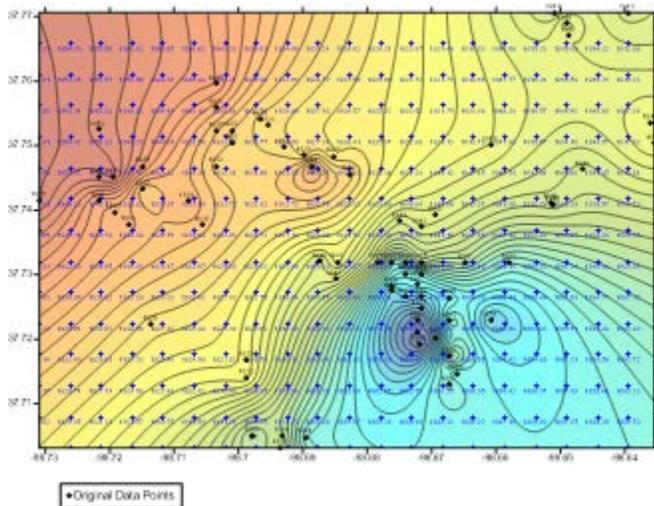
The **Surfer** trial is a fully functioning time-limited trial. This means that commands work exactly as the command works in the full program for the duration of the trial. The trial has no further restrictions on use. Any data set or image can be used to create any project. All properties can be changed in the trial. The trial can be installed on any computer that meets the system requirements. The trial can be activated with a product key or licensed by 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** installation folder is located in C:\Program Files\Golden Software\Surfer 14 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.

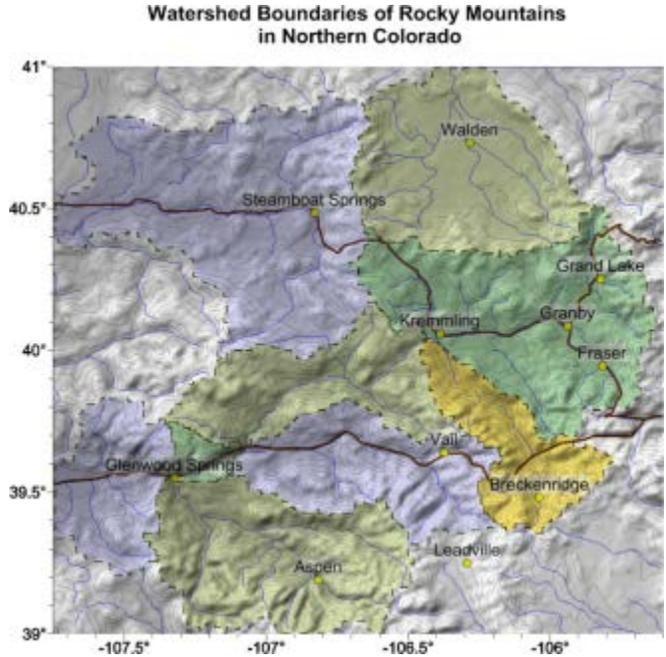


## GridValues.SRF

The *GridValues.srf* sample file displays a grid values, post, and filled contour layer overlaid in a single map. The grid values layer is used to visualize the grid geometry or post grid values on the map.

## Watershed.SRF

The *Watershed.srf* sample file displays a post map, two base maps, a contour map, a watershed map, and a surface map layer. The map shows roads, rivers, and the watershed delineation of a section of the Rocky Mountains in Colorado.

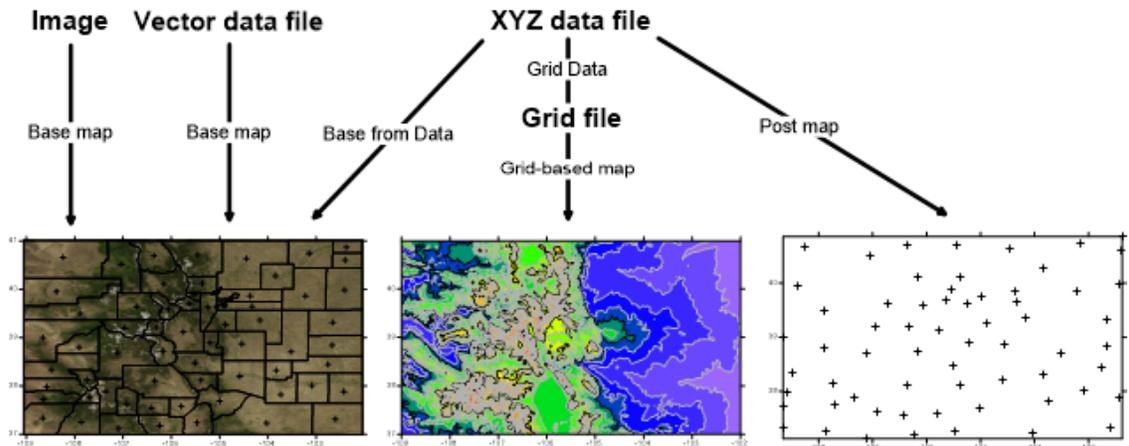


## Using Surfer

The most common application of **Surfer** is to create a grid-based map from an XYZ data file. The **Home | Grid Data | 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).
2. To display the data points, click the **Home | New Map | Post** command.
3. Create a grid file .GRD from the XYZ data file using the **Home | Grid Data | Grid Data** command.
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.
5. Click on the map to display the map properties in the **Properties** window where you can customize the map to fit your needs.
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.

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.

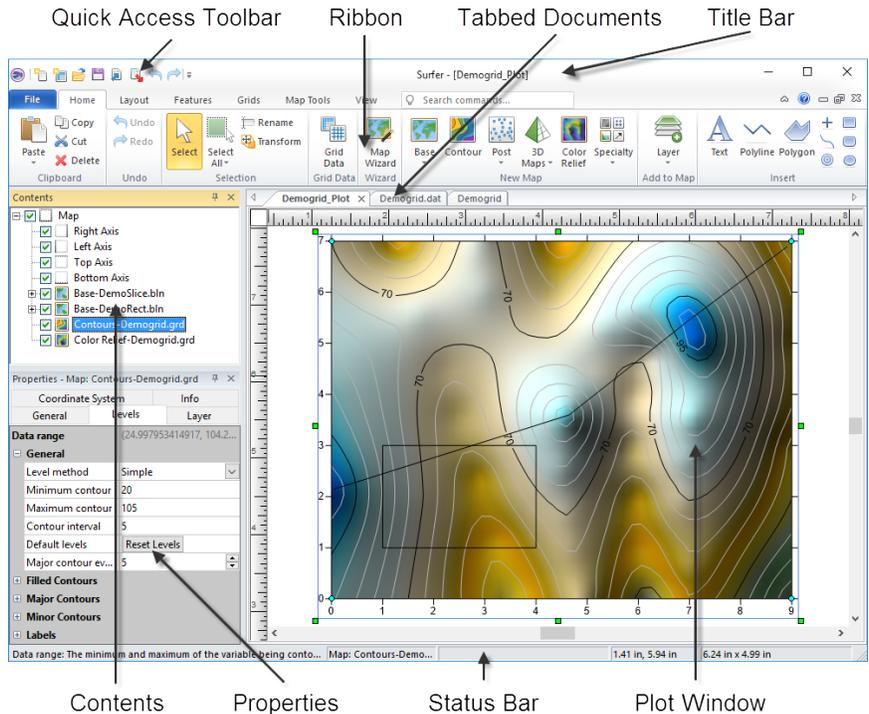
## Using Scripeter

Tasks can be automated in **Surfer** using Golden Software's **Scripeter** 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. **Scripeter** can be used to perform almost any task in **Surfer**. You can do practically everything with a script that you can do manually with the mouse or from your keyboard. Scripts are useful for automating repetitive tasks and consolidating a sequence of steps. **Scripeter** is installed in the same location as **Surfer**. Refer to the *Surfer Automation* help book for more information about **Scripeter**. We have included several example scripts so that you can quickly see some of **Scripeter's** capabilities:

1. Open **Scripeter** by navigating to the installation folder, C:\Program Files\Golden Software\Surfer 14\Scripeter. 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 14\Scripeter. Right-click on the Scripeter.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 14\Samples\Scripts folder or the C:\Program Files (x86)\Golden Software\Surfer 14\Samples\Scripts folder, if you are running a 32-bit version of **Surfer** on a 64-bit version of Windows.
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 three document window types: the plot document, worksheet document, and grid editor. Maps are created and displayed in the plot document. 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.

<u>Component Name</u>	<u>Component Function</u>
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 <b>Surfer</b> 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 command.
Ribbon	The ribbon includes all of the commands in <b>Surfer</b> . Commands are grouped under the <a href="#">File menu and various tabs</a> . Some commands and tabs are only available in specific views. For example, the <b>Features   Insert   Polyline</b> command is only available in the plot window. The ribbon commands can be modified and rearranged with the <b>Customize Ribbon</b> command.
Tabbed Documents	The plot, 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.
<a href="#">Contents</a>	<p>The <b>Contents</b> window contains a hierarchical list of all the objects in a Surfer plot document displayed in a tree view. The objects can be selected, added, arranged, and edited. Changes made in the <b>Contents</b> window are reflected in the plot document, and vice versa.</p> <p>The <b>Contents</b> window is initially docked at the left side of the window, giving the window a split appearance; however, it can be dragged and placed anywhere on the screen. The <b>Contents</b> window can also be hidden as a tab or displayed as a floating dialog.</p>
<a href="#">Properties</a>	<p>The <b>Properties</b> window contains all of the properties for the selected object or objects. Changes made in the <b>Properties</b> window are reflected in the plot document. The properties in the <b>Properties</b> window are grouped by page.</p> <p>The <b>Properties</b> window is initially docked below the <b>Contents</b> window. The <b>Properties</b> window can also be hidden as a tab or displayed as a floating dialog.</p>
<a href="#">Status Bar</a>	<p>The status bar displays information about the current command or activity in <b>Surfer</b>. The status bar is divided into five sections. The sections display basic plot commands and descriptions, the name of the selected object, the pointer map coordinates and units, the pointer page coordinates, and the dimensions of the selected object.</p> <p>The status bar also indicates the progress of a procedure, such as gridding. The percent of completion and time remaining will be displayed</p>

## 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.

## Changing the Layout

The plot window, **Properties** and **Contents** windows, and ribbon display in a docked view by default; however, they can also be displayed as floating windows. The visibility, size, and position of each item may also be changed.

### Visibility

Use the **View | Show/Hide** commands to toggle the display of the rulers, drawing grid, status bar, [Contents](#) window, and [Properties](#) window. Alternatively, click the  or  buttons in the **Contents** and **Properties** windows to auto-hide or close the windows.

Right-click the ribbon or quick access toolbar to minimize the ribbon, move the quick access toolbar above or below the ribbon, and customize the ribbon or quick access toolbar.

### Auto-Hiding the Contents or Properties Windows

Click the  button to auto-hide a docked [Contents](#) or [Properties](#) window. The window slides to the side of the **Surfer** main window and a tab appears with the window name.

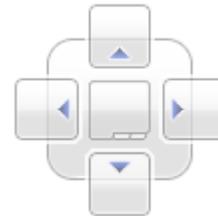
Position the mouse pointer over the tab to view the window. Move your mouse away from the window and the window "hides" again. You can also click inside the window to anchor it at its current position. Click in another window to release the anchor and hide the window. Click the  button to return the window to a docked position.

### Size

You can drag the sides of the application window, **Contents** window, **Properties** window, or document window to change its size. If a window is docked, its left and right bounds are indicated by a  cursor, and its upper and lower bounds are indicated by a  cursor. Click and drag the cursor to change the size.

### Position

To change the position of a docked window, click the title bar and drag it to a new location. To dock the **Contents** or **Properties** windows, use the docking mechanism. You can also double-click the window's title bar to toggle between floating and docked modes. Left-click the title bar of a window and drag it to a new location while holding the left mouse button. The docking mechanism displays with arrow indicators as you move the window.



*The docking mechanism makes it easy to position the **Contents** and **Properties** windows.*

When the cursor touches one of the docking indicators in the docking mechanism, a blue rectangle shows the window docking position. Release the left mouse button to allow the window to be docked in the specified location.

## Restoring the Windows to Their Original Locations

If the **Contents** or **Properties** windows have moved or become invisible, or if they are in undesired locations, you can use the **View | Windows | Reset Windows** command to move them back to their original locations. You must restart **Surfer** for the changes to take effect.

## Menu and Tab Commands

The ribbon contains the commands that allow you to add, edit, and control the objects on the plot window page.

## Plot Document Commands

When viewing a plot document the main ribbon tab commands are available:

<b>File</b>	Open and save files, import or export data, print, and set options and defaults
<b>Home</b>	Contains common editing, selection, feature, grid, and map commands
<b>Layout</b>	Set page display, and arrange or position maps and objects in the plot document
<b>Features</b>	Draw features and perform geoprocessing
<b>Grids</b>	Perform grid operations
<b>Map Tools</b>	Add map layers, and edit or analyze maps and map layers
<b>View</b>	Controls the display of toolbars, status bar, rulers, grids, and managers, resets window positions, tracks cursor between map and worksheet, and controls the zoom level of the plot

## Worksheet Commands

The primary commands when viewing a worksheet window are located on the **Data** tab. However, many of the **File** menu and **Grid** tab commands are also available when viewing a worksheet window, and a few of the **Home** and **View** tab commands are available as well:

<b>Data</b>	Contains commands to sort data, filter data, compute statistics, assign projection, reproject data, and calculate mathematical transformations
-------------	--

## Grid Editor Commands

The primary commands when viewing a grid in the grid editor are located on the **Grid Editor** tab:

<a href="#">Grid Editor</a>	Contains commands to open, edit, and save grids
-----------------------------	---

The Application/Document Control menu commands control the size and position of the application window or the document window.

## Status Bar

The status bar is located at the bottom of the **Surfer** window. The status bar displays information about the current command or activity in **Surfer**. Click the **View | Show/Hide | Status Bar** check box to show or hide the status bar. A check mark next to **Status Bar** indicates that the status bar is displayed. Clear the **Status Bar** check box to hide the status bar.

## Status Bar Sections

The status bar is divided into five sections. The left section displays information about the selected command or item in the **Properties** window. The second section shows the selected object name. The middle section shows the cursor coordinates in map units, if the cursor is placed above a map. The fourth section shows the cursor coordinates in page units of inches or centimeters. The right section displays the dimensions of the selected object.

When viewing a grid in the [grid editor](#), the first three sections of the status bar display a description for the selected property in the [Properties](#) window, the active grid node grid coordinates, and the map coordinates of the cursor location.

## Adjust Section Width

The status bar section widths can be adjusted to display additional text. If "..." is displayed at the end of the text, additional text can be displayed. To change the width, place the cursor over a section division. When the cursor changes to a , left-click and drag the divider left or right to a new location.

## Progress

The status bar indicates the progress of a procedure, such as gridding. The percent of completion and time remaining will be displayed.

When the program does not know how much time is required to complete a task, the *Indeterminate* mode is displayed in the status bar. This indicates that the program is actively completing the task, with an unknown time of completion. The program is not frozen.

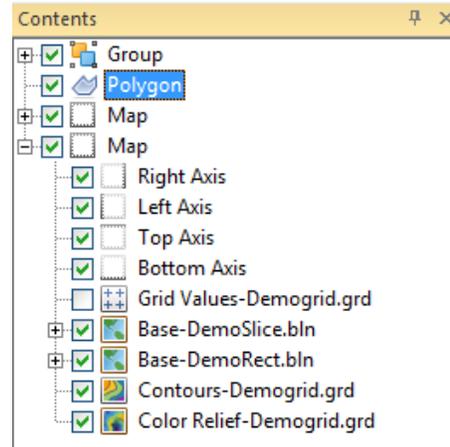
Click the *Cancel* button on the status bar to stop the current process, such as gridding.

## Contents Window

The **Contents** window contains a hierarchical list of all objects in the plot window. The objects can be selected, arranged, moved, renamed, or deleted in the **Contents** window. Changes made in the **Contents** window are reflected in the plot window, and vice versa.

## Object Tree

If an object contains sub-objects, a  $\oplus$  or  $\ominus$  is located to the left of the object name. Click on the  $\oplus$  or  $\ominus$  button to expand or collapse the list. For example, a map object normally contains at least one map layer (e.g. Contours) and four axes. The *Map* object may contain many other objects. To expand the *Map* tree, click on the  $\oplus$  control. You can also select the item, and press the PLUS key on the numeric keypad or press the RIGHT ARROW key on your keyboard. To collapse a branch of the tree, click on the  $\ominus$  control. You can also select the item, and press the MINUS key on the numeric keypad or press the LEFT ARROW key. The expansion state of sub-objects in the **Contents** window is retained in the **Surfer** file .SRF. Use the *Expand new Contents window items* option in the **Options** dialog to control the expansion state of new objects in **Contents** window.



The **Contents** window displays the structure of all the objects in the plot window.

## Arranging Objects

To change the display order of the objects with the mouse, select an object and drag it to a new position in the list above or below an object at the same level in the tree. The pointer changes to a black arrow if the object can be moved to the cursor location, or a red circle with a diagonal line if the object cannot be moved to the indicated location. Alternatively, select an object and use the **Bring to Front**, **Send to Back**, **Bring Forward**, and **Send Backward** commands. These commands can be accessed in the **Layout | Arrange** command group or by right-clicking on an object in the **Contents** window.

## Object Visibility

Each object in the **Contents** window includes an icon indicating the type of object and a text label for the object. All objects also have a check box that indicates if the object is visible. A  indicates the object is visible. A  indicates the object is not visible. Click on the check box to change the visibility state of the object. Invisible objects do not appear in the plot window and do not appear on printed output. The visibility check box also controls the visibility for all of its sub-objects. For example, if a *Map* object is made invisible the axes and layers within the *Map* will also be hidden. Note that if a surface is made invisible, any overlays also become invisible.

## Locked Objects

Objects and layers can be locked to prevent changes to their size and position with the Lock Position command. When an object or layer is locked, a small lock icon appears in the lower-right corner of the visibility check box. When a map, group, or base layer object is locked, all of its sub-objects are automatically locked.

## Opening Object Properties

To display the properties for an object, click once on the object in the **Contents** window or in the plot window. The properties are displayed in the [Properties](#) window. To display a context menu of

available actions for an object, right-click on that object. When the **Properties** window is hidden or closed, double-clicking on an object in the **Contents** window opens the **Properties** window with the properties for the selected object displayed. The map properties control the map's *View*, *Scale*, *Limits*, *Frame*, and *Coordinate System*. Each map layer has specific properties that controls the options for the specific [map type](#). Each map axis also has properties.

## Selecting Objects

To select an item in the **Contents** window, click on the item or press the arrow keys, and the object text is highlighted. The selection handles in the plot change to indicate the selected item. If you select an object in the plot window, its name is selected in the **Contents** window as well. Only one nested object can be selected at a time. For example, it is not currently possible to select two axes at once.

To select multiple objects at the same level in the tree, hold down the CTRL key and click on each object. To select multiple contiguous objects at the same level in the tree, select the first object, and then hold down the SHIFT key and click on the last object.

## Renaming Objects

To edit an object's text ID, select the object in the **Contents** window and then click again on the selected item (two slow clicks) to edit the text ID associated with an object. You must allow enough time between the two clicks, so the clicks are not interpreted as a double-click. Enter the new name into the box. Alternatively, you can right-click on an object name and select **Rename Object**, click the **Home | Selection | Rename** command, or press F2 on the keyboard. Enter an ID in the **Rename Object** dialog and click *OK*.

## Deleting Objects

To delete an object, select the object and press the DELETE key. To move a map layer from one map to a new map, click on the map layer and click **Map Tools | Layer Tools | Break Apart**. Alternatively right-click on the map layer and select **Break Apart Layer**.

## Scroll the Contents Window

If the list of objects in the **Contents** window is long, you can use the scroll bar on the side of the **Contents** window to scroll down to an object. Alternatively, you can use the mouse scroll wheel to scroll down. To scroll down using the mouse, click once in the **Contents** window to select the window. Roll the mouse wheel backward to scroll lower in the **Contents** window. Roll the mouse wheel forward to scroll higher in the **Contents** window.

## Properties Window

The **Properties** window allows you to edit the properties of a selected object, such as a contour map or axis. The **Properties** window contains a list of all properties for the selected object. The **Properties** window can be left open so that the properties of the selected object are always visible.

When the **Properties** window is hidden or closed, double-clicking on an object in the [Contents](#) window opens the **Properties** window with the properties for the selected object displayed. To activate the **Properties** window, click inside the **Properties** window or press ALT+ENTER on the keyboard.

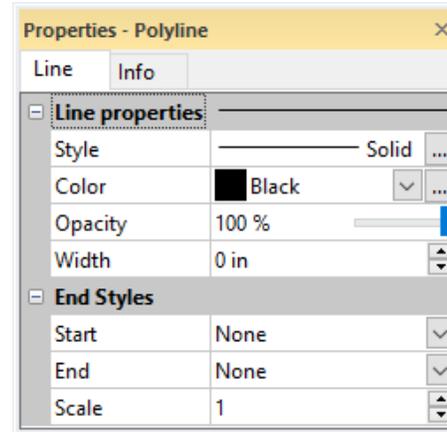
For information on a specific feature or property that is shown in the **Properties** window, refer to the help page for that **Properties** window page. For instance, if you are interested in determining

how to set the *Fill colors* for a contour map or how to save data for a post map, refer to the contour map Levels page or post map General page.

## Changing Properties

The **Properties** window displays the properties for selected objects. To change a property, click on the property's value and select a new property from the pop up box, scroll to a new number using the  buttons, select a new value using the slider , select a new value from the list or palette, or type a property value. Objects in the plot window automatically update after you select an item from a palette, use one of the controls, or press ENTER after typing a new value.

For example, a polyline has *Style*, *Color*, *Opacity*, *Width*, and *End Styles* properties. Changing the *Color* requires clicking on the current color and selecting a new color from the color palette. Changing the *Width* requires highlighting the current width and typing a new number or scrolling to a new number. Changing the *Opacity* requires highlighting the existing percentage and typing a new number or clicking on the slider bar and dragging it to a new value.



The **Properties** window displays the properties associated with the selected object.

You can modify more than one object at a time. Only shared properties can be changed are when multiple objects are selected. For example, you can click on a polyline in the **Contents** window. Hold the CTRL key and click on a polygon. You can then change the line properties of both objects at the same time. Fill properties, which are available if only a polygon was selected, are not available as the polyline does not have fill properties.

Some properties are dependent on your other selections. For example, there is a *Pattern Offset* section on the **Fill** page. This section is only available when an image fill type is selected as the *Pattern*.

## Expand and Collapse Features

Features with multiple options appear with a  or  to the left of the name. To expand a group, click on the  icon. To collapse the group, click on the  icon. For example, the expanded *Filled Contours* section in the **Levels** page contains three options, *Fill contours*, *Fill colors*, and *Color scale*.

## Keyboard Commands

To activate the **Properties** window, press ALT+ENTER on the keyboard. When working with the **Properties** window, the up and down arrow keys move up and down in the **Properties** window list. The TAB key activates the highlighted property. The right arrow key expands collapsed sections, e.g., *Filled Contours*, and the left arrow collapses the section.

## Property Defaults

Use the **File | Options** command to change the default settings. Default settings for rulers, drawing grid, line, fill, text, symbol, label format, and advanced settings that control each map type can be set from the **Options** dialog.

## Property Information Area

If the *Show property info area* is checked on the **Options** dialog **User Interface** page, a short help statement for each selected command in the **Properties** window.

## Worksheet Document

Worksheet windows are a view of the data file and are designed to display, edit, enter, and save data. The worksheet windows have several useful and powerful editing, transformation, and statistical operations available. In addition, a coordinate system can be assigned to the data file. Several import and export options are available for opening data files from other spreadsheet programs. The components of the worksheet window are displayed below.

## Worksheet Commands

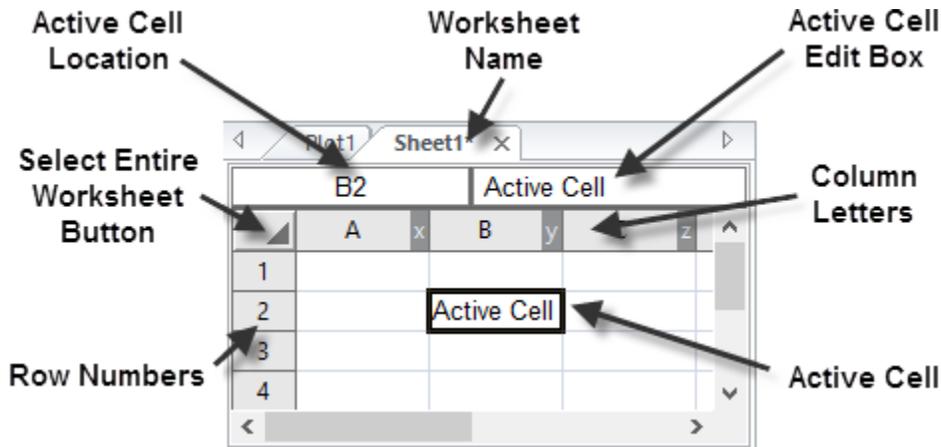
The worksheet commands include commands on the following tabs:

<b>File</b>	Open and save files, import or export data, print, and set options and defaults
<b>Home</b>	Contains clipboard and undo commands
<b>Grids</b>	Perform grid operations
<b>View</b>	Controls the display of status bar and windows and resets window positions
<b>Data</b>	Edit, find, format data in the worksheet. Manipulate, transform, and perform calculations with worksheet data. Assign or project coordinates. Track the cursor between the plot, worksheet, and grid windows.

Not all of the **File**, **Home**, **Grids**, and **View** commands are available in the worksheet view.

## 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.

<u>Component Name</u>	<u>Component Function</u>
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.

## Grid Editor

The **File | Open, Grids | Editor | Grid Editor**, and **Map Tools | Edit Layer | Grid** commands open the grid editor as a new document.

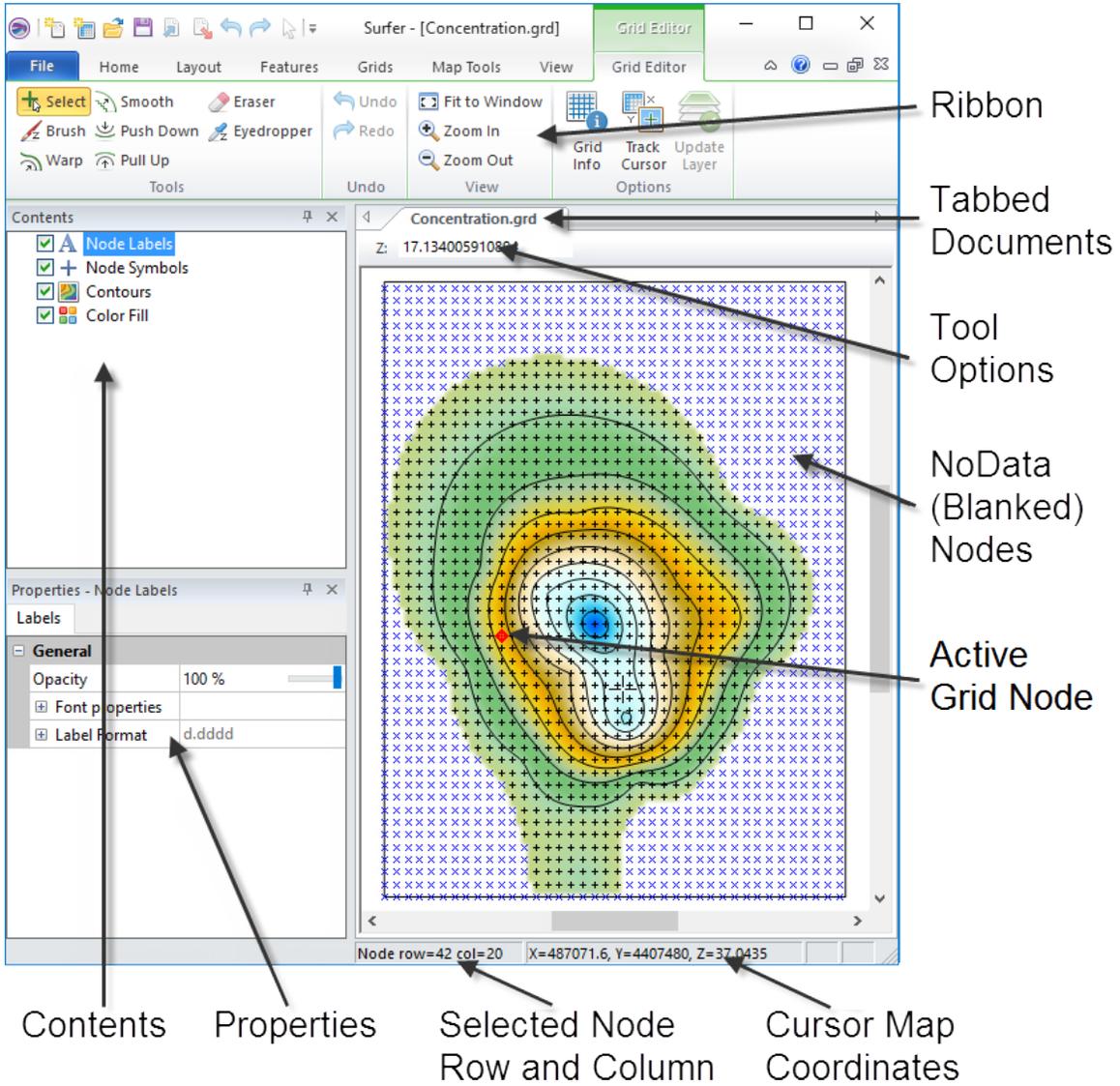
- The **File | Open** command opens the grid editor when a grid or image file is selected in the **Open** dialog.
- The **Grids | Editor | Grid Editor** command opens a grid file with the **Open Grid** dialog.
- The **Map Tools | Edit Layer | Grid** command opens the grid file from the selected map layer in the plot document. You can also edit the grid for a map layer by right-clicking on the map layer and clicking **Edit Grid**. This command enables the **Update Layer** command in the grid editor. The **Map Tools | Edit Layer | Grid** command is not available for 1-grid vector and 2-grid vector layers.

The grid editor contains various methods for editing the grid Z values. Editing the grid z values will change the appearance of any grid-based maps. For example, the grid editor can be used to edit contours on a contour map or change the surface in a 3D surface map.

Each grid node is indicated with a black "+" in the grid editor window by default. Each blanked (NoData) grid node is indicated with a blue "x" by default. The active node is highlighted with a red diamond. To move between grid nodes, press the arrow keys, or click a node with the **Select** tool active to make it the active node. The grid editor also includes contours, node labels, and a color fill. The grid appearance is controlled by the items in the **Contents** window and the properties displayed in the **Properties** window. Note the **Undo** command does not undo changes in the **Properties** window in the grid editor.

## Grid Editor Window

The following image and table explain the purpose of the grid editor window components.



This is the **Surfer** grid editor with the **Contents** and **Properties** windows on the left and grid editor window on the right.

<u>Component Name</u>	<u>Component Definition</u>
Ribbon	The ribbon contains the <b>Grid Editor</b> commands.
<a href="#">Contents</a>	Toggle the display of the Node Labels, Node Symbols, Contours, and Color Fill with the <b>Contents</b> window.
<a href="#">Properties</a>	Edit Node Labels, Node Symbols, Contours, and Color Fill display properties in the <b>Properties</b> window.
Tabbed Documents	Plot windows, worksheet windows, and grid editor windows are displayed as tabbed documents.
Tool Options	The tool options bar contains the Z value box, <i>Brush size</i> , <i>Density</i> , and/or <i>Pressure</i> depending on the selected tool mode.
Active Node	The node that is currently selected. The active node is highlighted with a red diamond.
Grid Node	Each grid node is indicated with a black "+" in the grid editor window by default. Blanked (NoData) nodes are indicated with a blue "x".
<a href="#">Status Bar</a>	The status bar includes information about the selected property, active node grid coordinates, and cursor map coordinates.

## Grid Editor Commands

The **Grid Editor** ribbon tab includes the following commands:

<u>Command</u>	<u>Description</u>
<b>Select</b>	Select a grid node to edit the grid Z values one node at a time
<b>Brush</b>	Apply a specific Z value to one or more nodes
<b>Warp</b>	Drag grid values from one region into another
<b>Smooth</b>	Apply weighted averaging to grid nodes
<b>Push Down</b>	Decrease grid node values
<b>Pull Up</b>	Increase grid node values
<b>Eraser</b>	Blank (assign NoData value) to grid nodes
<b>Eyedropper</b>	Acquire a grid node value by clicking on the grid
<b>Undo</b>	Undo the last operation
<b>Redo</b>	Redo the last undone operation
<b>Fit to Window</b>	Fits the entire grid in the grid editor window
<b>Zoom In</b>	Increase the grid editor window magnification
<b>Zoom Out</b>	Decrease the grid editor window magnification
<b>Grid Info</b>	Display information about the grid in a report window
<b>Track Cursor</b>	Track cursor location across plot, worksheet, and grid editor windows for maps, data files, and grids.
<b>Update Layer</b>	Updates the associated map layer with the edited grid

## Using the Grid Editor

The grid editor can be used on existing map layers or on grid files without first creating a map.

To edit a map layer's grid:

1. Select the map layer you wish to edit in the plot document **Contents** window. Only the grid for this map layer will be edited, even when multiple layers use the same grid file.
2. Click **Map Tools | Edit Layer | Grid** in the plot window. The grid file is opened and is represented by a filled contour map. The location of each grid node in the file is marked with a black "+". Blanked (NoData) nodes are marked with a blue "x".
3. Use the **Grid Editor | Tools** commands to make the desired adjustments to the grid.
4. When you are done editing the grid, click the **Grid Editor | Options | Update Layer** command to update the map layer in the plot document with your grid.
5. If you wish to save your edits to a file, click **File | Save As** to create a new grid file. Click **File | Save** to overwrite the existing grid file. It is necessary to save your edits to a file with **Save** or **Save As** if you wish to update all layers in your map to use the edited grid.
6. To close the grid editor window, click the **File | Close** command or click the X in the grid editor document tab. To view an existing window and keep the grid editor window open, click on another document tab.

To edit a grid file:

1. Click the **Grids | Editor | Grid Editor** command and select the grid file in the **Open Grid** dialog. Alternatively, click the **File | Open** command and select a grid file in the **Open** dialog. The grid file is opened and is represented by a filled contour map. The location of each grid node in the file is marked with a black "+". Blanked (NoData) nodes are marked with a blue "x".
2. Use the **Grid Editor | Tools** commands to make the desired adjustments to the grid.
3. When you are done editing the grid, click **File | Save As** to create a new grid file. Click **File | Save** to overwrite the existing grid file. It is necessary to save your edited grid to a file with **Save** or **Save As** if you wish to create map layers with the grid.
4. To close the grid editor window, click the **File | Close** command or click the X in the grid editor document tab. To view an existing window and keep the grid editor window open, click on another document tab.

## File Types

**Surfer** uses four basic file types: data, grid, base map, and **Surfer** .SRF files.

### Data Files

Data files are used to produce grid files, post data points on a map, or generate a residuals log. These files are generally referred to as "XYZ data files" or "data files" throughout the help. Data can be read from various file types. Most data files contain numeric XY location coordinates and optional Z values. The Z values contain the variable to be modeled, such as elevation, concentration, rainfall, or similar types of values.

XYZ data files contain raw data that **Surfer** interprets to produce a grid file. To create a grid file, you must start with an XYZ data file. XYZ data files are organized in column and row format. Surfer requires the X, Y, and Z data to be in three separate columns.

## Grid Files

Grid files produce several different types of grid-based maps, are used to perform grid calculations, and to carry out grid operations. Grid files are a regularly spaced rectangular array of Z values in columns and rows. Grid files can be created in **Surfer** using the **Home | Grid Data | Grid Data** command or can be imported from a wide variety of sources such as WCS servers or other applications.

## Base Map Files

Base map files contain XY location data such as aerial photography, state boundaries, rivers, or point locations. Base map files are used to create base layers overlaid on other map types, or to specify the limits for blanking, faults, breaklines, or slice calculations. Base maps can be created from a wide variety of vector and image formats.

## Surfer Files

**Surfer** .SRF files preserve all the objects and object settings contained in a plot window. These files are called **Surfer** .SRF files throughout the documentation. **Surfer 14** can open .SRF files from previous versions of **Surfer 7, 8, 9, 10, 11, 12,** and **13**. **Surfer 14** saves in **Surfer 11, Surfer 12, Surfer 13,** and **Surfer 14** .SRF format. For example, the **Surfer 13** .SRF file can be opened in **Surfer 13** or **Surfer 14**, but does not contain features that are new in **Surfer 14**. Previous versions of **Surfer** (e.g. **Surfer 13**) cannot open **Surfer 14** .SRF files.

# Gridding Overview

## What is a grid?

A grid is a rectangular region comprised of evenly spaced rows and columns. The intersection of a row and column is called a grid node. Rows contain grid nodes with the same Y coordinate. Columns contain grid nodes with the same X coordinate. Contour, color relief, shaded relief, grid values, vector, viewshed, watershed, 3D surface, and 3D wireframe map layers all require grids in **Surfer**.

## What is gridding?

Gridding is the process of taking irregularly spaced XYZ data and generating a regularly spaced grid of Z values at each grid node by interpolating or extrapolating the data values. In addition to gridding data, **Surfer** can also use a variety of other grid files directly. For a list of these, refer to the *File Format Chart* in the online help.

## Gridding Methods

Gridding the data produces a regularly spaced, rectangular array of Z values from irregularly spaced XYZ data. The term "irregularly spaced" means that the distance between data points varies in the X or Y direction, or both. Irregularly spaced data often has many holes where data are missing. Gridding fills in these holes by extrapolating or interpolating Z values at those locations where no data exists. The gridding method determines the mathematical algorithms used to compute the Z value at each grid node. Each method results in a different representation of your data. It is advantageous to test each method with a typical data set to determine the gridding method that provides you with the most satisfying interpretation of your data.

When your XYZ data is regularly spaced, meaning the distance between data points does not change in the X and Y directions, you may produce a grid file that uses the Z values directly and does not interpolate values for the grid nodes. See the *Producing a grid file from a regular array of XYZ data* topic for more information.

## General Gridding Options

Each gridding method has its own set of gridding options. Some of the options are the same or similar for the different gridding methods, while other options are specific to particular gridding methods. Some options that are available to multiple gridding methods include: *Search*, *Anisotropy*, *Breaklines*, and *Faults*.

## Grids Tab Commands

There are many ways to manipulate grid files in **Surfer**. The **Grids** tab contains commands used to blank, convert, create, extract, filter, mosaic, slice, smooth, and transform grid files. In addition, volume calculations, variogram generation, calculus operations, cross section creation, and residual calculations can be performed using the commands under the **Grids** tab.

## Grid Data

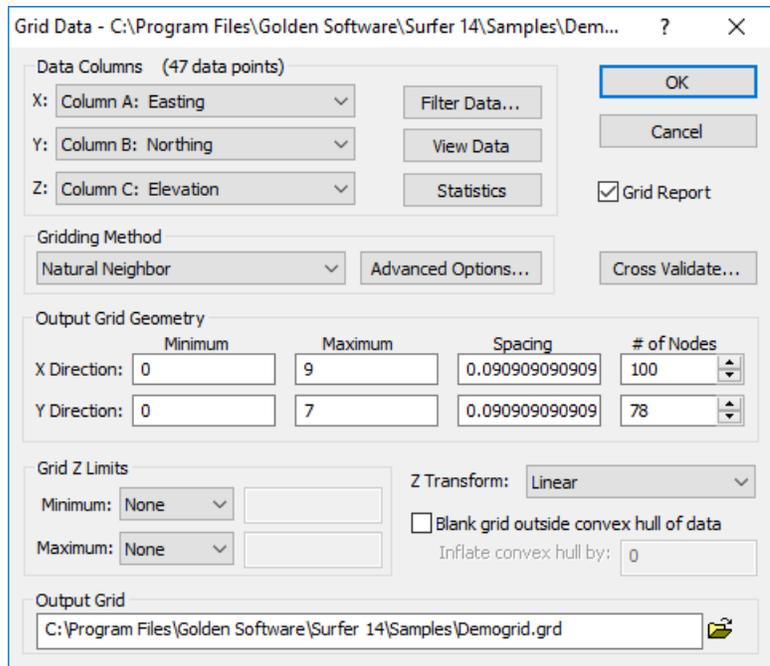
Grid files are necessary in **Surfer** to create grid-based [maps types](#). Data files are typically randomly spaced files, and this data must be converted into an evenly spaced grid before using many of **Surfer's** features. Grid files are produced from XYZ data using the **Home | Grid Data | Grid 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.

## Data Columns

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.

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.

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

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.

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 blanked.

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 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.

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.

## 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.

Check the box next to the *Blank grid outside convex hull of data* to automatically blank the grid nodes outside the convex hull of the data. Leave the box unchecked to extrapolate the data to the minimum and maximum grid limits, regardless of whether data exists in these areas.

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 blanked is moved outside the convex hull boundary by the number of map units specified. When set to a negative value, the area blanked 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. When the value is set to too high of a positive value, the contours will extend all the way to the minimum and maximum X and Y limits of the grid. When the value is set to too low of a negative value, the entire grid will be blanked, resulting in no grid file being created.

## Z Transform

The *Z Transform* option changes how the Z values are gridded. Available options are *Linear*; *Log, save as log*; and *Log, save as linear*. To change the *Z Transform* option, click on the existing option and select the desired option from the list.

*Linear* uses the Z values in the worksheet for gridding. No transformation is applied to the Z values. The *Linear* method is a good option for data that gradually increases over space. This is the default *Z Transform*.

Both *Log* options use take the log (base 10) of the Z values before gridding. The log (base 10) of the Z value is then used for gridding. The *Log, save as log* takes the log (base 10) of the Z values

and uses the log value for gridding. The grid is then saved with the log (base 10) values. The *Log, save as linear* takes the log (base 10) of the Z values and uses the log value for gridding. The grid is then converted back to the linear Z values by taking the antilog of the gridded results. When *Log, save as log* or *Log, save as linear* is selected, at least three non-collinear data points must be positive Z values. Negative values are ignored for gridding. Both *Log* methods are good options when the data changes very quickly over a small area or when very high and very low values occur very closely to each other. This can be common with concentration values in ground water or geochemical data.

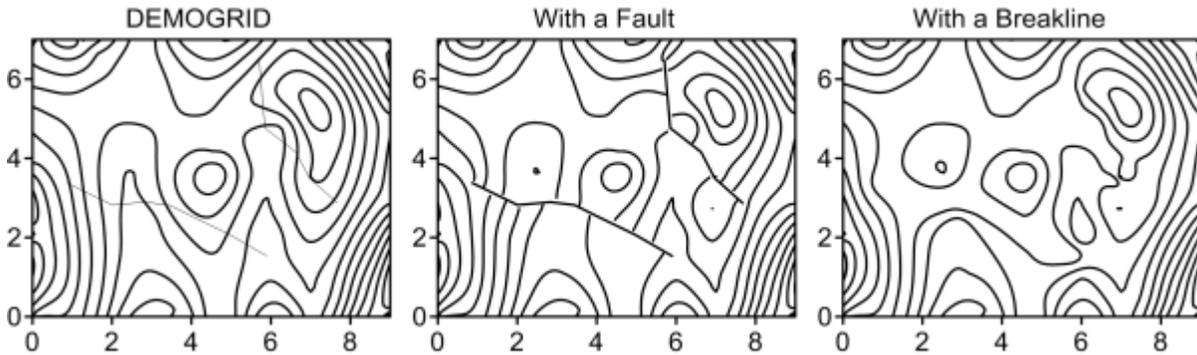
## Breaklines

Breaklines are used when gridding to show discontinuity in the grid. A breakline is a three-dimensional boundary file .BLN that defines a line with X, Y, and Z values at each vertex. When the gridding algorithm sees a breakline, it calculates the Z value of the nearest point along the breakline, and uses that value in combination with nearby data points to calculate the grid node value. **Surfer** uses linear interpolation to determine the values between breakline vertices when gridding. Unlike faults, breaklines are not barriers to information flow, and the gridding algorithm can cross the breakline to use a point on the other side of the breakline. If a point lies on the breakline, the value of the breakline takes precedence over the point. Breakline applications include defining streamlines, ridges, and other breaks in the slope.

## Faults

Faults are used to show discontinuity when gridding, similar to [breaklines](#). A fault is a two-dimensional boundary file .BLN defining a line acting as a barrier to information flow when gridding. When gridding a data set, data on one side of a fault is not directly used when calculating grid node values on the other side of the fault.

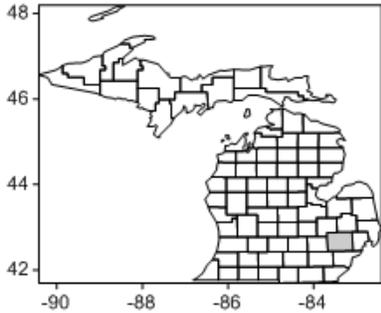
If the fault line is a closed polygon, the gridding algorithm will grid the data on the side of the polygon where the data are located. If the fault line is not a closed polygon, the gridding algorithm can search around the end of the fault to see a point on the other side of the fault, but this longer distance reduces the weight of the point in interpolating the grid node value. If a point lies directly on the fault line, random round-off error determines which side of the fault captures the point.



The map on the left is created from *demogrid.grd* using default settings. The center map is created with two fault lines. The right map is created with breaklines.

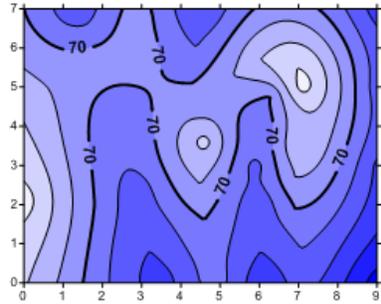
# Map Types

Several different map types can be created, modified, and displayed with **Surfer**. These map types include base, contour, post, classed post, 3D surface, 3D wireframe, color relief, shaded relief, grid values, watershed, 1-grid vector, and 2-grid vector maps. A brief description and example of each map is listed below.



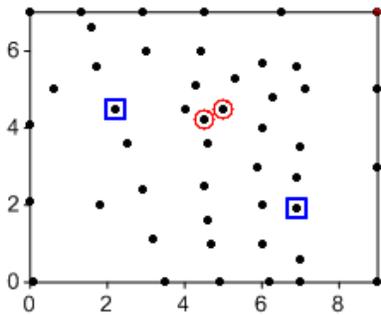
## Base Maps

Base maps display boundaries on a map and can contain polygons, polylines, points, text, images, or metafiles. Base maps can be overlaid with other map layers to provide details such as roads, buildings, streams, city locations, areas of no data, and so on. Base maps can be produced from vector files, images, and data files. Individual base map objects can be edited, moved, reshaped, or deleted. Empty base maps can be created and used for drawing objects on other maps. Image and vector base maps can be downloaded from online WMS, OSM, and WFS mapping servers.



## Contour Maps

Contour maps are two-dimensional representations of three-dimensional data. Contours define lines of equal Z values across the map extents. The shape of the surface is shown by the contour lines. Contour maps can display the contour lines and colors or patterns between the contour lines. Contours can be linearly or logarithmically spaced, or a custom spacing can be set between each set of lines.



## Post Maps

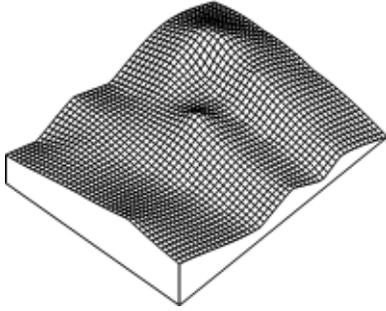
Post maps and classed post maps show data locations on a map. You can customize the symbols and text associated with each data location on the map. Each location can have multiple labels. Classed post maps allow you to specify classes and change symbol properties for each class. Classes can be saved and loaded for future maps.



## 3D Surface Maps

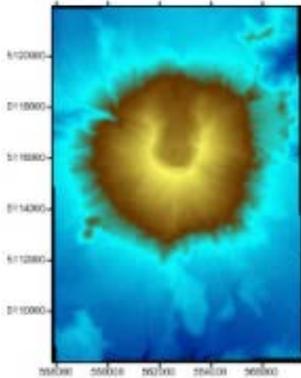
3D surface maps are color three-dimensional representations of a grid file. The colors, lighting, overlays, and mesh can be altered on a surface. Multiple 3D surface maps can be layered to create a block diagram.

## Map Types



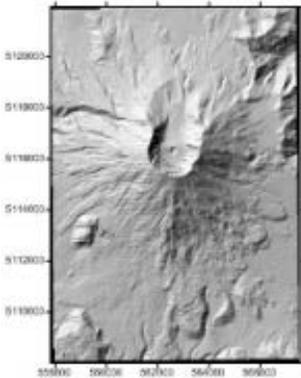
### 3D Wireframe Maps

3D wireframe maps are three-dimensional representations of a grid file. Wireframes are created by connecting Z values along lines of constant X and Y.



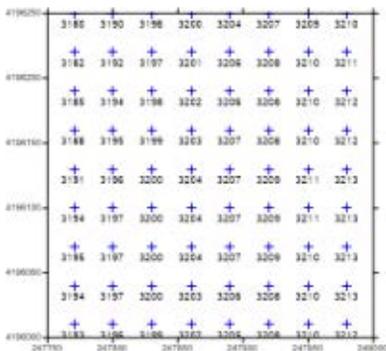
### Color Relief Maps

Color relief maps are raster images based on grid files. Color relief maps assign colors based on Z values from a grid file. Blanked regions on the color relief map are shown as a separate color or as a transparent fill. Pixels can be interpolated to create a smooth image. Hill shading can be applied to the color relief map to enhance its depth and appearance.



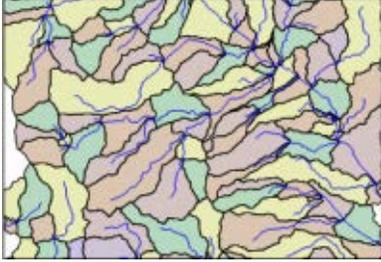
### Shaded Relief Maps

Shaded relief maps are raster images based on grid files. Shaded relief maps assign colors based on slope orientation relative to a light source. Surfer determines the orientation of each grid cell and calculates reflectance of a point light source on the grid surface. The light source can be thought of as the sun shining on a topographic surface.



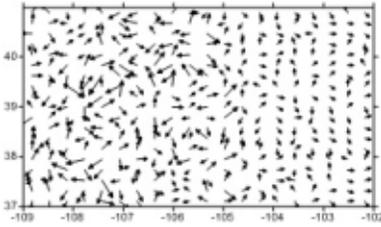
### Grid Values Maps

Grid values maps show symbols and labels at grid node locations across the map. The density of the labels and symbols is controlled in the X and Y directions independently. Symbol color can vary by value across a colormap, and symbols and labels can be displayed for only a specific range of values. Grid lines can be added to the map.



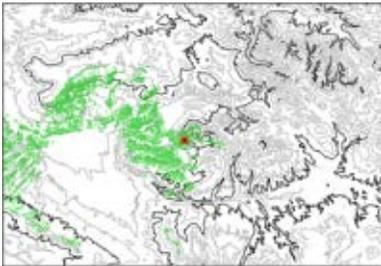
## Watershed Maps

Watershed maps display the direction that water flows across the grid. The watershed map breaks the grid into drainage basins and streams. Colors can be assigned to the basins and line properties can be associated with the streams. In addition, depressions can be removed by filling the depression.



## Vector Maps

1-grid and 2-grid vector maps display direction and magnitude data using individually oriented arrows. At any grid node on the map, the arrow points in the downhill direction of the steepest descent and the arrow length is proportional to the slope magnitude. Vector maps can be created using information in one grid file (i.e. a numerically computed gradient) or two different grid files (i.e. each grid giving a component of the vectors).



## Viewshed Layers

Viewshed layers highlight the regions of a map that are visible (or invisible) from a transmitter location. The transmitter, receiver, and obstruction height above the surface can be specified. The viewshed analysis radius and angle can also be specified. Viewsheds can be added to any 2D grid based map. A viewshed can also be added to a 3D surface map that is displayed with no tilt (90 degrees) and in the orthographic view.

## Map Layers

A map layer is a single map type contained in a larger map object. The map layer may be a contour layer, a post layer, a base layer, or any other layer type that **Surfer** can create. The larger map object contains all of the individual map layers and axes used to create the entire map. Map layers can be created as separate maps or added to a single map object.

It is possible to combine several maps created from related data to create one map object with multiple map layers. You can add any combination and number of contour, base, post, color relief, shaded relief, vector, watershed, viewshed, or 3D surface layers to a single map. However, a map can contain only one 3D wireframe layer.

There are multiple ways to overlay map layers in **Surfer**. If you have multiple maps and wish to move only one layer, you can drag a map layer from one map object to another map object in the **Contents** window. If you wish to combine all the layers from multiple maps, you can select all of the maps and use the **Map Tools | Map Tools | Overlay Maps** command. This moves all of the map layers to a single map object. If you have already created a map and need to add map layers to it, you can select the map and use one of the **Home | Add to Map | Layer** commands to add a map layer to the existing map.

## Coordinate Systems

A coordinate system is method of defining how a file's point locations display on a map. Different types of coordinate systems exist that control how the coordinates are shown on the map. In

**Surfer**, a map can be unreferenced in local coordinates, referenced to a geographic latitude and longitude coordinate system, or referenced to a known projection and datum. Each data set, grid, map layer, and the map frame can have an associated coordinate system. All coordinate systems for individual layers are converted “on the fly” to the map’s target coordinate system. This allows maps with different coordinate systems to be easily combined in **Surfer**.

A local coordinate system generally is considered unreferenced. A local system has a location that begins numbering at an arbitrary location and increments numbers from this location. This is frequently referred to as a *Cartesian coordinate system*. The distance units can be specified for an unreferenced local system in the **Assign Coordinate System** dialog.

A *Geographic coordinate system* uses a spherical surface to define locations on the earth. Geographic coordinate systems are commonly called unprojected lat/long. **Surfer** has several predefined geographic coordinate systems available. Each system has a different datum. The same latitude and longitude value will plot in different locations depending on the datum.

A *Projected coordinate system* consists of a projection and a datum. Each projection distorts some portion of the map, based on the ellipsoid and datum specified. Coordinates can be lat/long, meters, feet, or other units. Different projections cause different types of distortion. It is recommended that you do not use projected coordinate systems if you do not need to convert between coordinate systems or if all your data are in the same coordinate system.

## Source Coordinate System - Map Layer

Maps can be created from data, grids, or base map files in any coordinate system. The *Source Coordinate System* is the coordinate system for the original data, grid, or base map used to create a map layer. Each map layer can reference a different projection and datum. If some map layers are using a different source coordinate system than what you want the map to display, the map layer is converted to the map’s [Target Coordinate System](#).

3D surface maps and wireframe maps do not have an associated coordinate system and cannot be converted to a different coordinate system. When a layer with a coordinate system is overlaid onto either a surface or wireframe map, the layer’s coordinate system is removed and the layers are displayed in Cartesian coordinates.

## Target Coordinate System - Map

Maps can be displayed in any coordinate system. The map is displayed in the coordinate system defined as the *Target Coordinate System*. A coordinate system normally has a defined projection and datum. When a map layer uses a different a different [Source Coordinate System](#) than the map’s *Target Coordinate System*, the map layer is converted to the map’s *Target Coordinate System*.

The standard procedure for creating maps in a specific coordinate system is as follows:

1. Create the map by clicking on the appropriate **Home | New Map** command.
2. Click on the map layer to select it.
3. In the [Properties](#) window, click on the [Coordinate System](#) tab.
4. If the *Coordinate system* is not correct, click the *Set* button next to *Coordinate System*. The **Assign Coordinate System** dialog opens. This is the initial coordinate system for the map layer, i.e. the coordinate system for the source data. Select the correct coordinate system in the dialog. When finished making changes, click *OK*.

5. To change the target coordinate system for the map, click on the *Map* object in the **Contents** window. In the **Properties** window, click on the [Coordinate System](#) tab. This is the coordinate system in which you want the map to display.
6. Click on the *Change* button next to *Coordinate System* to set the desired [target coordinate system](#). When finished, click *OK*.
7. All of the map layers are converted on the fly to the target coordinate system. The entire map is now displayed in the desired coordinate system.

**Surfer** does not require a map projection be defined. Maps can be created from unreferenced data, grid, and map layers. As long as all map layers have the same X and Y ranges, coordinate systems do not need to be specified. If you do not specify a source coordinate system for each map layer, it is highly recommended that you do not change the target coordinate system. Changes to the target coordinate system for the map can cause the unreferenced map layers to appear incorrectly or to not appear.

## 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.

## 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 14\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 14\Samples, by default.

## Starting Surfer

To begin a **Surfer** session:

1. Navigate to the installation folder, which is C:\Program Files\Golden Software\Surfer 14 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.

	A1	X Coord.	
	A	B	C
1	X Coord.	Y Coord.	Z value
2	1665.4	9567.2	234.7
3	7659.3	2324.6	275.2
4	1499.5	3212.9	253.5
5	5438.1	5753.9	231.1
6	4327.4	4013.9	245.8

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

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

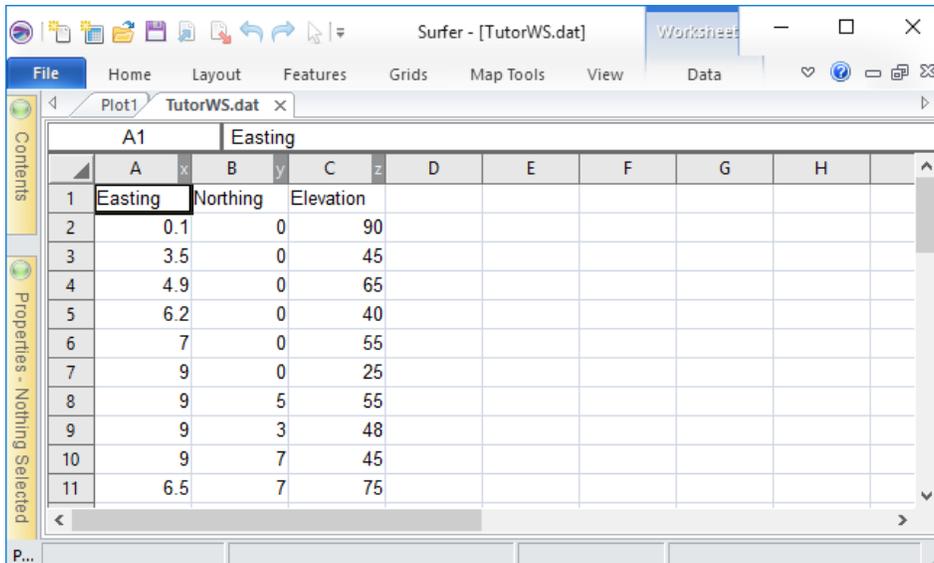
1. Click the **File | New | Worksheet** command, click the  on the quick access toolbar, or press CTRL+W on the keyboard. A new empty worksheet window is displayed.
2. Data is entered into the active cell. The active cell is selected by clicking on the cell or by using the arrow keys to move between 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.

## Opening an Existing Data File

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 14. 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.



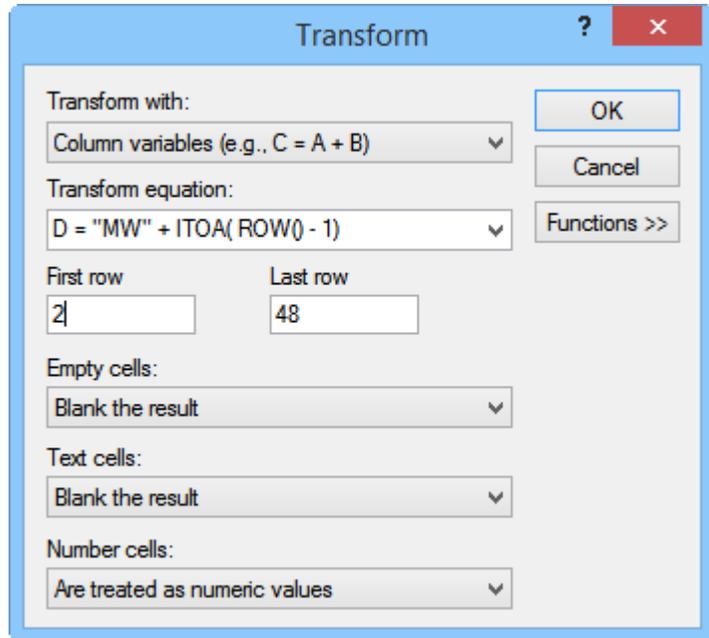
	A	B	C	D	E	F	G	H
1	Easting	Northing	Elevation					
2	0.1	0	90					
3	3.5	0	45					
4	4.9	0	65					
5	6.2	0	40					
6	7	0	55					
7	9	0	25					
8	9	5	55					
9	9	3	48					
10	9	7	45					
11	6.5	7	75					

*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

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.

	A	B	C	D	E	F	G	H
1	Easting	Northing	Elevation	Name				
2	0.1	0	90	MW1				
3	3.5	0	45	MW2				
4	4.9	0	65	MW3				
5	6.2	0	40	MW4				
6	7	0	55	MW5				
7	0	0	25	MW6				

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

## Saving the Data File

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

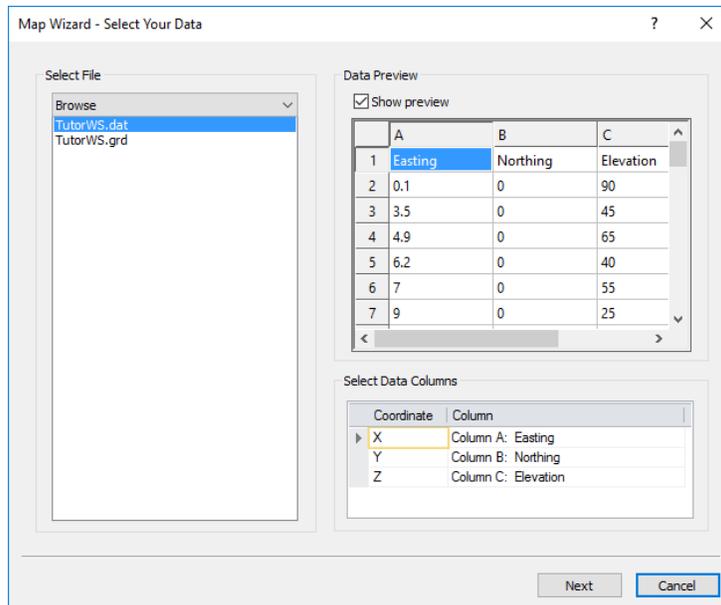
Now that we have saved the data file, we will use the **Map Wizard** to create a grid and a map with contour and post layers. The **Map Wizard** steps through the map creation process from raw data to a map with one or more layers. The **Map Wizard** is useful for creating multiple map types from a single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

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



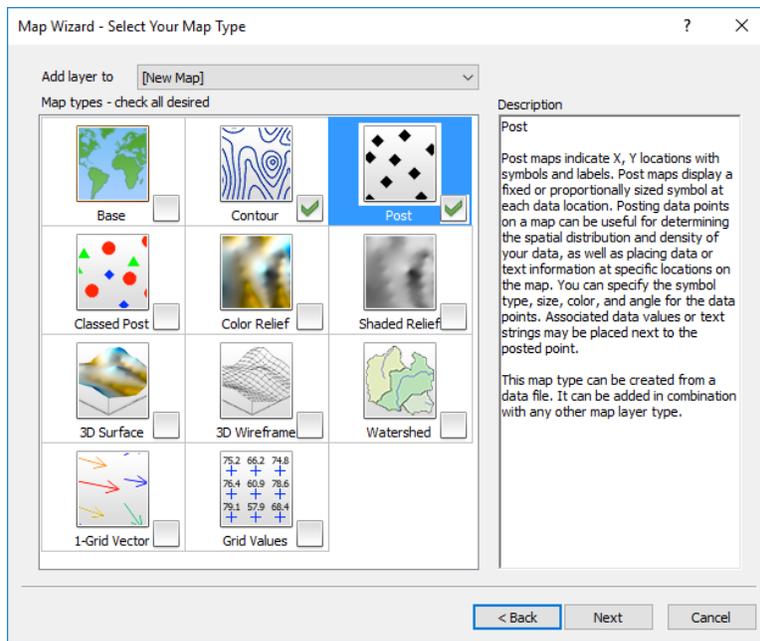
Select the data file from Lesson 1 in the **Select Your Data** page.

## Tutorial

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.
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

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 when an XYZ data file is selected 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*.

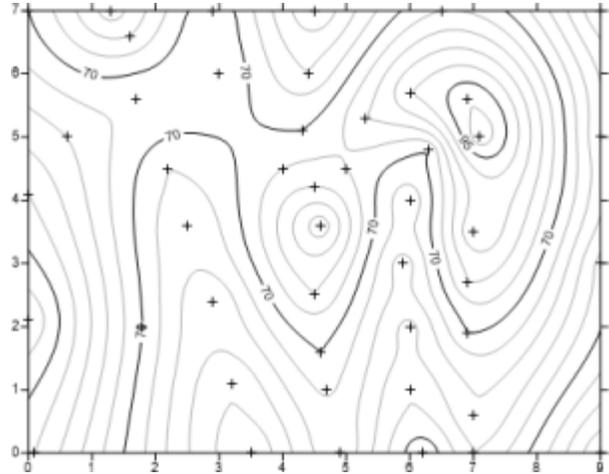
## Select Gridding Parameters

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.

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 *Output grid file* is named *Tutorial.grd* and in the desired directory, for example your *Documents* folder.
3. 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.



A map is created with default contour and post layers.

## Adding a Color Relief Layer

[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 created, 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.

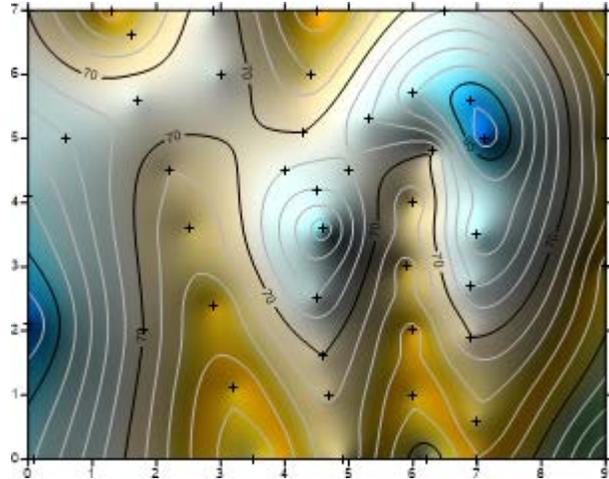
## Tutorial

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.

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

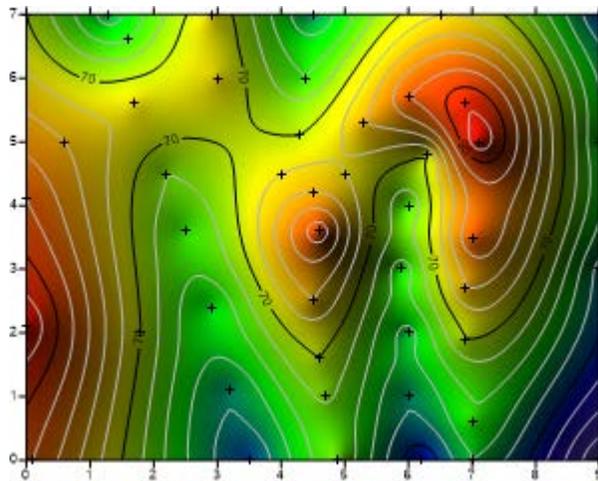
The map's appearance is mainly determined by the properties of the map layers. This lesson will demonstrate a few of the common properties for controlling the display of contour, post, and color relief layers. However, each map type has many properties and display options. A description and explanation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



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

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 **Contents** window. When the color relief layer is selected, the color relief layer properties are displayed in the [Properties](#) window.
2. Click the **General** tab in the **Properties** window to display the **General** page.
3. If necessary, click the  button next to *General* to expand the *General* section.
4. The *Colors* property determines the colormap used in the color relief map. The default colormap is *Terrain*. Click *Terrain* and select *Rainbow* from the *Colors* list.



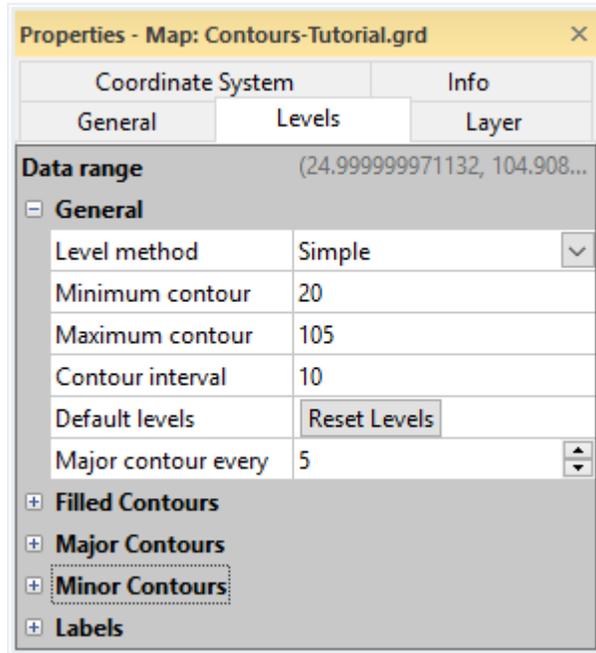
This color relief layer uses the Rainbow colormap.

Now the color relief layer is using the *Rainbow* colormap. You can click the  next to the *Colors* property to customize the colormap in the **Colormap** dialog.

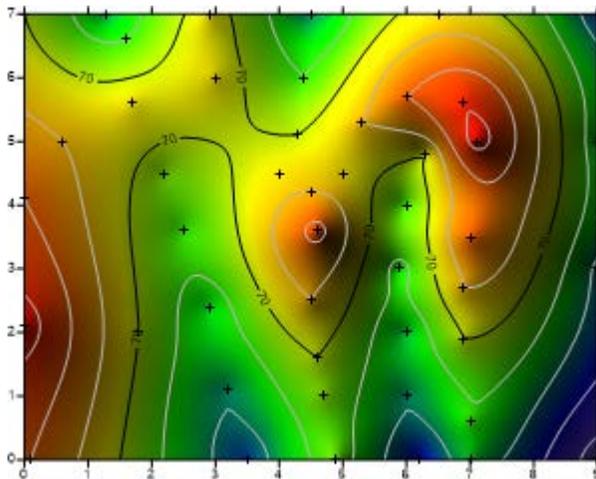
## Changing Contour Levels

You can easily modify any of the contour map features. For example, you might want to change the contour levels displayed on the map. To change the contour levels:

1. Click on the *Contours-Tutorial.grd* object in the **Contents** window. When the contour layer is selected, the contour properties are displayed in the [Properties](#) window.
2. In the **Properties** window, click the **Levels** tab to display the contour levels and contour line properties for the map. In this example, the contour levels begin at  $Z = 20$ . This is displayed next to *Minimum contour*. The *Maximum contour* level is  $Z = 105$ .
3. To change the contour range, click in the box next to *Minimum contour* or *Maximum contour*. Highlight the existing value and type a new value. The *Data range* of the grid file is displayed at the top of the **Levels** page, making selecting an appropriate range easier. For best results, select values for *Minimum contour* and *Maximum contour* that are in or near this *Data range*.
4. The *Contour interval*, or the frequency of contour lines, is five. This means that a contour line will be displayed every five  $Z$  units. We should see contour lines at 20, 25, 30, 35, etc. up to 105. Click in the *Contour interval* box, highlight the value 5, and type the value 10.
5. Press ENTER on the keyboard. The map automatically updates to show contour lines every 10  $Z$  units. The minimum contour level is  $Z = 20$ , and the largest contour level is  $Z = 100$ .



Go to the **Levels** page to display the contour level properties.



The contour map is redrawn using new contour levels based on a contour interval of 10.

## Changing Contour Line Properties

You can set any of the options in the list on the **Levels** page to customize the contour map. The *Major contour every* value allows the setting of two different line styles, the major and minor contour lines, for the contour map. By default, the major contour lines are black and labeled and the minor contour lines are gray and unlabeled. The number of minor contour lines and the line properties for both the major and minor contours can be changed.

### Setting the Major Contour Value

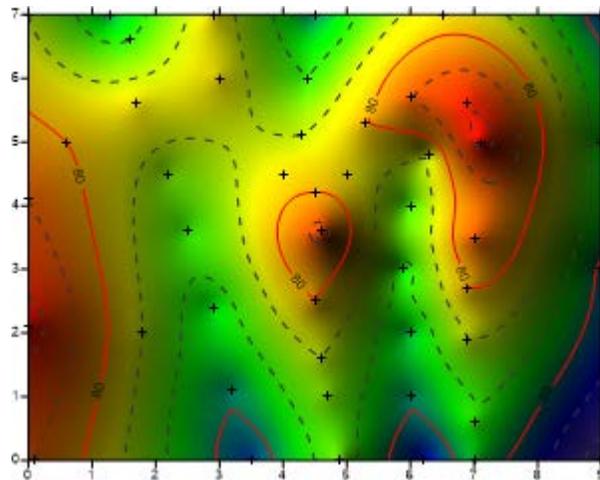
1. Highlight the number in the box next to *Major contour every* and type in a new value of 3.
2. Press ENTER on the keyboard and every third line is a major contour line.

### Changing the Major Contour Line Properties

1. Click the  next to *Major Contours*, if it is not already open.
2. Click the  next to *Line Properties* in the *Major Contours* section. The major line properties appear.
3. Click the *Black* color box next to *Color*. Select another color, such as *Red*, from the list. The map automatically updates.
4. Click the  next to *Width* and change the value to 0.03 inches. Thick red lines now appear at the major contours.

### Changing the Minor Contour Line Properties

1. Click the  next to *Minor Contours*, if it is not already open.
2. Click the  next to *Line Properties* in the *Minor Contours* section. The minor line properties appear.
3. Click the *30% Black* color box next to *Color*. Select another color, such as *80% Black*, from the list.
4. Click in the box next to *Style* and select a dashed line from the list. Dashed gray lines now appear at the minor contours.

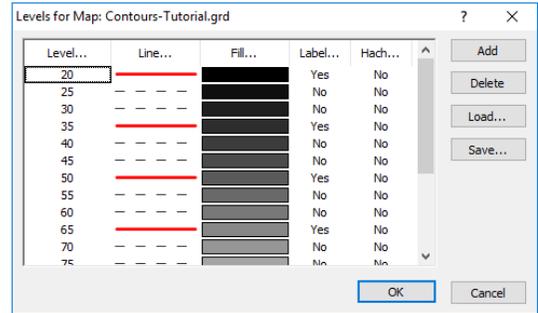


The contour map should look similar to this example after changing the major and minor line properties.

## Advanced Contour Level Properties

Contour map level properties can be set in one of three methods: *Simple*, *Logarithmic*, or *Advanced*. As seen in the previous topic, the *Simple* method is easy to use and quick to adjust. The *Logarithmic* method is very similar to the *Simple* method, but it uses a logarithmic scale rather than a linear scale. When using the *Advanced* method, each contour line is individually controlled.

Control advanced settings for the *Level*, *Line*, *Fill*, *Label*, and *Hach* properties of the contour map in the **Levels for Map** dialog. Properties can be adjusted for all contours at once by clicking on the column buttons, or for individual contours by double-clicking on the specific contour level.



The **Levels for Map** dialog is used to adjust level properties with the *Advanced* level method.

The changes that can be made by clicking the **Levels for Map** dialog header buttons include the following:

- Set the minimum, maximum, and contour interval by clicking the *Level* button.
- Set the line properties for all lines to a uniform or gradational color and style by clicking the *Line* button.
- Set the *Colormap* for the foreground and background color and the fill pattern between all contour lines by clicking the *Fill* button.
- Set the label properties for all contour labels or contour labels on a frequency basis by clicking the *Label* button.
- Set the hachure properties for all contours or on a frequency basis by clicking the *Hach* button.

Individual level changes that can be made include the following items:

- Set an individual level value by double-click on the level value to enter a new Z value.
- Set the individual line properties for a single level by double-clicking the line style for that level.
- Set the fill color or pattern for a single level by double-clicking on the fill pattern for that level.
- Set the label properties for a single contour label by double-clicking on the *Yes* or *No* under the *Label* column for that level.
- Set the hachure properties for a single contour level by double-clicking on the *Yes* or *No* under the *Hach* column for that level.

Now we will apply the *Advanced* level method and customize the contour levels with some bulk changes:

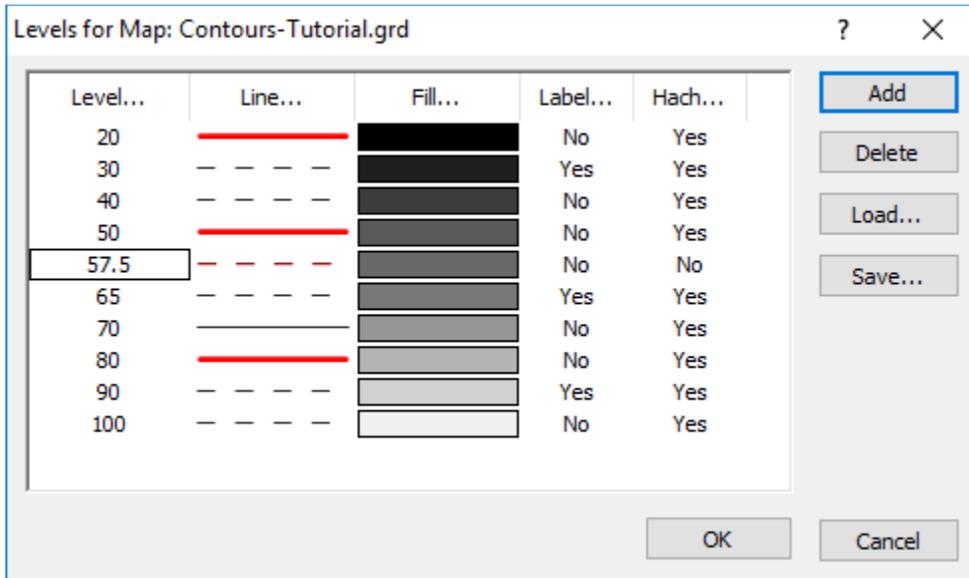
1. In the **Contents** window, click once on the *Contours-Tutorial.grd* contour layer to select it.
2. In the **Properties** window, click on the **Levels** tab.
3. Change the *Level method* by clicking on the word *Simple* next to *Level method* and selecting *Advanced* from the list.
4. Click the *Edit Levels* button next to *Contour levels* to open the advanced **Levels for Map** dialog.
5. Clicking the column header buttons makes bulk changes at regular intervals. Click on the *Label* button. The **Labels** dialog opens.
6. Change the *First* value to 2, the *Set* value to 1, and the *Skip* value to 2.

- The *First* value tells **Surfer** which contour line to first change. This says to set the label format for the second contour line (Z=30).
  - The *Set* value tells **Surfer** how many lines to set with this style. This says to set only one line with the label format.
  - The *Skip* value tells **Surfer** how many lines to skip before setting the next contour line. This says to skip two contour lines. So, the Z=40 and Z=50 contours are not set. The next contour line Z=60 uses the label format. Z=70 and Z=80 are skipped. Z=90 is set. Z=100 is skipped.
7. Click the *Font* button. The **Font Properties** dialog opens.
  8. Set the *Size (points)* to 12.
  9. Set the *Foreground color and opacity* color to White.
  10. Click *OK* in the **Font Properties** dialog.
  11. Click *OK* in the **Labels** dialog. Notice how the label status is changed in the **Levels for Map** dialog.
  12. Click on the *Hach* button. The **Hachures** dialog opens.
  13. Set the *First* to 1, the *Set* to 1, and the *Skip* to 0.
    - The *First* value tells **Surfer** to set the hachure setting for the first contour line, Z=20.
    - The *Set* value tells **Surfer** to set only one contour line to the hachure style.
    - The *Skip* value tells **Surfer** how many contours to skip. In this case, no contours are skipped. This means that all of the contours will have the hachure style.
  14. Check the *Hachure Closed Contours Only* box, if it is not already checked.
  15. Change the *Direction* to *Uphill*.
  16. Click *OK* in the **Hachures** dialog. This changes all of the items under *Hach* to Yes. All closed contours will have hachure marks.
  17. Click *OK* in the **Levels for Map** dialog and the bulk changes are made to the contour map.

Now we will open the **Levels for Map** dialog again and set properties for individual contour levels:

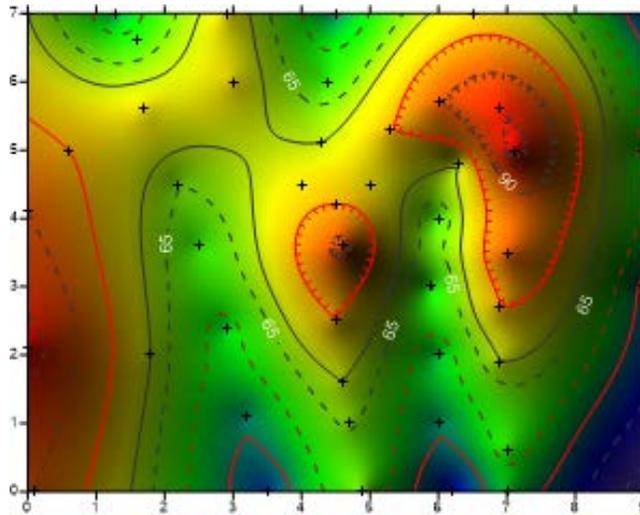
1. In the **Contents** window, click once on the *Contours-Tutorial.grd* contour layer to select it.
2. In the **Properties** window, click on the **Levels** tab.
3. Make sure that the *Level method* is set to *Advanced*.
4. Click the *Edit Levels* button next to *Contour levels* to open the advanced **Levels for Map** dialog.
5. In the **Levels for Map** dialog, you can double-click an individual Z value in the list underneath the *Level* button to change the Z value for that particular contour level. Let's double-click on the number 60.
6. In the Z Level dialog, highlight the value 60 and type in 65.
7. Click *OK* in the **Z Level** dialog, and the contour line level changes to 65.
8. You can also double-click the line style for an individual level to modify the line properties for the selected level. This provides a way to emphasize individual contour levels on the map. Double-click on the line style next to the level 70.
9. In the **Line Properties** dialog, change the *Style* to a solid line by clicking on the dashed line and selecting the *Solid* line from the list.
10. Click *OK* in the **Line Properties** dialog.
11. Let's add a single contour line halfway between two existing values. Click on the number 65 under the *Level* column.

12. Click the *Add* button. The value 57.5 is added between the 50 and the 65.



Use the **Levels for Map** dialog to make bulk and individual changes to contour levels.

13. Click *OK* in the **Levels for Map** dialog and the individual settings are made to the contour map.



Now the advanced level properties have been applied to the contour map.

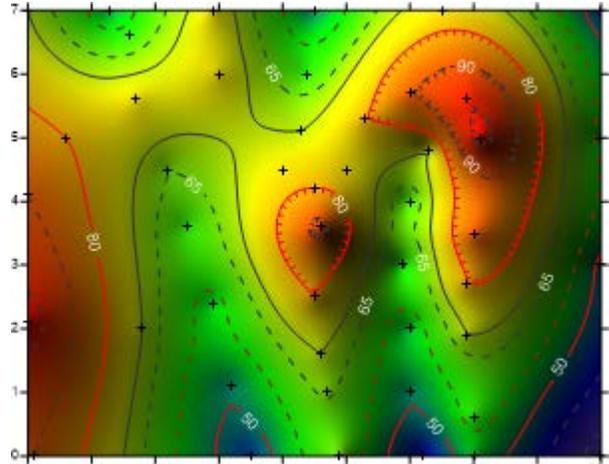
### Adding, Deleting, and Moving Contour Labels

Contour label locations can be changed on an individual basis. Labels can be added, deleted, or moved. This section will demonstrate adding, deleting, and moving contour labels:

1. Select the contour layer by clicking the *Contours-Tutorial.grd* object in the **Contents** window.
2. Click the **Map Tools | Edit Layer | Contour Labels** command or right-click on the contour map and select **Edit Contour Labels**. The cursor changes to  to indicate that you are in edit mode. Contour labels have rectangular boxes around them in edit mode.

## Tutorial

- To delete a label, click on the label and press the DELETE key on the keyboard. For example, left-click on one of the 65 labels and press the DELETE key on your keyboard.
- To add a label, press and hold the CTRL key on the keyboard and left-click the location on the contour line where you want the new label to be located. The cursor changes to a black arrowhead with a plus sign  to indicate you are able to add a new label. Add several contour labels to the red lines.
- To move a contour label, left-click on the label, hold down the left mouse button, and drag the label. Release the left mouse button to complete the label movement.
- To duplicate a label, hold the CTRL key while clicking and dragging an existing label. The duplicate label will be dragged to a new location along the line.
- To exit the *Edit Contour Labels* mode, press the ESC key, click the **Home | Selection | Select** command, or click the **Map Tools | Edit Layer | Contour Labels** command.



Contour labels can be moved, added, or deleted with the **Map Tools | Edit Layer | Contour Labels** command.

## Exporting 3D Contours

When you have completed a contour map in the plot window, you can export the contour lines with associated Z values to an AutoCAD DXF, 2D SHP, 3D SHP, or TXT file. To export contour lines to a DXF, 2D or 3D SHP, or TXT file:

- Select the contour map layer by clicking *Contours-Tutorial.grd* in the [Contents](#) window.
- Click the **Map Tools | Layer Tools | Export Contours** command.
- In the **Save As** dialog, type *Tutorial contours* in the *File name* box.
- Select AutoCAD DXF File (\*.dxf), 2D Esri Shapefile (\*.shp), 3D Esri Shapefile (\*.shp), or Text format (\*.txt) in the *Save as type* list.
- Click *Save* and the file is exported to the current directory. This creates a file titled *Tutorial contours.dxf*, *Tutorial contours.shp*, or *Tutorial contours.txt* depending on what file type you selected. Additional files may also be created that accompany the DXF or SHP file.

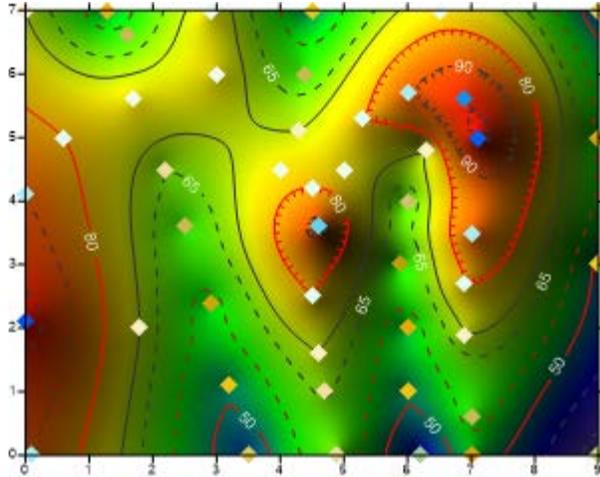
The contours are exported as polylines or polygons. The labels and gaps are removed. The exported file can be used in **Surfer** as a base map, or used in other applications. The **File | Export** command can also be used to export 2D or 3D contours. A comparison between the **Export Contours** and **Export** commands is available on the [Export Contours](#) help topic.

## Changing the Post Layer Properties

Symbols in a post map can all be the same or can be selected with a worksheet column. Symbol sizes can all be the same or have proportional sizes. Symbol colors can all be the same or have color based on a column. Now we will edit the post map layer properties:

- Click on the *Post-Tutorial.dat* layer in the **Contents** window.
- In the **Properties** window, click on the Symbol tab.
- Click the  next to *Symbol*, if the *Symbol* section is not already expanded.
- Click the  next to *Symbol Properties* to open the Symbol Properties section.

5. Click the selected symbol next to the *Symbol* property. In the list, click on the filled diamond symbol (*Symbol set: GSI Default Symbols, Number: 6*) from the symbol palette.
6. Click the  $\boxplus$  next to *Symbol Size* to open the *Symbol Size* section.
7. Highlight the value next to the *Symbol size* option and type 0.15 in.
8. Press ENTER on the keyboard. The symbols update with the new symbol size.
9. Click the  $\boxplus$  next to *Symbol Color*.
10. To change the symbol colors based on a worksheet value, click on the *None* next to the *Color column* option and select *Column C: Elevation*.
11. Verify that the *Color method* is set to *Numeric via colormap*.
12. Click the colormap next to the *Symbol colors* and select the desired colormap, such as *Terrain*.



The updated post map is displayed overlaid on the contour layer and color relief layer.

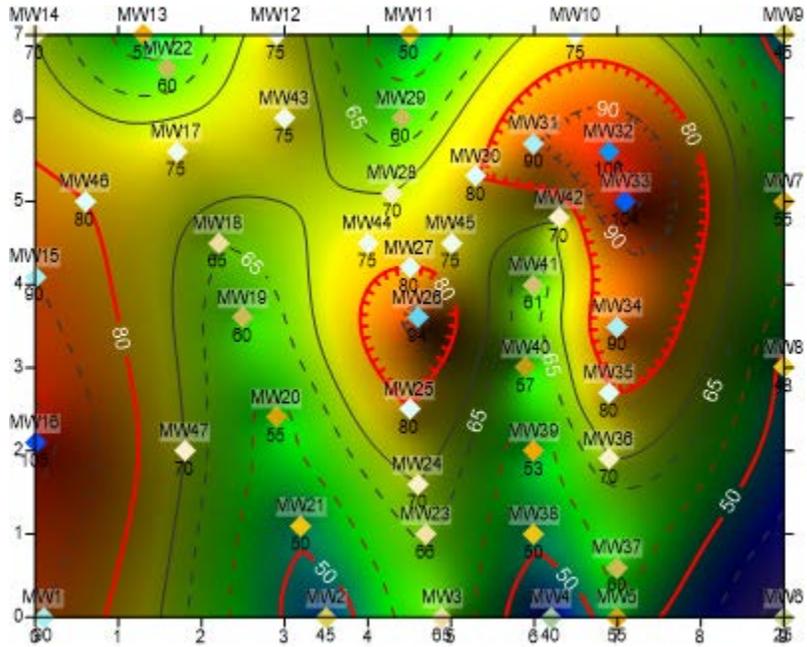
If the post map is not visible, ensure that the post layer is on top of the contour layer in the **Contents** window. The order the layers are listed in a map object is the order the map layers are drawn in the plot window. To move the post layer in the **Contents** window, left-click and drag the post layer above the other layers in the map object. Alternatively, select the post layer and click the **Layout | Arrange | Bring to Front | Bring Forward** command, or right-click the post layer and select **Order Objects | Move Forward**.

## Adding Labels to the Post Layer

You can add labels to the data points on post maps and classed post maps. Multiple labels can be added to display all of the information desired in the map. We will add labels showing the elevation and names for the data points:

1. Click on the *Post-Tutorial.dat* layer in the [Contents](#) window.
2. In the **Properties** window, click on the **Labels** tab.
3. Click the  $\boxplus$  next to *Label Set 1*, if the section is not already open.
4. Next to *Worksheet column*, click the word *None*. A list displaying all of the columns in *Tutorial.dat* are displayed. Select *Column C: Elevation* from the list.
5. For the *Position relative to symbol* option, click on the existing option and select *Below* from the list.
6. Click the *Add* button next to the *Add label set* option to add a second label to the post map.
7. Next to *Worksheet column*, click the word *None*. A list displaying all of the columns in *Tutorial.dat* are displayed. Select *Column D: Name* from the list.
8. For the *Position relative to symbol* option, click on the existing option and select *Above* from the list.
9. Click the  $\boxplus$  next to *Font Properties* to open the *Font Properties* section.
10. Change the *Background opacity* to 33%. This places a semi-transparent white box around the names.

The post map layer is automatically redrawn with labels on each of the data points.

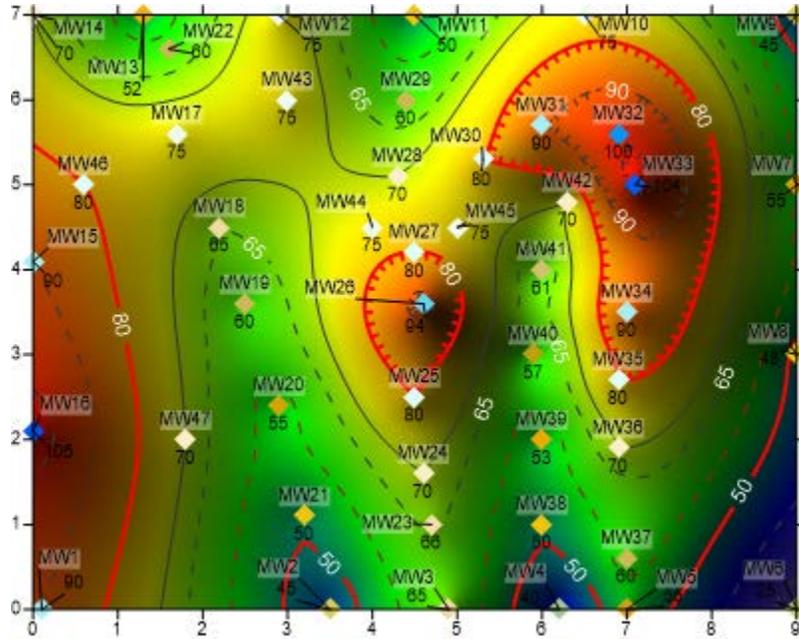


Add labels to post maps in the **Properties** window on the **Labels** tab.

### Moving Individual Post Labels

You can move individual labels on post maps and classed post maps with the **Map Tools | Edit Layer | Post Labels** command. Alternatively, add labels, and then right-click the post map and select **Edit Post Labels** to enter edit mode. A customizable line is automatically added from the data point label to the actual X, Y data point location.

1. Select the *Post-Tutorial.dat* layer in the **Contents** window.
2. Click the **Map Tools | Edit Layer | Post Labels** command or right-click on the selected map and select **Edit Post Labels**. The cursor will change to  to indicate you are now in post label editing mode.
3. Left-click on a label, hold the left mouse button down, and drag the label to a new location. With the left mouse button held down, the arrow keyboard keys can be used to nudge the label location. Release the left mouse button to place the label in the new location. A leader line will be added from the point location to the new label location by default. The leader line visibility and line properties are controlled on the **Labels** page in the **Properties** window when the post layer is selected.
4. Press the ESC key to exit the post label editing mode.



Customize the post map labels with the **Edit Post Labels** command.

## Lesson 4 - Modifying an Axis

Every map is created with four map axes: the bottom, right, top, and left axes. 3D maps also have an additional Z axis. You can control the display of each axis independently of the other axes on the map. Additional left, right, top, bottom, or Z axes can be added to a map with the **Map Tools | Add to Map | Axis** commands. You can control the display of each axis independently of the other axes on the map. In this example, we will change the axis label spacing and add an axis title:

1. Move the cursor over one of the axis tick labels on the bottom X axis and left-click the mouse. In the [status bar](#) at the bottom of the plot window, the words "Map: Bottom Axis" are displayed. The *Bottom Axis* object is selected in the **Contents** window. This indicates that you have selected the bottom axis of the map. Additionally, blue circle handles appear at each end of the axis, and green square handles appear surrounding the entire map. This indicates that the axis is a "sub-object" of the entire map.
2. The bottom axis properties are displayed in the [Properties](#) window. Click on the **General** tab.
3. Click the  $\oplus$  next to *Title* to open the *Title* section if it is not already open.
4. Click in the box next to *Title text*. Type *Bottom Axis* and press the ENTER key on the keyboard. This places a title on the selected axis. Alternatively, click the  $\Sigma$  button. Type the text in the **Text Editor** and click **OK**.
5. If you cannot see the axis title, click the **View | Zoom | Selected** command. The map automatically increases its size to fill the plot window.

## Changing the Tick Label Properties

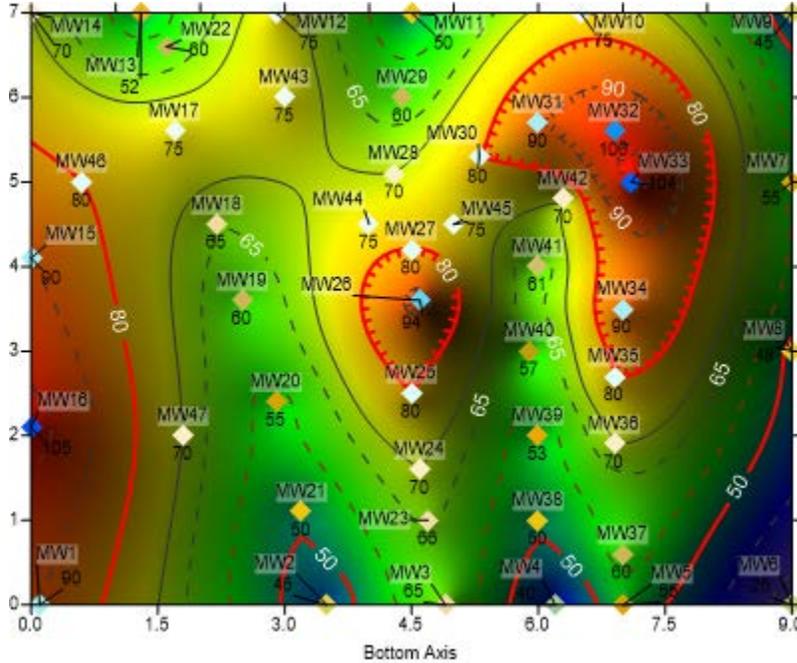
All properties of the axis can be edited, including the tick label format and frequency. We will change both format and frequency in this example:

1. In the **Properties** window, click on the **Scaling** tab to display the axis scaling options.
2. In the *Major interval* field, highlight the value 1 and type the value 1.5.
3. Press ENTER on the keyboard to place 1.5 X map units between tick marks. This spacing automatically updates on the map axis.

## Tutorial

4. Click on the **General** tab in the **Properties** window.
5. Click the  $\boxplus$  next to *Labels*, if it is not already open.
6. Click the  $\boxplus$  next to *Label Format* to open the *Label Format* section.
7. In the *Label Format* section, select *Fixed* for the *Type*.
8. Click in the box next to *Decimal digits*. Highlight the existing value and type the value 1.
9. Press ENTER on the keyboard. This indicates that only one digit follows the decimal point for the axis tick labels.

The map is updated immediately after every change, showing the axis tick spacing, labels, and the axis title.



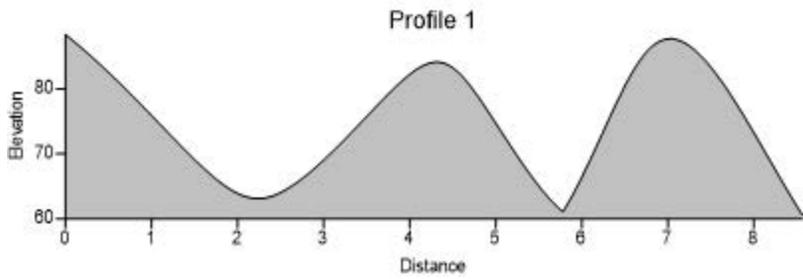
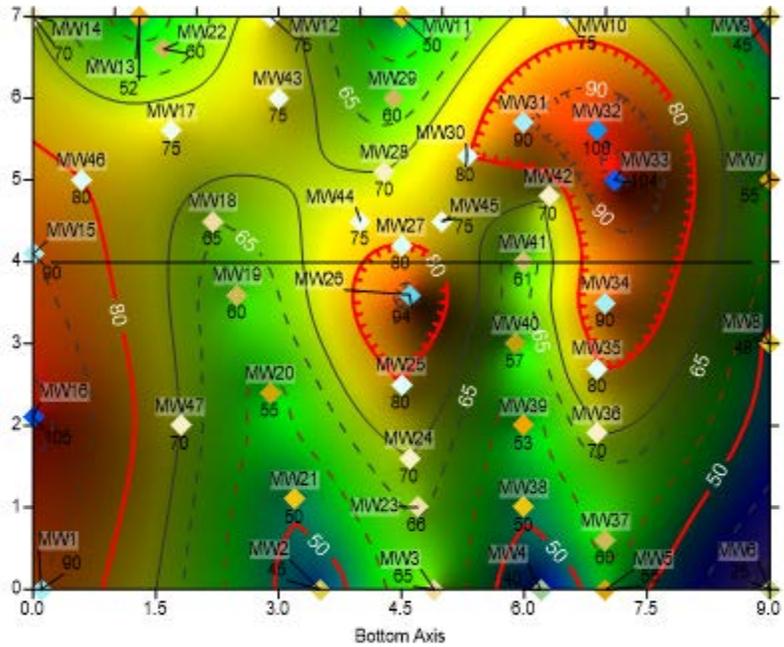
You can use the axis properties to change the tick mark and axis title properties.

## Lesson 5 - Creating a Profile

The ability to slice a grid file in **Surfer** to create a file of data points along a specified line of section is a very powerful tool. The sliced data can be visually displayed as a profile in **Surfer**, or multiple profiles can be combined to display a cross section. However, if being able to quickly see the profile on the map and on a graph is the desire, the **Map Tools | Add to Map | Profile** command provides an excellent quick method. The profile line will be drawn directly on the map:

1. Click once on the *Contours-Tutorial.grd* contour layer to select it.
2. Click the **Map Tools | Add to Map | Profile** command. The cursor changes to a  $\perp$  to indicate that you are in the drawing mode.
3. Click inside the contour map near the (0,4) and (9,4) coordinate locations. The exact coordinates of the cursor are displayed in the status bar for reference.
4. After the second point has been clicked, a line connects the points. Press ENTER on the keyboard to end drawing mode.
5. Click the **View | Zoom | Fit to Window** command to see the entire map and profile.

The base map layer is automatically added to the contour map and the profile graph is automatically created. The properties can be edited by clicking on the *Profile 1* object in the **Contents** window and adjusting the properties in the **Properties** window.



The location of the profile is displayed on the map.  
The actual profile is displayed in a graph below the contour map.

## Lesson 6 - Saving a Map

When you have completed the map in the plot window, you can save the map to a **Surfer** .SRF file. **Surfer** .SRF files contain all the information necessary to reproduce the project. When you save a map as a .SRF file, all the scaling, formatting, and map properties are preserved in the file. An asterisk (\*) next to the file name in the title bar and tab indicates the file has been modified and the modifications have not yet been saved.

1. Click the **File | Save** command or click the  button on the quick access toolbar. The **Save As** dialog is displayed because the map has not been previously saved. Set the *Save in* directory to any directory on your computer.
2. In the *File name* box, type *Tutorial*.
3. Make sure that the *Save as type* is set to **Surfer** Document (\*.srf).
4. Click *Save* and the file is saved to the current directory with a .SRF extension. The saved map remains open and the title bar changes to reflect the name change. There is no longer an asterisk next to the file name.

If desired, the *Save as type* can be set to *Surfer 11 Document (\*.srf)*, *Surfer 12 Document (\*.srf)*, or *Surfer 13 Document (\*.srf)* if the file is to be shared with users using **Surfer 11**, **Surfer 12**, or **Surfer 13**. After selecting the format, click **Yes** in the dialog. Any **Surfer 14** specific features are lost when saving to a previous **Surfer** version format.

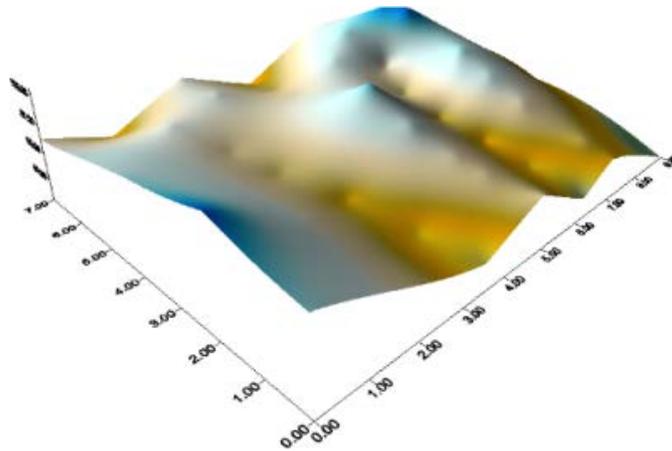
## Lesson 7 - Creating a 3D Surface Map

Surfaces are three-dimensional shaded renderings of a grid file. Surfaces provide an impressive visual interpretation of data. Surfaces can be layered with other surfaces, so that the surfaces will intersect with each other. Surfaces can also have layers of other map types, excluding 3D wireframes. Surfaces allow you to generate an elevation model of your area of interest and then add layers of data on the top of the surface. You can control the color, lighting, overlay blending, and wire mesh grid of a 3D surface.

For example, if you have location (X, Y) and temperature (Z) data for a region and you have the same location (X, Y) and corresponding elevation (Z) data for the area, you could create a grid file with the Z variable being elevation and a grid file with the Z variable being temperature. You could create a 3D surface of the elevation grid to represent topography, then add a contour map of the temperature variation. You could continue to add map layers, such as a classed post map layer with the temperature collection stations that have different symbols depending on the elevation.

We are going to use the same grid file you used to create the tutorial contour map. The 3D surface map will provide a new perspective to the contour map you have already created. Although we are going to create this map in a new plot window, the surface map could easily be added to the existing plot window.

1. Click the **File | New | Plot** command or click the  button on the quick access toolbar to open a plot document.
2. Click the **Home | New Map | 3D Maps | Surface** command.
3. In the **Open** dialog, select the grid file *Tutorial.grd* from the list of files. The *Tutorial.grd* file was created in [Lesson 2 - Using the Map Wizard](#).
4. Click *Open* and the 3D surface is created using the default settings.



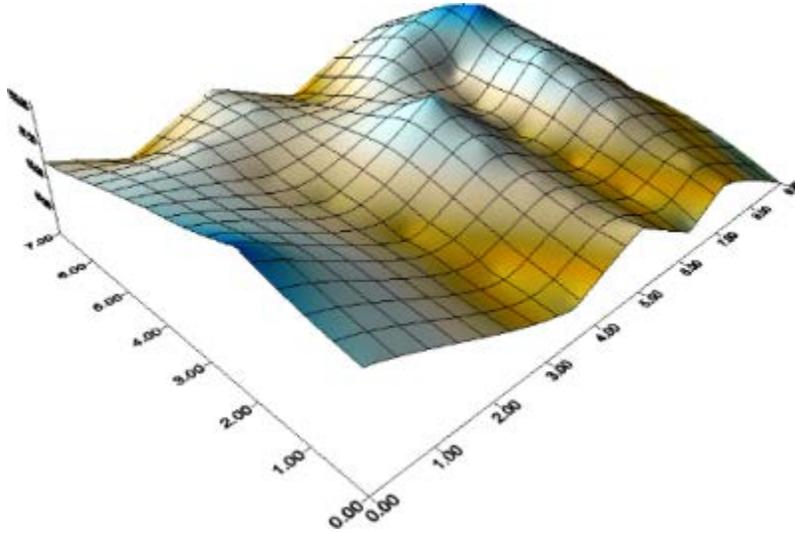
*The 3D surface map shows the grid with a 3D aspect and color filled areas.*

## Adding a Mesh

Mesh lines can be applied to surfaces. 3D surface maps have more capability than 3D wireframe maps. 3D surfaces can be combined with more map types, and the surface map limits can be changed. Adding mesh lines to a 3D surface map simulates a 3D wireframe map. We will add a surface mesh to the map:

1. Click once on *3D Surface-Tutorial.grd* in the **Contents** window to select it. The 3D surface properties are displayed in the **Properties** window.
2. Click the **Mesh** tab.
3. Check the box next to the *Draw lines* option in both the *Lines of Constant X* and *Lines of Constant Y* sections.
4. Change the *Frequency* in both the *Lines of Constant X* section and *Lines of Constant Y* section to 5.

The mesh is automatically added to the selected 3D surface.



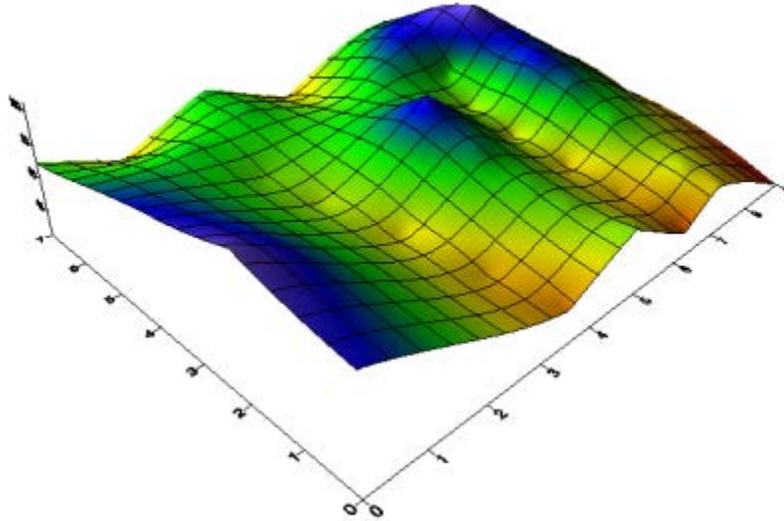
The mesh lines indicate lines of constant X and Y on the 3D surface.

## Changing the 3D Surface Layer Colors

Changing color schemes on 3D surfaces is similar to changing colors on other map types such as color relief maps or contour maps. A colormap is used to load previously defined color schemes or to create your own color schemes. In this example, we will use a modified *Rainbow* colormap:

1. Click on the *3D Surface-Tutorial.grd* layer in the **Contents** window to select it.
2. In the **Properties** window, click on the **General** tab.
3. Click the  next to *Material Color* to open the section if it is not already open.
4. Click the  button to the right of the selected colormap for *Upper*. The **Colormap** dialog opens.
5. In the **Colormap** dialog, select the *Rainbow* colormap from the *Presets* list. The *Presets* list contains a variety of predefined color schemes.
6. The *Rainbow* preset has six nodes that range from purple to red. You can add, remove, apply opacity, customize the nodes, or accept the default selections. To reverse the color order, click the *Reverse* button.
7. Click *OK* in the **Colormap** dialog to update the surface map properties with your color changes.

You can continue to experiment with the colors by selecting other color spectrums from the list next to *Upper*. Or, click the  button to the right of the colormap and make changes in the **Colormap** dialog. You can experiment with selecting custom node locations and colors.



*This is a 3D surface map with a mesh displayed at a frequency of five. The 3D surface map is using the reverse of the Rainbow color spectrum.*

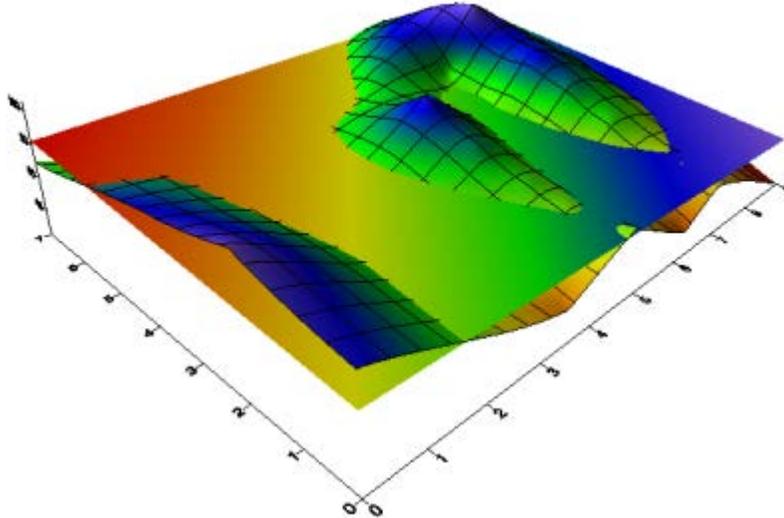
## Adding a Surface Map Layer

You can add additional map layers to the 3D surface with the **Home | Add to Map | Layer** command. All map layers, except other 3D surfaces, are converted into a type of image known as a texture map. This texture map is then applied to the surface by stretching it and shrinking it as necessary. When these maps are added to the surface map, you have a choice on how to treat the texture map. You can use the colors from overlays only, from the surface only, or blend colors from the overlays and surface. For example, you could create a color filled contour map, add the contour map and surface, and then use the colors from the contour map only.

When multiple 3D surfaces of differing elevations are added, the surfaces can intersect and overlap each other. If a surface map is added to another surface map with the **Home | Add to Map | Layer | 3D Surface** command and the two maps are adjacent to each other in the X or Y direction, the surfaces are drawn side-by-side. In this example, we will add a planar layer to the surface you just created:

1. Click on the *3D Surface-Tutorial.grd* layer in the **Contents** window.
2. Click the **Home | Add to Map | Layer | 3D Surface** command, or right-click the surface map and select **Add to Map | 3D Surface**.
3. In the **Open Grid** dialog, select the planar grid, *TutorPI.grd* from **Surfer's Samples** directory. 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 14\.
4. Click *Open* and the new surface map layer is added using the default settings.
5. Click on the *3D Surface-TutorPI.grd* surface map layer in the **Contents** window.
6. In the **Properties** window, click on the **General** tab.
7. Click the  next to *Material Color* to open the *Material Color* section.
8. Click on the color next to *Upper*. Select *Rainbow* in the list to match the *3D Surface-TutorWS.grd* color fill.

If you wish to save your map, click the **File | Save** command. We will create a new plot in the next lesson.



*You can overlay two or more 3D surfaces. Depending on each surface's XYZ ranges, the surfaces may overlap or intersect each other. This example shows the intersection of the Tutorial.grd and TutorPl.grd sample files.*

## Lesson 8 - Adding Transparency, Color Scales, and Titles

The opacity of a map, image, text, line, fill, symbol, or entire layer can be customized in **Surfer**. Opacity is the amount of light that is obscured by an object. An object can be made semi-transparent by adjusting the opacity value. Reducing the opacity of an object makes other objects visible through the less than 100% opaque object. An *Opacity* value of 0% means that the object is invisible. An *Opacity* value of 100% means that the object is fully opaque.

Setting the opacity is useful when creating a semi-transparent map layer. For example, you may want to display a semi-transparent contour map layer over a satellite image base map layer so that both map layers can be seen. Being able to set the opacity of entire layers is especially useful when you have multiple layers with filled objects and you need to see all of the layers.

### Creating a Filled Contour Map

First we will create a filled contour map:

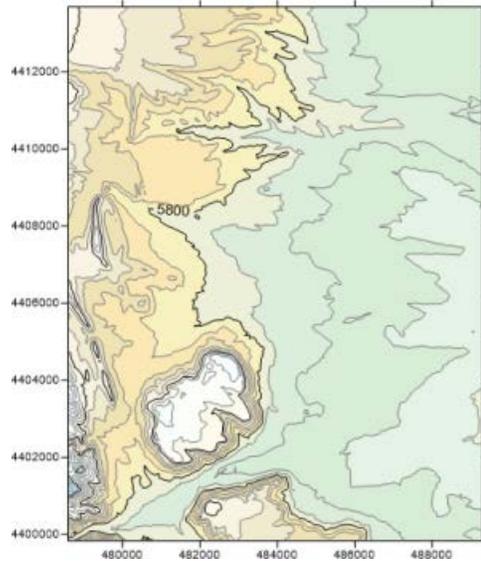
1. Click the **File | New | Plot** command or click the  button on the quick access toolbar. A new empty plot window is displayed.
2. Click the **Home | New Map | Contour** command.
3. Select the grid file *Golden.grd* from the list of files in the **Open Grid** dialog. By default, the *Samples* folder is located in C:\Program Files\Golden Software\Surfer 14.
4. Click *Open*. The map is created using the default settings. Some settings are persistent while **Surfer** is open. If you have completed [Lesson 3](#) in the same session, the map created in this step will have uphill hachures and white-text contour labels.
5. Click on the contour map layer to select it.
6. In the **Properties** window, click on the **Levels** tab.
7. Set the *Level method* to *Simple*, if it is not already *Simple*.

8. Click the  next to *Filled Contours* to open the *Filled Contours* section, if it is not already open.
9. Check the box next to *Fill contours* to fill the contours with the default color scale.
10. Click the  next to *Labels* to open the *Labels* section, if it is not already open.
11. Click the  next to *Font properties* to open the *Font properties* section.
12. If the *Foreground color* is not *Black*, click the current color and select *Black* from the color palette.

## Adding Transparency to Map Layers

You can adjust the *Opacity* value of a map layer or of individual contour fill, polygon fill, text, lines, or symbols when the appropriate object is selected. Adjusting the *Opacity* for an entire layer may be useful when you have multiple map layers and need to make one or more layers semi-transparent to best represent your data. For this example, we will adjust the opacity for the contour fill while keeping the contour lines and labels completely opaque.

1. Click on the *Contours-Golden.grd* layer in the **Contents** window to select it.
2. In the **Properties** window, click on the **Levels** tab.
3. Click the  button next to *Fill colors*. The **Colormap** dialog opens.
4. Click the current selection in the *Presets* list and select *Terrain*.
5. Verify the *Apply opacity to ALL nodes* check box is checked. If it is not checked, click the check box.
6. Highlight the existing *100%* value next to the *Opacity* option and type *30*.
7. Click *OK* in the **Colormap** dialog. The *Terrain* colormap and 30% opacity setting is applied to the contour layer's *Fill colors*. Notice *Custom* is displayed in the *Fill colors* field.



The contour map is displayed with a partially transparent fill color.

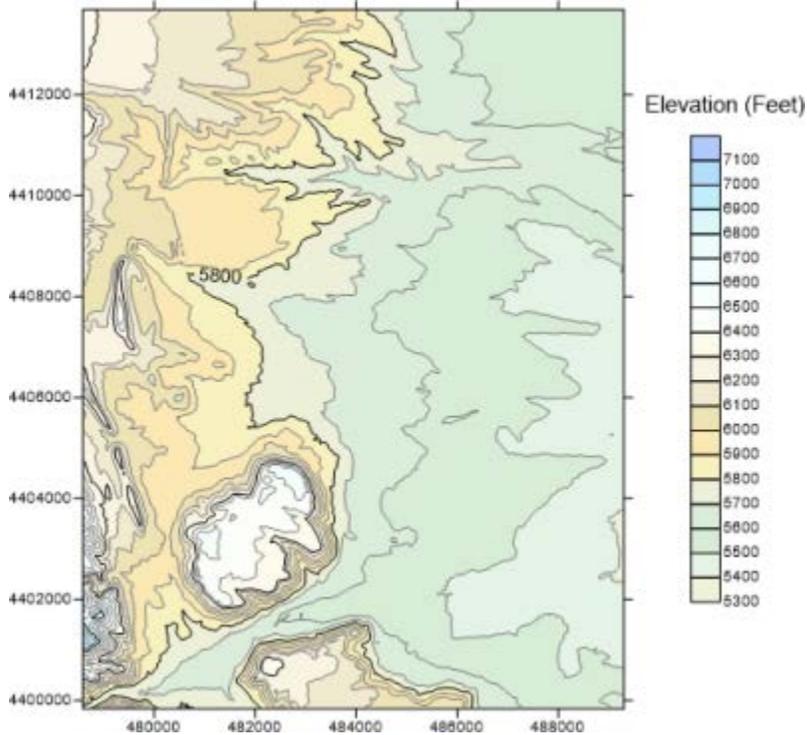
## Adding and Editing a Color Scale

Color scales are legends that show the fill colors. Color scales are available for contour, 3D wireframe, 3D surface, color relief, and vector maps. The color scale displays the colors assigned to levels in a filled contour map or 3D wireframe, the colors used in a color relief map or 3D surface, and the fill assigned to vector symbols. Let's add a color scale and color scale title to the contour map

1. Click on the *Contours-Golden.grd* contour layer to select it. The properties are displayed in the **Properties** window.
2. Click on the **Levels** tab in the **Properties** window.
3. Click the  next to *Filled Contours* to open the *Filled Contours* section, if it is not already open.
4. Select the box next to *Color scale*. A default color scale is created. A new *Color Scale* object is added to the **Contents** window.
5. Click on *Color Scale* in the **Contents** window to select it.
6. In the **Properties** window, click on the **General** tab to edit the color scale properties.
7. Click the  next to *Title* to open the *Title* section, if it is not already open.
8. Click in the empty box next to *Title text*.
9. In the *Title text* field, type *Elevation (feet)*.
10. Press ENTER. The title is added with the default settings.

11. Change the title position by clicking the current selection next to *Position*. Select *Top* from the *Position* list.

Notice the color scale title moves to the top of the color scale, and the text orientation automatically changes to horizontal. The color scale has the same opacity as the contour layer when transparency is applied to the contour layer *Fill colors* colormap.



The map and color scale object are shown in this image.

## Downloading an Online Base Map Layer

A base map layer can be added below the existing semi-transparent contour layer to enhance the map's appearance. To add a base map layer from an online server,

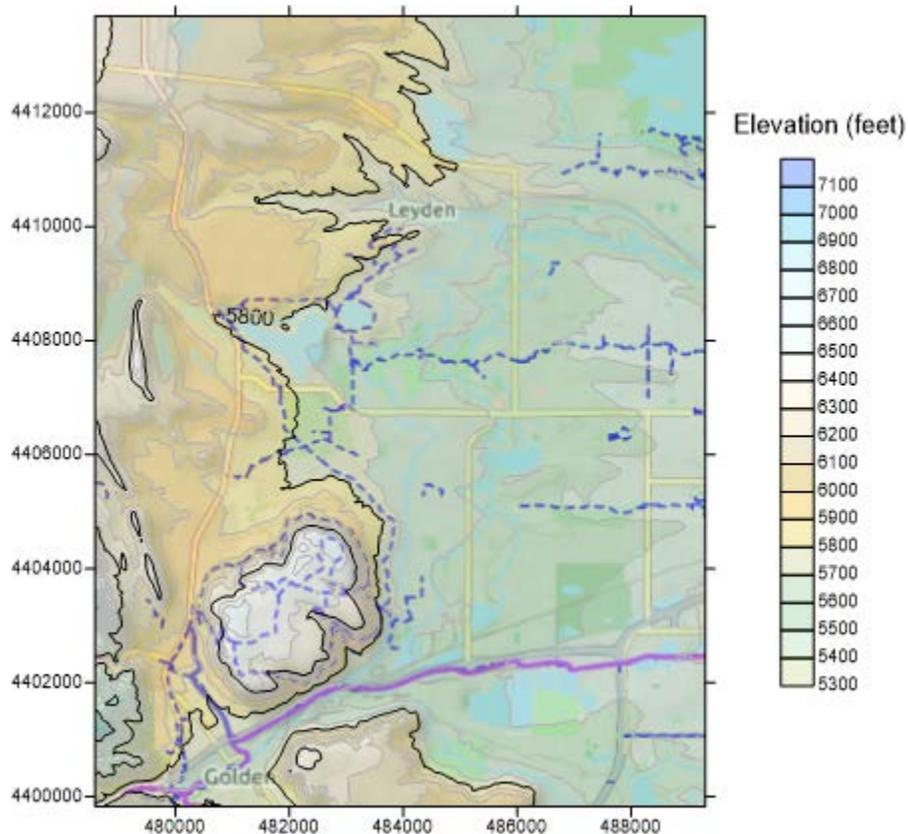
1. Click anywhere on the map to select it.
2. Click the **Home | Add to Map | Layer | Base from Server** command to download an image base map from an online server. The **Download Online Maps** dialog is displayed. **Surfer** can download base layers from WMS, OSM, and WFS servers. **Surfer** can also download grids from WCS servers.
3. In the **Download Online Maps** dialog, click the  next to *OpenStreetMaps Imagery*.
4. Click the *OpenCycleMap* server in the *OpenStreetMaps Imagery* category. A preview is displayed in the preview section.
5. Notice *Specify Latitude/Longitude Extents* is selected, and the values are set to the boundaries of the *Map*. When the [map coordinate system](#) is a geographic or projected system and the **Home | Add to Map | Layer | Base from Server** command is used, the area to download will be automatically set to the map extents.

Select Area to Download  
 Entire data source extents  
 Within  Miles of Longitude  Latitude   
 Specify Latitude/Longitude extents  
 West:  North:   
 South:  East:

The Specify Latitude/Longitude extents values are automatically filled with the extents of the selected map.

- For the tutorial, we will use the default setting in the *Select Image Resolution to Download* section.
- Click *OK* and the base layer downloads. The base layer is automatically placed behind the contour layer. If a **Surfer Warning** dialog appears prompting you to adjust the map limits, click *No*.

Increasing the image resolution will increase the download size when retrieving layers with the **Download Online Maps** dialog. With some servers such as the *OpenCycleMap* server, increasing the resolution will also return a different layer than the one displayed in the preview. Feel free to experiment with different resolutions by repeating steps 2 through 9 and selecting a higher or lower resolution in step 7. You will need to hide previous base layers to view the new one. In the **Contents** window, clear or select the check box next to the *Contours-Golden.grd* or *Base-OpenCycleMap* layers to toggle the visibility of the maps on and off.



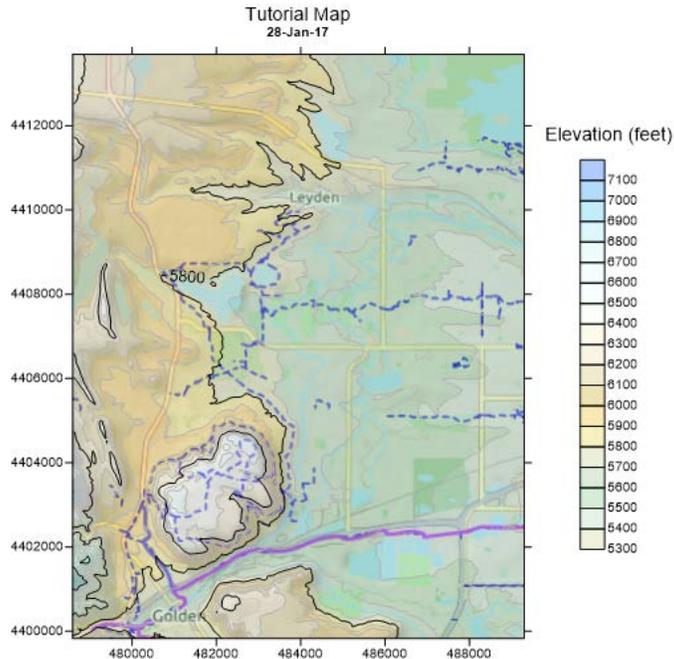
The base map is visible behind the partially transparent contour map.

## Adding a Map Title

Adding a title to a map is a great way to stay organized and create publication quality maps.

1. Click once on the *Top Axis* in the **Contents** window to select it.
2. In the **Properties** window, click on the **General** tab.
3. Click the  $\oplus$  next to *Title*, if the section is not already open.
4. In the box next to *Title text*, click the  $\Sigma$  button to open the **Text Editor**. The **Text Editor** provides more control over the text appearance than the **Properties** window.
5. Type *Tutorial Map* and press the ENTER key on the keyboard.
6. On the second line, we will use a dynamic predefined math text instruction to insert the current date. Click the  button.
7. In the **Date/Time Format Builder** dialog, select the desired date/time format in the *Predefined date/time formats* list. For instance, select *dd-MMM-yy*.
8. Click *Insert* next to the selected date/time format in the *Predefined date/time formats* list. Notice the format in the *Date/Time format* field updates to the selected format.
9. Click *OK* in the **Date/Time Format Builder** dialog. Today's date is added to the **Text Editor**.
10. Select the date in the **Text Editor** by double-clicking the date or by clicking and dragging across the date.
11. Click the **B** button to make the highlighted text bold.
12. Select the *Tutorial Map* text.
13. Change the *Size (points)* to 14. The size is located immediately to the right of the font name.
14. Click the center justification button  to center the text.
15. Click *OK* to close the **Text Editor**.

The map is automatically updated with the new map title. Save the project if you wish. We will open a new plot window in the next lesson.



*This map contains a semi-transparent contour layer on top of a base layer. A color scale and title were added to the map.*

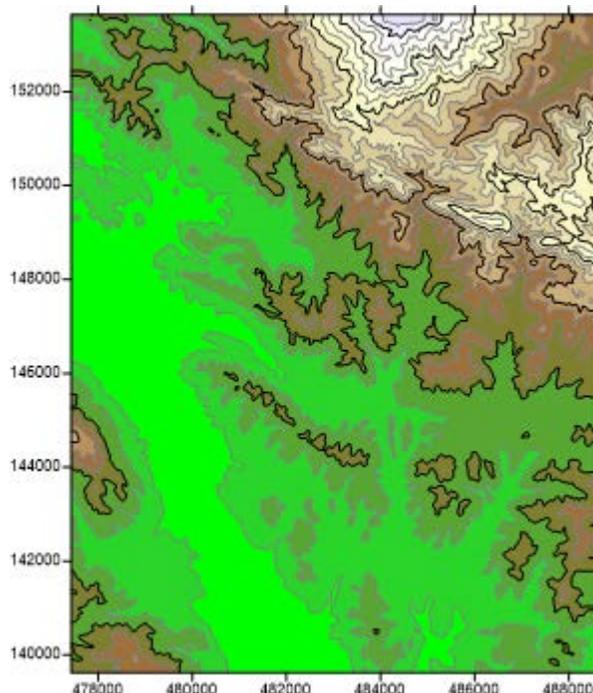
## Lesson 9 - Creating Maps from Different Coordinate Systems

Map layers from different coordinate systems can be created in the same map object. **Surfer** converts the source coordinate system for each map layer to the target coordinate system for the entire map. The axes display the target coordinate system. A coordinate system is method of defining how a file's point locations display on a map. Different types of coordinate systems exist that control how the coordinates are shown on the map. In **Surfer**, a map can be unreferenced in local coordinates, referenced to a geographic lat/long coordinate system, or referenced to a known projection and datum.

### Creating the First Map

First, we will create a map with a defined coordinate system in **Surfer**:

1. Click the **File | New | Plot** command to open a new plot window.
2. Click **Home | New Map | Contour** to create the map with a contour layer.
3. In the **Open Grid** dialog, click on the *Diablo.grd* file from **Surfer's Samples** folder. 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 14.
4. Click *Open*. The contour map is created.
5. Click on *Contours-Diablo.grd* in the **Contents** window to select the contour layer.
6. Click the **Levels** tab in the **Properties** window. Set the interval, fill, and contour lines properties for the contour map using the methods described in [Lesson 3](#) and [Lesson 8](#).
7. In the **Properties** window, click on the [Coordinate System](#) tab. Note that the contour map layer was imported with a coordinate system already specified. This map layer is in the *State Plane 1927 - California III (Meters)* coordinate system.

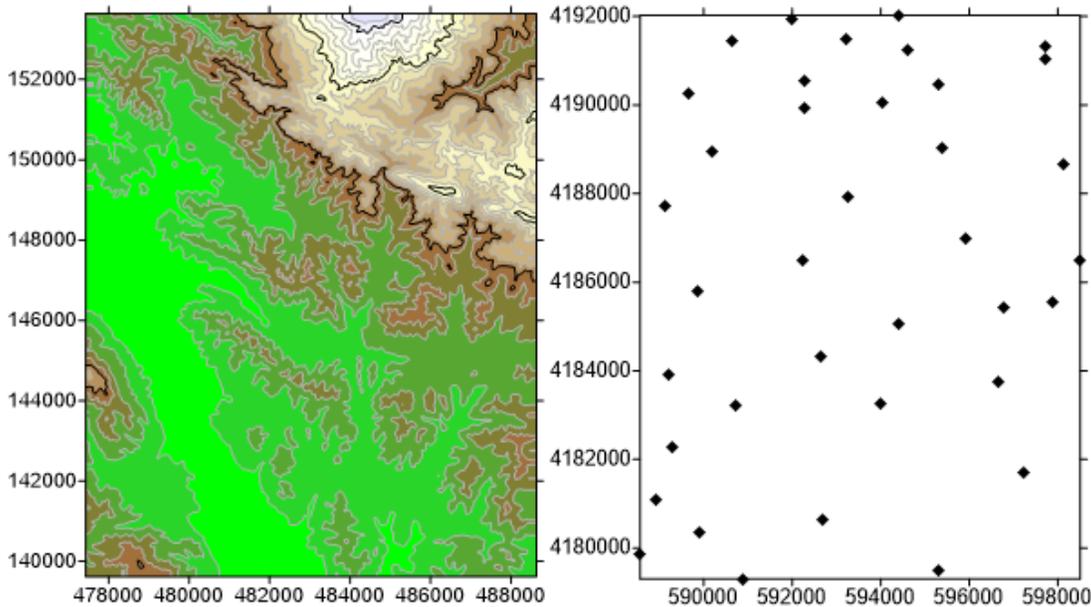


*The first map layer is created with a predefined coordinate system.*

## Adding a Post Map Layer

Maps can be created without predefined coordinate systems and assigned the correct coordinate system in the layer properties.

1. Create a new post map with the **Home | New Map | Post** command.
2. In the **Open Data** dialog, select the *Diablo Example.dat* file in the **Surfer Samples** directory. 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 14.
3. Click *Open*.
4. Click on the *Map* in the **Contents** window that contains the post map to select it.
5. Click and drag the map in the plot window to move the post map. Move the post map until the two maps are side by side. Note that the axes on the two maps have very different coordinates.
6. Click on *Post-Diablo Example.dat* in the **Contents** window to select the post layer.
7. In the **Properties** window, click on the **Coordinate System** tab. Note that the post map does not have a predefined coordinate system.
8. Click the *Set* button to define the coordinate system for the post map. The **Assign Coordinate System** dialog is displayed. Since we know this coordinate system, we can set it.
9. We can use the search bar to reduce the number of projections listed in the **Assign Coordinate System** dialog, since we know the map coordinate system. In the *Search for text or EPSG code* box, type *UTM Zone 10N*.
10. Press ENTER or click the  button.
11. In the **Assign Coordinate System** dialog, click the  next to *Predefined* to open the *Predefined* section.
12. Click the  next to *Projected Systems* to open the *Projected Systems* section.
13. Click the  next to *UTM* to open the *UTM* section.
14. Click the  next to *North America* to open the *North America* section.
15. Click on the *North America NAD27 UTM Zone 10N* coordinate system to select it.
16. Click *OK*. On the **Coordinate System** tab, the post layer shows the defined coordinate system next to *Name*.



The two maps are displayed side by side with very different coordinates displayed on the axes.

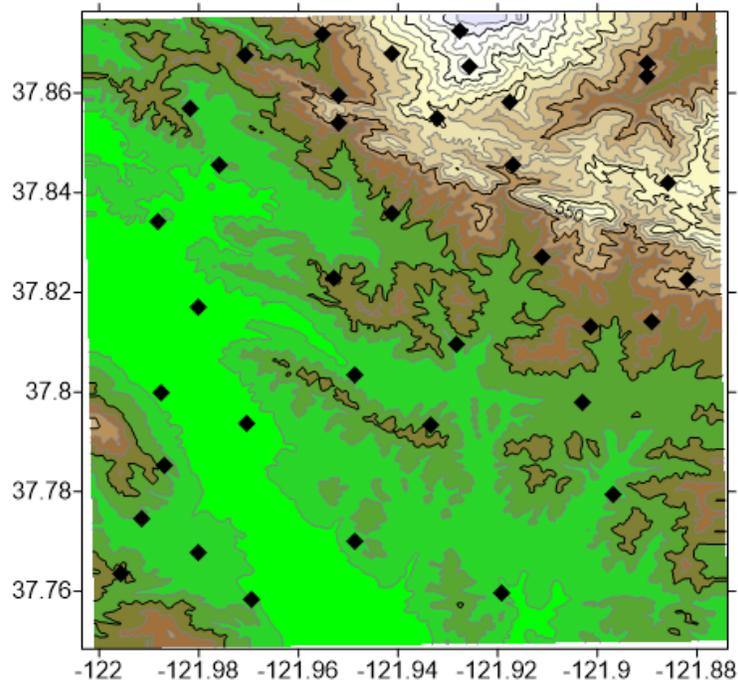
17. In the **Contents** window, click and drag the *Post-Diablo Example.dat* layer into the *Map* just above the *Contours-Diablo.grd* map layer. The two map layers are now overlaid. You can see the posted symbols are located on the contour lines, despite the different coordinate systems.

## Setting the Target Coordinate System for the Map

The target coordinate system is the system displayed in the plot and on the map axes. Once all map layers are defined, the target coordinate system can be changed to any desired coordinate system.

1. Click on the *Map* object in the **Contents** window.
2. In the **Properties** window, click on the [Coordinate System](#) tab.
3. Click the *Change* button.
4. In the **Assign Coordinate System** dialog, click the  next to *Predefined* to open the *Predefined* section.
5. Click the  next to *Geographic (lat/lon)* to open the *Geographic (lat/lon)* section.
6. Click on *World Geodetic System 1984* near the bottom of the list to select it.
7. Click *OK*.

The map now has a different coordinate system than either the contour or post map layers on the **Coordinate System** page. Notice that the axes are now showing latitude and longitude values as well. In the above section, we did not use the search function in the **Assign Coordinate System** dialog. When searching in the **Assign Coordinate System** dialog, the search string must exactly match a portion of the desired coordinate system name or EPSG code. However, the search string does not need to be the complete name or EPSG code. For example, searching for *System 1984* will return the *World Geodetic System 1984* coordinate system, but searching for *World 1984* returns no results.



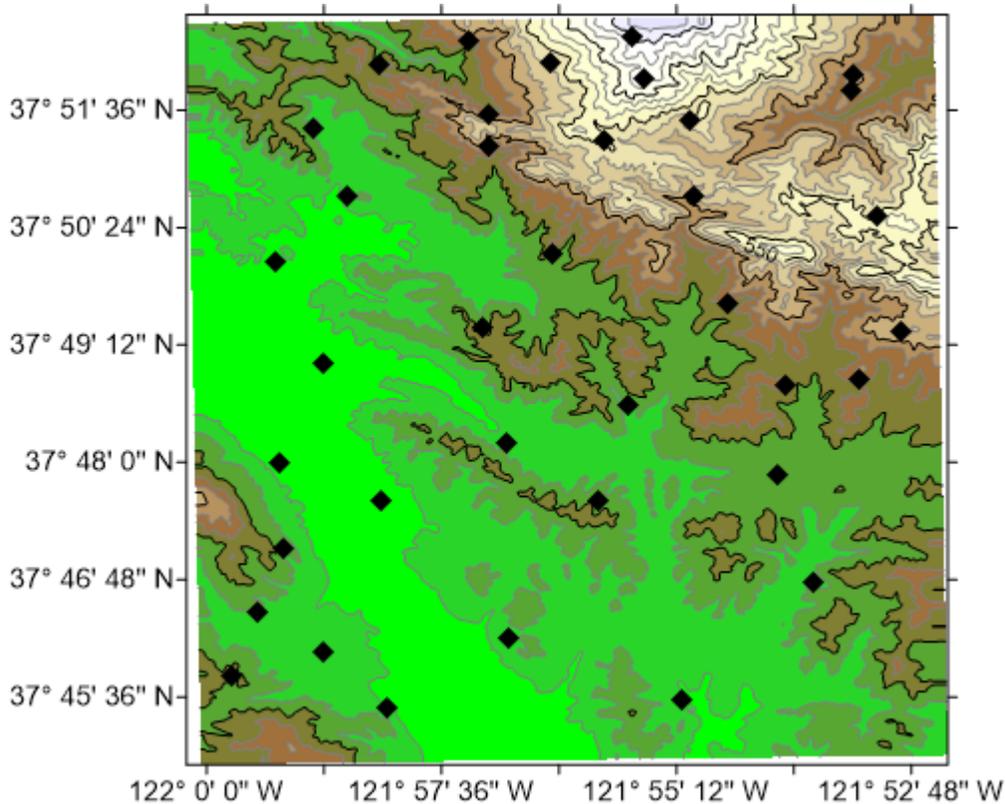
The map axes now display latitude and longitude coordinates.

## Changing the Axis Label Format

The axis labels can be displayed in a variety of number formats. We will change the axis labels to Degrees, Minutes, Seconds format.

1. Click on the *Left Axis* object in the **Contents** window.
2. In the **Properties** window, click on the **General** tab to view the **General** page.
3. Click the  $\oplus$  next to *Labels* if the *Labels* section is not already open.
4. Click the  $\oplus$  next to *Label Format* to view the *Label Format* properties.
5. Click the current selection next to *Type* and select *DMS (Lat/long)* from the list.
6. Click on the *Bottom Axis* object in the **Contents** window.
7. Repeat steps 2 through 5 for the *Bottom Axis*.

The axis labels are now in Degrees, Minutes, Seconds format. Many additional edits can be made to the map. You can continue to experiment with the various coordinate systems or editing any portion of the map layers.



*The final map contains two overlaid layers, each with different source coordinate systems. The axis labels are in Degrees, Minutes, Seconds format.*

## Tutorial Complete

Congratulations! You have completed the **Surfer** tutorial. The remaining tutorial lessons are optional advanced lessons. It is recommended that you complete the optional lessons, because these lessons provide additional information about how **Surfer** works. If you have questions, try looking for answers in the online help, online [knowledge base](#), and interactive [forum](#). If you find you still have questions, do not hesitate to contact Golden Software's [technical support](#) team.

## Printing the Online Help

The online help topics may be printed. You can print part a single topic, a section of the Table of Contents, or all topics in the Table of Contents.

To print one help topic, click the topic you wish to print and click the *Print* button. If the **Contents** page is open in the help navigation pane, the **Print Topics** dialog appears. Select *Print the selected topic* and click *OK*.

To print one help book, click the **Contents** tab in the help window navigation pane. Click the book you want to print, for example click the *Tutorial* book. Click the *Print* button. If the **Contents** page is open in the help navigation pane, the **Print Topics** dialog appears. Select *Print the selected heading and all subtopics* and click *OK*.

To print all the topics in the help file Table of Contents, select the top-level book in the **Contents** navigation pane, *Surfer 14*. Click the *Print* button. If the **Contents** page is open in the help navigation pane, the **Print Topics** dialog appears. Select *Print the selected heading and all subtopics* and click *OK*. **WARNING:** Printing the entire help file takes hundreds of letter-sized sheets of paper and is very time consuming. There is no Table of Contents or Index printed with the file.

You can purchase the PDF Surfer User's Guide that includes all of the documentation for the program. The PDF user's guide is the online help rearranged in a book format and can be printed by the user, if desired. The Surfer User's Guide includes a Table of Contents and Index. The guide can be purchased at [www.goldensoftware.com](http://www.goldensoftware.com).

## Getting Help

Within **Surfer**, the online help file is opened by clicking the help button  in the upper right corner of the ribbon. You can also quickly search the help by typing a term in the command and help search above the ribbon and clicking *Search help file* in the results. Alternatively, press F1 at anytime to open the help. You can navigate help using the **Contents**, **Index**, **Search**, and **Favorites** pages in the navigation pane two the left of the topic page.

## Context-Sensitive Help

To obtain context-sensitive help about dialogs or highlighted commands:

- Find the function of commands by hovering the cursor over the command and pressing F1.
- Click the  button, the *Help* button, or press F1 in dialogs to open the help topic pertaining to that dialog.
- Press SHIFT + F1 on your keyboard, then click a screen region to view information regarding that item.

## Internet Help Resources

There are several Internet help resources.

- Click the *Forums* button or the *Knowledge Base* button at the top of the online help to post a question on the forum or search the knowledge base.
- Use the **File | Feedback** commands to send an Information Request, Problem Report, or Suggestion by email.
- Search our website at [www.goldensoftware.com](http://www.goldensoftware.com) or use the **File | Online** commands for additional help, including the [Golden Software Home Page](#), [Surfer Product Page](#), and [Frequently Asked Questions](#).
- The Golden Software support website has a variety of resources including [training videos](#), a [support forum](#), a [blog](#), a [user image gallery](#), and a variety of downloads.
- The **Surfer** web help can be viewed in a browser window by navigating to [surferhelp.goldensoftware.com](http://surferhelp.goldensoftware.com).

## Technical Support

Golden Software's technical support is free to registered users of Golden Software products. Our technical support staff is trained to help you find answers to your questions quickly and accurately. We are happy to answer all of your questions about any of our products, both before and after your purchase. We also welcome suggestions for improvements to our software and encourage you to contact us with any ideas you may have for adding new features and capabilities to our programs.

Technical support is available Monday through Friday 8:00 AM to 5:00 PM Mountain Time, excluding major United States holidays. We respond to email and fax technical questions within one business day. When contacting us with your question please have the following information available:

- Your **Surfer** product key
- Your **Surfer** version number, found in **File | About Surfer**
- The operating system you are using (Windows Vista, 7, 8, 10 or higher)
- The steps taken to produce your problem
- The exact wording of the first error message that appears (if any)

If you cannot find the answer to your question in online help, the quick start guide, or on our web page [FAQs](#), [KB](#), or [support forum](#), please do not hesitate to contact us:

Phone: 303-279-1021

Fax: 303-279-0909

Email: [surfersupport@goldensoftware.com](mailto:surfersupport@goldensoftware.com)

Web: [www.goldensoftware.com](http://www.goldensoftware.com)

Mail: Golden Software, LLC, 809 14th Street, Golden, Colorado, 80401-1866, USA

# Index

- # of lines, 19
- 3D DXF, 40
- 3D SHP, 40
- a note about the
  - documentation, 27, 58
- active cell, 13
- active cell edit box, 13
- active cell location, 13
- add contour labels, 39
- add text, 57
- add, delete, and move
  - contour labels, 39
- adding a color scale, 50
- adding a map layer, 48
- adding a map title, 53
- adding a mesh, 47
- adding a shaded relief map
  - layer, 51
- adding a unique column
  - identifier, 30
- adding an overlay, 48
- adding labels to the post
  - map, 41
- adding new data, 30
- adding transparency to
  - map layers, 50
- adjacent maps, 25
- advanced contour level
  - properties, 37
- arrange objects, 10
- asterisk, 5
- auto hide, 10
- AutoCAD DXF export, 40
- axis tick labels, 43
- blank grid outside convex
  - hull, 19
- blank grid outside convex
  - hull of data, 19
- blank grid outside data, 19
- blank inside data, 19
- blank outside convex hull,
  - 19
- blank outside data, 19
- blanking file, 22
- BLN, 22
- boundary around data, 19
- boundary files, 17
- breakline example, 22
- breakline format, 22
- breaklines, 22
- breaklines and faults, 22
- bulk contour levels, 37
- changing colors, 47
- changing the grid node
  - editor, 7
- changing the layout, 7
- changing the managers, 7
- changing the menu bar, 7
- changing the object
  - manager location, 10
- changing the plot window,
  - 7
- changing the post map
  - properties, 40
- changing the toolbars, 7
- changing the worksheet, 7
- changing tick label
  - properties, 43
- changing tick labels, 43
- closing the object
  - manager, 10
- CLR, 47
- color, 47
- color scale, 50
- column letters, 13
- combine maps, 25
- combining maps, 25
- compatibility, 17
- contact us, 59
- contour interval, 35
- contour labels, 39
- contour levels, 35
- contour line properties, 36
- contour lines, 40
- convex, 19
- convex hull, 19
- coordinate, 26
- coordinate system, 25, 26
- create a grid file from an
  - XYZ data file, 19
- creating a grid file, 19
- creating a new data file, 29
- creating grid files, 19
- current command, 9
- custom labels, 39
- DAT, 31
- data, 19
- data columns, 19
- data file, 4, 29, 31
- data files, 17
- data transform, 30
- default gridding method,
  - 19
- deflate convex hull by, 19
- delete contour labels, 39
- delete map in overlay, 25
- DEM, 18
- demo, 1
- density of grid, 19
- digital elevation model
  - [.DEM], 18
- dock object manager, 10
- docking mechanism, 10
- documentation, 58
- downloads, 58
- drag and drop map layer,
  - 25
- drape maps on wireframes,
  - 25
- draw contours, 14
- edit contour, 14
- edit contour labels, 39
- edit contours, 14
- edit grid, 14
- edit grid value, 14
- edit maps in an overlay, 25
- edit menu, 11
- edit overlay, 25
- edit properties, 11
- edit surface, 14
- editing worksheet cells, 13
- email, 59
- enter group, 57
- enter group and add text
  - to a base map layer, 57
- entering data, 13
- export 3D contour lines, 40
- export contour lines, 40
- faults, 22
- faults and breaklines, 22
- fax, 59
- file menu - grid node
  - editor, 14
- file types, 17
- fill, 11
- filter data, 19
- forums, 58
- general gridding options,
  - 18, 22
- getting help, 58
- grid columns, 19
- grid data, 19
- grid density, 19
- grid editor, 14
- grid extents, 19
- grid files, 17
- grid limits, 19
- grid line geometry, 19
- grid lines, 19
- grid menu, 14, 19
- grid menu commands, 19
- grid node, 14
- grid node editor, 14

- grid node editor
  - commands, 8
- grid rows, 19
- grid size maximum, 19
- grid spacing, 19
- grid toolbar, 19
- grid utilities, 19
- gridding, 18, 19
- gridding data, 19
- gridding faults, 22
- gridding methods, 19
- gridding overview, 18
- gridding parameters, 19
- gridding with breaklines, 22
- gridding with faults, 22
- help, 27, 58
- hidden lines, 25
- hide a map in an overlay, 25
- hide object manager, 10
- how to use Surfer, 4
- hull, 19
- image gallery, 58
- indeterminate mode, 9
- individual contour levels, 37
- inflate convex hull by, 19
- info, 58
- internet, 58
- introduction to map layers, 25
- introduction to Surfer, 1
- introduction to the worksheet window, 13
- knowledge base, 58
- label format, 41
- labels, 39, 41
- latitude/longitude, 29
- layer, 25, 48
- lesson 1 - creating an XYZ data file, 29, 31
- lesson 3 - creating a contour map, 35, 36, 40
- lesson 4 - posting data points and working with map layers, 40, 41
- lesson 5 - creating a 3D surface map, 47, 48
- lesson 6 - adding transparency, color scales, and titles, 50, 51, 53
- levels, 35
- line properties, 36
- line spacing, 19
- mail, 59
- main, 8
- map coordinate system, 26
- map layer, 25, 48
- map layers, 25
- map overlay, 25
- map projection, 26
- map types, 23
- map units, 26
- material color, 47
- maximum, 19
- maximum grid size, 19
- menu commands, 8
- mesh, 47
- minimum, 19
- move contour labels, 39
- moving individual post map labels, 42
- newsletter, 58
- note about the documentation, 27, 58
- number of columns and rows, 19
- number of lines, 19
- object dimensions, 9
- object manager, 5, 10
- object manager tree, 10
- object name, 9
- object properties, 11
- object visibility, 10
- online help, 27, 58
- online tutorial, 27
- opacity, 50, 51
- opening an existing data file, 29
- opening surfer, 28
- opening the object manager, 10
- opening windows, 5
- options menu - grid node editor, 14
- output grid file, 19
- overlay, 25, 48
- overlay adjacent maps, 25
- overlay maps, 25
- overlying maps, 25
- overlying two or more maps, 25
- parts of the worksheet, 13
- phone, 59
- plot document commands, 8
- pointer coordinates, 9
- post map labels, 41
- post map properties, 40
- printing the online help, 58
- progress of task, 9
- projection, 26
- projections, 25, 26
- properties, 11, 40
- properties of multiple selections, 11
- property manager, 11
- remove map from overlay, 25
- row numbers, 13
- running surfer, 28
- sample files, 3
- saving a data file, 31
- saving the data file, 31
- scale bar, 50
- screen layout, 5
- select entire worksheet button, 13
- selecting objects, 10
- serial number, 28
- SHP export, 40
- source coordinate system, 26
- spacing, 19
- SRF, 17
- SRF file compatibility, 17
- starting surfer, 28
- statistics, 19
- status bar, 9
- support, 59
- surface material color, 47
- surface mesh, 47
- surface overlay, 48
- Surfer files, 17
- surfer help, 58
- surfer tutorial, 28
- Surfer user interface, 5
- system requirements, 1
- tabbed document, 5, 13, 14
- tabbed view, 5
- tabbed windows, 5
- target coordinate system, 26
- task progress, 9
- tech support, 59
- technical support, 59
- three-minute tour, 3
- toolbars, 5
- tools menu, 8
- tooltips, 8
- training videos, 58
- transparency, 50, 51
- tutorial, 27, 30
- tutorial - changing tick labels, 43
- tutorial advanced contour levels, 37
- tutorial introduction, 27
- tutorial lessons, 27
- tutorial overview, 27
- understanding how to use Surfer, 4
- uninstalling Surfer, 1
- user interface, 5

## Index

using breaklines and faults  
  when gridding, 22  
using Scriptor, 5  
using surfer, 4  
using the online tutorial,  
  27  
using the tutorial with the  
  demo version, 27  
videos, 58

view data, 19  
view menu, 9, 10  
view menu - grid node  
  editor, 14  
vista, 1  
welcome to Surfer help, 58  
window types, 5  
windows, 5  
worksheet, 13

worksheet commands, 8,  
  13  
worksheet document, 13  
worksheet name, 13  
worksheet window, 13  
X direction, 19  
XYZ data file, 29, 31  
Y direction, 19

## Customer Service Resources

---

Before calling, please check the following available resources as your question may already be answered.

<b>Registration:</b> Register online at <a href="http://www.goldensoftware.com">www.goldensoftware.com</a> or fax to the number below.
<b>Knowledge Base:</b> <a href="http://support.GoldenSoftware.com">support.GoldenSoftware.com</a> or in the <b>Surfer</b> program using the <b>File   Online   Knowledge Base</b> command
<b>Forums:</b> <a href="http://support.GoldenSoftware.com">support.GoldenSoftware.com</a> or in the <b>Surfer</b> program using the <b>Forums</b> button in the online help.
<b>Frequently Asked Questions:</b> In the <b>Surfer</b> program using the <b>File   Online   Frequently Asked Questions</b> command
<b>Tutorial:</b> Complete the tutorial section in this guide or in the <i>Tutorial</i> book in the online help.
<b>Online Help:</b> <a href="http://surferhelp.GoldenSoftware.com">surferhelp.GoldenSoftware.com</a> or press F1 in the <b>Surfer</b> program.
<b>Support Videos:</b> <a href="http://support.GoldenSoftware.com">support.GoldenSoftware.com</a> for <b>Surfer</b> specific training videos and webinars, or check out the Golden Software channel on YouTube.

### Business Hours

Technical Support:

Monday through Friday, 8:00 AM - 5:00 PM, Mountain Time

Product Sales:

Online orders available 24 hours, 7 days a week

### Golden Software Contact Information

[www.goldensoftware.com](http://www.goldensoftware.com)

[SurferSupport@goldensoftware.com](mailto:SurferSupport@goldensoftware.com)

phone: 303-279-1021

fax: 303-279-0909



Golden Software, LLC  
809 14th Street  
Golden, Colorado 80401 USA

**Phone** +1 303 279 1021  
**Fax** +1 303 279 0909

[www.goldensoftware.com](http://www.goldensoftware.com)