

Help for EnterVol Version 1.84 October 30, 2013

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Slice at Elevation	
Slice at Northing (Y)	
Explode tool	
Set View to Azimuth/Inclination	
Set View from Cardinal Direction	

EnterVol for ArcGIS Overview



EnterVol for ArcGIS creates and manipulates true 3D volumetric geology and/or analyte models created in EnterVol Geology, EnterVol GeoStats, or saved in C Tech's EVS Field File (EFF) format. *EnterVol for ArcGIS* performs subsetting (plumes, cuts, slices, cross-sections, contouring, etc.) and analysis (volumetrics) inside of ArcGIS Desktop10.1 3D visualization of these models is performed in ArcSceneTM.

EVS Field Files can be created in C Tech's EVS or MVS software and in the EnterVol Product Suite components *EnterVol GeoStats* and *EnterVol Geology*.

In ESRI terminology, C Tech's EFFs represent a feature dataset, usually consisting of a single feature class (*a collection of geographic features with the same geometry type (such as point, line, or polygon), the same attributes, and the same spatial reference)*. EnterVol extends the definition of feature class to include volumetric geometry types.

A single EFF file can contain multiple features classes in that there can be feature datasets with multiple geometry types. A single EFF can contain any or all of EnterVol's supported geometry types including points, lines, surfaces and volumes.

Each of the above geometry types is composed of nodes which represent endpoints or vertices of the object. Each node has x, y, & z coordinates to specify its location. Unique to EnterVol is the ability to associate with the nodes as well as the features. Nodal data is a concept that is new to ArcGIS desktop just like volumetric geometry types.

We need volumetric geometry types because without them volumes cannot be represented as anything more than the space enclosed by surfaces. These volumetric features allow us to create volumetric grids which can have simple or incredibly complex shapes.

But why do we need nodal data? What can it do that normal attribute data associated with each feature cannot do?

As you apply the volumetric subsetting operations in EnterVol, you will notice that plumes and arbitrary cuts through volumes have smooth surfaces. Furthermore, when EnterVol cuts or slices through a volumetric dataset, the result incorporates the data throughout the resulting subset. These smooth subsetting operations are only possible because of nodal data. When attributes (data) are associated with each feature such as a triangle, the resolution or smoothness with which we can subset is limited to the size of each triangle. EnterVol's paradigm of associating continuum data with the nodes (vertices) of each feature allow us to subset to a sub-feature level. This dramatically improves accuracy and allow you to use coarser grids without compromise. It also greatly improves analytical accuracy of computing plume volumes and makes possible the integration of chemical masses.

EnterVol has two toolbars. The primary is the EnterVol toolbar and also EnterVol Tools. The EnterVol toolbar includes options to:

- Layer Operations
 - Adding data
 - Layer Selector
 - Set symbology
 - Copy symbology
 - Export to EVS
- Subsetting Tools
 - Slice
 - Cut
 - Plume
 - Fence
- Display Tools
 - Isolines
 - Edges
 - Exploding geologic layers
- Mass and Volume (Volumetric Analysis)
- Open this Help File

🚳 new-tools.sxd - ArcScene	
File Edit View Bookmarks Selection Geoprocessing Customize Windows Help	
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Table of Contents # ×	

The EnterVol Tools toolbar includes options to:

- Label Features
- EnterVol Raster to Volume
- Project Features to 2D
- Open the EnterVol Tools Scene Control window
- Add Direction Indicator
- Add Axes (ArcScene) & Add Grid (ArcMap)



Installation of EnterVol

EnterVol's Product Suite runs under ArcGIS Desktop 10.x. Earlier version of ArcGIS (e.g. 9.x) are not supported. EnterVol requires an ArcGIS Desktop 10 license and the ArcScene extension. No other ESRI products or third party applications are required.

The EnterVol Product Suite and support applications and files can be downloaded at www.ctech.com. Without registering and logging in, you will have access to the primary EnterVol files shown below:



The EnterVol for ArcGIS Installer includes EnterVol for ArcGIS (the core product), EnterVol Geology, EnterVol GeoStats and EnterVol Tools. The EnterVol Sample Data is recommended to allow you to duplicate the exercises in the Tutorials which are included in this help file.

Installation of EnterVol

EnterVol's Product Suite runs under ArcGIS Desktop 10.x. Earlier version of ArcGIS (e.g. 9.x) are not supported. EnterVol requires an ArcGIS Desktop 10 license and the ArcScene extension. No other ESRI products or third party applications are required.

The EnterVol Product Suite and support applications and files can be downloaded at www.ctech.com. Without registering and logging in, you will have access to the primary EnterVol files shown below:

· ⇒ C ♠ (www.ctech.com/?page=download		
C TECH Devel	opment Corporation		
2 (1990)	is Submit Support Request Known Issues Release Not	tes Privacy	Policy Workbo
Support: Do Varning - You are ertain downloads			
arning - You are	not logged in.		
arning - You are	not logged in. will not be available until you have logged in.	Туре	Size
arning - You are ertain downloads	not logged in. will not be available until you have logged in. EnterVol Installations		Size 38.27 MB (40,131,540 bytes)

The EnterVol for ArcGIS Installer includes EnterVol for ArcGIS (the core product), EnterVol Geology, EnterVol GeoStats and EnterVol Tools. The EnterVol Sample Data is recommended to allow you to duplicate the exercises in the Tutorials which are included in this help file.

Trial License

Provided you have never before installed any version of EnterVol on your computer, upon installation you will automatically receive a 15 day fully functional license. Installing a newer version of EnterVol or uninstalling and re-installing will not extend the trial license.

To see the status of your license you can open the EnterVol License Manager

EnterVol License Manager

or *Licensing* in the EnterVol menu in ArcGIS.

	Server version 1.3 - Released on 11/23/2011	
System Identifier:	CEE5-33DD-6D89-0E33-7D23-395A	
License Summary:	Licensed successfully: 15 Days Remaining in Trial Licenses available: EnterVolForArcGis : 1 EnterVolTools : 1 EnterVolGeoStats : 1 EnterVolGeology : 1	•
Maintenance Date:	1/16/2012	

After the trial period, if you have not purchased an EnterVol license, it will show:

	Server version 1.3 - Released on 11/23/2011	
System Identifier:	3B11-4949-6DA7-7FCD-1123-AE4C	
License Summary:	Trial License Expired. No licenses available	
Maintenance Date:	1/1/0001	Ŧ

Installing an EnterVol Fixed License

To purchase and install an EnterVol fixed license you must:

- Select the computer with ArcGIS 10.x and ArcScene already installed to be licensed
- Install EnterVol



• Open the EnterVol License Manager EnterVol License Manager or *Licensing* in the EnterVol menu in ArcGIS.

	Server version 1.3 - R	eleased on 11/23/2011	
System Identifier:	3B11-4949-6DA7-7FCD	0-1123-AE4C	
License Summary:	Trial License Expired. No licenses available		*
			Ŧ
Maintenance Date:	1/1/0001		
D	fresh	Load C Tech License File (*.license)	

PLEASE NOTE: Your System Identifier will vary and the Trial License shown above may be different.

To create your license, C Tech must receive your System Identifier. DO NOT send us a screenshot of this window. Rather, select the alphanumeric string in the System Identifier window and select Copy as shown below.

	Server version 1.3 - Released on 11/2	23/2011		
System Identifier:	3B11-4949-6DA7-7FCD-1123-AE4C	Cut	Ctrl+X	1
	Trial License Expired.	Сору	Ctrl+C	-
	No licenses available	Paste	Ctrl+V	
				1

E-mail the System Identifier string to sales@ctech.com along with the following required information:

- System Identifier: XXXX-1234-YYYY-5678-ZZZZ-0009
- Company: ABC Consultants, Inc.
- User: Ms. Jane Doe
- E-Mail: j.doe@abc-cons-inc.com

- **Phone**: 505-555-1212
- **C Tech's Invoice number** for your order (this is to ensure that you receive the proper licenses)

Upon verification of the information you provide, C Tech will generate a license file which will be sent to the e-mail address provided above.

Open the EnterVol License Manager and click the *Load C Tech License File* (*.*license*) button. Browse to the .license file and select it. The License Manager should update to reflect the licenses you have purchased.

EnterVol Licensin	ig Information
System Identifier:	3B11-4949-6DA7-7FCD-1123-AE4C
Licensed Products:	Licensed for EnterVol for ArcGIS Licensed for EnterVol Tools Licensed for EnterVol GeoStats Licensed for EnterVol Geology
License Details:	Licensed successfully until 1/16/2013
Maintenance Date:	1/16/2013
Release Date:	3/28/2011
Use Floating Lice	nsing
	Load C Tech License File (*.license)
	ОК

The above window shows a single fixed license for all EnterVol products through January 16, 2013.

If you start ArcScene, you should see the EnterVol menus enabled. If you have any license problems see the <u>License Troubleshooting Section</u>

Server Installation for EnterVol Concurrent Licenses

To purchase and install EnterVol Concurrent Licenses you must:

- Select the computer which will be the **license server** for EnterVol licenses.
 - The computer to be the *license server* does not require ArcGIS 10.x or any third party software.
- Download and install the EnterVol Concurrent License Server Installation from the downloads page ctech.com. Please note that this program is only accessible to registered users at ctech.com who are logged in.
 - Don't miss the **FINAL STEP** at the end of this topic.

f C Tech Facebook 🔮 Ente	erVol 👂 PayPal 🧧 Network Camera 🍖 VRBO ▶ directv TV 🌄 Netflix 🗿	ASB BIZ 🛂	C Tech Development Cor
<u>C Tech Video Codec</u> <u>Pack</u>	This allows clients to view animations created with the HuffYUV, XviD, and Lagarith video codecs. (Automatically included in standard EVS and MVS installations.)	.exe	851.28 KB (871,708 bytes)
	Floating License Server Installations		
<u>File</u>	Description	Type	Size
EVS and MVS Floating License Server Installation	Required for all servers managing EVS or MVS floating licenses.	.exe	5.93 MB (6,215,634 bytes)
EnterVol Concurrent License Server Installation	EnterVol License Server Version 1.3. Required for all servers managing EnterVol concurrent use licenses.	.exe	2.25 MB (2,358,204 bytes)
	Licensing and Maintenance Agreements		
File	Description	Type	Size
EVS, MVS, and 4DIM Software License	Terms and conditions for licensing C Tech software. Must be included with all purchase orders.	.pdf	42.26 KB (43,271 bytes)
EnterVol Software License	Terms and conditions for licensing C Tech's EnterVol software. Must be included with all purchase orders.	.pdf	34.46 KB (35,292 bytes)
Premier Licensing	Staff-level certification form for C Tech's Premier Licensing	.pdf	36.77 KB

Open the EnterVol License Manager



C EnterVol License Manager

System Identifier: CEE5-33DD-6D89-0E33-7D23-395A Licensed successfully: 15 Days Remaining in Trial Licenses available: EnterVolForArcGis : 1 EnterVolGeoStats : 1 EnterVolGeology : 1 License Summary:		Server version 1.3 - Released on 11/23/2011
Licenses available: EnterVolForArcGis : 1 EnterVolTools : 1 EnterVolGeoStats : 1 EnterVolGeology : 1	System Identifier:	CEE5-33DD-6D89-0E33-7D23-395A
	License Summary:	Licenses available: EnterVolForArcGis : 1 EnterVolTools : 1 EnterVolGeoStats : 1
Maintenance Date: 1/16/2012	Maintenance Date:	1/16/2012

PLEASE NOTE: Your System Identifier will vary and the Trial License shown above may be different.

To create your license C Tech must receive your System Identifier. DO NOT send us a screenshot of this window. Rather, select the alphanumeric string in the System Identifier window and select Copy.

	Server version 1.3 - Released on 11/	23/2011		
System Identifier:	3B11-4949-6DA7-7FCD-1123-AE4C	Cut	Ctrl+X	1
	Trial License Expired.	Сору	Ctrl+C	1
	No licenses available	Paste	Ctrl+V	
	-			

Then send that string to sales@ctech.com along with the following required information:

- System Identifier: XXXX-1234-YYYY-5678-ZZZ-0009
- **Company**: ABC Consultants, Inc.

- User: Ms. Jane Doe
- E-Mail: j.doe@abc-cons-inc.com
- **Phone**: 505-555-1212
- **C Tech's Invoice number** for your order (this is to ensure that you receive the proper licenses)

Upon verification of the information you provide, C Tech will generate a license file which will be sent to the e-mail address provided above.

Open the EnterVol License Manager and click the *Load C Tech License File* (*.*license*) button. Browse to the .license file and select it. The License Manager should update to reflect the licenses you have purchased.

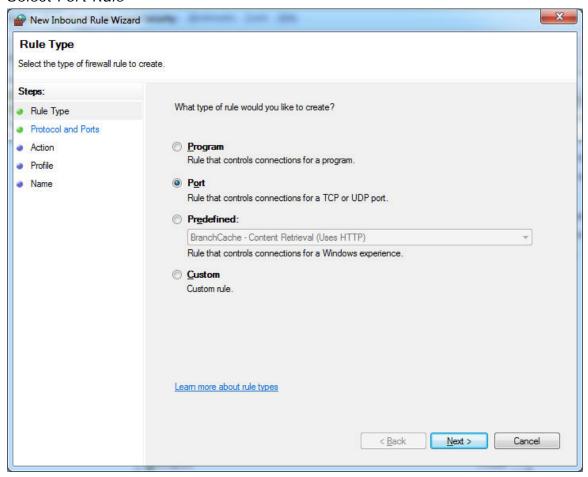
EnterVol License	Information 📃	
	Server version 1.3 - Released on 11/23/2011	
System Identifier:	CEE5-33DD-6D89-0E33-7D23-395A	
License Summary:	Licensed successfully until 7/16/2012 Concurrent License Usage Allowed Licenses available: EnterVolForArcGis : 20 EnterVolTools : 20 EnterVolGeology : 20 EnterVolGeoStats : 20	
Maintenance Date:	7/16/2012	
Re	efresh Load C Tech License File (*.license)	

The above window shows a 20 user concurrent license for all EnterVol products through July 16, 2012.

FINAL STEP: The last step in the server installation is to unblock port 9347 to inbound TCP queries. The process to do this will depend on what Firewall software your server uses. The example below is for Windows 7.

Open Windows Firewall with Advanced Security.

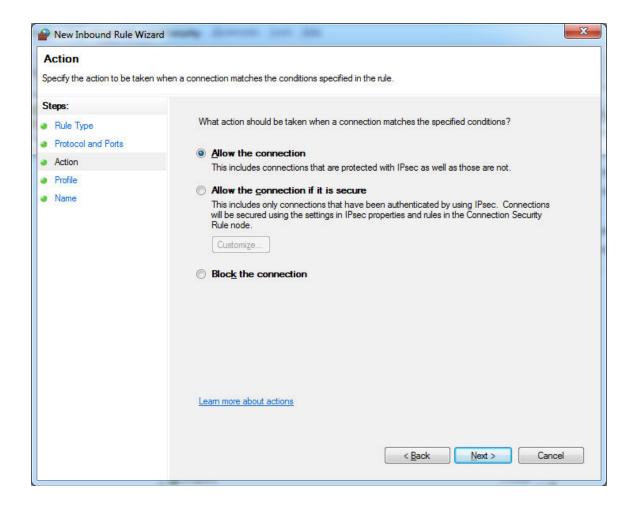
Select Inbound Rules and create a New Rule Select Port Rule

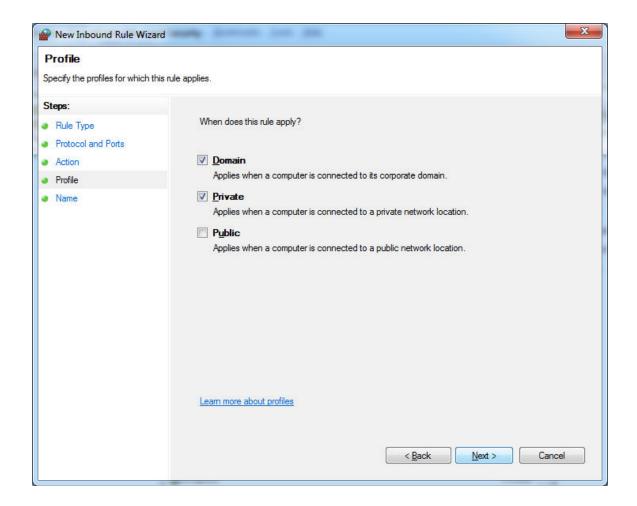


Choose TCP and set the port to 9347

Provident Antice Wizar	d market in the second s		X
Protocol and Ports Specify the protocols and ports	to which this rule applies.		
Steps: Rule Type Protocol and Ports	Does this rule apply to TCP or UI	DP?	
 Action Profile Name 	Does this rule apply to all local points	orts or specific local ports?	
	Specific local ports:	9347 Example: 80, 443, 5000-5010	
	Leam more about protocol and p	orts < <u>B</u> ack Next > Cane	cel

Allow the connection with settings that meet your company's IT policies.





Prew Inbound Rule Wizard	and here in the	X
Name		
Specify the name and description	of this rule.	
Steps:		
Rule Type		
Protocol and Ports		
Action		
Profile	Name:	136
Name	EnterVol Server on 9347	
	Description (optional):	
	Allow inbound TCP for EnterVol server on port 9347	
	< <u>B</u> ack Finish Can	cel

Client Installation for Concurrent Licenses

If your organization has purchased EnterVol concurrent licenses and properly installed and configured an EnterVol license server on your network, you can follow the simple steps below to configure a client installation for a concurrent license.

• Open the EnterVol Licensing Window and turn on the "Use Floating License" toggle as shown below.

EnterVol Licensing Info	rmation	
Remote System Identifier:		
Licensed Products:	C Tech License Service is currently no Please contact C Tech support at sup	-
License Details:	Unable to connect to license service	
Maintenance Date:	1/1/2011	
Release Date:	3/28/2011	
V se Floating Licensing		
Remote Host Address /	Port:	9347
License Types to Reque	 ✓ EnterVol Tools ✓ EnterVol for ArcGIS ✓ EnterVol GeoStats ✓ EnterVol Geology 	
	Apply Remote Settings	
	ОК	

- Enter the Remote Host (Server) Name or IP address
- Select the License Types to Request
 Click "Apply Remote Settings"

EnterVol Licensing Infor	mation	
Remote System Identifier:	CEE5-33DD-6D89-0E33-7D23-39	5A
Licensed Products:	Licensed for EnterVol for ArcGIS Licensed for EnterVol Tools Licensed for EnterVol GeoStats Licensed for EnterVol Geology	
License Details:	Licensed successfully until 7/16/2	2012
Maintenance Date:	7/16/2012	
Release Date:	3/28/2011	
Use Floating Licensing		
Remote Host Address / P	ort: REED-ZEN	9347
License Types to Request	 EnterVol Tools EnterVol for ArcGIS EnterVol GeoStats EnterVol Geology 	
	Apply Remote Settings	
	ОК	

If your client computer can connect to a valid server, your licensing window should show something like the above.

License Troubleshooting Section

Provided you've followed the installation instructions, you shouldn't need to be here.

However here are a list of common issues:

- Fixed Licenses
 - Confirm that the C Tech License Service is started (see image below)
 - Open the EnterVol License window and confirm you have a license that is not expired and has a Maintenance Date compatible with the EnterVol version you are running

- Please note that you cannot install newer versions of EnterVol during a Trial License period.
- Concurrent Licenses on Server
 - Confirm that the C Tech License Service is started (see image below)
 - Confirm that the Server's Firewall is not blocking port 9347 (see <u>Final Step</u>)
 - Open the EnterVol License Manager and confirm you have licenses that are not expired
- Concurrent Licenses on Client
 - Open the EnterVol License window and confirm:
 - You turn on the toggle: Use Floating License
 - You have properly specified your server
 - Your server has licenses that are not expired and has a Maintenance Date compatible with the EnterVol version you are running
 - If you "Cannot connect to the License Server":
 - Try to ping to the server name
 - Confirm that the server's firewall is not blocking port 9347
- Releasing Concurrent Licenses on Client
 - If multiple users are sharing a limited number of EnterVol seats, they must be released.
 - Open the EnterVol License window (see image below)
 - UNCHECK the licenses that you wish to release (see second image below)
 - Click Apply Remote Settings
 - Click *OK* to close the window
 - Note: It will take up to 5 minutes for the licenses to be released and available to another user.

EnterVol Licensing Infor	mati	on	
Remote System Identifier:	r: 3B11-4949-6DA7-7FCD-1123-AE4C		E4C
Licensed Products:	Lic Lic	ensed for EnterVol for ArcGIS ensed for EnterVol Tools ensed for EnterVol GeoStats ensed for EnterVol Geology	
License Details:	Lic	ensed successfullyPermanent	License
Maintenance Date:	1/1	19/2013	
Release Date:	8/2	20/2012	
Use Floating Licensing			
Remote Host Address / P	ort:	REED-ZEN	9347
		EnterVol Tools	
License Types to Request		EnterVol for ArcGIS	
License Types to Request		EnterVol GeoStats	
		EnterVol Geology	
	Ар	ply Remote Settings	
		ОК	

☑ Use Floating Licensing

Remote Host Address / Port:	REED-ZEN	9347
License Types to Request:	 EnterVol Tools EnterVol for ArcGIS EnterVol GeoStats EnterVol Geology 	
Ар	ply Remote Settings	
	OK	

The *C Tech License Server* must be started in order for EnterVol to run.

ile <u>A</u> ction <u>V</u> iew	/ <u>H</u> elp Q 🕞 👔 🖬 ▷ ■ II I▷					
Services (Local)	Services (Local)					
	C Tech License Service	Name	Description	Status	Startup Type	Log On As
	C recircle service	B's Recorder GOL	Provides CD		Automatic	Local Syste
	Stop the service	C Tech License Se			Automatic	
	Restart the service	Certificate Propag		Started	Manual	Local Syste Local Syste
		Certificate Propag	The CNG ke	Started	Manual	Local Syste
	Description:	COM+ Event Syst	Supports Sy	Started	Automatic	Local Service
	Service to manage registrations for C	COM+ Event System Ap		Statteu	Manual	Local Syste
	Tech products	Computer Browser	Maintains a	Started	Manual	Local Syste
		Credential Manager		Starteu	Manual	Local Syste
		Cryptographic Ser		Started	Automatic	Network S
		DCOM Server Pro	The DCOM	Started	Automatic	Local Syste
		Desktop Window	Provides De	Started	Automatic	Local Syste
		CINCP Client	Registers an	Started	Automatic	Local Service
		Diagnostic Policy	1	Started	Automatic	Local Service
		Diagnostic Service	Carl and the second second	Started	Manual	Local Service
		Diagnostic System	-	Started	Manual	Local Syste
			Provides Dis		Manual	Local Syste
		Distributed Link Tr		Started	Automatic	Local Syste
		Distributed Transa			Manual	Network S
		DNS Client	The DNS Cli	Started	Automatic	Network S
		Encrypting File Sy	Provides th		Manual	Local Syste
	Extended Standard /					

Configuration

The Configuration window provides some basic settings that affect other operations in EnterVol. Once settings are changed, you must exit ArcScene and restart it for the configuration setting to be set.

_		Select an Enter	and the second se
	Modeling Window		Ψ×
¢	Scene Control		
	Layer Operations	•	
	Subsetting	•	
	Display	•	
	Analysis	•	
-0	Licensing		
0	Configuration		
•	About		
2	EnterVol Help		

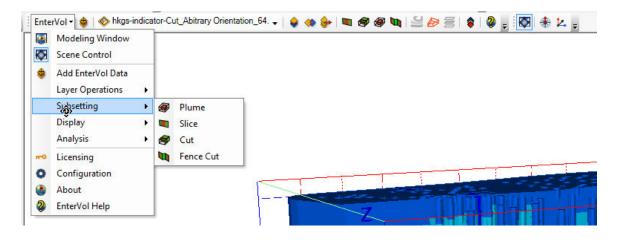
The primary configuration options are:

- "Auto Show Toolbar" which is on by default, shows the EnterVol toolbar by default.
- The Default Material Colors allows you to set standard colors to be used as defaults.
- "Industry Specialization" is an important feature. This affects some of the basic terminology (plume vs. ore body) used for tools as well as default units and the reporting in volumetrics. The current options are:
 - Environmental
 - Mining

Toolbar Settings		
Auto Show Toolbar:		1
License Settings		
Seconds to Timeout for Concurr	ent License: 5	10 ≜ 0 10₹0
Default Material Colors		
Material 1:		
Material 2:		
Material 3:		
Material 4:		
Material 5:		
Material 6:		
Material 7:		100
Material 8:		
Material 9:		
Material 10:		
Usability Settings	7.92	
Industry Specialization:	Environme	
ОК	Environme Mining	ntal

Using EnterVol

EnterVol provides multiple ways to access its functionality. If you turn on the EnterVol Toolbar, it provides access to all EnterVol functionality:



Tools and operations can be accessed in three different ways:

- 1. The menu structure shown above
- 2. Individual icons. 🗣 🗇 🗣 🔍 🖉 🍘 🐚 🖆 🔗 🚍 🛊 😵 🖕 🐼 🚸 🔽
- 3. By *Right-Clicking* on the Scene or Individual Layers in the Table of Contents (TOC) shown at the end of this topic

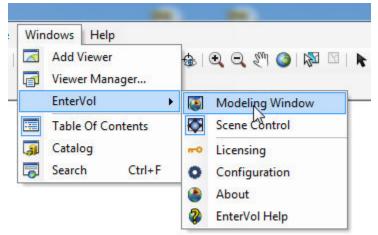
The Operations Include:

- Modeling Window
 - Loading or Creating Projects
 - Importing Data
 - Building 2D, Surface and 3D Grids
 - Building Geologic models with Stratigraphy or Lithology
 - Mapping Analytical Data to 3D Grids
- Scene Control: Opens the EnterVol Scene Control window
- Add EnterVol Data: Directly import C Tech legacy grids and data files
- Layer Operations:
 - Set Symbology
 - Copy Symbology
 - Export to EVS: Outputs objects in C Tech format for use in EVS & MVS
- Subsetting:
 - Plume
 - Slice
 - Cut
 - Fence Cut
- Display:

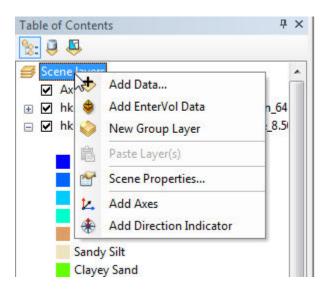
EnterVol Ver. 1.84 Help System www.ctech.com

- Contour
- Isolines
- Extract Points
- Extract Edges
- Explode Layers
- Analysis: Mass and Volume
- Licensing, Configuration, About and EnterVol Help

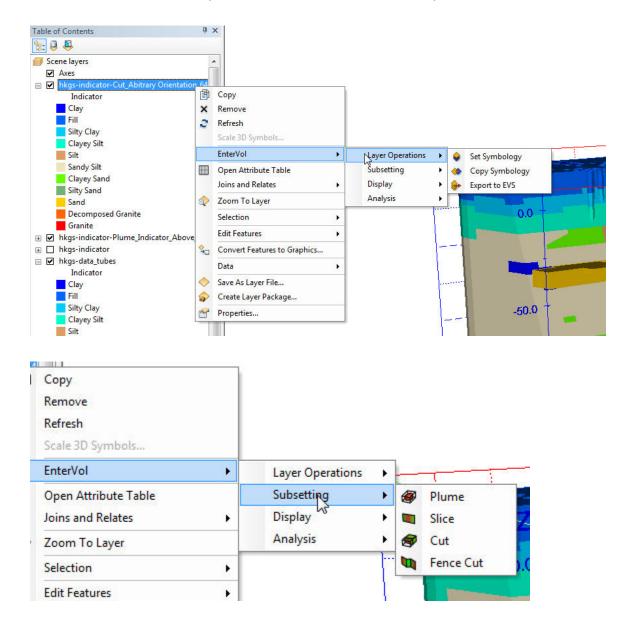
With the EnterVol toolbar not visible, all operations may still be accessed. Access to all EnterVol windows are available in the Pull-Down menus under Windows:



All other operations are accessed with Right Clicking in the TOC. If you Right-Click on *Scene Layers* you can access *Add EnterVol Data, Add Axes and Add Direction Indicator.*



If you Right-Click on Individual *Layers* in the TOC you can access all other EnterVol operations which would be relevant to that layer. Different types of layers will have different functionality available. For example, you can't put isolines on models colored by unique values (like geologic material), but you could on a contaminant plume. Below are some examples:



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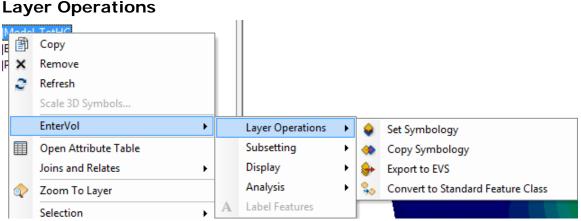
EnterVol	•	Layer Operations	•	L	
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Selection	•			8	Extract Points
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Layer Operations

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		EnterVol	·	Layer Operations	►	\$	Set Symbology
				Layer Operations Subsetting	•	\$	Set Symbology Copy Symbology
		EnterVol Open Attribute Table	•		• •	♦ ♦ ♦	
		EnterVol Open Attribute Table	•	Subsetting	•	♦ ♦ ♦ ٩	Copy Symbology

Layer Operations allow you to import any element of an EnterVol Project Files (.EVP), EnterVol Model Files (.EVMs), EVS Field Files (.EFF, .EFZ and .EFB) and various other C Tech file formats, and to set and copy the symbology to be applied to those objects.

Most EFFs contain features which can have multiple attributes. In fact, C Tech's EFFs have unique characteristics that set them apart from traditional ESRI objects. EFF objects of all types (points, lines, surfaces and volumes) can contain both cell attributes (traditional ESRI paradigm) and nodal data.



Layer Operations allow you to import any element of an EnterVol Project Files (.EVP), EnterVol Model Files (.EVMs), EVS Field Files (.EFF, .EFZ and .EFB) and various other C Tech file formats, and to set and copy the symbology to be applied to those objects.

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Add	EnterVol Dat	a

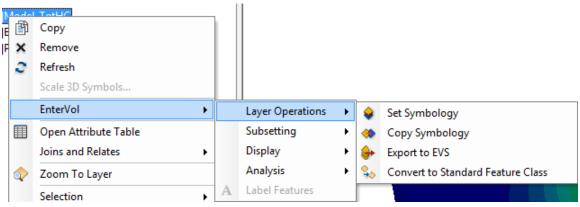
L E	امام ۲ ×	Copy Remove					
	2	Refresh					
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	\Diamond	Zoom To Layer		Analysis	•	\$₀	Convert to Standard Feature Class
		Selection	A	Label Features		_	

Using this button, you can add various types of data to your scenes:

- EnterVol Project Files (.EVP) can contain all of the file types listed below. Selecting an EVP file allows you to select any one of them.
- EnterVol Model Files (.EVM) are a superset of EVS Field Files and are the default file format for all models created in EnterVol.
- EFF (EVS Field Files) representing both volumetric grids, surfaces and/or lines. Includes .EFF (ASCII), .EFZ (zip archive) and .EFB (binary) formats
- GEO: Geologic boring data representing hierarchical geology data collected in vertical borings
- GMF: C Tech's Geology Multi-File allows you to import a cloud of points corresponding to uncorrelated points on one or more surfaces representing hierarchical geology data
- PGF: Pre-Geology data representing 3D boring logs (can be non-vertical)
- apdv: C Tech's chemistry (analyte) file format for contamination and ore grade data representing point samples (can be non-vertical)
- aidv: C Tech's chemistry (analyte) file format for contamination and ore grade data representing samples collected over an interval (can be non-vertical)

When EnterVol data is added, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

Add EnterVol Data



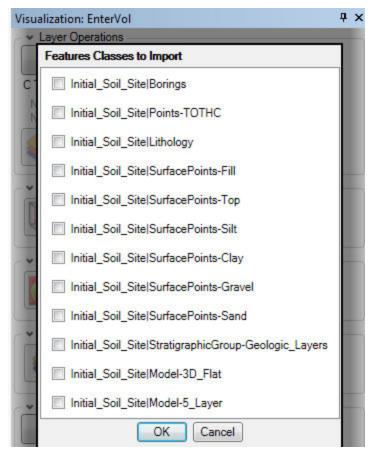
Using this button, you can add various types of data to your scenes:

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- aidv: C Tech's chemistry (analyte) file format for contamination and ore grade data representing samples collected over an interval (can be non-vertical)

When EnterVol data is added, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

Add EnterVol Project File Data

EnterVol Project Files (.EVP) can contain all of the file types listed <u>here</u>. Selecting an EVP file allows you to select any one of them.



When EnterVol data is added, a summary of the data and settings used to create it is added to the Layer Properties under <u>General Description</u>.

Add EnterVol Models EVM

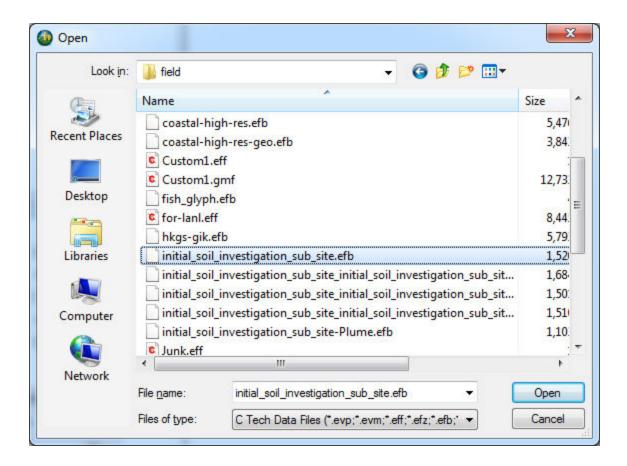
EnterVol Model Files (.EVM) are a superset of EVS Field Files and are the default file format for all models created in EnterVol. They are typically stored in the EnterVol Project File and can be selected from the check list that opens when an EVP file is selected.

In general loading a .EVM file is equivalent to loading a .EFF (or .EFB) file. When EnterVol data is added, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

Add C Tech EFF



Select the *Add EnterVol Data* button above to add a new EFF to your ArcGIS project.



After the EFF loads, a new window will appear to allow you to set the initial symbology:

Current Progress:	
Step: 1 of 1	
Data: Initial_Soil_Site Mode	
Symbology Options:	
Color By Field:	
ТОТНС	*
Coloring Method:	
Break at Even Intervals	*
Intervals per decade:	3
Capture Full Data Range:	
Lower Breaks Bound:	0.001000000474974
Upper Breaks Bound:	71,049.0329812292
Advanced	

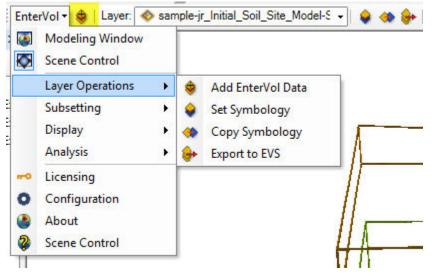
If we choose the first pull-down menu we can see that this EFF has several attributes which can be used for coloring:

🚳 Add Data	
Current Progress:	
Step: 1 of 1 Data: initial_soil_investigatic	
Symbology Options:	
Color By Field:	
Geo_Layer	•
Coloring Method:	
Unique Values	•
✓ Advanced	
OK	el

However, if we choose Geo_Layer, the results in our ArcScene window will be:

Untitled - ArcScene - ArcView	
File Edit View Bookmarks Selection Geoprocessing Custo	
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Z Scale: 4.00	
Entervor lools	

Add C Tech GEO: Geology File



Beginning with the scene at the end of the <u>Add C Tech EFF</u> topic, press the Add EnterVol Data button and select the file initial_soil_investigation_subsite.geo.

	C C CTech95 Data geology	 ✓ 4₁ Search geology
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E Recent Places	GW_Elevations_43_times.geo	12/30/2010 8:54 A
	hkgs_tung_chung-onelayer.geo	1/31/2003 8:55 PM
词 Libraries	initial_soil_investigation_subsite.geo	1/30/2007 7:49 AI
<mark>∂</mark> C	single_surface_topography.gmf	10/12/1998 2:14 P
Documents	🖻 tunnel_hill.geo	7/1/2005 1:17 PM
J Music	vickers_top_plus_aquifer.geo	8/17/2005 7:27 AI
Pictures +	< III	۲
File n	ame: initial_soil_investigation_subsite.geo	✓ C Tech Data Files (*.eff;*.efz;*.et ▼

	Symbology Options:	
	Color By Field:	
	Material Name	
	Coloring Method:	
	Unique Values 🔹	
	Advanced	
	OK Cancel	
lues		a

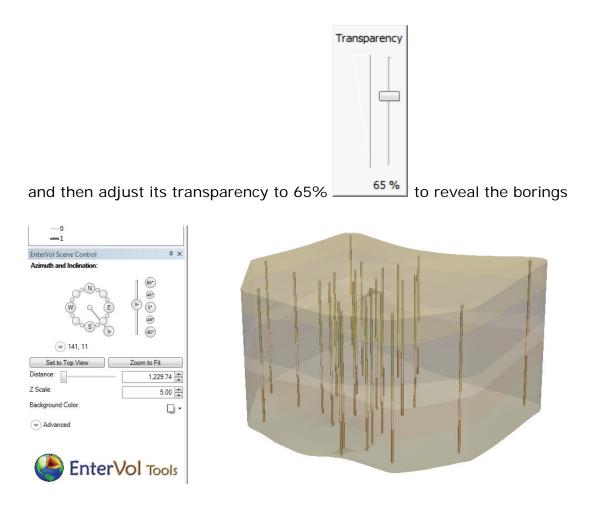
Accept the default values borings will be added to your scene.

However, since the volumetric model is opaque, we can only see a hint of them on the surface.

From the 3D Effects toolbar select the volumetric model

: Layer.	Initial_soil_investigation_sub_▼ ▲ ▲ ↓ Initial_soil_investigation_sub_site	-

geologic



Add C Tech GMF

Let's begin with a new project (scene).

Click the Add EnterVol Data button and browse to find the file vickers.gmf

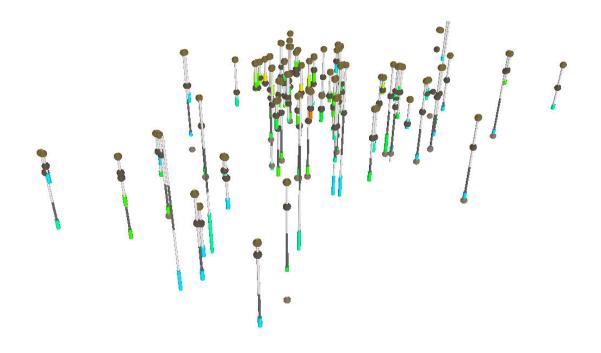
Organize 👻 🛛 New f	older		8= - 🗔 🧔
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		vickers_top_plus_aquifer.geo	2/25/2011 12:06 F
Pictures	-		•

Let's accept the default coloring by surface number to get



This will get more interesting if we add the aidv file from the <u>Add C Tech</u> <u>aidv: Groundwater Chemistry</u> topic.

With that added we'll see:



This give us the ability to see how the geology data correlates with the groundwater data.

Add C Tech Pre-Geology File

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Beginning with the scene at the end of the <u>Add C Tech EFF</u> topic, press the Add EnterVol Data button and select the file initial_soil_investigation_subsite.pgf.

)	C CTech95 Data pregeology	✓ ✓ Search prege	eology .
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Favorites	C library pregeology	Arran	nge by: Folder 🔻
\rm Public 🛛 🛓	Name		Date modified
Desktop	5_material_complex_geology.pgf		9/7/2005 7:54 AM
Downloads	dipping_strata_lens.pgf		2/1/2006 9:10 AM
Recent Places	dipping_strata_lens_pgf_created.geo		2/7/2006 8:31 AM
libraries	dipping_strata_lens_pgf_created.gmf		2/7/2006 8:31 AM
C	hkgs_tung_chung.pgf		8/29/2005 1:44 PM
Documents	initial_soil_investigation_subsite.pgf		8/14/2003 6:51 AI
J Music			
Pictures 👻	٠ [
File n	ame: initial_soil_investigation_subsite.pgf	✓ C Tech Data F	Files (*.eff;*.efz;*.et 🔻

	Symbology Options:	
	Color By Field:	
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	Coloring Method:	
	Unique Values 🔹	
- 1	Advanced	
	OK Cancel	
lues		a

Accept the default values

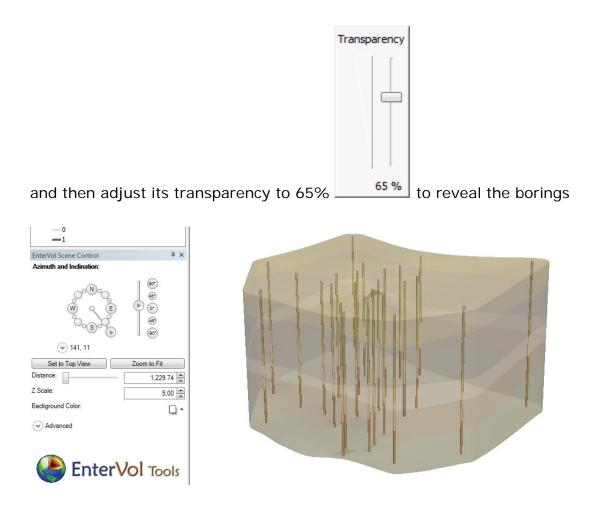
and geologic

borings will be added to your scene.

However, since the volumetric model is opaque, we can only see a hint of them on the surface.

From the 3D Effects toolbar select the volumetric model

E Layer:	Initial_soil_investigation_sub_ ▲ ▲ ▲ ▲
	initial_soil_investigation_subsite-Data



Add C Tech APDV: Analytical Point Data Value

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If you start with the project state at the end of the <u>Set Symbology</u> topic, we're ready to add our sample data to the scene.

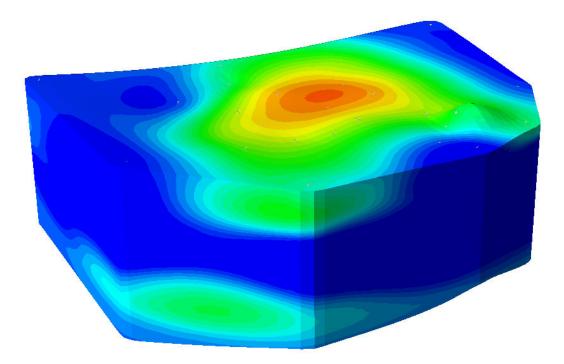
The model that we've added was created with two C Tech Data files. One for the geology (5 stratigraphic layers) and the other for Total Hydrocarbon soil contamination (TOTHC). Our apdv chemistry file format can be used for any volumetrically measured parameter where one or more measurements are taken at a point vs. over a length of a boring or well screen (in that case use our <u>aidv</u> format).

Press the Add EnterVol Data button and browse to find the file initial_soil_investigation_subsite.apdv

INETWORK	File name:	initial_soil_investigation_subsite	apdy 👻	Open
Network	•			+
Computer			21001.0000, TODU (11)	
	vickers-41-		3/30/2011 2:48 PM	EFB File
	vickers-41-	Plume3.efb	3/30/2011 2:47 PM	EFB File
Libraries	vickers-41-		2/25/2011 1:36 PM	EFB File
	vickers-41-		2/25/2011 1:35 PM	EFB File
	vickers-41.e		2/25/2011 1:29 PM	EFB File
Desktop	TCE_time_d		9/6/2007 2:20 PM	AIDV File
	,	nvestigation_subsite.apdv	3/1/2012 11:37 AM	APDV File
	vickers-tce.		2/25/2011 1:30 PM	File folde
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2	tce krig2d t	time.tcf.files	3/15/2011 12:36 PM	File folde
(Pros)	Name	*	Date modified	Туре
Look in:	chemistry		- 🔇 🤌 📂 🛄-	

We'll accept the defaults since they match the EFF data previously added:

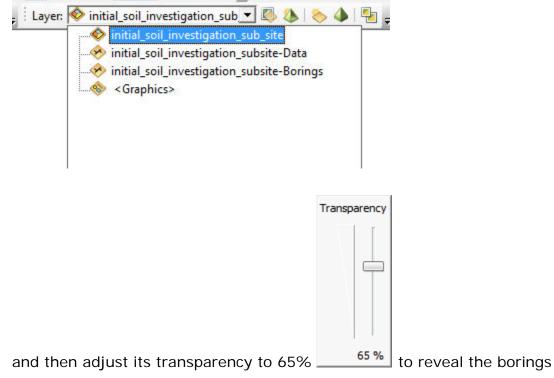
Symbology Options:	
Color By Field:	
ТОТНС	•
Coloring Method:	
Break at Even Intervals	•
Intervals per decade:	3
Capture Full Data Range:	
Lower Breaks Bound:	0.001000000474974
Upper Breaks Bound:	71,049.0329812292
Advanced	

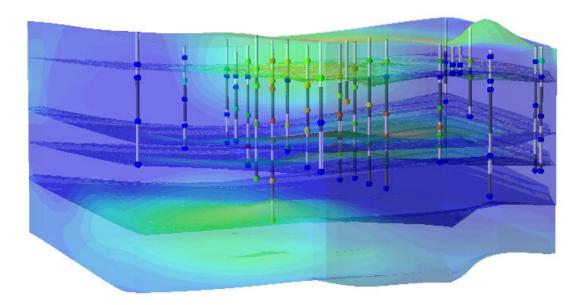


Has our data actually been added? You can see some evidence of boring peaking out of the ground surface since the tubes representing them have horizontal tops which partially extend from the non-level surface.

However, since the volumetric model is opaque, we can only see a hint of them on the surface.

From the 3D Effects toolbar select the volumetric model





Please note that the borings are actually two independent layers in your scene

Table of (Contents		×
S: 4			
			-
	<mark>e layers</mark> itial_Soil_Site Model-TOTHC		
1000	itial_soil_investigation_subsite-Data		
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1 STR	0.1000000-0.21544347		
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	21.544347-46.415888		
	46.415888-100.00000		
-	100.00000-215.44347		
	215.44347-464.15888		
	464.15888-1000.0000		
•	1000.0000-2154.4347		
•	2154.4347-4641.5888		
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State of the	46415.888-81000.000 itial_soil_investigation_subsite-Borings		
00000	all other values>		
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_	•1		

The first layer is the data represented as spheres. The second is the borings represented as lines, with a radius...making them tubes.

Add C Tech AIDV: Analytical Interval Data Value

Let's begin with a new project (scene).

Click the Add EnterVol Data button shows to find the file TCE_time_data.aidv

) Open		3.4	Trans.	X
Look in:	🍌 chemistry	8	- 🗿 🎓 📂 🛄-	
P	Name	*	Date modified	Туре
~>>	📕 tce_krig2d	_time.tcf.files	3/15/2011 12:36 PM	File folder
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	🃗 vickers-tce	e.tcf.files	2/25/2011 1:30 PM	File folder
	initial_soil_	investigation_subsite.apdv	3/1/2012 11:37 AM	APDV File
Desktop	TCE_time_	data.aidv	9/6/2007 2:20 PM	AIDV File
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6778.	vickers-41-Plume.efb vickers-41-Plume2.efb vickers-41-Plume3.efb		2/25/2011 1:35 PM	EFB File
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			3/30/2011 2:47 PM	EFB File
	vickers-41-Slice.efb		3/30/2011 2:48 PM	EFB File
Computer				
(È)	•			•
Network				
	File <u>n</u> ame:	TCE_time_data.aidv		<u>O</u> pen
	Files of type:	C Tech Data Files (*.evp;*.evm;	*.eff;*.efz;*.efb;* 💌	Cancel

In the Color By Field pull-down, select the last time listed of 10/1/01

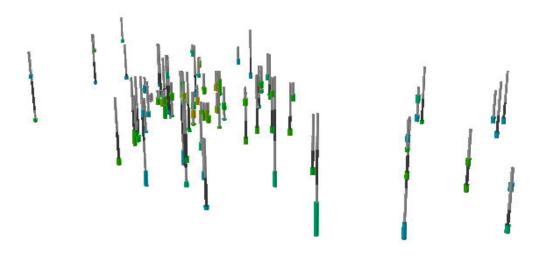
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6/1/90	-
9/1/94 11/1/94	
3/1/95	
5/1/95	
8/1/95 10/1/95	
1/1/96	
5/1/96 9/1/96	
11/1/96	
12/1/96	1.00
3/1/97 6/1/97	
9/1/97	
12/1/97 3/1/98	
6/1/98	
9/1/98	
11/1/98 5/1/99	E
10/1/99	
3/1/00	
7/1/00 11/1/00	
3/1/01	
5/1/01	
10/1/01 Boring Name	

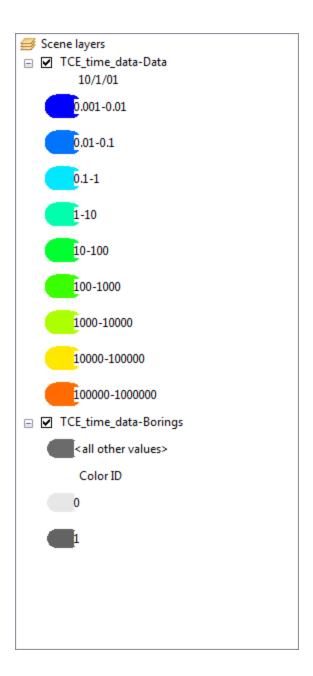
Since this data spans several orders of magnitude, let's choose the Break and Even Intevals coloring method.

•
•
1

Upon clicking OK you'll see this in your scene.



Note that there are two layers for the colored screen intervals and the borings.



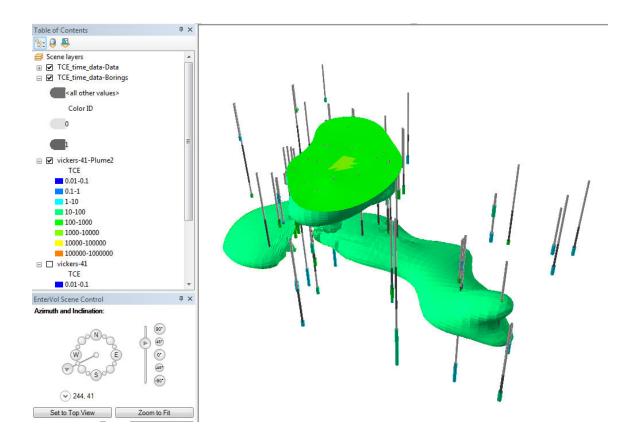
If we add the corresponding EFF

🔍 🗢 🚺 🕨 Libraries	▶ C ▶ CTech ▶ Data ▶ chemistry ▶	✓ 4y Search chemistry
Organize 👻 New fold	er	H 🕈 🔳 🤅
Favorites C library		Arrange by: Folder 🔻
퉬 Public 📃	Name	Date modified
Desktop	vickers-tce.tcf.files	2/25/2011 1:30 F
Downloads	tce_krig3d_time.tcf.files	6/23/2010 12:41
Recent Places	vickers-41.efb	2/25/2011 1:29 F
libraries	2D-Inapl.csv	10/22/2010 8:21
C C	initial_soil_investigation_subsite.csv	10/6/2010 10:37
Documents	Evergreen-nickel.csv	9/24/2010 10:09
A Music	ground-water-tce.gwc	3/5/2009 12:33 P
E Pictures	€ 100-ft-cube-0-int.awc	2/3/2009 12:24 F
File n	ame: vickers-41.efb	✓ C Tech Data Files (*.eff;*.efz;*.ef
		Open 🚽 Cancel

Select appropriate settings:

Features Classes to Import vickers-41	
Symbology Options:	1915
Color By Field:	
TCE	•
Coloring Method:	
Break at Even Intervals	•
Intervals per decade:	1
OK Cancel	

And now make a plume at 100 mg/l



Layer Description Summary

When EnterVol (or EVS) data is added, or when subsetting operations are performed, EnterVol adds a summary description of the settings which resulted in the creation of the object. This provides a substantial level of automatic documentation of your work.

The description only gets filled in when you use the EnterVol "Add Data" button or run a subsetting tool (and add the results directly).

Using ArcScene/ArcView's "Add Data" or dragging from ArcCatalog will not show the descriptions, since it's part of the "layer" in the .sxd/.mxd and not part of the feature class.

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er Properties							X
Base Heights	Time		Extrusion	Ren	dering	HTM	IL Popup
General Sour	rce Selection	Display	Symbology	Fields	Definition G	uery	Joins & Relates
Layer Name:	initial_subsite_chem_	geo-Plume_T	OTHC_Above_9.01	49	Visible		
Description:	Plume: TOTHC above Source File: D: \Devel \TestDatasets\initial Source Dataset: initia Target File: D: \Devel	lopment\CTec _subsite_chen al_subsite_che	ch\Source\Dev-Ente n_geo.efb em_geo	rVol-for-Arc		4 III +	
Credits:							
Scale Range							
You can specify th	ne range of scales at v	which this laye	er will be shown:				
Show layer at	-						
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Out beyond:	<none></none>	🚽 (minim	num scale)				
In beyond:	<none></none>	🚽 (maxir	mum scale)		52 3	L.S	
					ок	Abbrechen	Übernehme
					116		

For the example plume above the full text of the description which is added is:

Plume: TOTHC above 9.01, Shared Surfaces Removed

 $Source File: D: Development CTech Source Dev-EnterVol-for-ArcGIS TestDatasets initial_subsite_chem_geo.efb$

Source Dataset: initial_subsite_chem_geo

 $Target File: D:\Development\CTech\Source\Dev-EnterVol-for-ArcGIS\TestDatasets\initial_subsite_chem_geo-Plume8.evm$

Created: Fri, 24 May 2013 22:24:28 GMT

EnterVol for ArcGIS Version 1.8.1 - © 2013 ctech.com

Set Symbology

Set Symbology provides a simple menu to assign symbology and coloring to your objects using techniques not available in ArcGIS. However, you can set the symbology of any of the objects created in EnterVol using standard ArcGIS techniques also.

Features Classes to Import
initial_soil_investigation_sub_site 📝
Symbology Options:
Color By Field:
Geo_Layer 🔹
Coloring Method:
Unique Values 🔹
Color ramp:
 Advanced
OK Cancel

Let's change the data used for coloring

Fea	tures Classes to Import	
init	ial_soil_investigation_sub_site	1
Syn	nbology Options:	
Col	or By Field:	
	Geo_Layer 🔹	
Col	Geo Layer Material_ID TOTHC Confidence-TOTHC Uncertainty-TOTHC Elevation Layer Thickness	
	OK Cancel	

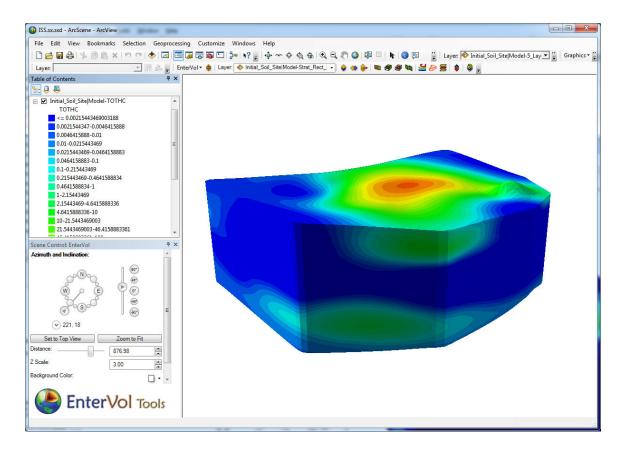
Choose TOTHC and Break at Even Intervals with 3 Intervals per decade

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Symbology Options:	
Color By Field:	
TOTHC	•
Coloring Method:	
Break at Even Intervals	•
Intervals per decade:	1
Advanced	
OK Cancel	

and press OK

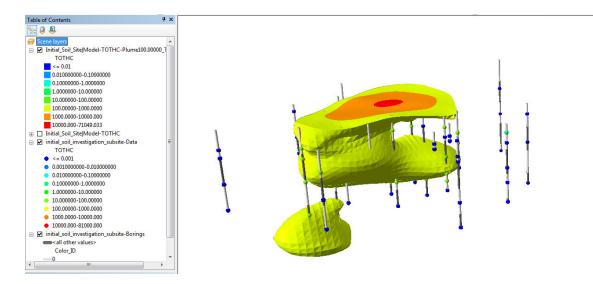
This changes how our initial feature class is colored:



Copy Symbology

When layers are not created from other layers where you would normally have the symbology copied from the input during creation, it is common that the symbology (coloring and breaks) will not be the same. When different layers in the same scene represent the same data, but do not share common symbology, your map can be confusing and even deceptive.

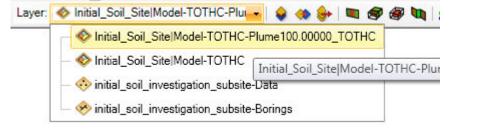
The Copy Symbology tools makes it easy to apply the symbology from one layer to another.



For this example we have a 100 ppm plume and the TOTHC points in the scene, however the minimum and maximum values are not the same.

The color blue (and all in between) have different connotations in each layer.

Start by selecting the plume



layer

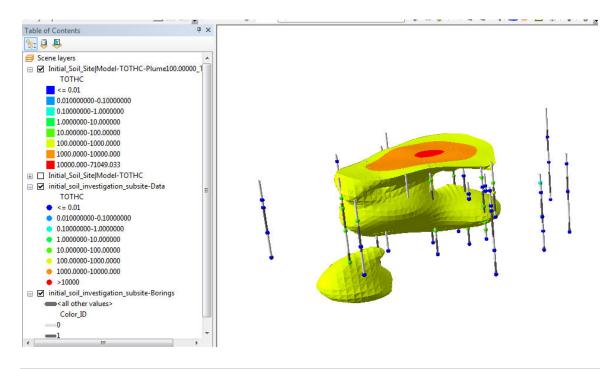
and then click on Copy Symbology

EnterVol - 💠 Layer: 🐟 Initial_Soil_Site	Model-TOTHC-Plui 🗸 💊 🐟 🐎 🛯 🖏 🛷 🖤 🗎 🈂 🔗 🧮
×	Copy Symbology

The Copy Symbology opens. For this example, we'll copy TOTHC from the plume to the data points.

🚯 Copy Symbology
Copy Symbology
Copy From:
Initial_Soil_Site Model-TOTHC- Plume100.00000_TOTHC
Сору То:
initial_soil_investigation_subsite-Data
Source Data Component:
TOTHC
Map to:
ТОТНС •
OK Cancel

when you press ok, you should see



Subsetting Tools Subsetting Tools EnterVol • 🛊 Layer: 🐟 Initial_Soil_Site|Model-Strat_ Modeling Window Scene Control

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Plume

Slice Tool

Cut Tool

Fence Cut

Layer Operations

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About



- 1. Slice
- 2. Cut
- 3. Create Plume
- 4. Create Fence Cut

If you start with the project state at the end of the <u>Set Symbology</u> topic, we're ready to apply some subsetting operations. If your Subsetting Tools buttons look faded as compared with the image above, make sure you select the object from EnterVol's Layer Selector to which you want to apply the subsetting operations.

When any subsetting operation is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

Slice

Slicing through a volume of data is a common requirement. ESRI tools offer ways to create slices through (hollow) volumes, but lack the ability to map the data within the volume onto the slice. When EnterVol slices through a volume, the data is inherently present in the internal volumetric EFF. This data is accurately mapped to the slice based on either cell attributes or nodal data.

When a slice is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

Let's begin with the scene layer created at the end of the <u>Set Symbology</u> topic and slice through the volume.



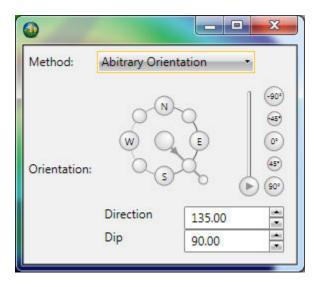
🚳 Untitled - ArcScene - ArcView <u>File Edit View Bookmarks Selection G</u>eoprocessing <u>C</u>ustomize <u>W</u>indows <u>H</u>elp 🗋 🚰 🖶 🕼 | % 🛞 🏝 🛪 | 🔊 🗠 🚸 🗔 🔲 🗊 🗊 🛜 🖸 | 🎾 | 🍕 🝃 🔅 🔷 🔶 🍓 💩 🔍 🖓 🖞 Layer: 核 Initial_Soil_Site|Model-TOTH 🛨 🍟 🗄 Graphics - 🍟 💌 🏸 🚵 🥃 EnterVol 🕶 👙 | Layer: Initial_Soil_SitelModel-TOTHC - 💊 🚸 🖢 📾 🔗 🍘 🖬 💆 🔗 🥃 🌲 🖉 🖕 Layer: Table of Contents S: 🛛 📮 Scene layers
 □ Initial_Soil_Site|Model-TOTHC
 □ тотнс <= 0.00316227766016838 0.0031622777-0.01 0.01-0.0316227766 0.0316227766-0.1 0.1-0.316227766 0.316227766-1 1-3.1622776602 3.1622776602-10 10-31.6227766017 31.6227766017-100 100-316.2277660168 316 2277660168-1000 ąх Scene Control: EnterVol 457 • 45 -90* 204, 28 Set to Top Vie Zoom to Fit Distance 934.09 0.00 Z Scale 4.00 ()) (*) ackground Color: n. * EnterVol Tools

Select the scene layer you want to slice through and click on the Slice icon

If you right-click on the grey slice, there will be four choices for how you will specify the location and orientation of the slice plane.



Slice at an Easting (X) coordinate is the first (default), but for this exercise we will choose "Arbitrary Orientation" which is the most flexible.



The arbitrary slice menu has many parameters. The initial two are the slice Direction and Dip which defines the orientation. Note that with the default Dip of 0.0 (zero), the plane direction become irrelevant (changing it will have no effect), however for any other Dip, the Direction rotates the plane through 360 degrees.

With these two angles the slice can be fully defined by providing any X-Y-Z point through which the slice passes. You specify that point by clicking with the left mouse button.

Once you do that an expanded menu allows you to refine the precise location for the slice.

You'll notice that as you adjust the Dip, Direction and Origin, a transparent gray slice will be shown in the view to display precisely where the slice will be created.

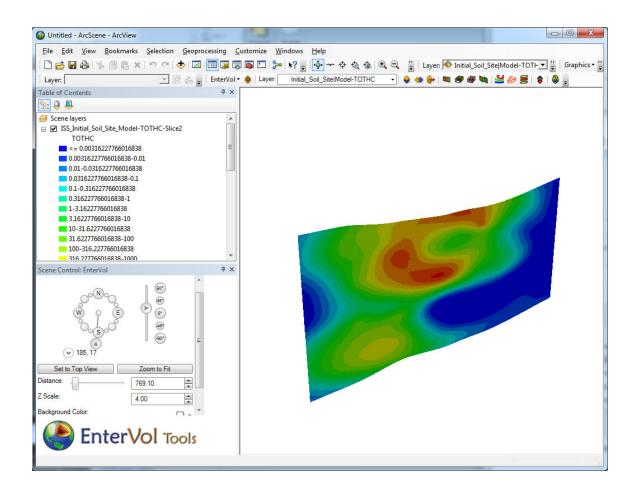
Choose the options you want such as:

- Add Output Layer:
 - If this is not checked, the EFF will be created but not added to your scene or Table of Contents.
- Hide Input Layer
 - if not checked, your slice will exist but will be inside the input layer and not visible unless the input layer is turned off or made transparent.

- Copy Symbology from Input
 - use the same coloring as the object being sliced

Below we have made some small changes and then click OK.

Slice				x
✓ Options				-
Method:		Abitrary (Orientatio	n •
Immediate Tracking:				1
Slice Location:				
			89	
Direction	144.8	2		
Dip	90.00			
Planar Origin				
X:			11,341.5	C 📥
Y:	-		12,915.8	7
Z:		-[]	3.00	(*)
> Output File: ISS_Ini	itial_Soil_S	ite		
V Display Options				
Add Output Layer				1
Hide Input Layer				1
Copy Symbology from	Input			1
	ОК Са	incel		



There are many other things we'll likely want to do. Four interesting ones would be:

- Add <u>External Edges</u>
- Add a <u>Cut</u>
- Add <u>Isolines</u>

Cut

Cutting through a volume of data is a common requirement. A cut is distinctly different than a slice, though the cutting plane is defined in an identical manner to slice planes. When you cut a volume (or any object), everything on one side of the cutting plane is "cut" away. Cutting through a volume results in a volumetric output, whereas slicing through a volume creates a slice surface.

When a cut is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

ESRI tools offer ways to cut through (hollow) volumes, but lack the ability to map the data within the volume onto the remaining portion. When EnterVol

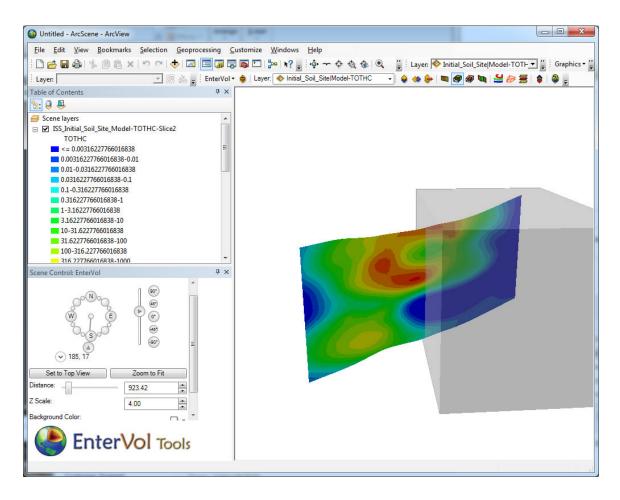
cuts through a volume, the remaining portion of the volume inherits all data present in the parent volumetric object.

Let's begin with the scene layer created at the end of the <u>slice</u> topic and add a cut through the volume.

Select the scene layer representing the original EFF and click on the Cut icon.

EnterVol - 💠 Layer: Ir	nitial_Soil_Site Model-TOTHC -] 😜		+		9	۲		2		3	۲	2	Ŧ
------------------------	--------------------------------	-----	--	---	--	---	---	--	---	--	---	---	---	---

the scene will display the cutting volume:



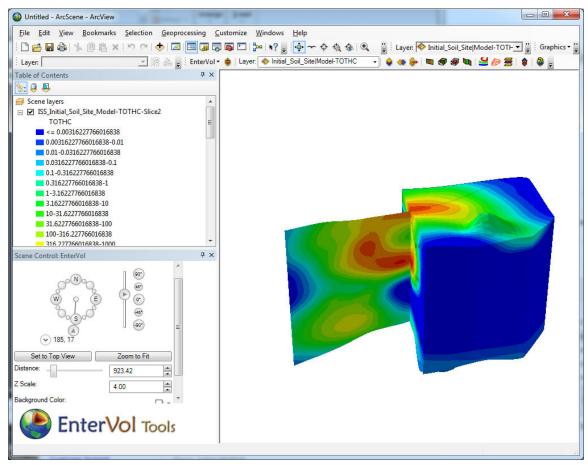
Cut has all the same options for controlling the cutting plane as <u>Slice</u>. You can right click to choose the cutting method and a left click will initially position the cut.

For this topic, we'll just use the default position of an Eastings



Cut	
✓ Options	
Method:	Eastings 🔹
Reverse Cut:	
Immediate Tracking:	
Cut Location:	11,336.32
Output File: ISS_Initial_Soil_Sit Oisplay Options	e
 Output File: ISS_Initial_Soil_Sit Display Options Add Output Layer 	e
✓ Display Options	

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Plume (volumetric subset) of Analytical Data

The display of Plume icon vs. Ore Body is dependent on your <u>Configuration</u> settings.

When a plume is created, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

Let's begin with the scene layer created at the end of the <u>Set Symbology</u> topic.

Since the object we're using has several attributes including Total Hydrocarbon Concentrations (TOTHC) which have a continuum of values ranging from 0.001 to ~100,000 (8 orders of magnitude), let's create a plume at 0.2 mg/kg.



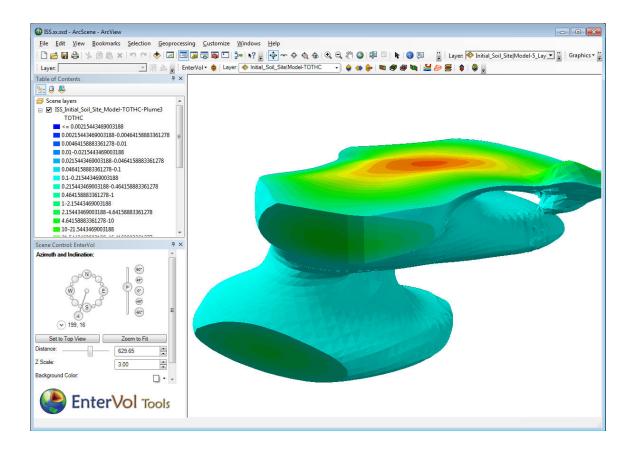
Openation of the second sec	
✓ Options]
Subsetting Component:	
ТОТНС	•
Subsetting Level:	9.01
Include Data:	Above 🔹
Remove Shared Surfaces:	
> Output File: initial_subsit	te_chem
✓ Display Options	
Add Output Layer	
Hide Input Layer	
Copy Symbology from Input	
ОК	Cancel

Choose the options you want such as:

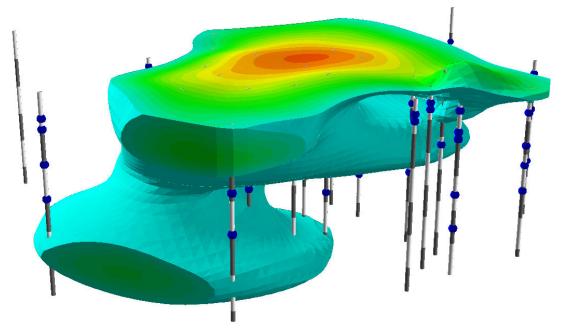
- Subsetting Component: the data used for subsetting
- Include Data: Options are *Above* or *Below*
- **Remove Shared Surfaces:** when creating plumes in models with stratigraphic layers or lithology, this option removes the internal surfaces.
- Add Output Layer: if this is not checked, the EFF representing the plume will be created but not added to your scene or Table of Contents
- **Hide Input Layer:** if not checked, your plume will exist but will be inside the input layer and not visible unless the input layer is turned off or made transparent.
- Copy Symbology from Input: use the same coloring as the input layer

By default new layers will be written to the same folder as their input layers and their name will identify the type of subsetting or display operation being performed.

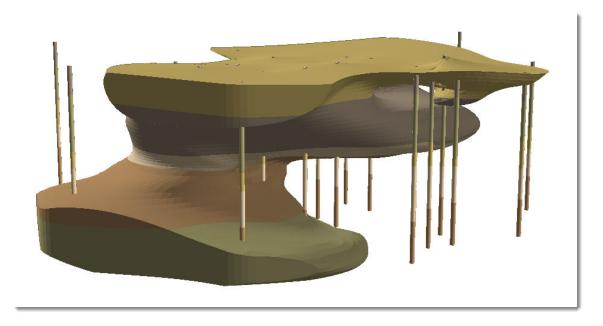
Upon pressing OK, and waiting several seconds, our initial scene layer is unselected and our plume should appear.



Adding in the analyte data and borings we have



The same plume level colored by geologic material with borings will give us: (Z Scale is 3.0)



Other examples of using the Plume tool are at the bottom of this topic.

Plume for Unique Values

The Plume tool can also be used to subset models containing unique values. This includes attributes such as:

- Material IDs
- Geologic Layers Order
- Geologic Layers Names
- Lithology Names

When a plume is created, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

Beginning with the project below, which has stratigraphic layers with analytical data:

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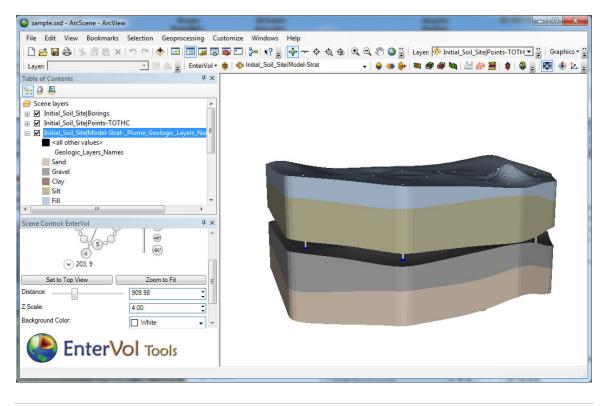
Sample.sxd - ArcScene - ArcView	-					-			- 0 ×
<u>File Edit View Bookmarks Selection Geoprocessing Customize</u>	<u>W</u> indows	<u>H</u> elp							
i 🗅 🚰 🖶 🐥 I 🧏 🖄 🛍 🔺 I א א I א 🖂 🗔 🗔 🗔 🖓 🔂 🚺	•• ▶ ? ₌	🌵 🔶 🔶	۹ 🚯 🖉	Q Q 2	۹ 🔘 🗒	Layer: 🐼 Ir	itial_Soil_Site P	oints-TOTH 💌	Graphics -
🕴 Layer: 📃 💌 🏸 🚵 🖕 🗄 EnterVol 🕶 👙 🛛 🕎 İn	itial_Soil_Sit	te Model-Strat		- 💊		۵	🐚 🐸 🔗 🕯	😸 🛊 🖓 📮	🔯 🚸 🔽 🖕
Table of Contents 4	×								
Scene layers									
□ ✓ Initial_Soil_Site Model-Strat									
<all other="" values=""></all>									
Geologic_Layers_Names									
Gravel				-					
Clay									
Silt									
Fill									
Scene Control: EnterVol 4	×								-
Azimuth and Inclination:	*						_		
O ^{ON} OQ 0	=								
wo e Pe									
(ar)									
✓ 207.24								1	
	-								
EnterVol Tools									
								_	

We can select the Plume tool and the default will show the *Geologic Layer Names*:

Subsetting Compo	nent:	
Geologic_Layer	s_Names	•
Values to Include:	Sand	
	Gravel	E
	Clay	
	Silt	-
 Output File: sa Display Option Add Output Layer 	mple2_Initial_Soil	

If we turn off Clay, which is the middle (third) layer, the resulting model will show:

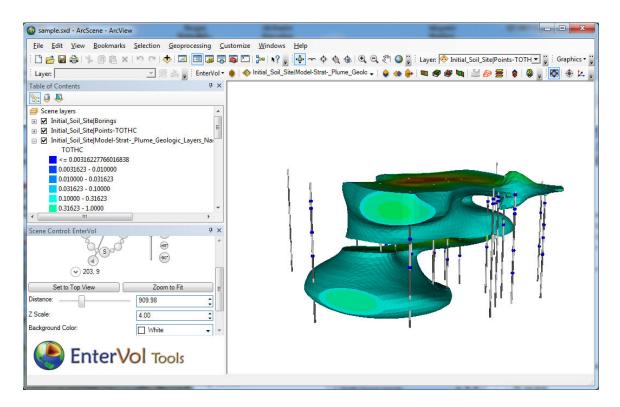
Subsetting Compor			
Geologic_Layer	s_Names		•
Values to Include:	Sar	nd	
	🔽 Gra	avel	E
	Cla	W.	
		y .	
	Silt	2	+
> Output File: sa > Display Option Add Output Layer Hide Input Layer	mple2_In		



We can then subset this layer by TOTHC to show a plume with the Clay layer absent:

Subsetting Component:		
ТОТНС		•
Subsetting Level:	.2	
Include Data:	Above	•
Add Output Layer		
Hide Input Layer		
Copy Symbology from Inp	out	

Symbology Options:	
Color By Field:	
TOTHC	•
Coloring Method:	
Break at Even Interva	ils 🔹
Intervals per decade:	2.000
Capture Full Data Range	
Lower Breaks Bound:	0.001
Upper Breaks Bound:	53,785.030
 Advanced 	



Ore Body

The Ore Body tool is nearly identical to the plume tool, except that its option are tailored to mining.

When an ore body is created, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

The display of Ore Body (vs. Plume) is dependent on your <u>Configuration</u> settings.

EnterVol • Layer: Nickel_Site_1 Model-Nickel	Create Ore Body
Ore Body • Options Subsetting Component:	
Options Subsetting Component:	
Subsetting Component:	
Nickel	
THERE	•
Subsetting Level: 291.0	00
Include Data: Above	
> Output File: Evergreen_Nickel_Sit	
✓ Display Options	
Add Output Layer	
Hide Input Layer	
Copy Symbology from Input	

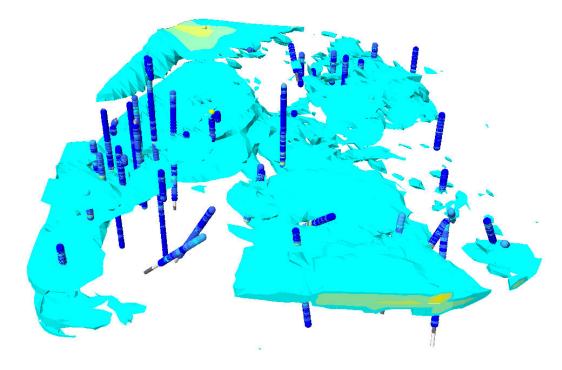
Choose the options you want such as:

- Add Output Layer:
 - If this is not checked, the feature class representing the plume will be created but not added to your scene or Table of Contents.
- Hide Input Layer

- if not checked, your plume will exist but will be inside the input layer and not visible unless the input layer is turned off or made transparent.
- Copy Symbology from Input
 - use the same coloring as the input layer

By default new layers will be written to the same folder as their input layers and their name will identify the type of subsetting or display operation being performed.

Upon pressing OK, and waiting several seconds, our initial scene layer is unselected and our plume should appear.



Create Fence Cut

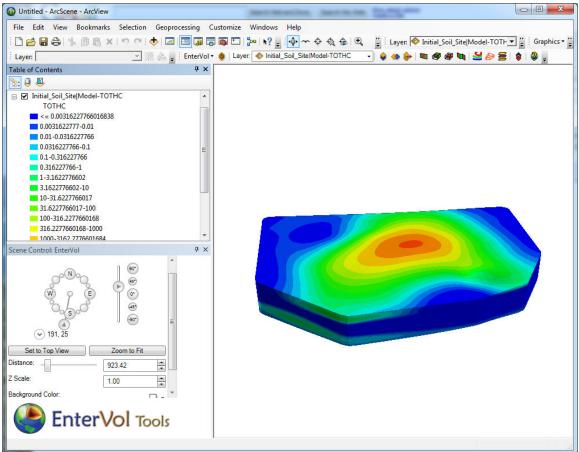
Generation of true fence diagrams cut from your 3D layers is easy with EnterVol. The process is simple:

- 1. Read, specify or draw the path for the fence
- 2. Select the layer to be used as input
- 3. Create the fence

When a fence operation is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

For the example below we will draw our fence paths in ArcScene and use ArcMap to convert the graphics object to a shapefile.

Begin with the scene from the end of the <u>Set Symbology</u> topic making sure that the topmost layer (which is the original EFF) is on.

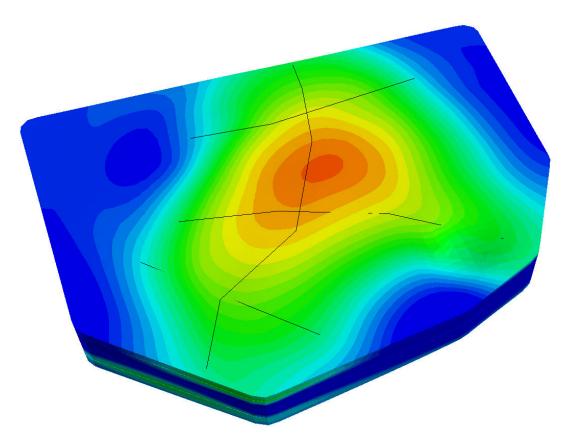


Set the Z Scale in the EnterVol Scene Control to be 1.0

Make the Graphics toolbar visible and choose the line tool.

It is best to create a new Graphics Layer. This is the only way to later control visibility of that layer other than deleting it.

Draw each segment of your fence path on the top surface of the layer, completing each segment with a left-double click.



Note that the lines look broken because they are passing through the 3D top surface as we draw points that fall in low spots. There are two options at this point:

- 1. You can use the new graphics layer to directly create the fence. This does not require the additional steps in ArcMap.
- 2. You can copy the graphics into ArcMap and save them as a shapefile. This extra step is important if you wish to straighten your fence to a 2D projection and want to use our <u>advanced axes (grid) operations</u>.

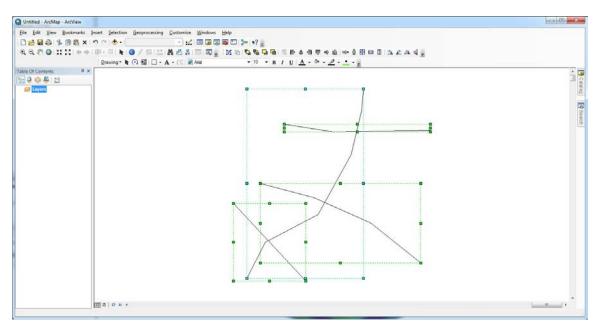
From the edit menu, choose Select All Graphics

5	Undo	Ctrl+Z			
0	Redo	Ctrl+Y			
to	Cut	Ctrl+X			
P	Сору	Ctrl+C			
陷	Paste	Ctrl+V			
×	Delete	Delete Delete			
	Copy Scene To	Clipboard			
0 0 0 0	Select All Graphics				
	Unselect All Gr	aphics			
	Zoom to Select	ted Graphics			

and then Copy (Ctrl+C)

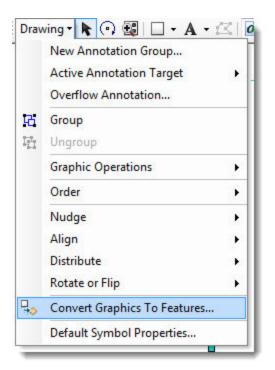
At this point we want to convert our path to a shapefile. We do this in ArcMap.

Open ArcMap with a New Blank Map. Highlight Layers and Paste (Ctrl+V) into ArcMap and from the Edit menu choose "Zoom to Selected Elements". You should see:



From the Drawing toolbar, choose "Convert Graphics to Features"

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Provide a suitable name and folder

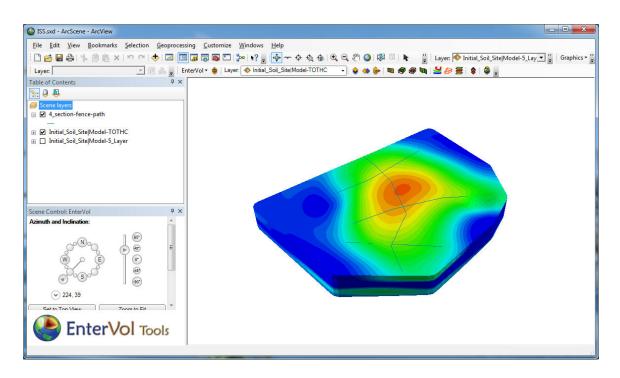
Selected graphics only (4 selected) Jse the same coordinate system as: the data frame this layer's source data: 	
this layer's source data:	
,	~
the feature dataset you export the data into (only applies if you export to a feature dataset in a geodatabase)	
Ithe annotation groups in this data frame	
Output shapefile or feature class:	
C:\CTech\Data\EnterVol Sample Project\4 section-fence-path.shp	

and click OK.

Back in ArcScene, delete the "graphics object" we just drew and click the Add Data button and add the shapefile we just created to the project.

Select the original EFF layer and click the Create Fence Cut button



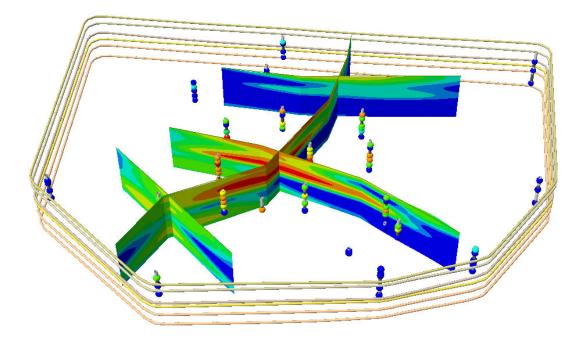


Choose the options you want such as:

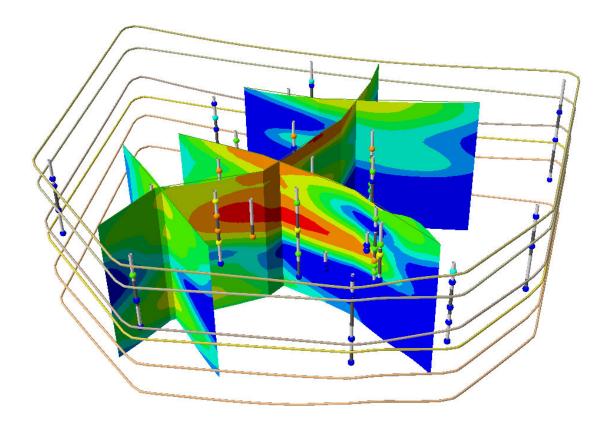
✓ Options	
Cut by:	
From Feature	•
Cut Feature:	
4_section-fence-path	•
Smooth Corners	
Flatten to 2D	
> Output File: ISS_Initial_Soil_Site	
✓ Display Options	
Add Output Layer	
Hide Input Layer	
Copy Symbology from Input	1

- Add Output Layer:
 - If this is not checked, the EFF will be created but not added to your scene or Table of Contents.
- Hide Input Layer
 - if not checked, your slice will exist but will be inside the input layer and not visible unless the input layer is turned off or made transparent.
- Copy Symbology from Input
 - use the same coloring as the object being sliced

You should see something like the view above and then choose OK. After turning on edges, the view will look like:



With Z Scale at 3.0, it is a bit easier to see details!



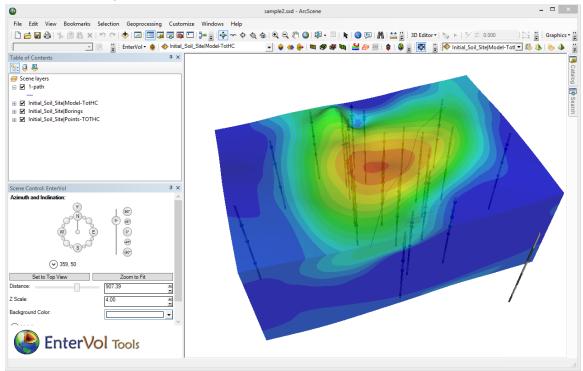
Fence Cut Flatten to 2D

When you create a fence cut with a single path, you have the option to flatten the fence to 2D, which straightens the path after creation and remaps the resulting object to either the XY, XZ or YZ plane.

Note: The path used must contain only a single fence cross section.

In the project below, we have a single path shapefile line and a 3D model of Total HC. The volumetric model is slightly transparent since the fence path falls inside its extents. Remember, the Z coordinates of fence paths are irrelevant.

When any subsetting operation is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

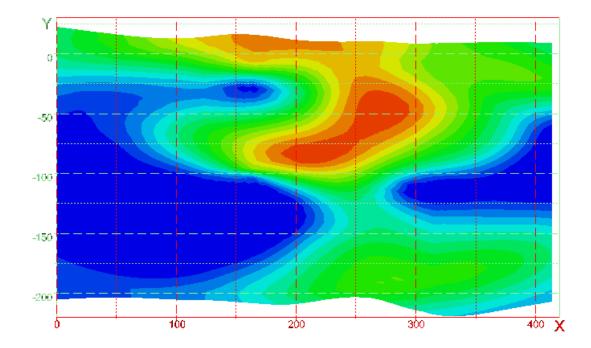


٩	FenceCut	- 🗆 🗙
✓ Options —		
Cut by:		
From Feature	e	~
Cut Feature:		
1-path		~
Smooth Corners		
Flatten to 2D		✓
Output Plane	XY	~
Z-Scale	4	
Trim Input Lines	At Model:	
> Output File:	sample2_Initial_Soil	
 V Display Optic 	ons	
Add Output Laye	er	\checkmark
Hide Input Layer		\checkmark
Copy Symbology	r from Input	✓
	OK Cancel	

The Output Plane options are:

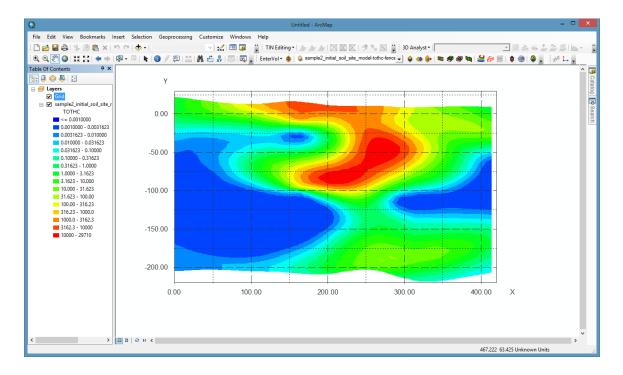
- XY is best for use with ArcMap
- XZ and YZ can be used with ArcScene or exported to EVS, however, please recognize that the coordinates of the flattened fence begin at the origin of the line (path) used to create it, which means that it will not be in the projection of the rest of your project.

Zooming to the resulting flattened fence in ArcScene with axes added will show:



However, because we created this in the XY plane with a Z-Scale of 4, the Y axes coordinates are now 4 times greater than they should be.

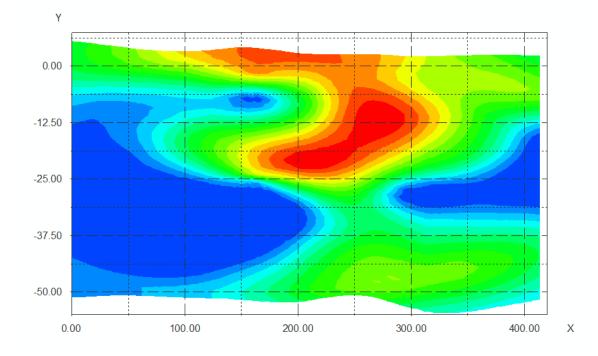
If we import the same 2D fence into ArcMap and add axes (called grid in ArcMap) we get:



However, in ArcMap, the Grid (axes) layer has an option to set Y Scale. If we change that to be 4

		Layer	Properties				×
Spatial Definition	Display Options	Axes Labeling	X Axis Options	Y Axis Options	Conversion	Gener	al
Axis Options Display: Color: Axis Scale: Title Options Name: Offset: Position:				4 Y 5.00 % Max		✓ ▼ ▼	~
Label Offset:				2.00 %			
Label Options Show Labels: Auto Place La	bels:					✓ ✓	~
			(ок с	ancel	Apply	

our axes will show correct elevations:



Another important option is "Trim lines at Model". When this toggle is off, the origin of the fence corresponds to the start of the line. The order of the points that define the line therefore makes a significant direction in the resulting fence. If the toggle is ON, the origin is determined by the line as trimmed by the model, however the order of drawing is still relevant.

Finally, our bottom (X) axis is really showing the path length, not an actual X coordinate. Under Grid.Display_Options, we can set the projection path using the same shapefile that was used to generate the fence.

		Layer	Properties				< -				Ì	3		
Spatial Definition	Display Options	Axes Labeling	X Axis Options	Y Axis Options	Conversion	General						Searc	rcGIS	
Preset Style to	Apply					^				I	_	3		×
	Axes Style			Colors										
1 ++	‡ ‡		Use Single C Color	olor				sample2_lr	nitial_Soil_S	Data\EnterVol Sample Site_Model-TotHC-F Site_Model-TotHC-S		•	21 22	
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			(OK Ca	ancel	Apply						10	0:08 AM 0:08 AM	DBF File SBN File

Be sure to turn on Display Projected X (and Y) and we'll change the Offset to 10%.

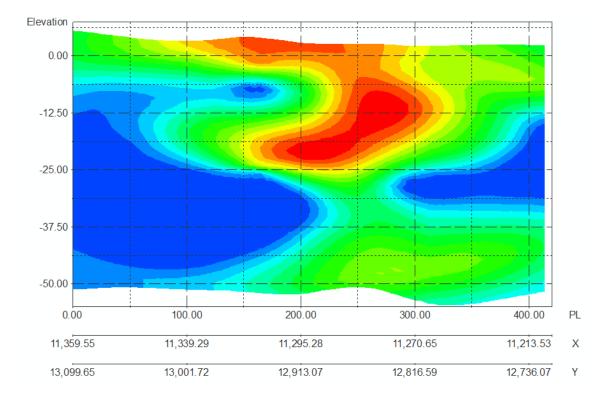
At this point there are two other interesting options. These are:

- 1. Include Ticks: which will put the X (and Y) true coordinate labels that correspond to the major axis tick distances along the path. In this case 100 feet.
- 2. Include Path Corners: This will put labels at the endpoints of each segment of the fence. If your fence was drawn from boring-to-boring, these will be your boring coordinates.

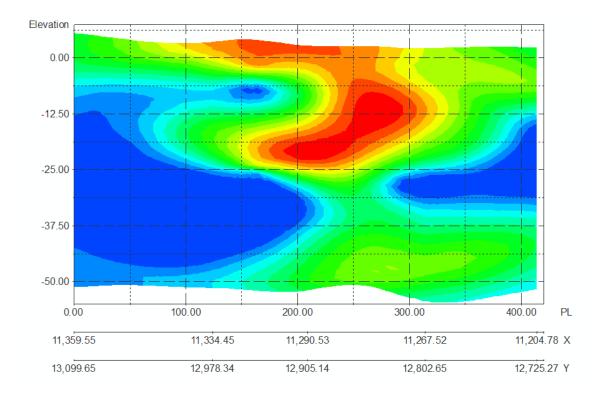
Generally you will not want both of the above options as the labels will tend to be on top of each other.

		Layer	Properties				x
Spatial Definition	Display Options	Axes Labeling	X Axis Options	Y Axis Options	Conversion	Gener	al
Projection Option Projection Path							^
Path Point Cou	nt					5	
Offset				10	0.00000 %		
Display Project	ed X:					✓	
Display Project	ted Y:					✓	
Include Ticks:						V	
Include Path C	orners:						
Box Options							
Draw Box						✓	
Draw Ticks						✓	
Box And Axes	Line Width			0		▲ ▼	~
			(ОК С	ancel	Apply	/

For the first *Include Ticks* option we get:

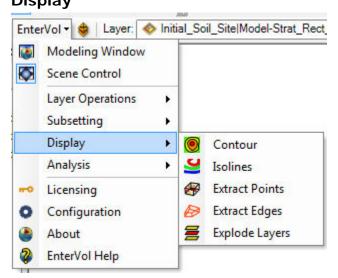


And for the second Path Corners option:



note: for the above two figures we've also edited the X and Y Axis Title Names

Display Display



The display tools consist of:

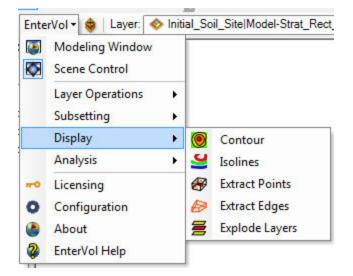
- 1. Contour
- 2. Isolines
- 3. Extract Points
- 4. Extract Edges
- 5. Explode (geologic) Layers
- 6. Set View from Direction (ArcMap only)

Contour

Smooth Contours are automatically generated whenever any subsetting operation is performed. Please note that contours are only possible because of nodal data. The "Contour" tool is accessible from the EnterVol menu:

When a contour is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

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Since contouring of all subsetting displays is automatic, the only time when the contour tool is needed is when you want to export a subsetting operation as a shapefile.

Select the scene layer representing slice output and click on the *Contour* icon.

✓ Options	
> Working File: initial_soil_inve	estigatio
✓ Display Options	
Copy Symbology from Parent	
Add Result to Map	1

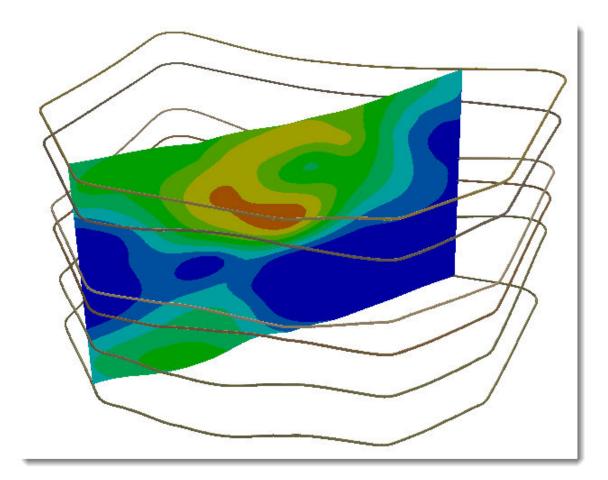
You can specify the layer to be contoured.



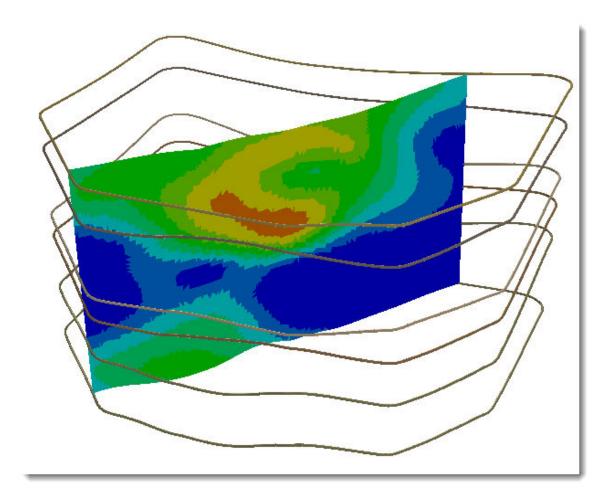
Choose the Display Options you want such as:

- Add Output Layer:
 - If this is not checked, the EFF will be created but not added to your scene or Table of Contents.
- Hide Input Layer
 - if checked your input layer will be turned off
- Copy Symbology from Input
 - use the same coloring as the object being sliced

Press OK with the default options and you should see:



Compare this to the original slice output below that would be obtained if you were to write a shapefile without contouring first.



The jagged appearance above is the result of having to color each original triangle in the slice surface a solid color. Using the nodal data inherent in the slice, more accurate boundaries between the data regions can be computed and individual triangles are divided to create the more accurate and smoother output.

Isolines

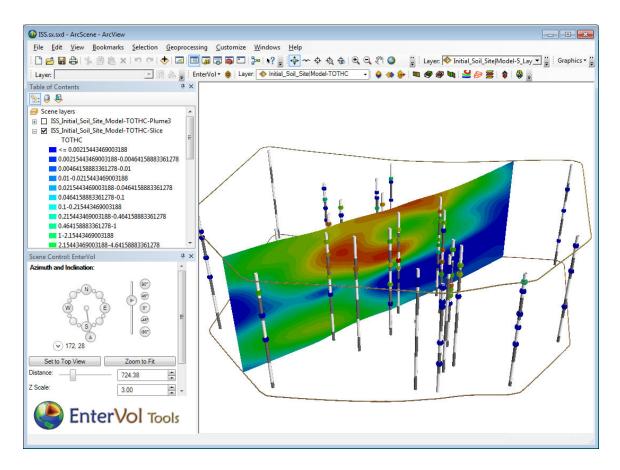
Isolines can be created on planar or complex surfaces. They require that the underlying layer have continuum data such as elevations, concentrations, etc. EnterVol determines the path of the isolines using the nodal data in order to achieve smooth and accurate contours.

When isolines are created, a summary of the data and settings used to create it is added to the Layer Properties under <u>General Description</u>.

The isolines will be generated using the symbology (data) displayed on the layer used as input. It will also inherit the same breaks. In the case below, this will be TOTHC (total Hydrocarbons) with even decade intervals.

Let's begin with the scene layer created at the end of the <u>Smooth Contours</u> topic and add isolines to our slice.

Begin by choosing the layer on which you want to apply isolines We'll choose the Contour layer,



and press the Isolines button under Display.

Note that the default options are a bit different.

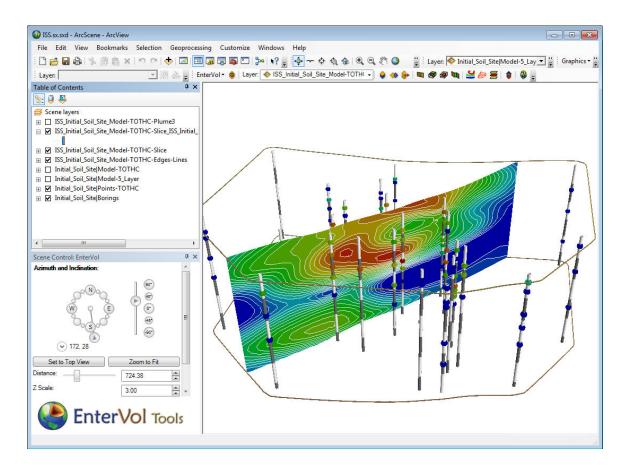
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> Working File: initial_soil_inve	stigatio
Copy Symbology from Parent	
Add Result to Map	1
Hide Parent on Completion	
Coloring Method:	
Solid Color	•
Color:	•
Advanced	
OK Cancel	

Choose the options you want such as:

- Add Output Layer:
 - If this is not checked, the EFF will be created but not added to your scene or Table of Contents.
- Hide Input Layer
 - if checked your input layer will be turned off
- Copy Symbology from Input
 - Default is off which gives a solid off-white color
 - If checked, use the same coloring as the object being sliced

By default we don't copy the Input symbology, since when our isolines are the same color as the input layer, they are difficult to see. If you want only isolines and not the source, then you might want to copy the symbology and Hide the Input Layer.



Note that the isolines are on the same breaks as our underlying surface. The isolines would be identical if we had chosen the original slice layer rather than the smooth contour layer. The reason is that both are based on the same nodal data though the cell attributes (data) are quite different.

Extract Points

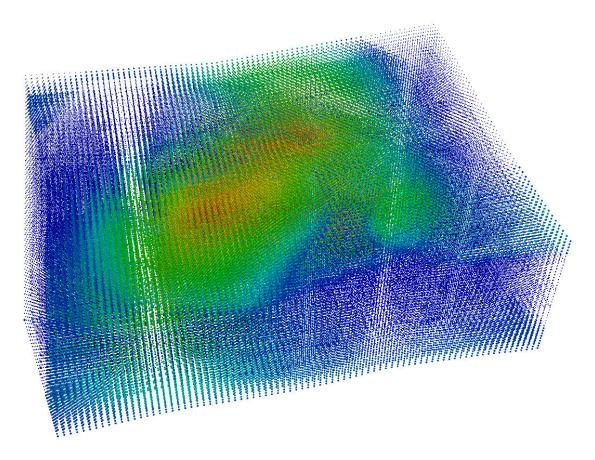
The Extract Points tool allows you to extract and display a point cloud representing:

- The Points (nodes) that define the corners of each cell.
 - When the data is cell data, such as geologic (stratigraphic) material, the data is not there and therefore the Points option will not map the symbology. In this case, use the cell centers option.
- The cell centers as points.
 - If mapping nodal data, the displayed value is the average of all of each cells corners.

When extract points is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

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 • extract-points_Options Extract Points Method: Points • Output File: sample-jr_Initial_Soil • Display Options Add Output Layer 	



Explode Layers

C Tech EFF files representing multiple geologic layers can be exploded, or separated based on the layer number (Geo_Layer) or Material IDs. This allows you to visualize the internal lithology of model and to see how analytes are distributed by geology.

When explode layers is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.

It is generally confusing to have layers visible which represent both exploded and unexploded representations of the same model in your scene. For that reason, it is often best to explode the entire model and then perform subsetting and display operations on the exploded model. Otherwise you will need to perform two operations for each output (e.g. smooth contours, fences, isolines, etc.)

For the example below, we'll begin with the scene at the end of the <u>Add C</u> <u>Tech Field</u> topic. Select the primary layer and click on the Explode Layers button



	Method:		Geologic	Hierarchy 🔹	1
Select the method to explode	Distance to Exp	olode:	Geologic Indicator		
Let's change the default explore	de distance	Distance to E	xplode:	15.00	and
set the options you want such					ana

- Add Output Layer:
 - If this is not checked, the EFF will be created but not added to your scene or Table of Contents.
- Hide Input Layer
 - if not checked, your slice will exist but will be inside the input layer and not visible unless the input layer is turned off or made transparent.
- Copy Symbology from Input
 - use the same coloring as the object being sliced

Upon clicking OK, and setting Z Scale to 5.0 your scene should show.

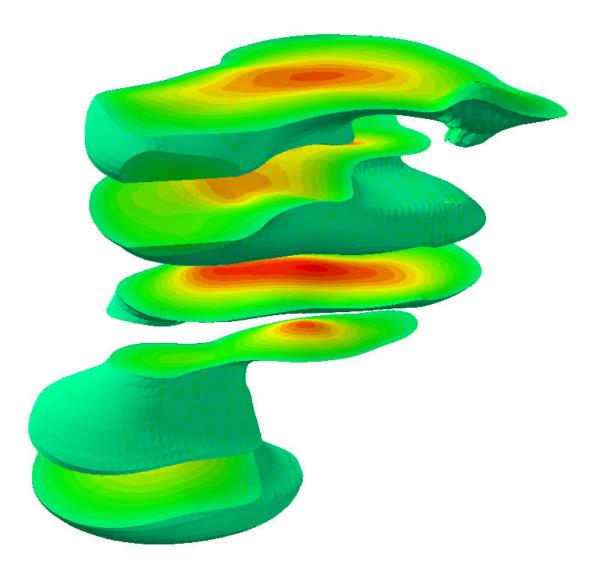


If we select the exploded layer, and create a TOTHC plume at 10.0 mg/kg

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Subsetting Level:	10.00
> Working File: initial_so	oil_investigatio
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Add Result to Map	
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Color By Field:	
TOTHC	•
Coloring Method:	
Break at Even Interva	ls 🔻
Intervals per decade:	1
Advanced	

we would have



Extract Edges

Let's begin with the scene layer created at the end of the <u>Create Fence Cut</u> topic and add the external edges of the volume.

Select the scene layer representing the original volumetric grid and click on the Extract Edges icon.

Note: When extract edges is performed, a summary of the data and settings used to create it is added to the Layer Properties under <u>General.Description</u>.



) Edges	
~ Options	
Extract Edges from:	
Feature Edges	•
Feature Angle Threshold:	60.00
Remove Shared Edges	1
Oisplay Options Add Output Layer	
Hide Input Layer	
Copy Symbology from Input	V

The following controls are available:

- Extract Edges from:
 - Boundary Edges are derived from the inherent grid rather than the topography of the grid
 - Feature Edges (Default) are derived from the topography of the grid
- *Feature Angle Threshold*: is used to determine the slope change between surface elements which results in an edge being constructed.
- *Remove Shared Edges* toggle: The edges between geologic layers which are not exploded will be removed if this toggle is on.

You can also specify the location and name of the EFF file which represents the slice will be created.

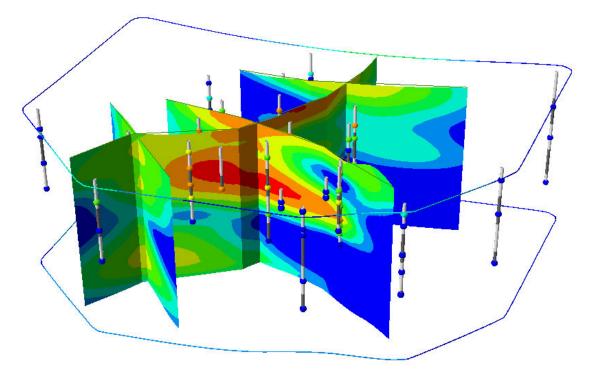
~ Wo	rtang File	e: initial_s	soil_inves	tigatio
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Choose the Display Options you want such as:

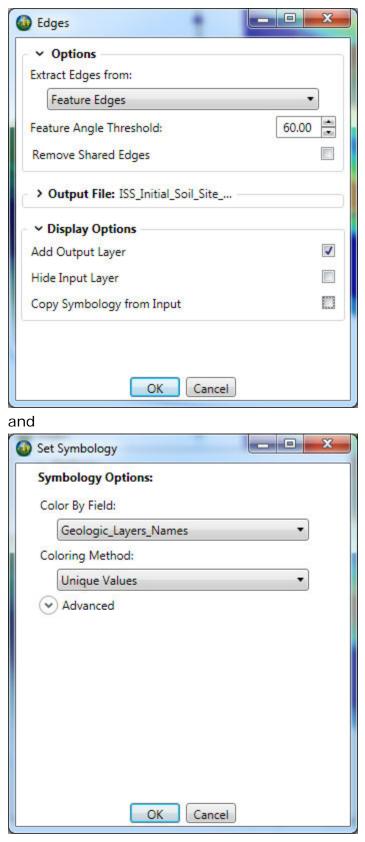
• Add Output Layer:

- If this is not checked, the EFF will be created but not added to your scene or Table of Contents.
- Hide Input Layer
 - if checked your input layer will be turned off
- Copy Symbology from Input
 - use the same coloring as the object being sliced

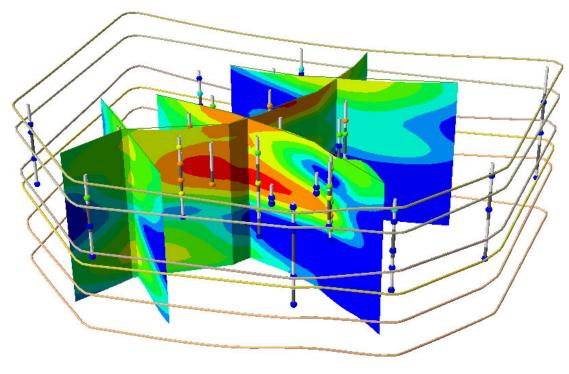
Press OK with the default options and you should see:



If we choose slightly different options we can get our geologic layer edges:



we get:



Set View from Direction



Set View from Direction applies to ArcMap only because it rotates 3D layers making them appear more three dimensional in ArcMap maps.

It sets rotations for an individual layer (EFF) for pseudo 3D display in ArcMap. Once this tool is applied, the layer is not in its true position in your map and therefore this should be used only for annotation purposes only because it rotates 3D objects making them appear more three dimensional in ArcMap maps.

To understand this, we will create a slice Easting and view it from the West.

In ArcMap, add the initial_soil_investigation_subsite.evp file with Layer Names as the symbology.

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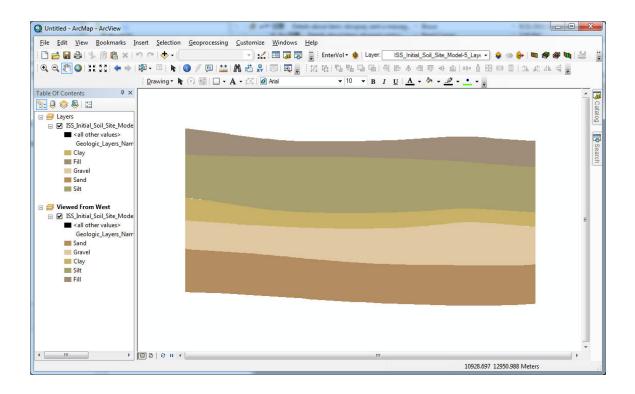
Next we'll create a Easting slice through the centroid (default location)

Slice	
✓ Options	
Method:	Eastings +
Immediate Tracking:	
Slice Location:	11,155.79
Add Output Layer	
Hide Input Layer	V
Copy Symbology from Input	
OK Cance	-]

Since this slice has no thickness and is being viewed on edge, our map appears blank (if the slice is the only selected layer).

Sele	ct the sli	ce layer a	t clio	ck
Ente	rVol 🕶 👙	Layer: 🚸 Init	ial_So	bil_SitelModel-5_Layer →
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0	Configurat	ion	₿	Extract Edges
۲	About		2	Explode Layers
2	EnterVol H	elp	۲	View From Direction
				Choose West with a Z
		Q View Fro	m Dir	
		View From:		
		West		•
		Add to Data	Fram	e:
		Viev	wed F	From West
		Z Scale:		5.00 🚔 Ok Cancel
Scale	e of 5.0			

A new data frame is created and will be active by default. This shows the slice in cross-section as below.

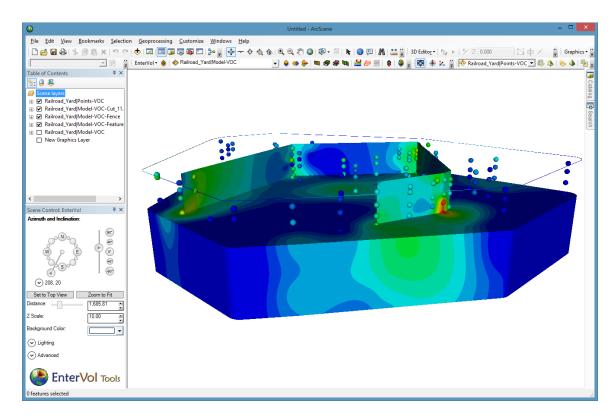


Exporting EnterVol Models

Since EnterVol models are true volumetric representations and use data associated with their nodes for more accuracy, it is desirable to keep them in EnterVol format.

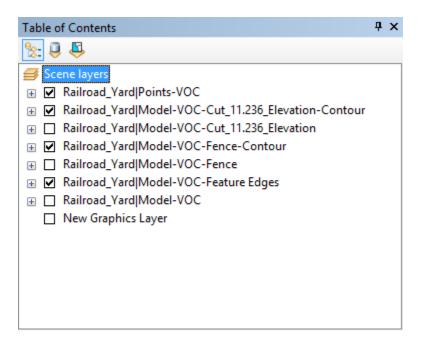
However, we recognize that users will want to export their EnterVol models for use by associates who may not have EnterVol. We make this process simple and painless.

First, make sure that any objects which are displayed with smooth contours, are <u>contoured as in this topic</u>. Even though we display all EnterVol created objects with smooth contours, unless the contour tool is used, the exported feature class will not have smooth contours. This is because the EnterVol objects are internally represented as more complex objects with multiple types of data. For export, we need to simplify them.



For our model above, we need to contour the cut and fence layers.

Note that we now have contoured layers in our TOC



At this point there are two option:

1) You can export individual layers one-at-a-time using the menu shown below:

EnterVol Ver. 1.84 Help System www.ctech.com

Image: Second system Railroad_Yard N Image: Second system Railroad_Yard N	i∰ × ₽	VOC Cut 11.225 Elevation Cont Copy Remove Refresh Scale 3D Symbols						
New Graphics L		EnterVol	•		Layer Operations	►	\$	Set Symbology
		Open Attribute Table			Subsetting	►	٠	Copy Symbology
		Joins and Relates	•		Display	•	⇔	Export to EVS
	\Diamond	Zoom To Layer			Analysis	•	9 0	Convert to Standard Feature Class
		Selection	•	Α	Label Features			Connect
Scene Control: EnterVol		Edit Features	•	φ×				Convert Converts the currently select
Azimuth and Indination	\$□	Convert Features to Graphics		^				laver to a standard feature la

2) You can Convert all EnterVol Layers to Standard Layers

Table of Conter	nts	џ	×
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 Scene ✓ Ra 	Add Data Add EnterVol Data New Group Layer Paste Layer(s) Scene Properties		
	Add Axes Add Direction Indicator		
80	Convert EnterVol Layers to Standard Layers		
	Convert Converts all EnterVol layers to standard layers		

Then select a geodatabase or create a new one:

		×
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Name:	New File Geodatabase.gdb Sa	ve
Save as type:	Catalog location v Car	icel

Once it completes, all EnterVol layers will be converted to standard (ArcGIS) layers. You can then save your project and deliver the geodatabase to anyone with ArcScene, without their needing to have EnterVol.

You can also select any folder and it outputs each layer as shapefiles in that folder.

EnterVol Tools

The EnterVol Tools are a licensed product which is included with EnterVol for ArcGIS. The primary licensed products are:

- The EnterVol Tools toolbar includes options to:
 - Label Features
 - EnterVol Raster to Volume
 - Project Features to 2D
 - Open the EnterVol Tools Scene Control window
 - Add Direction Indicator
 - Add Axes (ArcScene) & Add Grid (ArcMap)
- EnterVol Scene Control
 - Provides the ability to quickly set views using Azimuth and Inclination
 - Set Distance to layers, field of view
 - Provides enhanced lighting for true 3D objects
- EnterVol Axes
 - Labeled 3D Axes with auto or user defined extents
 - 3D Views need scale references which show distances along X, Y, & Z. Z axes are often scaled and 3D views distort objects.
- EnterVol Direction Indicator
 - 3D Arrow or Compass Rose
 - Auto or user defined extents and parameters

Without a license some products such as the Scene Control, can still be used but with limited functionality.

EnterVol Tools

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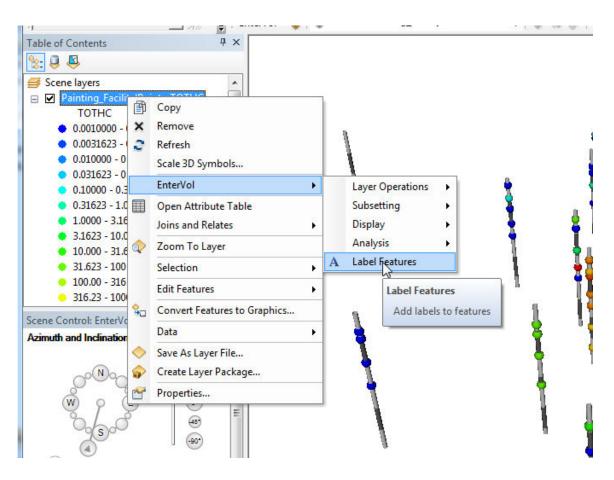
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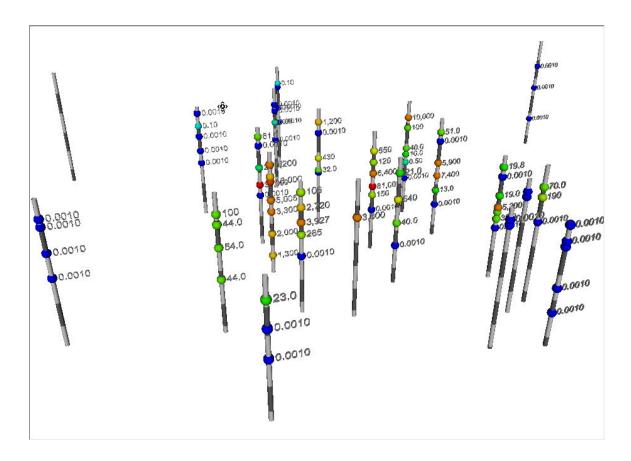
Without a license some products such as the Scene Control, can still be used but with limited functionality.

Label Features

EnterVol Tools includes the ability to place 3D labels on any feature class. Consider the example below



The default settings place 3D labels with intelligent precision on every object in the feature class.



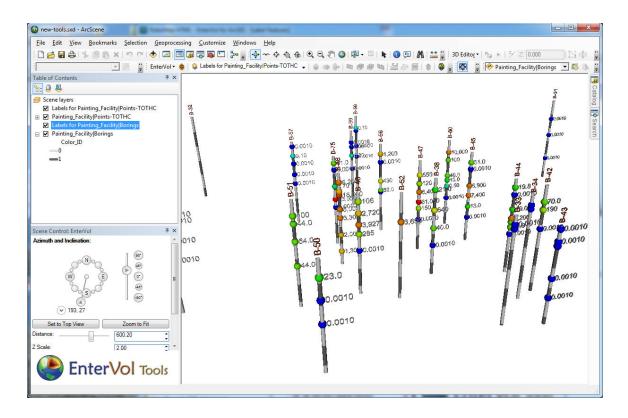
If you right click on the Labels and choose Properties, you can edit the settings:

er Prop	perties					
abels		े General B	ase Heights	Rendering		
Genera	al Options				0	
Field:						TOTHC
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						Y: 0.00
						Z: 0.00
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Axis	Rotation					
X		Angle:	0.00			
					ОК	Cancel Apply

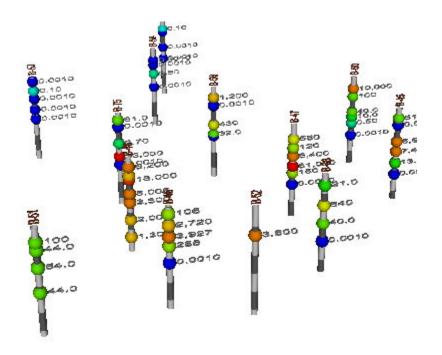
• **Offset**: determines the positioning of each label with respect to its object

- The default for point samples is about 1/2 of a sphere radius in
 (+) X
- Masking Options
 - Enable Masking turns on the ability to cull some labels
 - Masking can be Based on any attribute
 - By default, masking is *Prioritized* to favor High Values
 - The *Masking Offset Factor* determines how close labels can be to their neighbors before being masked
 - The *Max # of Labels* prevents accidentally creating huge numbers of labels on dense datasets. Remember that each label is a complex 3D object, and takes time to create and render.
- Data Options
 - Auto Precision provides intelligent display of numbers based on the number of significant figures.
 - Extra Decimal Precision adds additional decimal places
- Point Feature Label Options (applies to point features only)
 - Center positions labels relative to the center of point features
 - Radius positions labels relative to the outside surface of the sphere for point features
- FONT options include
 - Font & Size (in your project units)
 - Alignment options
 - Axis of Rotation and Angle

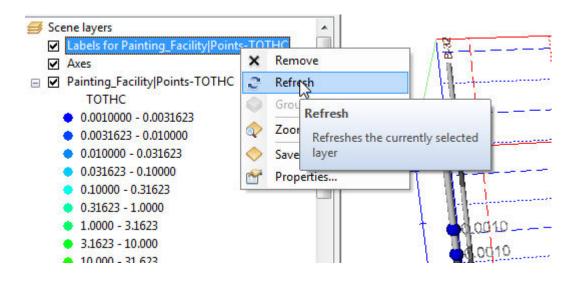
The default labeling for borings is vertical orientation and aligned with the top of each boring. The boring labels below have default options except that the color was changed to brown to make the boring labels more distinct from the Points labels.



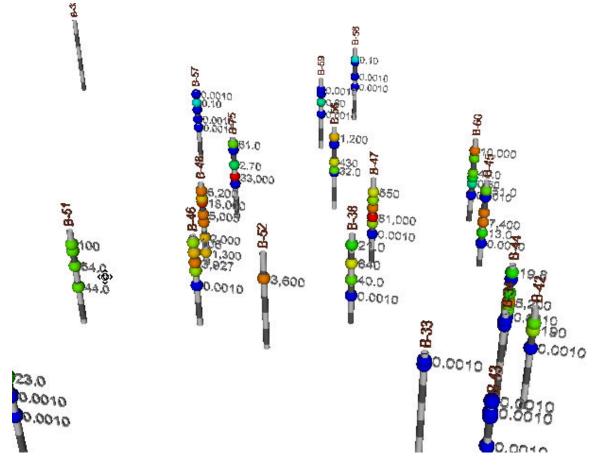
IMPORTANT NOTE: Labels, Axes and Direction Indicators are not automatically regenerated when the *Z Scale* is changed in the *EnterVol Scene Controls*. In the example above, if Z Scale is reduced to 1.0, the labels will appear highly compressed (see below)



Refreshing each label



is required to restore the proper aspect ratio for labels.



EnterVol Tools Raster to Volume

EnterVol Tools includes the ability to create closed multi-patch "volumes" from two rasters. The volume is created from any two rasters in your Scene. Please note that the "volume" created meets ESRI criteria for volumes, but is actually a closed shell which encloses a volumetric region. This is distinctly different from the true volumes created with EnterVol's Geology and GeoStats components.

The process is:

- 1. Specify which surface is TOP and which is BOTTOM. If the surfaces intersect one another the top/bottom relationship will determine which volume(s) will be created. If the surfaces do not intersect, the common areal extent will determine the extent of the volume created.
- 2. Specify the output grid resolution and interpolation parameters
- 3. Provide a name for the resultant multi-patch shapefile
- 4. Create the volume

First we'll add two rasters to our scene.

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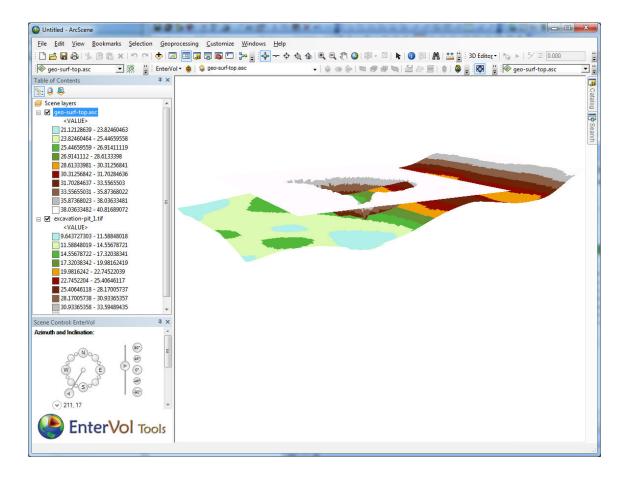
Let's adjust the symbology and base heights to better see each raster:

EnterVol Ver. 1.84 Help System www.ctech.com

eneral	Source	Extent	Display	Symbology	Base Heights	Rende	ing				
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@ No	feature-	based he	ights								
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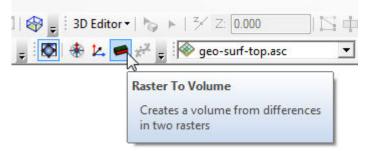
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				14.556787	21 - 17.3203834	41	14.55678722 - 17	.32038341		
				17.320383	41 - 19.981624	19	17.32038342 - 19	.98162419		
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Repeat for the other surface and



It is clear that the volume between these two surfaces depends on which one we want to be the top. We'll choose the geo_surf_top.asc

Click on the Raster to Volume



tool:

Set the surfaces and resolution:

EnterVol Ver. 1.84 Help System www.ctech.com

input		
Top Raster:	geo-surf-top.asc	•
Band:	0	\$
Bottom Raster:	excavation-pit_1.tif	•
Band:	0	\$
Options		
Resolution X:	100	\$
Resolution Y:	100	\$
interpolation:	Bilinear	•
Spatial Reference:	Unkr	nown [
Output		
Feature Class:		

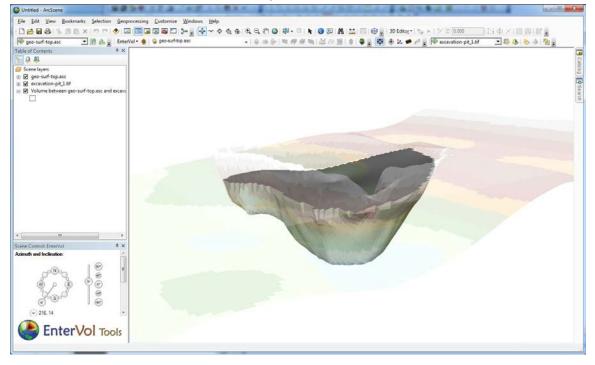
Name the output:

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Look in:	rasters	•	仓 🟠	a 🗰	- 🖴		
🗊 pit.gmf							
Name:	volume.shp					Save	
Save as type:	Feature classes				•	Cancel	

Input	
Top Raster:	geo-surf-top.asc 🔹
Band:	0
Bottom Raster:	excavation-pit_1.tif
Band:	0
Options	
Resolution X:	100
Resolution Y:	100
Interpolation:	Bilinear
Spatial Reference:	Unknown
Output	
Feature Class:	D:\CTech\Data\rasters\volume.shp

And click OK

I've made both of the rasters transparent so the volume is more obvious:



The resultant shapefile is a closed multi-patch

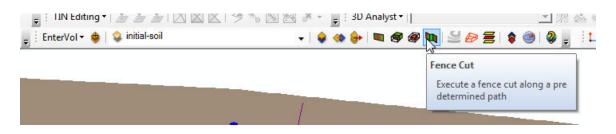
Project Features to 2D

EnterVol Tools' Project Feature tool allows you to project any line or point feature class onto a 2D fence diagram. To demonstrate this, we'll begin with an ArcMap project with a 3D geologic model, Point contaminant data and borings (from an APDV file), and a shapefile which defines the path of our fence.

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Initial_soil_investigation_subsite-Boring -Color ID Search □ Initial_soil_investigation_subsite-Data TOTHC 0 31623 - 81000 R 10 I I initial-soil Layer_Names Clay Fill Sand 1 [0] 0 10954.287 13221.639 Unkno

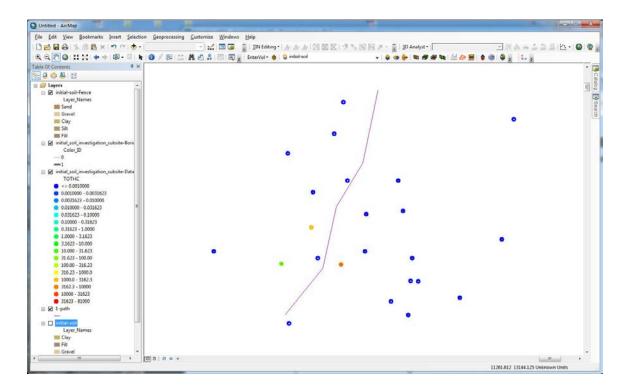
Note: The path used must contain only a single fence cross section.

First with our 3D model as the selected EnterVol object, we'll choose the Fence Cut tool to create our fence

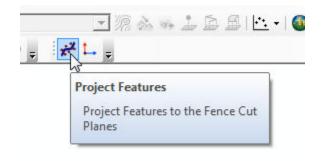


Select a Z Scale and turn on the Flatten to 2D toggle. This will reproject the fence into the X-Y plane making it far more useful in ArcMap.

Q FenceCut	
✓ Options	
Cut by:	
From Feature	•
Cut Feature:	
1-path	•
Smooth Corners	
Flatten to 2D	
Z-Scale 5.00	
Trim Input Lines At Model:	
> Output File: initial-soil-FenceCut	
✓ Display Options	
Add Output Layer	
Hide Input Layer	
Copy Symbology from Input	
OK Cance	



Our 2D fence is created, but is not in the same extents as our current view. We could create a new view, but let's project our borings and samples first. Note that because the Hide Input Layer toggle was ON, our 3D Geologic model is now not visible.



The parameters in the Feature Projection tool are:

- *Projection Path*: Select the line in your scene or view to use for the projection. Normally this is the same line that was used to create a Fence
- *Feature To Project*: Select the feature class to be projected. This can be a point (data points) or line (borings) object
- *Distance Threshold*: This is the distance from the path within which objects will be projected.
- *Condition:* The Condition setting controls which features will be projected.
 - When "Any Points in Proximity" is chosen, a feature will be included in the projected results if any of the points defining the feature are within the Distance Threshold.
 - When "All Points in Proximity" is chosen, every point defining the feature must be within the Distance Threshold for that feature to be included.
- *Clamp Projections*: When OFF, the projection path is extended along the direction determined by either the first or last line segment. When ON, points that would have been off the path are placed at the start or end of the path.
- *Flatten to 2D*: This transforms the projected data onto the X-Y plane, to make the original 3D results more useful in ArcMap.

So, when we select the Project Features tool we will want to choose the following options:

Q Feature Projection	
Projection Path:	1-path 🔹
Feature To Project:	initial_soil_investigation 💌
Distance Threshold:	4d
Condition:	All Points In Proximity
Clamp Projections:	
Flatten to 2D:	
Z-Scale:	5.00
Output:	
ОК	Cancel

Set the feature class output name:

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🔲 initial	-soil-Explode-FenceCut.evm	📑 test.evp	🖻 Laye 🖻 Path		
	-soil-Explode-Plume.evm -soil-Explode-Slice.evm	ADOTestDataset.xls AnalyteDepth_B41.xls	🖻 Path		
🗊 initial	-soil-Explode.evm	Concave Hull.shp			
	-soil-FenceCut.evm -soil-FenceCut2.evm	EPH-database.xls EVS_NAPL_Thickness.xls			
🗊 initial	-soil.efb	EVSAnalyticalResults.xls			
•	III		۲		
Name:	projected-points.shp		Save		
Save as t	/pe: Feature classes	•	Cancel		
	1				

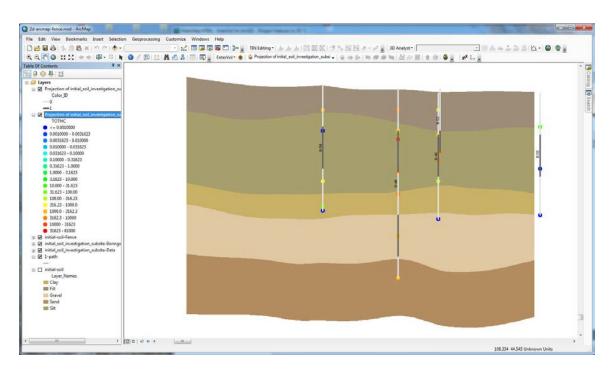
If we zoom to the 2D projected fence we will see:

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1.000 - 3.1623					
3.1623 - 10.000					
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			and the second se	and the second sec	
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And if we do the same for the borings

Q Feature Pro	jection	
Projection Path	:	1-path 🔹
Feature To Proj	ect:	initial_soil_investigation 💌
Distance Thres	hold:	40
Condition:		All Points In Proximity 🔹
Clamp Projection	ons:	
Flatten to 2D:		
Z-Scale:		5.00
Output:	D:\CTech\D	ata\EnterVol\projected-bo 📒
	ОК	Cancel

we get:



Scene Control

EnterVol's Scene Control provide a powerful new way to manipulate and monitor your three-dimensional view in ArcScene. The controls not only allow you to set your view, but provides a display of what your view represents when you manipulate the scene with your mouse.

The EnterVol Scene Control is a licensed product which is included with EnterVol for ArcGIS. Without a license, it can be used as a display of view settings, but cannot be used to set the view.

As a reference for the parameters below, a normal map view is an *Azimuth* of 180 degrees (South) and an *Inclination* of 90 degrees.

ESRI defines your view using four basic parameters which are shown in the image at the bottom of this page:

- 1. The Observer Position (x-y-z)
- 2. The Target Position (x-y-z)
- 3. Roll angle in degrees: This is equivalent to the roll of an aircraft or tilting the camera. Please note that when doing normal mouse manipulations, roll is always zero.

4. Viewfield angle in degrees : This is the field of view of the camera lens. Larger values result in "fish eye" effects, smaller values provide an effect like a telephoto lens.

From the 4 inputs above, the *Distance to Target* and *Pitch* (inclination) are determined.

However, please note that ESRI limits inclinations to not be equal to 90 degrees, so Top Views will set Inclination to 89.90 degrees. Even choosing Orthographic (2D view) in ArcScene's View Setting window will not set the observer and target x-y coordinates identical (required to achieve a true top view).

The basic EnterVol Scene Control is shown below.

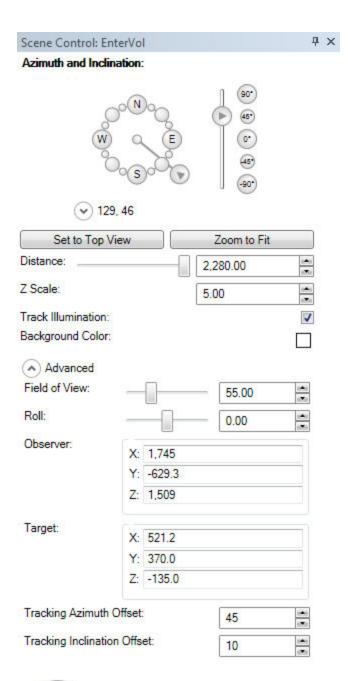
Scene Control: EnterVol		ά×
Azimuth and Inclination:		
W C E		
Set to Top View	Zoom to Fi	t)
Distance:	8,143.64	:
Z Scale:	1.00	\$
Background Color:		
✓ Lighting		
Advanced		
Enter	Vol To	ols

The controls have the following parameters:

- Azimuth dial, buttons and type-in: This sets the compass direction from which you are viewing your layers. Quick buttons are provided at 22.5 degree intervals
 - The Azimuth and Inclination type-ins are not visible by default and are accessed by pressing the v button.
- Inclination (vertical) slider, buttons and type-in: This sets the inclination of your view. 90 degrees (89.9) is looking straight down and

zero is a horizontal view. Quick buttons are provided at 45 degree intervals

- The Set to Top View button performs several simultaneous functions.
 - It sets your Azimuth and Inclination to 180,89.9.
 - It resets the view to show all active layers (zoom to fit)
- The Zoom to Fit button resets the view to show all active layers
- *Distance* provides a means to zoom.
- *Z Scale* allows you to control the Vertical Exaggeration which would otherwise be set in ArcScene's Scene Properties.
- The *Lighting* button opens up additional controls. Our tracking headlight ensures that you can see features on all sides of 3D objects.
 - Lighting Mode (EnterVol Headlight or ArcScene Default). The EnterVol Headlight is fixed with respect to the observer...the light follows the camera and is fixed with respect to your eye (not like a sun).
 - Headlight Intensity
- *Background Color* is the same control found in ArcScene's Scene Properties.
- The Advanced button opens up additional controls which are discussed above and are identical to those found in ArcScene's View Setting window.





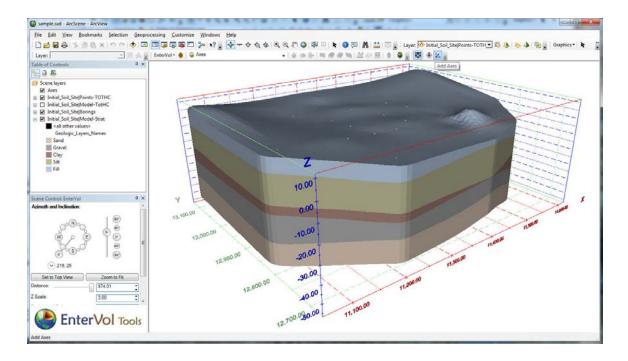
EnterVol Ver. 1.84 Help System www.ctech.com

oplie	s to: Main Vie	wer	-
	tions		
	Observer		Target
X:	11336.28	X :	11336.28
Y:	12882.78	Y:	12900.73
Z:	917.04	Z:	-111.25
		8.45	Apply
/iew Proji	ing characteristics ection: Perspective	R	oll angle and pitch:
View Proje	ing characteristics ection:	R	

Axes

The Add Axes button will add axes which serve as a scale reference in all three directions (X, Y & Z)

In ArcMap, this same button creates 2D Grid (axes). The relevant unique settings are discussed in the <u>Fence Cut Flatten to 2D</u> topic.



The image above shows the default axes that are obtained by clicking the Add Axes button.

If you right-click on Axes in the Scene Layers and choose properties, the following window will open. There are many options associated with Axes which are accessed through the 6 (non-ArcScene) tabs:

1. Spatial

Y Axis Option	ns i	Z Axis Options	General	Base He	ights	Rendering
Spatial Defi	nition	Display Opti	ons Av	es Labeling		X Axis Options
Extents		x	Y			Z
Axis Min	11,050.00	^	12,670.00		57.00	2
Axis Max	11,620.00		13,130.00		12.00	
AXIS Max	11,020.00		13,130.00		12.00	
			Select Ext	tents		
Offset	0.00					
Round		1				
Center						
Set Origin						
Axis Origin	11,050.00		12,670.00	-	57.00	
Set To		x	Min	C) Max	
		Y	Min	C	Max	
		Z	Min	C) Max	
nterval Set Intervals		[77]				
Spacing	100.00	Pinel	100.00		10.00	
	11,100.00		12,700.00		50.00	
Label Offset			12,700.00		00.00	
Max Intervals	100	:				
Subdivisions	2	:				

- 1. The *Extents* of your entire scene are automatically determined, but may be overridden.
- 2. You can add an offset to make the axes extents larger than the layers in your scene
- 3. The *Round* toggle uses intelligent rounding of the coordinates
- 4. The CENTER options allow you to specify where the axes labels occur. This can be the Min or Max of X, Y & Z
- 5. The INTERVAL options provide control over the labeling spacing

2. Display

Y Axis Options	Z Axis Options	General	Ba	ase Heights	Rendering
Spatial Definition	Display Options	Axe	es Labeli	ing	X Axis Options
Preset Style to Apply					
	Axes Style			Colo	rs
\wedge			Use Co	olor Per Axis	
			X	Red	•
		1	Y	LightGre	en 🔹
	V N		Ζ	Blue	•
	🔲 Make Def	ault For Future	Axes		
Box Options					
Draw Box					1
Draw Ticks					v
Box And Axes Line Wi	dth			1	\$
Draw XY Grid				Min	•
Draw XZ Grid				Max	•
Draw YZ Grid				Max	+
Major Options		Minor Op	ptions		
Display		Display			V
Gridline Style Das	hed 🔹	Gridline	Style	Dotted	•
Line Width 1	:		ith	1	:

- 1. *Axes Style* gives you access to three preset Styles. These can be later customized
- 2. *Colors* provides control over whether each axis is a unique color
- 3. *Box Options* determine whether the 8 edged box is fully drawn and whether grids are drawn or certain planes
- 4. *Major and Minor Options* determine the line width and line style

3. Axes

r Properties				?
Y Axis Options	Z Axis Options	General	Base Height	s Rendering
Spatial Definition	Display Options	s Ax	es Labeling	X Axis Options
Title Options				
Height:			1.50 %	
_				
Tick Options				
Label Height:			1.00 %	
Label Precision:			2	\$
Tick Size:			0.40 %	
			0.40 %	
Label Options				
Auto Place Labels:				X
Axes Font:			Arial	•
Font Depth:			12.00 %	
Axes Origin:				
		00000		0000
X 0.00000	Y 0.0	0000	Z 0.0	0000

- 1. Title Options
 - 1. *Height* is the height of all axes titles are displayed in percent and are proportional to the X-Y-Z extent of all layers in your scene
- 2. Tick Options
 - 1. *Label Height* is the height of the coordinate labels are displayed in percent and are proportional to the X-Y-Z extent of all layers in your scene
 - 2. *Precision* determines the number of decimal points displayed
 - 3. *Tick Length* is length of ticks are displayed in percent and are proportional to the X-Y-Z extent of all layers in your scene
- 3. Label Options

- 1. *Auto Place Labels* is on by default and sets the positioning of labels for you in an intelligent manner. Turn it off to have full control over label placement.
- 2. Axes Font sets the font used for all titles and coordinates
- 3. *Font Depth* is the extrusion depth as a percentage of label height.
- 4. Axes Origin provides X, Y & Z offsets to the coordinates displayed.

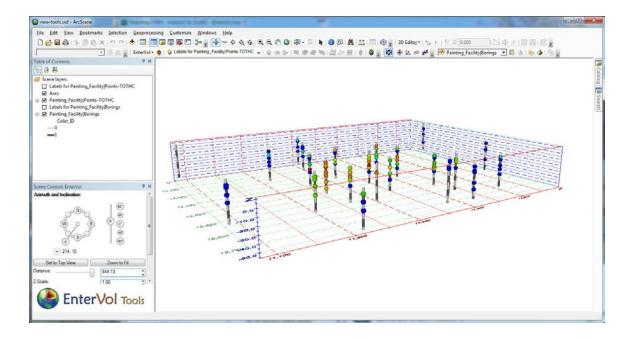
4. X, Y & Z Axis Ontions

Y Axis Options	Z Axis Options	General	Base Heights	Rendering
Spatial Definition	Display Options	s Axe	s Labeling	X Axis Options
Axis Options				
Display:				v
Color:			Red	•
Title Options				
Name:			×	
Offset:			X 10.00 %	
			Y 2.00 %	
			Z 2.00 %	
Position:			Max	•
Tick Options				
Label Offset:			X 0.00 %	
			Y 2.00 %	
			Z 2.00 %	
Label Options				
Show Labels:				v
Auto Place Labels:				1
Unique Label Color:	10.00			
Justification	Vertical A		Front/Back A	lignment
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Orientation Plane	Align	ment		
XY XZ	YZ	C A B C		
Axis Rotation			Label Color	
XYZ	Angle: 0.00	1	Red	•

- 1. The options for all three axes are identical. The
- 2. Axis Options
 - Display is a toggle whether to display this axis
 Color sets the color for this axis

- 3. Title Options
 - 1. *Name* is the string to display for this axis (e.g. X or Eastings)
 - 2. Offset provides X, Y & Z offsets for the placement of the axis title. These can be positive or negative and are displayed in percent and are proportional to the X-Y-Z extent of all layers in your scene
- 4. Tick Options
 - Offset provides X, Y & Z offsets for the placement of the axis tick labels. These can be positive or negative and are displayed in percent and are proportional to the X-Y-Z extent of all layers in your scene
- 5. Label Options
 - 1. Show Labels determines if labels are on.
 - 2. *Auto Place Labels* is on by default and sets the positioning of labels for you in an intelligent manner. Turn it off to have full control over label placement.
 - 3. *Unique Label Color* allows you to set the label color different than the axes color.
 - 4. Justification determines the Left-Right justification
 - 5. Vertical Alignment determines the Up-Down justification
 - 6. *Front/Back Alignment* determines the justification in the extrusion direction
 - 7. *Orientation Plane* determines in which plane the labels are drawn
 - 8. *Axis Rotation* and *Angle* determine the rotation of the labels in their plane
 - 9. Label Color is disabled unless unique label color is on

IMPORTANT NOTE: Labels, Axes and Direction Indicators are not automatically regenerated when the *Z Scale* is changed in the *EnterVol Scene Controls.* In the example above, if Z Scale is reduced to 1.0, the labels will appear highly compressed (see below)



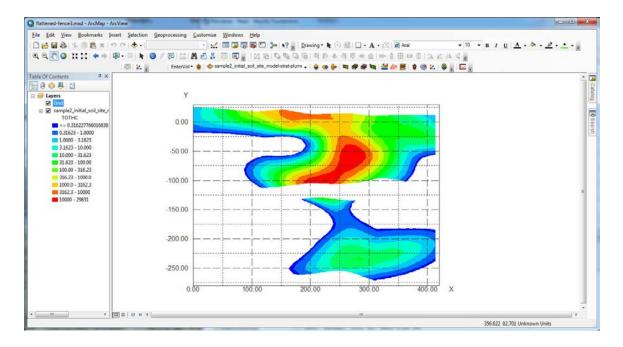
Refreshing the axes is required to restore the proper aspect ratio for labels.

1

Grid for ArcMap

Ę Add Grid In ArcMap, the Add Grid button creates 2D Grid (axes). An example using it was discussed in the Fence Cut Flatten to 2D topic.

In general, the path used should contain only a single fence cross section.



The image above shows the default axes that are obtained by clicking the *Add Grid* button.

If you right-click on Grid in the Map Layers and choose properties, the following window will open. There are many options associated with Grid which are accessed through the 5 (non-ArcMap) tabs:

1. Spatial

Spatial Definition	Display Options	Axes Labeling	X Axis Options	Y Axis Options	General	
Extents		X	S	Y	(6)()	
Axis Min	0.00	^	-280.	1		
AXIS MIIN	0.00		-200.	00		
Axis Max	420.00		30.00)		
			Select Extents			
Offset	0.00					
Round			V			
Center						
Set Origin						
Axis Origin	0.00		-280.	00		
Draw Labels at		x	OYN	1in	O Y Max	
		Y	O X N	1in	X Max	
Interval						
Set Intervals						
Constant	100.00		50.00	1		*

- 1. The *Extents* of your entire scene are automatically determined, but may be overridden.
- 2. You can add an offset to make the axes extents larger than the layers in your scene
- 3. The *Round* toggle uses intelligent rounding of the coordinates
- 4. The CENTER options allow you to specify where the axes labels occur. This can be the Min or Max of X & Y
- 5. The INTERVAL options provide control over the labeling spacing

2. Display Options

ptions	Layer	Properties			×
Spatial Definition Display Options	Axes Labeling	X Axis Options	Y Axis Options	Conversion	General
Axes Style			Colors		
4 4		Use Single Co	olor		~
	Make Defau	Color Ilt For Future Axe	s		
Projection Options					
Projection Path					
Path Point Count					-
Offset			10	.00000 %	
Display Projected X:					
Display Projected Y:					
Include Ticks:					
Include Path Corners:					\checkmark
Box Options					
Draw Box					✓
Draw Ticks					✓
Box And Axes Line Width			0		▲ ▼
Text Options					
Scale Text With Map					
Major Options		- Minor Option	s		
Display	\checkmark	Display			✓
Gridline Style Dashed	¥	Gridline Style	Dotted		¥
Line Width 0	▲	Line Width	0		▲ ▼ ∨
		C	K Ca	ancel	Apply

- 1. *Axes Style* gives you access to two preset Styles. These can be later customized
- 2. *Colors* provides control over whether each axis is a unique color

- 3. Projections Options provides control to import a projection path and labels the grid based on the original X and Y coordinates instead of just the path length. An example of using this is shown in <u>this topic</u>.
- 4. *Box Options* determine whether the 4 edged box is fully drawn and whether a grid is drawn
- 5. *Major and Minor Options* determine the line width and line style

3. Axes

Layer Properties	_				? ×
Spatial Definition	Display Options	Axes Labeling	X Axis Options	Y Axis Options	General
Title Options -					
Size:				12	
Tick Options					
Label Height:				12	
Precision:				2	\$
Tick Length:				0.20 %	
Label Options					
Auto Place La	abels:				V
Font:				Arial	•
Style:				В	I U ST
Axis Origin:					
,	X 0.00000			Y 0.00000	
				ОК Са	ancel Apply

- 1. Title Options
 - 1. Size is the height of all axes titles are displayed in percent and are proportional to the X-Y extent of all layers in your map
- 2. Tick Options
 - 1. *Label Height* is the height of the coordinate labels are displayed in percent and are proportional to the X-Y extent of all layers in your map
 - 2. *Precision* determines the number of decimal points displayed
 - 3. *Tick Length* is length of ticks are displayed in percent and are proportional to the X-Y extent of all layers in your scene
- 3. Label Options

- 1. *Auto Place Labels* is on by default and sets the positioning of labels for you in an intelligent manner. Turn it off to have full control over label placement.
- 2. Font sets the font used for all titles and coordinates
- 3. Axes Origin provides X & Y offsets to the coordinates displayed.
- 4. X & Y Axis

Spatial Definition	Display Options	Axes Labeling	X Axis Options	Y Axis Options Gen	eral
Axis Options					
Display:					V
Color:				Black	•
Axis Scale:				1.00	
Title Options					=
Name:				X	
Offset:				5.00 %	
Position:				Max	•
Tick Options				84 <u>-</u>	
Label Offset:				2.00 %	
Label Options					
Show Labels:	La La				
Auto Place La					
Unique Label Justification	n	Vertical Alig	Concernence of the second s	Label Color	
			0D0 enter Bottorr	Black	-
Rotation					
Angle:	0.00				
					·

- 1. The options for both X & Y axes are identical. The X Axis is shown above
- 2. Axis Options
 - 1. *Display* is a toggle whether to display this axis
 - 2. Color sets the color for this axis
 - 3. *Axis Scale* is an important and unique feature in EnterVol Tool's Grid. It allows you to apply a scale factor to the labeled coordinates for either axis. For maps representing

something other than X-Y Spatial coordinates, this is often critically important.

- 3. Title Options
 - 1. *Name* is the string to display for this axis (e.g. X or Eastings)
 - 2. Offset provides X & Y offsets for the placement of the axis title. These can be positive or negative and are displayed in percent and are proportional to the X-Y extent of all layers in your scene
 - 3. *Position* is the where the axis title will be placed. Options are Min and Max
- 4. Tick Options
 - 1. *Label Offset* provides X & Y offsets for the placement of the axis tick labels. These can be positive or negative and are displayed in percent and are proportional to the X-Y extent of all layers in your scene
- 5. Label Options
 - 1. Show Labels determines if labels are on.
 - 2. Auto Place Labels is on by default and sets the positioning of labels for you in an intelligent manner. Turn it off to have full control over label placement.
 - 3. *Unique Label Color* allows you to set the label color different than the axes color.
 - 4. Justification determines the Left-Right justification
 - 5. Vertical Alignment determines the Up-Down justification
 - 6. Label Color is disabled unless unique label color is on
 - 7. *RotationAngle* determine the rotation of the labels in the X-Y plane

Add Direction Indicator

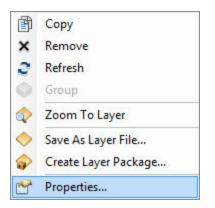
EnterVol's Tools includes the ability to add a "North" Direction Indicator

EnterVol • 🚸 Layer: 🚸 CoastallModel-VOC		- ♦ ↔ ♦ ■ ❷ ❷ ₩ ≦ ❷ ≣ ♣ \$ 9 ;
	ч х	Add Direction Indicator

As soon as you press the button, it adds a "North" scene layer to the Table of Contents.

To modify the position and properties of the indicator, right click on the North layer and choose Properties.

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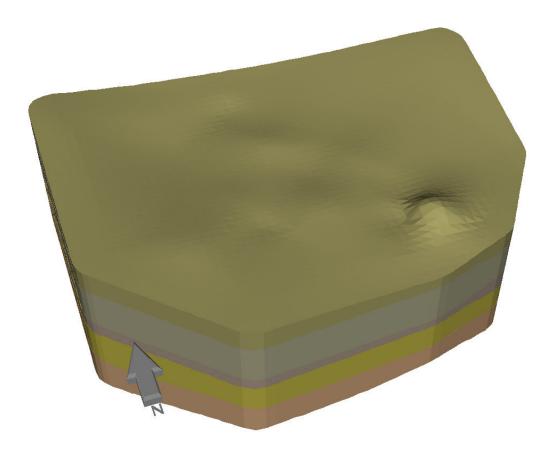
In the Properties window you'll find Direction Indicator Settings:

eneral	Base Height	ts Rendering	Direction Indicator	Settings	
🗸 Туре					
Nort	h		C) Compass	
🗸 Туре	Specific Op	otions			
Bevel:	1	0.00			:
Stem V	Vidth: 0	.40			:
Stem L	ength: 0).70			:
Triang	e Base: 0	.80			:
> Disp	lay Options				
SS - 152	Options				

Here you can choose between a North Arrow or Compass Rose indicator and set the size, aspect, and position of the indicator.

As you make changes, you can click *Apply* and it will update the indicator and view.

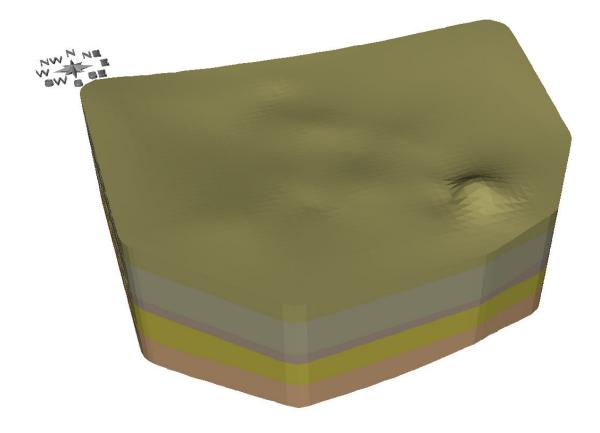
ieneral Base H	eights F	endering	Direction Ind	icator Setting	S		
🗸 Туре							
North				Com	pass		
✓ Type Specif	c Options	-					
Bevel:	10.00						\$
Stem Width:	0.40						:
Stem Length:	0.70						\$
Triangle Base:	0.80						÷
✓ Display Opti	ons						
Center X:	-						11089.322
Center Y:							12678.724
Center Z:	-						4.5714618
Size:							42.93 🛟
Height Factor:							0.25 🛟
Scene Z-Scale:							3.00 💲
> Label Option	IS						
					ОК	Cancel	Apply



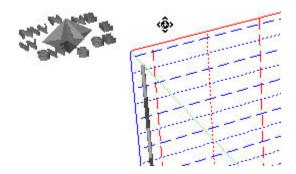
or

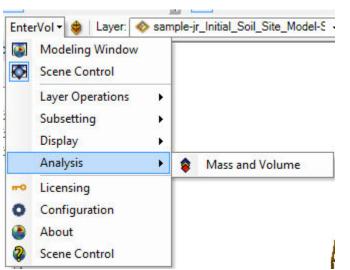
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yer Properties						8 X
General Base Height	s Rendering	Direction Indicate	or Settings			
✓ Type ○ North			Compass			
✓ Type Specific Op	tions					
North Length:	1.00					:
Sub Card Length:	0.50					:
Inner Radius:	0.35					:
✓ Display Options	_					
Center X: -						11055.752
Center Y: -						13135.832
Center Z: -						12.792969
Size:						50 🌻
Height Factor:						0.25 🛟
Scene Z-Scale:						3.00 🛟
> Label Options						
1997 - 1997 Te						
						()
			C	ж	Cancel	Apply



IMPORTANT NOTE: Labels, Axes and Direction Indicators are not automatically regenerated when the *Z Scale* is changed in the *EnterVol Scene Controls.* In the example above, if Z Scale is changed, the labels and indicator can appear highly distorted. Refresh the North layer to regenerate the indicator for the new Z Scale.





Mass and Volume for Environmental Sciences

In EnterVol, volumetric analysis is far more than determining the volume of space bounded by surfaces. Since everything we do is truly volumetric with data throughout the volumes, it is possible to compute many important characteristics of your models. This includes plume volume, chemical volume (if distilled or concentrated), soil mass, chemical mass, center of gravity and values (\$) associated with both volumes and masses. All calculations are performed for the entire layer and each geologic unit within it.

Let's begin by creating a plume at 100 mg/kg for the TOTHC scene at the end of the <u>Set Symbology</u> topic.

After creating the plume select it in the EnterVol Layer selector

11.5		
Layer:	Initial_Soil_Site Model-TOTHC-Plue	। 😝 🚸 📴 🔳 🚭 🖉 🐚
	Initial_Soil_Site Model-TOTH	C-Plume100.00000_TOTHC

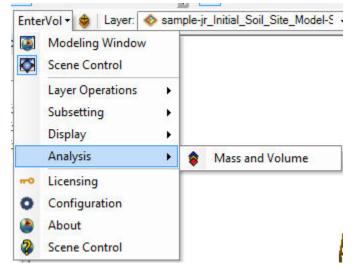
click on the *Mass and Volume* button and the Mass and Volume Analysis window opens. Let's set the Chemical Density to 0.875 and the Soil Density to 1.8.

✓ Calculation	
Calculation Type:	Soil Contamination 🔻
Data Component:	TOTHC •
nclude Children:	
✓ Input Units	
Verride Input Units	
ength Units:	meters
Concentration Units:	mg/kg
✓ Output Units	
ength Units:	Meters 🔻
/olume Units:	Cubic Meter 🔹
Concentration Units:	mg/kg 🔻
Mass Units:	Kilogram 🔹
Jse Scientific Notation:	V
✓ Parameters	
Soil Porosity:	0.25
Soil Density (g/cc):	1.8
Chemical Density (g/cc):	0.875
/olume Dollars	60.00
Mass Dollars	800.000

We'll accept these values and when the calculations are complete the following new window appears (please note that we've expanded this window to show all of it). Since the model used to create the plume had stratigraphy, we not only get the analysis for the total plume, but also for each stratigraphic layer.

Results Summary										
Calculation Type:	Soil Contaminatio	0								
Chemical Mass:	3.81536e+006 Kil	ogram								
Chemical Volume:	4.36041e+003 Cu	bic Meter								
Soil Volume:	7.76778e+005 Cu	bic Meter								
Soil Mass:	1.39816e+009 Kil	ogram								
Average Concentration										
Total Mass:	2.11954e+009 Kil	ogram								
Volume Dollar:	4.66067e+007 \$									
Mass Dollar:	3.05228e+009 \$									
Center of Gravity X:	1.13186e+004 Me	ters								
Center of Gravity Y:	1.28804e+004 Me									
Center of Gravity Z:	-1.51161e+001 M									
	7.76778e+005 Cu									
Foreign Foreiting.										
Total Volume: Total Mass:	1.39616e+009 Kil	ogram								
Total Mass: Center of Gravity X:	1.39816e+009 Kil 1.13186e+004 Me	ogram Iters								
Fotal Mass: Center of Gravity X: Center of Gravity Y:	1.39616e+009 Kil	ogram Kers Ners								
Total Mass:	1.39816e+009 Kil 1.13185e+004 Me 1.28804e+004 Me	ogram Kers Ners	Soil Volume(Cubic Meter)	Soil Mass (Kilogram)	Average Concentration (mg/kg (ppm))	Center of Gravity X (Meters)	Center of Gravity Y (Meters)	Center of Gravity Z (Meters)	Volume Dollar (\$)	Mass Dollar (Meters)
fotal Mass: Center of Gravity X: Center of Gravity Y: Center of Gravity Z: Results Detail	1.39816e+009 Kil 1.13186e+004 Me 1.28804e+004 Me -1.51161e+001 M	ogram Ners eters Chemical Volume	Meter)		Average Concentration (mg/kg (ppm)) 2.72884e+003	(Meters)	(Meters)		(5)	
Total Mass: Center of Gravity X: Center of Gravity Y: Center of Gravity Z: Results Detail Subset Full Dataset 3	1.39816e+009 Kii 1.13186e+004 Me 1.28804e+004 Me -1.51161e+001 M Chemical Mass (Kilogram)	ogram Iters eters Chemical Volume (Cubic Meter)	Meter)	(Kilogram)	(mg/kg (ppm))	(Meters)	(Meters) 1.28804e+004	(Meters)	(5) 4.66067e+007	(Meters)
Total Mass: Center of Gravity X: Center of Gravity Y: Center of Gravity Z: Results Detail Subset Full Dataset Stratagraphic Layer: Fill	1.39816e+009 Kii 1.13186e+004 Me 1.28804e+004 Me -1.51161e+001 M Chemical Mass (Kilogram) 3.81536e+006	ogram ters ters eters Chemical Volume (Cubic Meter) 4 36041e+003	Meter) 7.76778e+005	(Kilogram) 1.39816e+009	(mg/kg (ppm)) 2.72884e+003	(Meters) 1.13186e+004	(Meters) 1.28804e+004	(Meters) -1.51161e+001	(5) 4.66067e+007 1.33060e+007	(Meters) 3.05228e+009
otal Mass: Lenter of Gravity X: Sonter of Gravity Y: Arefer of Gravity Z: Lesuits Detail Subset Full Dataset 3 Strategraphic syrer. Fill Strategraphic 2 Strategraphic 2	1.39616e+009 Ka 1.13186e+004 Ma 1.28804e+004 Ma -1.51161e+001 M Chemical Mass (Kilogram) 3.81536e+006 5.78205e+005	ogram ters ters Chemical Volume (Cubic Meter) 4.36041e+003 6.60806e+002	Meter) 7.76778e+005 2.21766e+005	(Kilogram) 1.39816e+009 3.99167e+008	(mg/kg (ppm)) 2.72884e+003 1.44853e+003	(Meters) 1.13186e+004 1.13369e+004	(Meters) 1 28804e+004 1 29144e+004	(Meters) -1.51161e+001 7.64620e-001	(5) 4 66067e+007 1.33060e+007 2.16665e+007	(Meters) 3.05228e+009 4.62564e+008
total Mass: Lenter of Gravity X: Lenter of Gravity Y: Lenter of Gravity Z: Subset Subset Subset Stategraphic Strategraphic Layer: Stategraphic Layer: Stategraphic L	1.39816+009 Kil 1.3388e+004 Me 1.28804e+004 Me -1.51161e+001 M Chemical Mass (Kilogram) 3.81536e+006 5.78205e+005 2.64389e+006	ogram ters ters eters Chemical Volume (Cubic Meter) 4 360404+003 6 60806e+002 3 02159e+003	Meter) 7.76778e+005 2.21766e+005 3.61108e+005	(Kilogram) 1.39616e+009 3.99167e+008 6.49975e+008	(mg/kg (ppm)) 2.72884e+003 1.44853e+003 4.06768e+003	(Meters) 1 13186e+004 1 13369e+004 1 13169e+004	(Meters) 1.28804e+004 1.29144e+004 1.28710e+004	(Meters) -1.51161e+001 7.64620e-001 -1.64694e+001	(5) 4.66067e+007 1.33060e+007 2.16665e+007 4.38864e+006	(Meters) 3.05228e+009 4.62564e+008 2.11511e+009

Mass and Volume for Environmental Sciences



In EnterVol, volumetric analysis is far more than determining the volume of space bounded by surfaces. Since everything we do is truly volumetric with data throughout the volumes, it is possible to compute many important characteristics of your models. This includes plume volume, chemical volume (if distilled or concentrated), soil mass, chemical mass, center of gravity and values (\$) associated with both volumes and masses. All calculations are performed for the entire layer and each geologic unit within it.

Let's begin by creating a plume at 100 mg/kg for the TOTHC scene at the end of the <u>Set Symbology</u> topic.

After creating the plume select it in the EnterVol Layer selector

1.5			
Layer:	🚸 Initial_Soil_Site Model-TOTHC-Plu	جه 🐟	🔍 🔗 🎯 🐚
	Initial_Soil_Site Model-TOTHC-P	lume100.0	0000_TOTHC

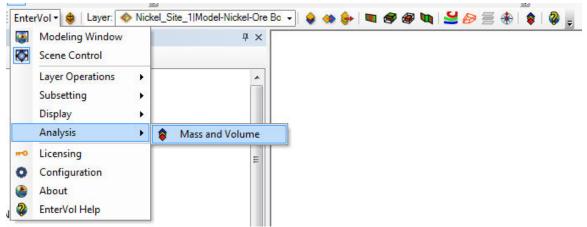
click on the *Mass and Volume* button and the Mass and Volume Analysis window opens. Let's set the Chemical Density to 0.875 and the Soil Density to 1.8.

✓ Calculation	
Calculation Type:	Soil Contamination
Data Component:	тотнс
include Children:	E
✓ Input Units	
Override Input Units	
Length Units:	meter
Concentration Units:	mg/k
✓ Output Units	
Length Units:	Meters
/olume Units:	Cubic Meter
Concentration Units:	mg/kg
Mass Units:	Kilogram
Use Scientific Notation:	l.
✓ Parameters	
Soil Porosity:	0.25
Soil Density (g/cc):	1.8
Chemical Density (g/cc):	0.875
/olume Dollars	60.00
Mass Dollars	800.000

We'll accept these values and when the calculations are complete the following new window appears (please note that we've expanded this window to show all of it). Since the model used to create the plume had stratigraphy, we not only get the analysis for the total plume, but also for each stratigraphic layer.

E I										
Results Summary	r									
Calculation Type:	Soil Contaminatio									
Chemical Mass:	3.81536e+006 Kil									
Chemical Volume:	4.36041e+003 Cu									
Soil Volume:	7.76778e+005 Cu									
Soil Mass:	1.39816e+009 Kil									
	tion: 2.72684e+003 mg									
Total Mass:	2.11964e+009 Kil	logram								
Volume Dollar:	4.66067e+007 \$									
Mass Dollar:	3.05228e+009 \$									
Center of Gravity X:										
Center of Gravity Y:										
Center of Gravity Z: Total Volume:										
	7.76778e+005 Cu									
Total & Annual										
Total Mass:	1.39816e+009 Kil									
Center of Gravity X:	1.13186e+004 Me	eters								
Center of Gravity X: Center of Gravity Y	1.13186e+004 Me 1.28804e+004 Me	eters eters								
- oren manara	1.13186e+004 Me 1.28804e+004 Me	eters eters	Soil Volume(Cubic Meter)	Soil Mass (Kilogram)	Average Concentration (mg/kg (ppm))	Center of Gravity X (Meters)	Center of Gravity Y (Meters)	Center of Gravity Z (Metors)	Volume Dollar (5)	Mass Dollar (Meters)
Center of Gravity X: Center of Gravity Y: Center of Gravity Z: Results Detail Subset	1 13185e+004 Mi 1 28904e+004 Mi -1.51161e+001 Mi	eters eters leters Chemical Volume				(Meters)	(Meters)		(\$)	
Center of Gravity X: Center of Gravity Y: Center of Gravity Z: Results Detail	1.13185e+004 Me 1.28804e+004 Me -1.51161e+001 M Chemical Mass (Kilogram)	eters Ners leters Chemical Volume (Cubic Meter)	Meter)	(Kilogram)	(mg/kg (ppm))	(Meters) 1.13186e+004	(Meters) 1.28804e+004	(Meters)	(\$) 4.66067e+007	(Meters)
Center of Gravity X: Center of Gravity Y: Center of Gravity Z: Results Detail Subset Full Dataset Stratagraphic	1.13185e+004 Me 1.28804e+004 Me -1.51161e+001 M Chemical Mass (Kilogram) 3.81536e+006	eters Nors leters Chemical Volume (Cubic Meter) 4.36041e+003	Meter) 7.76778e+005	(Kilogram) 1.39816e+009	(mg/kg (ppm)) 2.72884e+003	(Meters) 1.13186e+004	(Meters) 1.28804e+004	(Meters) -1.51161e+001	(5) 4.66067e+007 1.33060e+007	(Meters) 3.05228e+009
Center of Gravity X: Conter of Gravity Y: Center of Gravity Z: Results Detail Subset Full Dataset Stratagraphic Layer: Fill Stratagraphic	1.13186+004 Mi 1.28804+004 Mi -1.51161e+001 M Chemical Mass (Kilogram) 3.81536+006 5.78205e+005	Iters Nors leters Chemical Volume (Cubic Meter) 4 36041e+003 6.60806e+002	Meter) 7.76778e+005 2.21766e+005	(Kilogram) 1.39816e+009 3.99167e+008	(mg/kg (ppm)) 2.72884e+003 1.44853e+003	(Meters) 1.13186e+004 1.13369e+004	(Meters) 1.28804e+004 1.29144e+004 1.28710e+004	(Meters) -1.51161e+001 7.64620e-001	(5) 4 66067e+007 1.33060e+007 2.16665e+007	(Meters) 3.05228e+009 4.62564e+008
Center of Gravity X: Center of Gravity Y: Center of Gravity Z: Results Detail Subset Full Dataset Stratagraphic Layer: Fill Stratagraphic Layer: Silt	1.13186+004 Md 1.28804+004 Md -1.51161e+001 Md Chemical Mass (Kilogram) 3.81536+006 5.78205e+005 2.64389e+006	Aters Nors leters Chemical Volume (Cubic Meter) 4.36011e-003 6.60806e+002 3.02159e+003	Meter) 7.76778e+005 2.21766e+005 3.61108e+005	(Kilogram) 1.39816e+009 3.99167e+008 6.49975e+008	(mg/kg (ppm)) 2.72884e+003 1.44853e+003 4.06768e+003	(Meters) 1.13186e+004 1.13369e+004 1.13169e+004	(Meters) 1.28804e+004 1.29144e+004 1.28710e+004	(Meters) -1.51161e+001 7.64620e-001 -1.64694e+001	(5) 4.66067e+007 1.33060e+007 2.16665e+007 4.38864e+006	(Meters) 3 05228e+009 4 62564e+008 2 11511e+009

Mass and Volume for Mining



Using the same dataset used for the <u>Ore Body</u> topic, below is the default settings when we choose *Mass and Volume* with a 291 ppm ore body as the selected layer.

✓ Calculation		
Calculation Type:	Mineral Con	centration \bullet
Data Component:	Nickel	•
nclude Children:		
✓ Input Units		
verride Input Units		
ength Units:		Meters
Concentration Units:		mg/kg
✓ Output Units		
ength Units:	Meters	•
/olume Units:	Cubic Meter	r •
Concentration Units:	mg/kg	•
Mass Units:	Kilogram	•
Jse Scientific Notation:		1
✓ Parameters		
Soil Porosity:		0.25 +
Soil Density (g/cc):		1.85
Mineral Density (g/cc):		1.0
/olume Dollars		60.00
Mass Dollars		800.000

For our model of nickel ore, we'll want to change the *Soil Density* to 1.6, the *Mineral Density* to 8.9, and the *Mass Dollars* to \$18 (dollars per kg). Let's also estimate the excavation and ore processing cost as the *Volume Dollars* at \$2.00 per cubic meter.

✓ Calculation		
Calculation Type:	Mineral Con	centration \bullet
Data Component:	Nickel	•
include Children:		
✓ Input Units		
Override Input Units		
Length Units:		Meters
Concentration Units:		mg/kg
✓ Output Units		
Length Units:	Meters	•
Volume Units:	Cubic Mete	r 🔹
Concentration Units:	mg/kg	•
Mass Units:	Kilogram	•
Use Scientific Notation:		V
✓ Parameters		
Soil Porosity:		0.25
Soil Density (g/cc):		1.6
Mineral Density (g/cc):		8.9
Volume Dollars		2.0
Mass Dollars		18.00

When we click OK we get:

EnterVol Mass/Volume	Report								
5									
Results Summary									
Calculation Type:	Mineral Concentration								
Aineral Mass:	9.21386e+007 Kilogram								
fineral Volume:	1.03526e+004 Cubic Meter								
Soil Volume:	1.43596e+008 Cubic Meter								
Soil Mass:	2.29747e+011 Kilogram								
werage Concentration:	4.01043e+002 mg/kg (ppm))							
Total Mass:	5.75866e+010 Kilogram								
Volume Dollar:	2.87193e+008 \$								
Aass Dollar:	1.65849e+009 \$								
Center of Gravity X:	3.00625e+005 Meters								
Center of Gravity Y:	1.10969e+004 Meters								
Center of Gravity Z:	4.48248e+003 Meters								
Total Volume:	1.43596e+008 Cubic Meter								
Total Mass:	2.29747e+011 Kilogram								
Center of Gravity X:	3.00625e+005 Meters								
Center of Gravity Y:	1.10969e+004 Meters								
Center of Gravity Z:	4.48248e+003 Meters								
Results Detail									
Subset Mineral (Kilog			Soil Mass (Kilogram)	Average Concentration (mg/kg (ppm))	Center of Gravity X (Meters)	Center of Gravity Y (Meters)	Center of Gravity Z (Meters)	Volume Dollar (\$)	Mass Dollar (Meters)
Full 9.21386e+0	07 1.03526e+004	1.43596e+008	2.29747e+011	4.01043e+002	3.00625e+005	1.10969e+004	4.48248e+003	2.87193e+008	1.65849e+009

Note that our nickel reserves have a gross value \$1.65 billion and our excavation and processing costs (at \$2 per sq. m) are \$0.287 billion. We can easily determine the maximum processing costs where this ore body would still be profitable.

Load or Create a Project

A project is the first step towards creating volumetric models. You can load an existing project (.EVP - EnterVol Project) or create a new project.

Modeling: EnterVol	
No Project Loaded Load or Create a project.	EnterVol GeoStats
Ĵ,	
	EnterVol
	for ArcGIS
	EnterVol
	Geology
	Open Recent Project
	Sample.evp
	arpa2.evp
	<u>arpa.evp</u> Epidote.evp
	HKGS.evp

Project files (.evp) are databases into which you load your geologic and analyte data

No Project Loaded Load or Create a project.

Let's begin by creating a new project:

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which will then prompt you for the site name.

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Spatial Reference:	O Unknown, feet
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If you know the Project Coordinate System, choose *Projected Coordinates, a*nd browse for your coordinate system

EnterVol Ver. 1.84 Help System www.ctech.com

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Choose Select...and then browse

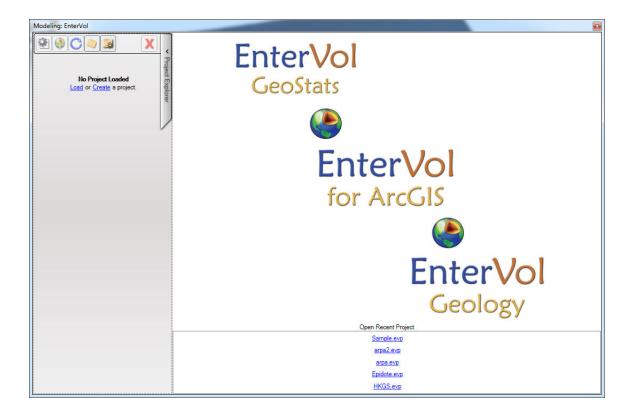
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Each project can contain multiple sites, however we will only enter data for a single site for this project. At this point, the Modeling window changes to show the window below. Here you can enter additional information about the project. For example, you can assign colors to Materials which will cause all layers added to the Table of Contents to use these colors.

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🛛 🧶 EnterVol T	
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Load or Create a Project

A project is the first step towards creating volumetric models. You can load an existing project (.EVP - EnterVol Project) or create a new project.



Project files (.evp) are databases into which you load your geologic and analyte data

No Project Loaded Load or Create a project.

Let's begin by creating a new project:

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	Save as type:	EnterVol Project File	(.evp)	-	Cancel

which will then prompt you for the site name.

Name for Site in Project:	Coastal Facility				
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If you know the Project Coordinate System, choose *Projected Coordinates, a*nd browse for your coordinate system

EnterVol Ver. 1.84 Help System www.ctech.com

in coordinate	System
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New	Create a new coordinate system.
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Choose Select...and then browse

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Each project can contain multiple sites, however we will only enter data for a single site for this project. At this point, the Modeling window changes to show the window below. Here you can enter additional information about the project. For example, you can assign colors to Materials which will cause all layers added to the Table of Contents to use these colors.

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EnterVol T	

Site Details and Settings

Below your Site are various sections for all site data and models.

Modeling: EnterVol	
▲ Project Data	Import from C Tech Data Files
▲ Initial Soil Site	Site Details
Borings	Projection: Unknown Change
Analytical Data	Coordinate Units: meters
Lithology	Borings: 24
Horizons	Horizons: 6
Hierarchy	Horizon Pick Locations: 144
Models	Horizon Scattered Data Locations: 0
	C Lithology Data Intervals: 120
	Measurement Scattered Data Locations:
	Measurement Boring Data Intervals: 99
Horizons Hierarchy	Horizons: 6 Horizon Pick Locations: 144 Horizon Scattered Data Locations: 0 Lithology Data Intervals: 120 Measurement Scattered Data Locations:

Selecting *Borings* shows all defined borings

Project Data)				+ Add Boring	X		
▲ Initial Soil Site	C		Name	Ground X T	Ground Y T	Ground Z T	Depth T	Туре
Borings	5	>	B-49	11086.51953125	12830.669921875	4.5	59.5	Î
Analytical Data	H		B-51	11199.0400390625	12810.16015625	4	57	Î
Lithology Horizons	-\$\$		B-57	11209.349609375	12993.9404296875	2	53	ĩ
Honzons	X		B-50	11211.8701171875	12710.75	2	53	î
Models	T		B-48	11248.75	12870.91015625	3	53	Ĩ
modela	Project Explorer		B-75	11251.2998046875	12929.26953125	2	55	Î
	Ť		B-46	11259.669921875	12819.2900390625	2	55	Î
	plore		B-59	11286.76953125	13026.7001953125	2	52	Î
	B-52 11298 12808.6298828125 3 B-58 11301.9697265625 13079.66015625 4.5 B-56 11309.0302734375 12948.990234375 4	3	58	Î				
		4.5	55.5	ĩ				
		B-56	11309.0302734375	12948.990234375	4	56	ĩ	
			B-38	11338	12830.7998046875	4	54	ĩ
			B-47	11340.490234375	12892.6103515625	2.5	54.5	î

Selecting Analytical Data provides and editable spreadsheet style table of all analyte data

Modeling: EnterVol									×
✓ Project Data ✓ Initial Soil Site									Analytes Editor
Borings Analytical Data	🔿 Dat	ta from Borin		dd Measureement I	nterval 🗶 Defau	lt Add Analy	te: TOTHC	•	
Lithology 🔡 Horizons	Drag a	i column head	er and drop it	here to group by that or	slumn				
Hierarchy	A	nalyte T	Boring T	Measurement T	Detection Limit τ	Error T	Start Depth T	End Depth T	- -
57594.4.4.C.C.	> T	готнс	B-49	0			7.5	7.5	
ojec	Т	ТОТНС	B-49	0			10.5	10.5	
Models Project Explorer	 Dat 	ta from Scatt			No Data cation data. Click bel Add Measurem	ow to impor	t or add scattered	location data.	_

Lithology section shows each boring log interval

▲ Project Data				+ Ac	dd Lithology	X	-
▲ Initial Soil Site	C			1			Materials Edito
Borings		Boring T	Material T	Start Depth T	End Depth T		
Analytical Data		> B-49	Fill	0	8.30000019073486		:
Lithology		B-49	Silt	8.30000019073486	25.5		
Horizons	X	B-51	Silt	9	24		
Hierarchy	5	B-51	Fill	0	9		
Models	Proj	B-51	Clay	24	29		
	Project Explorer	B-49	Clay	25.5	30.5		
	xplo	B-46	Clay	22.5	29		
	rer	B-46	Fill	0	9.5		
		B-46	Silt	9.5	22.5		
		B-46	Gravel	29	42		
		B-49	Gravel	30.5	46.5		
		B-51	Gravel	29	43		
		B-52	Gravel	28.7999992370605	44.7999992370605		

The *Horizons* section lists all surfaces used to define stratigraphy and all horizon picks from borings.

Modeling: EnterVol							×.
Project Data Initial Soil Site	Horizons			Horizon Da		2.2	
Borings Analytical Data	+ Add	Horizon	X	[1	Add Horizon Data
Lithology	Description	Material Below Horizon	Orde	Borir	100	Depth T	
Horizons	> Ground Surface	Fill	0	B-3		0	
Hierarchy	Top of Silt	Silt	1	B-3	2	0	-
Models Proje	Top of Clay	Clay	2	A Data f	rom So	attered Lo	ocations
ă E	Top of Gravel	Gravel	3	~			
Models Project Explore	Top of Sand	Sand	4				No Data
ē	Bottom of Model	Unknown	5	+ contains r	no scat	tered locati	ion data. Click below to import or add scattered location
	•		•	[+ Add Horizon Point

The *Hierarchy* section lists the stratigraphic layers in order and all horizons used to define stratigraphy. By selecting the horizons in the display below, you can move the order of horizons or eliminate layers in the hierarchy. Removing a horizon eliminates the layer below it.

Project Data	Edit Grou	: Geologic La	ayers	 Add Horizon Group 	X		
 Initial Soil Site Borings Analytical Data Lithology Horizons Hierarchy 	Group E Hierarc Top Ma	litor	Top of Silt Top of Clay Top of Grave Top of Sand			Horizons Ground Surface Top of Silt Top of Clay Top of Gravel Top of Sand Bottom of Sand	

In the example above, removing the horizon "Top of Clay" eliminates clay from the hierarchy resulting in a Silt layer that continues to the Top of Gravel.

The Models section is discussed in the Concepts and Modeling Process topic.

Concepts and Database Structure

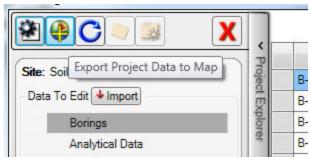
Data is stored in the Project database using one of two data structures:

Data which is collected from borings is stored based on the way that data is collected:

- Borings are defined based upon:
 - The X-Y-Z coordinate of the top of the boring collar
 - A sequence of boring interval definitions, each having Dip, Dip Direction, and Length
- Data, whether it is analytical (e.g. assay, contamination, etc.), lithologic, geophysical, or stratigraphy horizons is stored based upon the *Depth* and *Boring ID*.
 - *Depth* is defined as the distance down the boring, regardless of boring orientation with respect to ground surface or the horizon.

Data which is not collected from borings must have X-Y-Z coordinates and a measurement for each sample. Multiple analytes measured at the same location are each treated as unique data samples.

In the topics which follow the methods for importing data for direct display are shown. However, any data which is imported into the modeling database can be displayed by selecting the "Export Project Data to Map" button.



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	_	
	<	
Site: Soil Export Project Data to Map	Projec	B
Data To Edit 🔸 Import	1 m	B
Borings	plon	B
Analytical Data	er	B

Importing Data

Click on the add data buttons for each data type to enter new records into any of the database categories. Below we will demonstrate importing Borings data from a table. The following procedure is applicable to:

- Borings
- Analytical Data
- Lithology Data
- Stratigraphic Data

Modeling: EnterVol	No Data This site contains no borings. Click below to manually input. Add Boring	 Boring Editor
Horizons Hierarchy Models Settings Units: Meters Site Settings		194

We can enter new borings data. If the boring is a single vertical interval, it can be fully characterized by the ground X-Y-Z coordinates, the total depth and the Boring Name.

Upon clicking the Import button, we have the option to read any C Tech ASCII data file type or use any feature class or table in your current scene or map. Below we will choose an Excel spreadsheet from our scene.

EnterVol Wizard		×
	Import Data Specify a data source to import	
	Select Import Method:	
	○ From File (C Tech Data Formats)	
	From Current ArcGIS Document	
	Sheet1\$ [C:\CTech\Data\EnterVol\Initial Soil Subsite Analytical.xlsx]	
	Cancel < Back Next > Finish	

Next we must specify what type of information is in the table selected. We will be choosing *Borings from Points*

EnterVol Wizard		x
	Import Type Specify what type of data is represented in the subject file.	
	Borings from Points	
	Simple Vertical Borings Non-Vertical Borings from Dip and Direction Analytical Scattered Point Data Analytical Data Down Existing Borings Analytical Data On Existing Borings By Coordinates Scattered Surface Data Lithology Intervals	
	Lithology Depth Intervals Import borings from a collection of XYZ coordinates. Cancel < Back Next > Finis	b

EnterVol Wizard								×
	and the second			s from Poi lata into existing o				
	X Coordinates	s: X	_Coord		•			
	Y Coordinates	s: Y	_Coord		•			
	Z Coordinates	s; Z	_Coord		•			
	Boring Name	/Id: B	oring_ID		•			
	X_Coord Y_	Coord	Z_Coord	Total_Hydrocarbons	Boring_ID	Ground_Surface_Elevation		
	11086.52 12	2830.67	-3.0	0.0	B-49	4.5		-
	11086.52 12	2830.67	-6.0	0.0	B-49	4.5		
	11086.52 12	2830.67	-16.0	0.0	B-49	4.5		
	11086.52 12	2830.67	-26.0	0.0	B-49	4.5		_
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	11199.04 12	2810.16	-17.0	54.0	B-51	4		_
	11199.04 12	2810.16	-30.0	44.0	B-51	4		
	11209.35 12	2993.94	-1.0	0.0	B-57	2		
	11209.35 12	2993.94	-7.0	0.1	B-57	2		
	11200 25 12	002 04	-120	0.0	R-57	2		-
						Cancel < Back	Next > Finish	

The Tolerance options allow you to automatically merge data that is already in your database.

EnterVol Wizard		×.
	Import Mappings Specify mapping of file data into existing	database.
	Tolerance to Match Borings:	0.000010
	Angular Boring Merge Tolerance:	0.0000100000
	Merge Conflict Option:	Replace Existing With New
	Linear Units:	Feet
		Cancel < Back Next > Finish

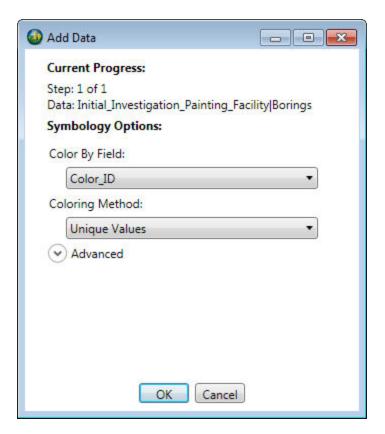
You have options when tolerance conditions are met. These include replacing data, disclosing errors or averaging.

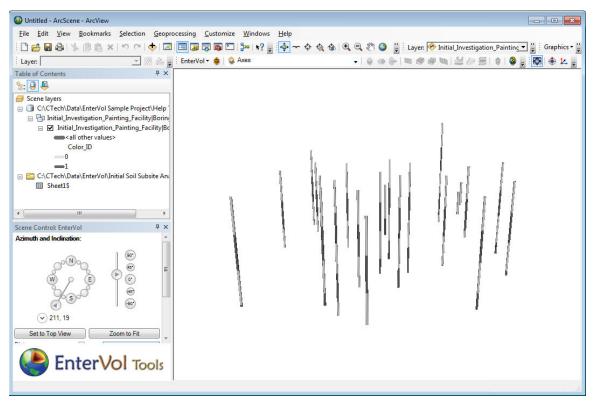
Merge Conflict Option:	Replace Existing With New	-		
Linear Units:	Use Existing			
	Replace Existing With New			
	Average Existing With New			
	Raise Error			

If units in this table or file are different, we will perform conversions automatically.

		oring 🗙 C Add	to Map	
		Ground X	Ground	Name B-49
te: Painting Facility ② lata To Edit ↓ Import Borings	B-49	11,086.52	12,830.67	Ground X 11086.52
Data To Edit 🔸 Import	B-51	11,199.04	12,810.16	Ground Y 12830.67
Borings	B-57	11,209.35	12,993.94	Ground Z -3
Analytical Data	B-50	11,211.87	12,710.75	
Lithology	B-48	11,248.75	12,870.91	Creation Date Wednesday , July 18 , 2012 -
Horizons	B-75	11,251.3	12,929.27	Segments
Hierarchy	B-46	11,259.67	12,819.29	- · · · · · · · · · · · · · · · · · · ·
Models	B-59	11,286.77	13,026.7	Ordering Dip Direction Length
ettings	B-52	11,298	12,808.63	
Inits: Feet Change	B-58	11,301.97	13,079.66	0 90 0 23
Site Settings	B-56	11,309.03	12,948.99	
	B-38	11,338	12,830.8	
	B-47	11,340.49	12,892.61	
	B-33	11,381.7	12,747.5	
	B-60	11,393.47	12,948.9	
	B-45	11,401.73	12,897.77	
	B-43	11,410.29	12,724.69	
	B-34	11,414.4	12,781.1	
	B-44	11,416.9	12,819.45	
	B-42	11,427	12,780.9	
	B-53	11,496.34	12,753.59	

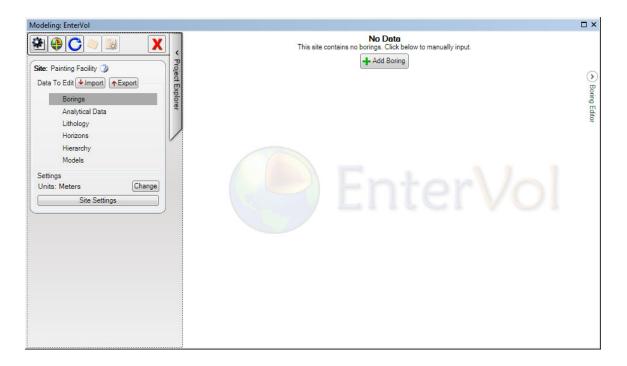
Now that the data has been imported, clicking "Add to Map" will import the data into your scene or map.





Importing Analyte Data from C Tech Files

Click on the Import button



Click on the Import button to open a browser to import analytical or geologic data. The five file types supported are:

- 1. .APDV: Analyte data measured at a point
- 2. .AIDV: Analyte data measured over an interval
- 3. .GEO: Stratigraphy data collected from vertical borings
- 4. .GMF: Stratigraphy data collected at scattered locations on each surface
- 5. .PGF: Lithology (boring log) data

Selecting From File will open a browser.

Look in:	🌗 analyte 👻	G 🥬 📂 🖽 🗸	
e	Name	Date modified	Туре
2	tce_krig3d_time.tcf.files	4/20/2012 9:26 AM	File fol
Recent Places	5_chemicals.apdv	8/14/2003 6:50 AM	APDV I
	anstalt_pipe_data.apdv	9/1/2000 12:51 PM	APDVI
	benzene_at_gas_station.apdv	6/27/2005 7:29 AM	APDV I
Desktop	coastal_contaminate_plume.apdv	5/15/2001 11:50 AM	APDV I =
	C Evergreen-nickel.apdv	12/30/2010 8:53 AM	APDVI
(internal)	c four_metals_in_soil.apdv	6/22/2005 11:12 AM	APDV I
Libraries	© ground-water-tce.aidv	3/5/2009 12:33 PM	AIDV F
-	initial_soil_investigation_full_site.apdv	6/15/2005 9:30 AM	APDVI
	initial_soil_investigation_subsite.apdv	1/30/2007 7:50 AM	APDV I
Computer	lake_surface_chemistry.apdv	3/22/2006 7:14 AM	APDV I
~	c ontariomoe.apdv	3/22/2006 7:14 AM	APDV I
	soil resistivity data.apdv	9/1/2000 12:51 PM	APDV I *
Network	•		+
Network	File name: initial_soil_investigation_subsite.a	apdv 👻 📘	Open
	Files of type: C Tech Data Files (*.apdv, *.aidv	* and * amf *	Cancel

Let's select initial_soil_investigation_subsite.apdv which is Total Hydrocarbon (TOTHC) soil contamination data from a site in California.

EnterVol Wizard	
	Import Data Specify a data source to import
Kan y	Select Import Method:
	From File (C Tech Data Formats)
	C:\CTech\Data\analyte\initial_soil_investigation_subsite.apdv
	O From Current ArcGIS Document
	Cancel < Back Next > Finish

After selecting an analyte file, the following window will open. If your data file represents data measured at different times, select **Yes** at which point you would choose the analyte which is associated with the time states.

EnterVol Wizard	
	Data Type Specify if selected file contains time doman data.
	Does this file contain time data?
	○ Yes
	No
	Cancel < Back Next > Finish

If your data is not measured at different times, just press Next to continue.

The next window allows you to confirm your data units and whether the tops of the borings specified in your .apdv or .aidv file should be used as a horizon surface (such as the ground surface).

EnterVol Wizard	Import Mappings	x
	Specify mapping of file data into existing database.	
	Tolerance to Match Borings: 0.114375	
	Angular Boring Merge Tolerance: 0.000000100	
	Merge Conflict Option: Replace Existing With New	
	Path Construction Method:	
	✓ Include Top of Borings as Horizon	
	Top Surface: Ground Surface 🔽 Create New	
	Analyte Mappings	
	Name: TOTHC Map To: TOTHC I Create New	
	Units: mg/kg Map To: mg/kg •	
	Cancel < Back Next > Finish	

The Tolerances are the same as with importing borings

Path Construction Method:		Auto	*
Include Top	o of Borings as Hori:	zo Auto	
	Ground Surface	Bottom Up	

Path Construction Method allows you to force borings to be sorted and defined *Top Down* or *Bottom Up*

When data collected in borings is imported, the samples and the borings data is separately entered into the database. As shown below, the file we've imported represents 23 borings and 99 TOTHC samples.

90 > 3	× (*)	Data from Borings	ld Measurement	Interval X Defa	ult Add Analyte: TOT	нс 🔹 С	Add to Map		
e: Initial Investigation Painting Fac	ility 3	Drag and drop a colum	nn header here t	o group by that colum	n				
ata To Edit 🔸 Import	Ū.	Analyte	Path	Quantity	Detection Limit	Error Band	Start Depth	1	E
Borings	plon	TOTHC	B-49	0.0	0.0	0.0	7.5	7.5	
Analytical Data	ę	тотнс	B-49	0.0	0.0	0.0	10.5	10.5	
Lithology		TOTHC	B-49	0.0	0.0	0.0	20.5	20.5	
Horizons		TOTHC	B-49	0.0	0.0	0.0	30.5	30.5	
Hierarchy		TOTHC	B-51	100	0.0	0.0	8	8	Ī
Models		TOTHC	B-51	44	0.0	0.0	12	12	Ī
ings		TOTHC	B-51	54	0.0	0.0	21	21	
	ange				and the	a lost in			
Site Settings		Data from Scattered	Locations		IIIC		101		
		Data from Scattered	Locations		No Data	:1 V	01		

If your data is inconsistent, upon importing, the wizard will detect the errors and report something like the following:

Results from import and merge, press finish to commit changes.	
1 New Analytes Added 0 New Borings Added. 0 Borings Merged. 1 Surfaces Added. 0 Surfaces Merged. 99 Measurement Intervals Added. 0 Measurement Points Added.	
Boring B-49 has a different ground location than existing data.[Distance from existing of 7.5]Boring B-51 has a different ground location than existing data.[Distance from existing of 3]Boring B-50 has a different ground location than existing data.[Distance from existing of 3]Boring B-50 has a different ground location than existing data.[Distance from existing of 8]Boring B-50 has a different ground location than existing data.[Distance from existing of 8]Boring B-48 has a different ground location than existing data.[Distance from existing of 4]Boring B-46 has a different ground location than existing data.[Distance from existing of 4]Boring B-59 has a different ground location than existing data.[Distance from existing of 4]Boring B-52 has a different ground location than existing data.[Distance from existing of 5]Boring B-54 has a different ground location than existing data.[Distance from existing of 5]Boring B-55 has a different ground location than existing data.[Distance from existing of 5]Boring B-56 has a different ground location than existing data.[Distance from existing of 6]Boring B-58 has a different ground location than existing data.[Distance from existing of 6]Boring B-38 has a different ground location than existing data.[Distance from existing of 6]Boring B-34 has a different ground location than existing data.[Distance from existing of 6]Boring B-34 has a different ground location than existing data.[Distance from existing of 6]Boring B-33 has a different ground location than existing data.[Distance from existing of 4.5]Bor	

Importing Stratigraphic Data from C Tech Files

Stratigraphy data is information about geologic surfaces (horizons) which form the tops and bottoms of stratigraphic units which comprise a geologic hierarchy.

C Tech has two ASCII file formats which define stratigraphic data: .GEO and .GMF formats. Normally, you would import one or the other. This is especially true if both file contain the same basic information. However, an exception would be if you'd imported a .GEO file and then also had a high resolution topographic surface. In this case, the GMF will be added to the total set of stratigraphic data allowing you to create a more refined model.

Modeling: EnterVol X Horizons 😤 🤑 Ċ х -8 Horizon Data X C Add to dd Horizon ۲ Pick Data From Borings Project Explorer Site: Initial Soil Site 3 Name + Add Horizon Data x Data To Edit Import AExport Ground Surface Drag and drop a column header here to group by that or 4 . Borings Path Depth Analytical Data B-51 0.0 Lithology B-49 0.0 Horizons Hierarchy Data from Scattered Locations Models Settings No Data Change Units: Feet no scattered location data. Click below to import or add scatte Site Settings + Add Horizon Point

Select the site and click on the Import Button

Browse to find a .GEO or .GMF file which contains stratigraphic data.

Look in:	EnterVol Sample F	Project 👻 🤇) 🏚 📂 🛄 ·	•
an	Name			Date modified
2	C initial_soil_invest	tigation_subsite.geo		1/25/2012 8:51
Recent Places	C dipping_strata_l			8/25/2011 1:09
	C dipping_strata_l		м	2/1/2006 9:10 /
Desktop	,		_	
Libraries				
i)				
Computer				
Network	•			*
	File <u>n</u> ame: init	ial_soil_investigation_subsite.geo		Open
	Files of type: C	Tech Data Files (*.apdv, *.aidv, *.geo	tamf ▼	Cancel

After selecting the .GEO file above, you are prompted whether the file contains stratigraphic layers. This same type of file can also contain other surface data such as time domain water table elevations, seismic horizons, etc.



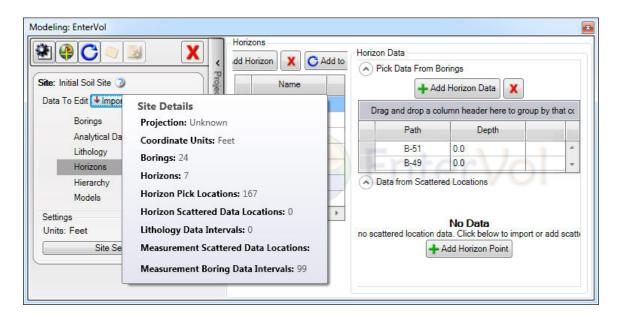
For our example, select Yes. Another window will appear which will have the Horizons and materials renamed to better fit the stratigraphic hierarchy represented by the data.

EnterVol Wizard	that I have	×
	Import Mappings Specify mapping of file data into exist	ing database.
	Tolerance to Match Borings:	0.201199
	Angular Boring Merge Tolerance	:: 0.000000100
	Horizon Mappings	
	Name: Top M	Map To: Ground Surfac 🔻 🗌 Create New
	Name: Fill	Map To: Top of Silt 🗸 Create New
	Name: Silt N	Map To: Top of Clay 🗸 Create New
	Name: Clay	Map To: Top of Gravel 🔽 Create New
	Name: Gravel M	Map To: Top of Sand 📿 Create New
	Name: Sand	Map To: Bottom of Model 🕼 Create New
	Material Mappings	
		Cancel < Back Next > Finish

You can override or edit any of the horizon name mappings or material mappings. C Tech's GEO and GMF file formats, traditionally name Horizons based on the layer above them. In other words, the default horizon names assume the horizons represent the Bottom of that layer.

In EnterVol, the process of creating stratigraphy begins with the material found at the ground surface, and your 3D grid is cut by horizons which define the Tops of each new stratigraphic layer. For this reason, the revised horizon names above make it much easier to understand the process and the consequences of horizon reordering or deletion.

After importing the .GEO file, the site tab will update to show 6 Horizons now exist and they will be listed in the Horizons window.



And the Hierarchy section will show:

EnterVol Ver. 1.84 Help System www.ctech.com

Modeling: EnterVol	Edit Group: Geologic Layers	Add to Map
Site: Initial Soil Site ② Data To Edit ● Import Borings Analytical Data Lithology Horizons Hierarchy Models Settings Units: Feet Change Site Settings	Group Editor Hierarchy Name: Geologic Layers Top Material: Fill • Fill • Fill Clay Top of Silt Clay Top of Clay Gravel Top of Gravel Sand Top of Sand	Horizons Ground Surface Ground Surface1 Top of Silt Top of Clay Top of Grave1 Top of Sand Bottom of Model

In this example, removing the horizon "Top of Clay" eliminates clay from the hierarchy resulting in a Silt layer that continues to the Top of Gravel.

Importing Lithology Data from C Tech Files

Lithology data defines the materials observed along borings. EnterVol uses C Tech's PGF file format for this type of data.

Modeling: EnterVol	
Site: Initial Soil Site Data To Edit Umport Export Borings Import data into the Site Analytical Data	No Data This site contains no lithography data. Click below to import or add data. Add Lithology
Lithology Horizons Hierarchy Models Settings Units: Feet Change Site Settings	

Open the file initial_soil_investigation_subsite.pgf

Look in:	pregeology		- 3 🕫	P.	
(Ha	Name		Size		Item type
	C hkgs_tung	_chung_pgf.gmf	26	KB	GMF File
Recent Places	hkgs_tung	_chung.pgf	147	KB	PGF File
17	C dipping_st	rata_lens_pgf.gmf	1	KB	GMF File
· · · · ·	C dipping_st	rata_lens_pgf_created.geo	3	KB	GEO File
Desktop	C dipping_st	trata_lens_pgf_created.gmf	9	KB	GMF File
<u> </u>	C dipping_st	trata_lens.pgf	4	KB	PGF File
6 77		_complex_geology.pgf	6	KB	PGF File
Libraries	initial_soil	_investigation_subsite.pgf	5	KB	PGF File
Computer	i New Folde	er			File folder
Network	•	III			
Network	File name:	initial soil investigation subsi	ite.paf	•	Open

The next window will allow you to remap material names.

EnterVol Wizard	- Armed		x
	Import Mappings Specify mapping of file data into existing	g database.	
	Tolerance to Match Borings:	0.114354	
	Angular Boring Merge Tolerance:	0.000000100	
	Include Top of Borings as Horizo	'n	
	Material Mappings		
	Name: Silt M	ap To: Silt Create New	
	Name: Fill M	ap To: Fill Create New	
	Name: Clay M	ap To: Clay	
	Name: Sand M	ap To: Sand Create New	
	Name: Gravel M	ap To: Gravel Create New	
		Cancel < Back Next > Finis	sh

Note that there are now 120 Lithology Data Intervals. For this simple PGF file, there were 24 borings, each having 5 materials observed. 5*24 = 120

ا () 🚯 🚯	😹 🗙		Add Lithology	C Add to Map		
		nn header here to	group by that column	1		
Site: Initial Soil Site 🥥	Path	Material	Start Depth	End Depth		
Data To Edit Hinpor	Site Details	Fill	0.0	8.3		
Borings		Fill	0.0	9		-
Analytical Da	Projection: Unknown	Silt	9	24		_
Lithology	Coordinate Units: Feet	Silt	8.3	25.5		
Horizons	Borings: 24	Silt	9.5	22.5		
Hierarchy	Horizons: 7	Fill	0.0	9.5		_
Models	Horizon Pick Locations: 167	Clay	22.5	29		_
		Clay	25.5	30.5 29		_
Settings	Horizon Scattered Data Locations: 0	Clay	24		VUL	
Units: Feet	Lithology Data Intervals: 120	Clay	22	28.8		
Site Se	Measurement Scattered Data Locations:	Fill	0.0	9		
		Silt	9	22		
	Measurement Boring Data Intervals: 99	Gravel	28.8	44.8		
	B-49	Gravel	30.5	46.5		
	B-51	Gravel	29	43		
	B-46	Gravel	29	42		
	B-34	Gravel	30	44		
	B-34	Fill	0.0	8		
	B-34	Silt	8	22.5		
	B-34	Clay	22.5	30		

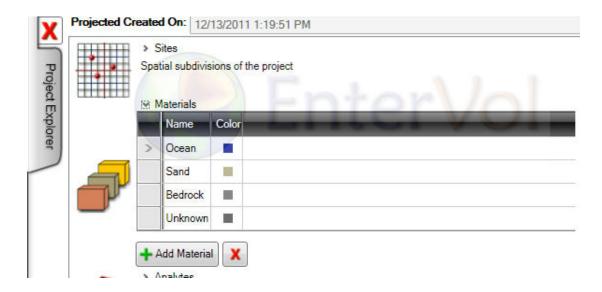
Project Settings

Once you've imported your data, you should confirm or adjust your Project settings.

Modeling: EnterVol	
😤 🖗 🔿 🛸 🖻	No Data This site contains no borings. Click below to manually input.
Creator	Paul D Garage
	Reed D Copsey
Company:	C Tech Development Corporation p
Notes:	
Projected Created On:	
	7/18/2012 2:19:25 PM
> Sites	
Spatial sul	bdivisions of the project
> Materia	
	ologic materials present within the project area
Analyte	25
XY_Z_ Chemical	compounds or elements to be tracked and modeled
4	
> Importe	d data and geometry
Generated	i data and geometry

The two important settings are the Materials settings and the Analytes settings.

Expanding Materials gives access to edit the names and colors associated with each geologic material



Expanding Analytes: Allows us to confirm or edit the following important information:

			Units	Log Process	7	Minimum Computat	ional Value	Default Detection L	imit T	Detection Limit M	ultiplier	Minimum Report	ing Value	Maximum Reporting Value
(xy,z,)	> 1	oc	mg/l			0.00010000	(A)	0.00100000	(A)	0.10000000	· A.	0.00100000	4	999,999,995,904.000000

- **Analyte Name** (VOC shown above)
- Analyte Units (mg/l shown above)

There are six other parameters which affect how your data is used for estimation and reporting.

- Log Process: When this is on, we take Log10 of the Analyte data. Before we can do this, we must be sure that the data has no ZERO or Negative values.
- Minimum Computational Value is a master clipping that is performed just before Log Processing or estimation (if Log is off). Any values less than this value are set to this value. If you are not log processing and your data has meaningful negative numbers be sure to properly set this parameter.

- **Default Detection Limit** is the value applied to any Analyte samples which have the value of zero (0.0)
- Detection Limit Multiplier is applied to all samples in the database which are flagged as non-detects. For example, when importing C Tech's .apdv (Soil Chemistry) data files, any values which are ZERO or have a value preceded by "<" (e.g. <0.2 ug/l) will be multiplied by this value before estimation.
- **Minimum Reporting Value** is a master clipping that is performed after estimation (e.g. kriging). Often this value is set to match the Default Detection Limit so that the resulting analyte grid does not have any values which are reported to be below the ability to detect.
- Maximum Reporting Value is a master clipping that is performed after estimation (e.g. kriging). It is seldom used, which is why the default value is a very large number.

Exporting Data

Modeling: EnterVol		□ ×
Site: Painting Facility Data To Edit Import Export Borings Analytical Data Lithology Horizons	No Data This site contains no borings. Click below to manually input. Add Boring	 Boring Editor
Horizons Hierarchy Models Settings Units: Meters Change Site Settings	EnterVol	

The Export button allows you to export data which has been imported into the EnterVol Modeling system in EVS (Earth Volumetric Studio) standard ASCII formats.

The Export button will export all of your project data at one time. This will include:

- Borings (vertical or non-vertical) in APDV format
- Analytical Data

- If Point data on borings is present, an APDV with borings will be written
- If Scattered Point data without borings is present, an APDV without borings will be written
- If Interval data is present, an APDV with borings will be written. During Export, you will be prompted for a *Maximum Gap* parameter which will convert intervals into points.
- Lithology Data will be exported in PGF format
- Horizons data is not exported.
- Hierarchy data is not exported.

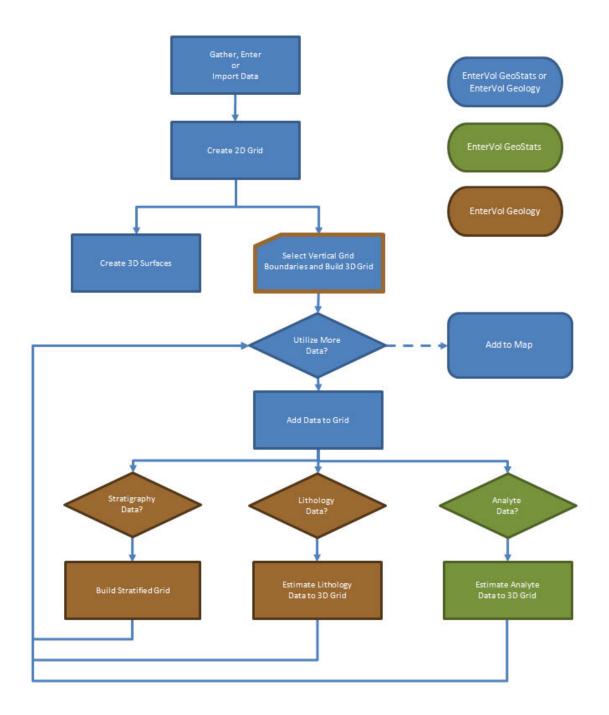
Concepts and Modeling Process

The EnterVol Modeling Process is shown in the flowchart below.

- Processes shown in blue require either EnterVol GeoStats or EnterVol Geology.
- Those in green require EnterVol GeoStats.
- Those in brown require EnterVol Geology.

The selection of the variable or analytic surfaces that provide the vertical bounding of the 3D grid is a process which has different functionality in EnterVol GeoStats and EnterVol Geology.

- In EnterVol GeoStats, the 3D grid can be bounded by:
 - Two specified elevations
 - An arbitrary (3D) surface and an elevation or thickness
- In EnterVol Geology, the 3D grid can be bounded by:
 - Two specified elevations
 - An arbitrary 3D surface and an elevation or thickness
 - Two arbitrary 3D surfaces



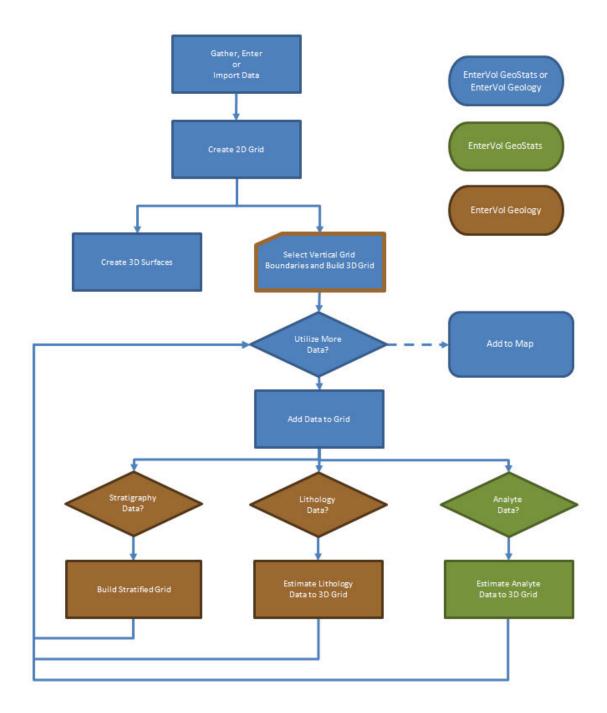
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 - An arbitrary 3D surface and an elevation or thickness
 - Two arbitrary 3D surfaces



2D Grid Generation

2D Grid Generation is a required step in building a 3D volumetric grid. The 2D grid is the triangles (cells) and the X-Y locations (nodes) that define the corners of the cells in the X-Y Plane

Click on the Add Model butto	วท

When you choose OK after providing a Model Name, the 2D Grid modeling options window opens

Modeling: EnterVol									□ ×
😤 🔮 😋 🔍 🔜 🛛 🗙		+4	Add Model	X	0	Туре:	Even Sized Cells Clipped	by a Polygon	•
	< P	Drag and drop a colu	mn header here to group	by that col	Models	Resolution X:	51		
Site: Painting Facility 3 Data To Edit Import	olect	Name	Туре			Resolution Y:	51		
Borings	Project Explorer	2D Grid	XY Grid			Offset:	10.00 %		
Analytical Data	ē					Hull Type:	Convex		•
Lithology						Include Sampl	le Points:		
Horizons						(olygon to Feature Class	
Models							ita Within Envelope: finimum Data Extent X:	-10.000,000,000.00	
Settings Units: Feet Change						N	faximum Data Extent X:	10,000,000,000.00	
Site Settings						N	finimum Data Extent Y:	-10,000,000,000.00	
						N	faximum Data Extent Y:	10,000,000,000.00	
						(Set Extents fro	m Document Layer	
							Show Preview	Remove Preview	

There are three different types of 2D grids.

1. Rectilinear

.

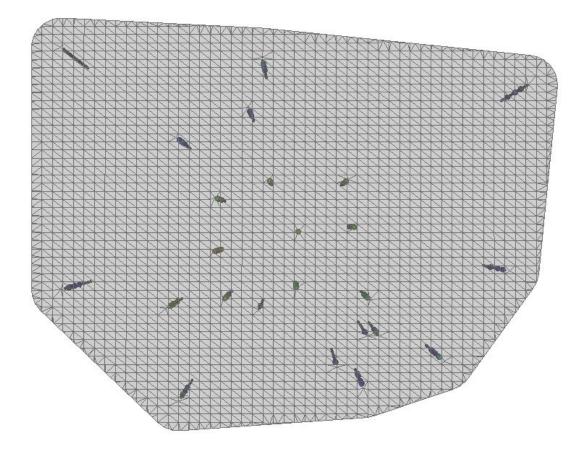
- 2. Even Sized Cells Clipped by a Polygon
- 3. Convex Hull with Smoothed Cells

The extents of your grid are determined automatically by the extent of all boring (tops), analytical points and surface data, however you can restrict the Minimum and Maximum X-Y Data extents to limit the data used to determine the grid. This grid restriction does not limit the data used to compute surfaces, horizons, 3D grids or Analyte Estimation. You must have data in your scene to set your extents. This can be one or many of your Scene Layers and you can then crop that extent with interactive sliders.

Press the *Set Extents from Document Layer* button. In the example below, there are two Scene Layer in the project. They are both selected by default.

Layer Nan	ne	
Painting_Facility BoPainting_Facility Po	and the second second	-
Extend Envelope in X:	[]
0.00 %	100.00 %	
Extend Envelope in Y:	[]
0.00 %	100.00 %	
	ОК	Cancel

If we click on Show Preview we can see the resulting grid created with the *Even Sized Cells Clipped to a Polygon* option and the default "convex hull":



The convex hull of your data is a shape equivalent to a rubber band stretched around all of your surface points. All three grid types can be offset (extended) a percentage of the X-Y diagonal extent. The default value of 10% was used in the example above.

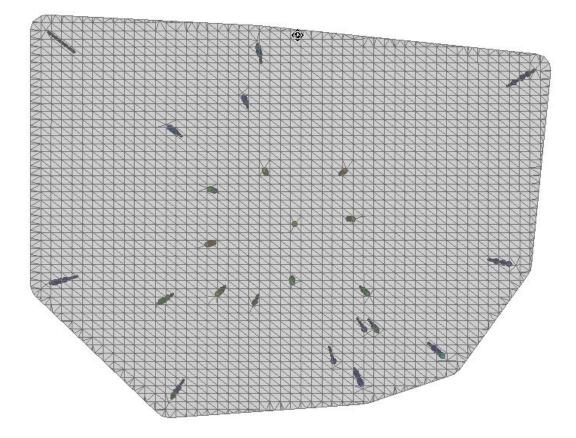
NOTE: The 2D grid preview is a Graphic added to the Scene's default Graphics Layer. If you save your project with the preview showing, it will be there when you next load the project. To remove it, select it as a graphic and delete.

Let's see our grid if we select the other convex hull option and reduce the offset to 5%. Make the changes below and click on Update Preview.

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			□ ×
Туре:	Even Sized Cells Clipped by	a Polygon	•
Resolution	X: 51		
Resolution	Y: 51		
Offset:	5.00 %		
Hull Type:	Convex		•
Include Sar	mple Points:		1
	Export Boundary Poly	gon to Feature Class	
Restrict to	Data Within Envelope:		
	Minimum Data Extent X:	11,081.30	
	Maximum Data Extent X:	11,591.34	
	Minimum Data Extent Y:	12,706.95	
	Maximum Data Extent Y:	13,094.40	
	Set Extents from	Document Layer	
-	Update Preview	Remove Preview	
10	7.81	(A)	

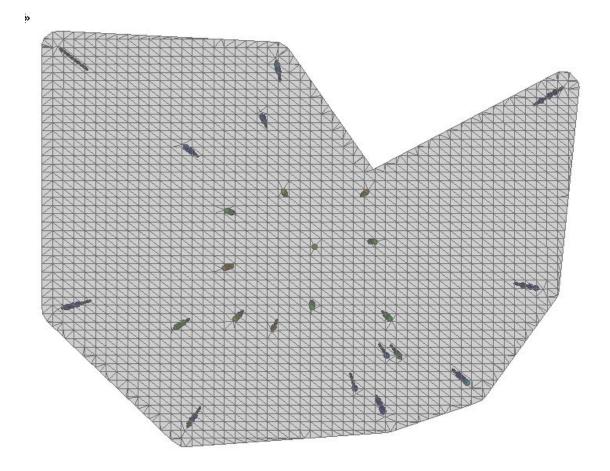
NOTE: When the *Include Sample Points* option is toggled on, the grid will include the X-Y coordinates of each point or sample. This helps to ensure that the estimations accurate include these values.



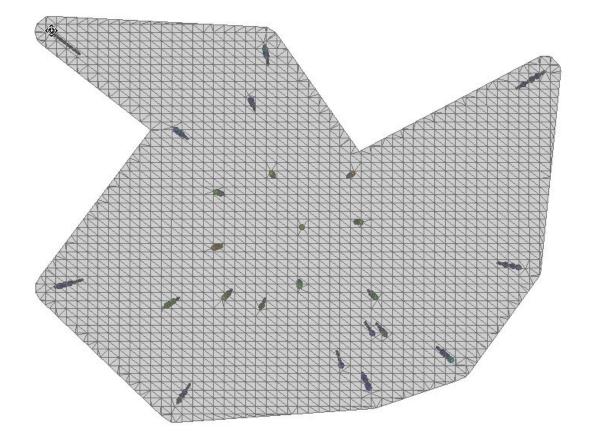
There is another interesting option which is similar to convex hull, but attempts to exclude regions of low data density. It is the *Concave Hull*. Using the default Alpha value of 100% yields

EnterVol Ver. 1.84 Help System www.ctech.com

				□ ×
Туре:	Even S	ized Cells Clipped by a	a Polygon	•
Resolution X:	51			
Resolution Y:	51			
Offset:	5.00 %			
Hull Type:		Concave		•
Alpha (Percent	tage):	100.00 %		
Include Sample	e Points:	C3		1
		Export Boundary Polyg	on to Feature Class	
Restrict to Da	ta Within	Envelope:		
M	linimum l	Data Extent X:	11,081.30	
M	laximum	Data Extent X:	11,591.34	
M	linimum (Data Extent Y:	12,706.95	
M	laximum	Data Extent Y:	13,094.40	
		Set Extents from D	Oocument Layer	
· · · · · ·	Jpdate Pi	review	Remove Preview	



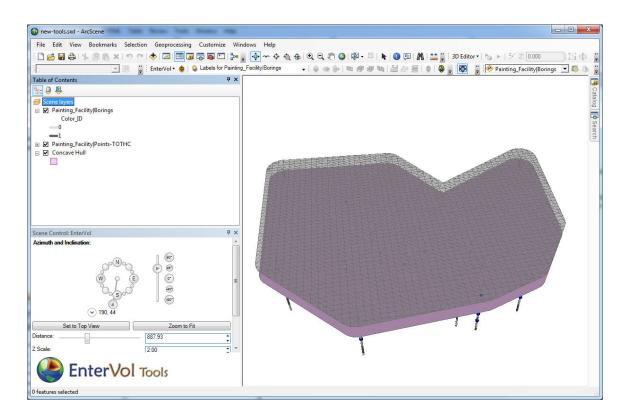
Lowering Alpha to 80% (which is the lowest allowed value) gives:



For the convex and concave hull options, you can *Export Boundary Polygon to Feature Class*. This allow you to export the current grid shape and then add more data to your project. You can then use this polygon to restrict your grid in ways that are not possible if the new data has larger extents.

For the Concave hull with 100% alpha and 10% offset, the polygon would be:

.ook in:	uh-hilo 🔹	🗄 🏠 🗔 🏢 🕶 😂 😂 💕 👒
old		UH-Hilo_salinity2_Salinity_
bathy.gmf		UH-Hilo_salinity2_Salinity_
salinity-rdc		UH-Hilo_salinity2_Salinity_
salinity.apc		uh2.evp
🗍 UH-Hilo_sa	linity.evp	BathyPointData.xlsx
🗍 UH-Hilo_sa	linity2.evp	🖾 Concave Hull.shp
UH-Hilo_sa	linity2_Salinity_Model-Salinity-Cut	t.evm 📼 points.xls
UH-Hilo_sa	linity2_Salinity_Model-Salinity-Plu	me.evm 🖻 points-rdc.xls
UH-Hilo_sa	linity2_Salinity_Model-Salinity-Plu	me2.evm
	III	•
•		
∢ Name:	Concave-hull-100.shp	Save

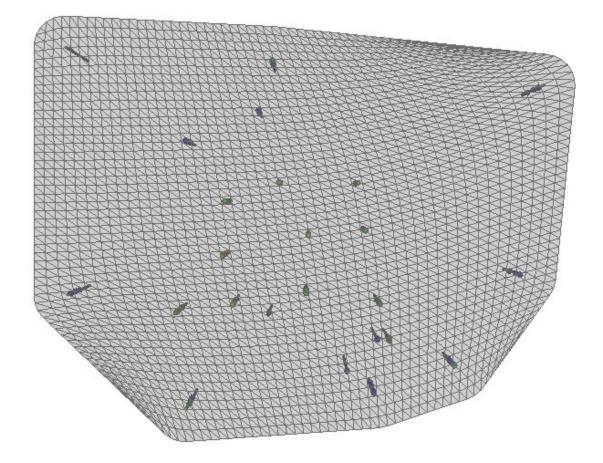


To use this polygon, choose the User Specified boundary polygon options:

2	Type:	Even Sized Cells Clip	oped by a Polygon 🗸
Models	Resolution X:	51	
20	Resolution Y:	51	
	Offset:	10.00 %	
	Hull Type:	User Sper	offied
	Keep Original	Boundary:	
	Include Sampl	e Points:	
	Region of Inte	erest:	
	E	xtent X:	0.00
	E	xtent Y:	0.00
	E	xtent Size X:	0.00
	E	xtent Size Y:	0.00
	(Choos	e Boundary Polygon
	l	Jpdate Preview	Remove Preview

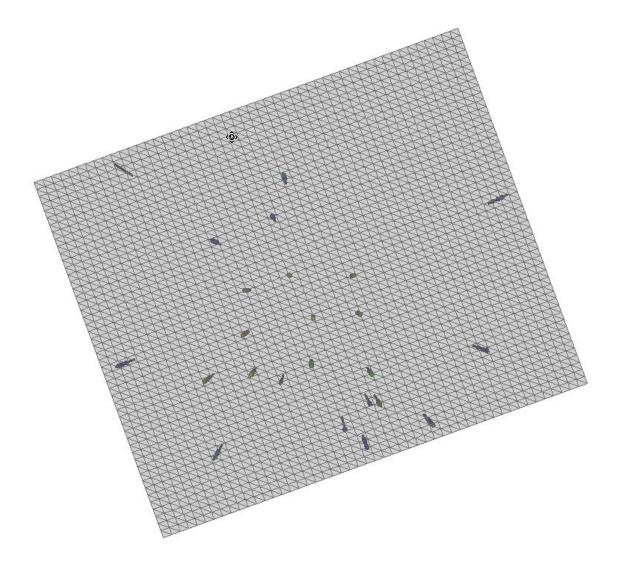
Another option is the Convex Hull with Smoothed Cells. This is very similar to the Convex Hull standard in EVS and MVS.

			□ ×
Type:	Convex Hull with Smoothed	Cells	•
Resolution X:	51		
Resolution Y:	51		
Offset:	10.00 %		
Restrict to Da	ta Within Envelope:		5
M	linimum Data Extent X:	11,081.30	
M	laximum Data Extent X:	11,591.34	
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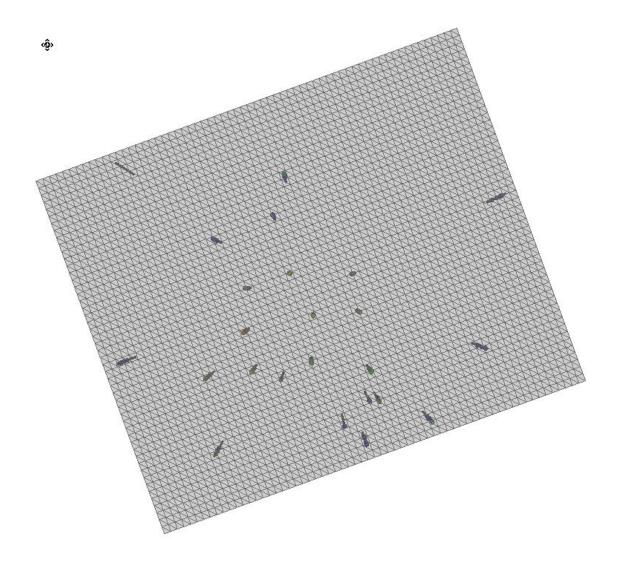
For completeness, let's look at the Rectilinear gridding option. It has an additional parameter which is the grid rotation (from the X axis). Looking at the convex hull grid above, we can see how a grid rotated about 20 degrees (counterclockwise) might better fit our data.

			□ ×
Туре:	Rectilinear		•
Resolution X:	51		
Resolution Y:	51		
Offset:	5.00 %		
Rotation (Degrees):	20		\$
Restrict to Data Wit	hin Envelope:		
Minimu	m Data Extent X:	11,081.30	
Maxim	um Data Extent X:	11,591.34	
Minimu	m Data Extent Y:	12,706.95	
Maxim	um Data Extent Y:	13,094.40	
	Set Extents from	Document Layer	
Update	e Preview	Remove Preview	



Notice that in the 2D rectilinear grid above, the cells are longer in the X direction than Y because the grid had the same resolutions but different X-Y extents.

Changing the Resolution X to 65 will give us a more symmetrical grid.



Each time we change the settings our 2D grid is updated (regardless of its name) to reflect the setting chosen. Before moving on, let's go back to *Even Sized Cells Clipped to a Polygon* (Convex Hull) with a 5% (.05) offset.

3D Surface Generation

3D Surfaces are created by specifying a previously created 2D Grid and choosing Surface data from one of your Stratigraphy surfaces.

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Model Name:	Topographic Surface			
Model Type:	Surface			

Modeling: EnterVol						□ ×
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Site: Painting Facility Data To Edit Import Borings Analytical Data Lithology	Drag and drop a column h Name 2D Grid Topographic Surfac			Surface Data: Estimation Options Interpolation Method: Use Gradients: Extrapolation Offset:	Ground Surface Natural Neighbor 50.00 %	•
Horizons Hierarchy Models Settings Units: Feet Change Site Settings				Model Generation Options	late and Display Model	

There are three Interpolation Methods. Natural Neighbor is shown above.

Inverse Distance Weighted has different creation options:

Site: Painting Facility 2 Data To Edit Import	+ Add g and drop a column Name	header here to gr	oup by that col	 Models 	XY Grid: Surface Data:		2D Grid	•
			oup by that col	Mod	Surface Data:			
Site: Painting Facility Data To Edit Import Borings	Name	N2A		<u>o</u>	Canado Data.		Ground Surface	•
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Borings) Grid	XY Grid			Interpolation Method:		Inverse Distance Weighted	······ •
Analytical Data	pographic Surfac	Surface			Search Options Use Full Data Sampling:			
Lithology					Full Data Sample Limit:	1000		
Horizons					Octant Search:			
Hierarchy Models				-	Points:	20		
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					IDW Power:		1.00	:
						Update and [Display Model	
					Model Generation Opti	ions		
						Export Surfac	e to ESRI TIN	

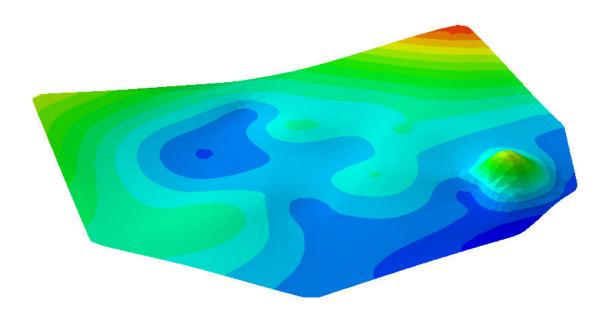
As does Kriging:

Modeling: EnterVol							□ ×
📽 🔮 😋 🔍 🔛 🕺 🕺	+ Add	Model		K) ()		2D Grid	•
· · · · · · · · · · · · · · · · · · ·	Drag and drop a column	header here to grou	up by that o	Models	Surface Data:	Ground Surface	•
Site: Painting Facility ② Data To Edit Borings	Name	Туре			Estimation Options Interpolation Method:	Ordinary Kriging	•
Borings	2D Grid	XY Grid			Search Options		
Analytical Data	Topographic Surfac	Surface			Use Full Data Sampling:		
Lithology					Full Data Sample Limit:	1000	
Horizons					Octant Search:		
Hierarchy Models				-	Points:	20	
Settings					Reach:	10,000,000,000.00	:
Units: Feet Change					Kriging Options		
Site Settings					Variogram Type:	Spherical	•
					Nugget:	0.00	:
					Automatically Compute:		
						Update and Display Model	
					Model Generation Opt	tions	
						Export Surface to ESRI TIN	

Once you select the surface to be created (from those in Horizons) and the method (let's use Natural Neighbor), you have two options.

- Update and Display Model: This option should be used to add the surface layer to your Table of Contents
- Export Surface to ESRI TIN: This option has some extra steps (since you must specify the folder name for the TIN files), and it also adds the surface layer to your Table of Contents. The big difference is that as a TIN, you can use the surface as elevation data for imagery (aerial photos).

Visualization: EnterVol	д	×
✓ Layer Operations		
Current Progress:	1	
Step: 1 of 1 Data: Initial_Soil_Site Model-1	1	
Symbology Options:	1	
Color By Field:	1	
Elevations	1	
Coloring Method:		
Fixed Number of Breaks		
Number of levels: 15		
Advanced		
	1	
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EnterVol for ArcGIS		



3D Grid Generation

3D Grid Generation is one of the processes which has enhanced capabilities when EnterVol Geology is licensed.

Main Options		
XY Grid:	2D Grid	•
Method:	Surface Top + Surface Bottom	•
Interpolation Method:	Natural Neighbor	•
Use Gradients:		1
Top Of Model		
Surface:	Ground Surface	*
Bottom Of Model		
Surface:	Bottom of Model	•
Model Resolution		
Number of Cells:	31	
Pinch Out Handling		
Remove Pinch Outs:	No	•
Minimum Model Thickness:	0.010000	
Surface Priority	Top Down	•
Data to Include		
Elevation:		1
Depth:		1
Model Thickness:		1
Ur	odate and Display Model	
✓ Model Generation Options		
Force Regeneration:		
Regenerate Dependencies:		1

The 3D Grid Generation options are:

- XY Grid: Here you choose from the XY grids that you have created. Your modeling project can have more than one.
- Method:
 - Flat Top + Flat Bottom at specified elevations
 - Surface Top + Flat Bottom
 - Flat Top + Surface Bottom
 - Constant Thickness
 - Surface Top + Surface Bottom (requires EnterVol Geology)

Interpolation Method:	Natural Neighbor	1
Use Gradients:	Natural Neighbor	-4
Extrapolation Offset:	Inverse Distance Weighted Ordinary Kriging	

- Interpolation Method: Each method has different options. See the <u>3D</u> <u>Surface Generation</u> topic for examples.
 - Natural Neighbor is the default and recommended method
 - Inverse Distance Weighted
 - Ordinary Kriging
- Use Gradients: Determines if surface gradients will affect the surface shape. Often makes more realistic surfaces, but occasionally extrapolates in bizarre ways if your data is clustered.
- Top Of Model: Here you select the surface which will define the top of your 3D Grid
- Bottom Of Model: Here you select the surface which will define the bottom of your 3D Grid
- Model Resolution: The number of cells in the vertical direction. If you plan to stratify your model or add analyte data you need a reasonable number of cells (depends on the number of layers and/or amount of data in the z direction).
- Pinch Out Handling
 - Remove Pinch Outs: If layers drop below a threshold thickness they will be removed or will remain as a thin sheet. If your grid will be exported to initialize ground water models you may not want to remove these sections.
 - Minimum Model Thickness: The threshold below which layers will be removed. This will also be the minimum thickness for layers that would otherwise pinch if the above option is set to NO.
 - Surface Priority: If horizons intersect one another, this option determine the hierarchy (precedence) of horizons.
- Data to Include:
 - Elevation (z coordinate)
 - Depth (distance below the ground surface)
 - Model Thickness
- Update and Display Button (creates the model and adds it to your table of contents
- Model Generation Options
 - Force Regeneration: Recomputes all dependent models. In this case the XY grid specified.

Click on the to create a new model element. Provided that at least one 2D grid has already been created, the option of creating a 3D Grid will be available. Choose a Model Name and hit OK.

3D Flat		
3D Grid		

As discussed above, there are 5 basic options for creating the 3D Grid. The simplest is to define an elevation for the top and bottom of the model and the number of cells to span the resulting thickness.

XY Grid:	2D Grid CVX
Method:	Surface Top + Surface Bottom
Top Of Model Surface:	Flat Top + Flat Bottom Surface Top + Flat Bottom Flat Top + Surface Bottom Constant Thickness
Bottom Of Model Surface:	Surface Top + Surface Bottom

3D Grid Generation

3D Grid Generation is one of the processes which has enhanced capabilities when EnterVol Geology is licensed.

Main Options		
XY Grid:	2D Grid	•
Method:	Surface Top + Surface Bottom	•
Interpolation Method:	Natural Neighbor	•
Use Gradients:		1
Top Of Model		
Surface:	Ground Surface	•
Bottom Of Model		
Surface:	Bottom of Model	•
Model Resolution		
Number of Cells:	31	(*)
Pinch Out Handling		
Remove Pinch Outs:	No	•
Minimum Model Thickness:	0.010000	
Surface Priority	Top Down	•
Data to Include		
Elevation:		1
Depth:		1
Model Thickness:		1
Ur	odate and Display Model	
✓ Model Generation Options		
Force Regeneration:		
Regenerate Dependencies:		1

The 3D Grid Generation options are:

- XY Grid: Here you choose from the XY grids that you have created. Your modeling project can have more than one.
- Method:
 - Flat Top + Flat Bottom at specified elevations
 - Surface Top + Flat Bottom
 - Flat Top + Surface Bottom
 - Constant Thickness
 - Surface Top + Surface Bottom (requires EnterVol Geology)

nterpolation Method:	Natural Neighbor
	Natural Neighbor
Use Gradients:	Inverse Distance Weighted
Extrapolation Offset:	Ordinary Kriging

- Interpolation Method: Each method has different options. See the <u>3D</u> <u>Surface Generation</u> topic for examples.
 - Natural Neighbor is the default and recommended method
 - Inverse Distance Weighted
 - Ordinary Kriging
- Use Gradients: Determines if surface gradients will affect the surface shape. Often makes more realistic surfaces, but occasionally extrapolates in bizarre ways if your data is clustered.
- Top Of Model: Here you select the surface which will define the top of your 3D Grid
- Bottom Of Model: Here you select the surface which will define the bottom of your 3D Grid
- Model Resolution: The number of cells in the vertical direction. If you plan to stratify your model or add analyte data you need a reasonable number of cells (depends on the number of layers and/or amount of data in the z direction).
- Pinch Out Handling
 - Remove Pinch Outs: If layers drop below a threshold thickness they will be removed or will remain as a thin sheet. If your grid will be exported to initialize ground water models you may not want to remove these sections.
 - Minimum Model Thickness: The threshold below which layers will be removed. This will also be the minimum thickness for layers that would otherwise pinch if the above option is set to NO.
 - Surface Priority: If horizons intersect one another, this option determine the hierarchy (precedence) of horizons.
- Data to Include:
 - Elevation (z coordinate)
 - Depth (distance below the ground surface)
 - Model Thickness
- Update and Display Button (creates the model and adds it to your table of contents
- Model Generation Options
 - Force Regeneration: Recomputes all dependent models. In this case the XY grid specified.

Click on the to create a new model element. Provided that at least one 2D grid has already been created, the option of creating a 3D Grid will be available. Choose a Model Name and hit OK.

3D Flat
3D Grid

As discussed above, there are 5 basic options for creating the 3D Grid. The simplest is to define an elevation for the top and bottom of the model and the number of cells to span the resulting thickness.

XY Grid:	2D Grid CVX
Method:	Surface Top + Surface Bottom
Top Of Model Surface:	Flat Top + Flat Bottom Surface Top + Flat Bottom Flat Top + Surface Bottom Constant Thickness
Bottom Of Model Surface:	Surface Top + Surface Bottom

Flat Top + Flat Bottom

As discussed in the previous topic, there are 5 basic options for creating the 3D Grid. The simplest 3D Grid is defined by an elevation for the top and bottom of the model and the number of cells to span the resulting thickness.

In the example below we create a 3D grid using the 2D grid previously created spanning elevations from -40 to +12. We'll change the default model resolution to be 52 so that each of cells will represent 1.0 units in Z. It is not required to make the cells a particular size.

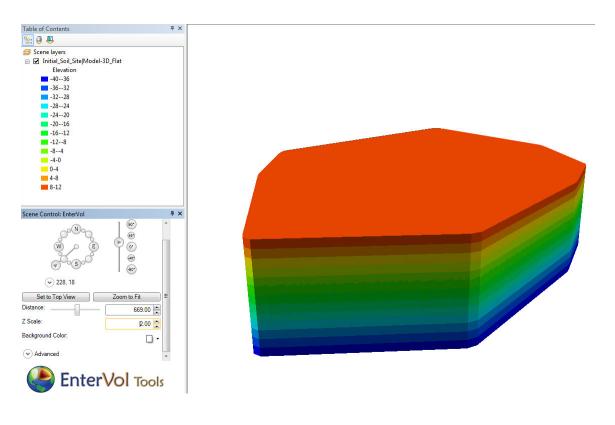
Mo	deling: EnterVol						
	deling: EnterVol Project Data Initial Soil Site Borings Analytical Data Lithology Stratigraphy Models	Mod	Name 2D Grid CVX	Type XY Grid 3D Grid	Models		Grid CVX • t Top + Flat Bottom • 12.000000 * -40.000000 * 52 * 0.010000 * 0.010000 *
						Thickness:	

When we click on Generate, the grid will be created and the following window will appear in the Visualization: EnterVol panel.

Since our Z elevations will span 52, let's choose 13 levels for the Symbology so that each break will be 2 meters.

Visuali	zation: EnterVol	ą×
v La	ayer Operations	
(Current Progress:	
C C	Step: 1 of 1 Data: Initial_Soil_Site Model-3	
N S	Symbology Options:	
	Color By Field:	
1	Elevation	•
6	Coloring Method:	
~	Fixed Number of Breaks	•
0	Number of levels:	13 💼
-	Advanced OK Cancel	
-*		

When we select our settings and click OK, the 3D Grid will be added to the project.



Surface Top + Flat Bottom

A much more useful 3D Grid can be defined by a surface determined by ground survey data and an elevation for the bottom of the model.

Click on the to create a new model element with surface topography as our upper bounding surface and a flat bottom at a constant elevation.

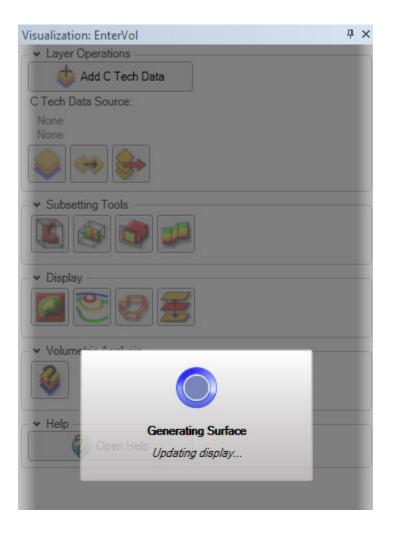
Topo Top Flat Bottom		
3D Grid		

Adjust your settings to match those below. We've chosen the "Top" surface as the Top of Model and an elevation of -42 as the Bottom.

The number of cells (in the Z direction) was increased to 40. All other parameters are defaults.

Modeling: EnterVol						
▲ Project Data	Mode	els				
▲ Initial Soil Site Borings Analytical Data		Name T 2D Grid CVX	Type XY Grid	> Models	Main Options XY Grid: Method:	2D Grid CVX • Surface Top + Flat Bottom •
Lithology Stratigraphy Models	x	3D Flat 3D G	3D Grid Surface		Top Of Model Surface:	Тор •
	> Project	Topo Top Flat Bottom	3D Grid		Bottom Of Model Elevation:	-42.000000
	Project Explorer				Model Resolution Number of Cells:	40 🛋
					Pinch Out Handling Remove Pinch Outs:	Yes
Models					Minimum Layer Size: Data to Include Elevation:	0.010000
					Depth: Thickness:	
						Generate

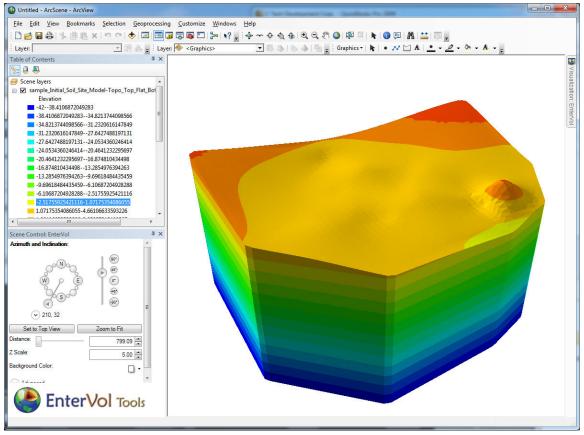
When we click on Generate,



When the grid is created and the following window will appear in the Visualization: EnterVol panel.

ualization: EnterVol	
Layer Operations	
Current Progress:	
Step: 1 of 1 Data: Initial_Soil_SitelModel-1	
Symbology Options:	
N CONTRACTOR CONTRACTOR	
Color By Field:	
Elevation	•
Coloring Method:	
Fixed Number of Breaks	•
Number of levels:	15
Advanced	
OK Cancel	

When we select our settings and click OK, the 3D Grid will be added to the project.

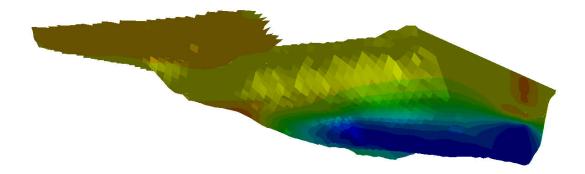


Flat Top + Surface Bottom

Having a flat top and a variable surface bottom is the correct grid type for most all water bodies (lakes, rivers, reservoirs, etc.).

Modeling: EnterVol		1					×
▲ Project Data		🕂 Add M	lodel X	0	Main Options		
▲ Initial Soil Site	C		τ Type τ	 Models 	XY Grid:	2D Grid CVX	•
Borings		2D Grid CVX	XY Grid	els	Method:	Flat Top + Surface Bottom	•
Analytical Data		3D Top to Sand	3D Grid		Interpolation Method:	Natural Neighbor	
Lithology			Stratified		Transmit Seren State State Seren Seren Seren	Natural Neighbor	
Horizons	X	5 Layer	and the second sec		Use Gradients:		
Hierarchy	5	тотнс	Analyte Estimation		Top Of Model	12-	
Models	Pro	> Flat Top Surf Bot	3D Grid		Elevation:	12.398972	
	oject				Bottom Of Model		
	X				Surface:	Sand	•
	Project Explorer				Model Resolution		
	2				Number of Cells:	31	<u>100</u>
					Pinch Out Handling		
					Remove Pinch Outs:	No	•
					Minimum Layer Size:	0.010000	*
					Data to Include		
					Elevation:		
					Depth:		
					Thickness:		v
					U	odate and Display Model	
					> Model Generation Options		

Below is a model of a lake in Saskatchewan, Canada which has been cut through a region with high dissolved oxygen levels.



Constant Thickness

Another useful 3D Grid can be defined by an upper surface and a constant thickness (e.g. constant depth below the upper surface).

Click on the to create a new model element with surface topography as our upper bounding surface and a constant depth.

EnterVol Ver. 1.84 Help System www.ctech.com

🚯 Add New Mod	el:	
Model Name:	Constant Thickness	
Model Type:	3D Grid	
ОК	Cancel	

Adjust your settings to match those below. We've chosen the "Top" surface as the Top of Model and a thickness of 50.

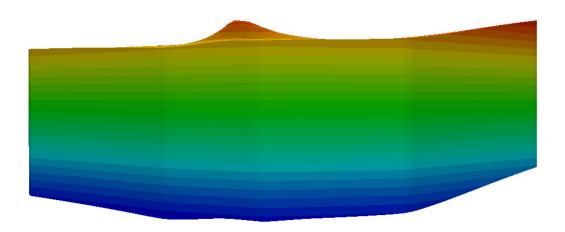
The number of cells (in the Z direction) was increased to 50. All other parameters are defaults.

Modeling: EnterVol			Contraction of Contra			
▲ Project Data) M	odels				
▲ Initial Soil Site		+	×	•	Main Options XY Grid:	2D Grid CVX -
Borings		Name T	Туре	T		2D Grid CVX
Analytical Data		2D Grid CVX	XY Grid	co.	Method:	Constant Thickness
Lithology		3D Flat	3D Grid		Top Of Model	
Stratigraphy	X	Topographic Surface	Surface		Surface:	Тор •
Models	7	Topo Top Flat Bottom	3D Grid		Bottom Of Model	
	roje	> Constant Thickness	3D Grid		Thickness:	50.000000
	ê –		6		Model Resolution	
	Project Explorer				Number of Cells:	50 🛋
	۳				Pinch Out Handling	
					Remove Pinch Outs:	Yes
					Minimum Layer Size:	
					Minimum Edyer Orze.	0.010000
					Data to Include Elevation:	
					Depth:	
					Thickness:	
						Generate
]

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Visua	alization: EnterVol	•
~ *	Layer Operations	
	Current Progress:	
C.	Step: 1 of 1 Data: Initial_Soil_Site Model-(
1	Symbology Options:	
-	Color By Field:	
1	Elevation	
-	Coloring Method:	-
~	Fixed Number of Breaks 👻	
0	Number of levels: 25	
-		-
1	Advanced	
1	OK Cancel	
*		

You can see in the view below (Z Scale - 3) that the model is constant thickness.



Surface Top + Surface Bottom

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EnterVol Geology adds the ability to create 3D grids which are defined by two arbitrary surfaces.

For our example database, we have 6 surfaces. Any of these can be selected as the top of our grid

Surface:	Тор	
20117 100550 DIDI	Fill	
Bottom Of Model Surface:	Тор	
	Silt	
	Clay	
Model Resolution	Gravel	
Number of Cells:	Sand	

provided we choose a lower surface as the bottom. For these 6 surfaces the hierarchy is:

- 1. Top
- 2. Fill (bottom)
- 3. Silt (bottom)
- 4. Clay (bottom)
- 5. Gravel (bottom)
- 6. Sand (bottom)

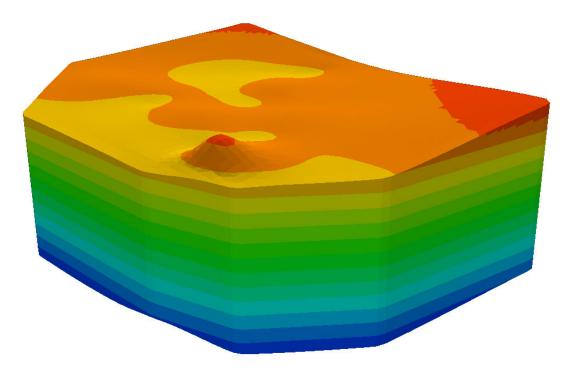
If we chose Top and Fill we would create a model of the Fill layer. If we use Gravel and Sand we'd be building the Sand layer, since the "top of Sand" is the bottom of Gravel.

Let's choose Top and Sand so we create a model that includes all 5 layers of our stratigraphy. We can later use EnterVol Geology to create a Stratified Grid.

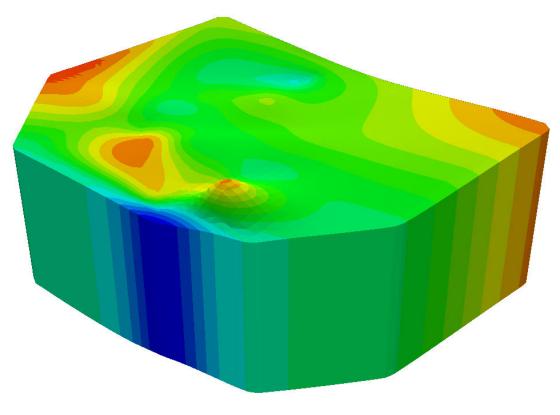
Model Name:	3D Top to Sand		
Model Type:	3D Grid		
woder Type:	BD Grid		

Modeling: EnterVol					×
Modeling: EnterVol Project Data Initial Soil Site Borings Analytical Data Lithology Horizons Hierarchy Models	2 Project Explorer	Name Type Type 2D Grid CVX XY Grid 3D Top to Sand 3D Grid	Main Options XY Grid: Method: Top Of Model Surface: Bottom Of Model Surface: Model Resolution Number of Cells: Pinch Out Handling Remove Pinch Outs: Minimum Layer Size: Surface Priority Data to Include Elevation: Depth: Thickness:	ZD Grid CVX • Surface Top + Surface Bottom • Top • Sand • 31 • 0.010000 • Bottom Up • I I	
			Thickness:		

> Output File: sample_Initial_Soil_Sit.	
Add Output Layer	
Hide Input Layer	
Copy Symbology from Input	V
OK Cancel	



One of the best ways to appreciate that this grid has variable surfaces on top and bottom is to compare the elevation contours above to the contours of Thickness shown below. To create this, choose the model above and <u>Set</u> <u>Symbology</u>

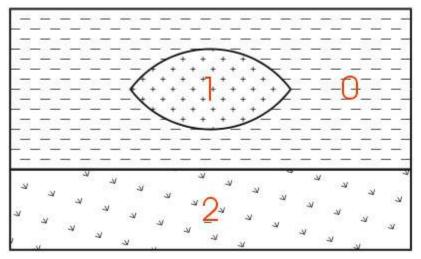


Geology: Stratified Models

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EnterVol allows you to use stratigraphic data to further refine and subset your 3D grids. Stratigraphic data represents surfaces which form a Geologic Hierarchy.

Simply stated, hierarchy requires that all geologic horizons throughout the domain be ordered from top to bottom and that a consistent hierarchy be used for all borings. At first, it may not seem possible for a uniform layer hierarchy to be applicable for all borings. Layers often pinch out or exist as localized lenses. Also layers may be continuous in one portion of the domain, but may be split by another layer in other portions of the domain. However, all of these scenarios and many others can be easily modeled using a hierarchical approach.



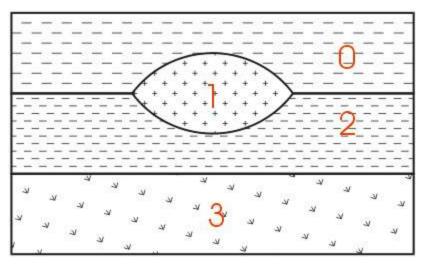
The easiest way to describe geologic hierarchy is with an example. Consider the example above of a clay lens in sand with gravel below.

Imagine borings on the left and right sides of the domain and one in the center. Those outside the center would not detect the clay lens. On the sides, it appears that there are only two layers in the hierarchy, but in the middle there are three materials and four layers.

EnterVol's hierarchical geologic modeling approach accommodates the clay lens by treating every layer as a sedimentary layer. Because we can accommodate "pinching out" layers (making the thickness of layers ZERO) we are able to produce most geologic structures with this approach.

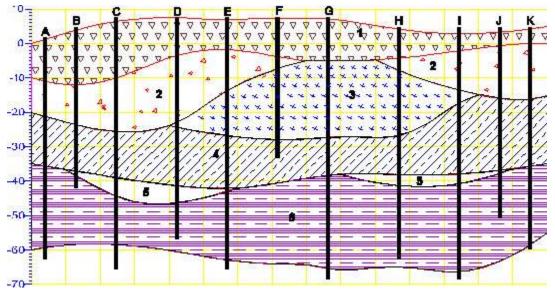
Geologic layer hierarchy requires that we treat this domain as 4 geologic layers. These layers would be

- 1. Upper Sand (0)
- 2. Clay (1)
- 3. Lower Sand (2)
- 4. Gravel (3).



If desired, both Upper and Lower Sand can have identical symbology in the final output.

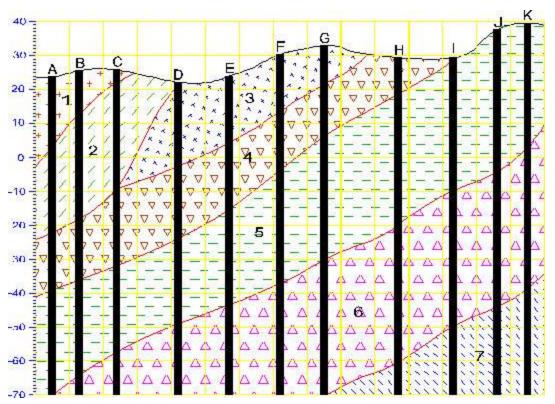
For those sites that can be described using the above method, it remains the best approach for building a 3D geologic model. Each layer has smooth boundaries and the layers (by nature of hierarchy) can be exploded apart to reveal the individual layer surface features. In the above example, the numbers represent the layer numbers for this site (even though the layers labeled 0 and 2 are both sand). Two examples of much more complex sites that are best described by this original approach are shown below.



Stratified Model Example: Sedimentary Layers and Lenses

Stratified Model Example: Outcrop of Dipping Strata

EnterVol is not limited to sedimentary layers or lenses. The figure below shows a cross-section through an outcrop of dipping geologic strata. EnterVol can easily model the layers truncating on the top ground surface.

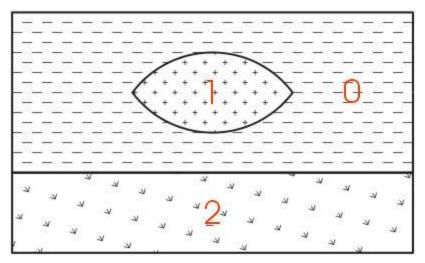


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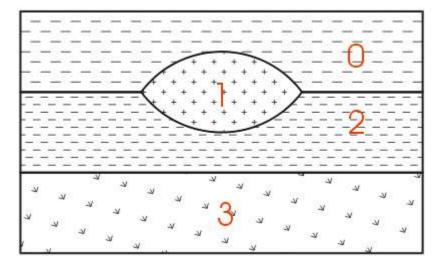
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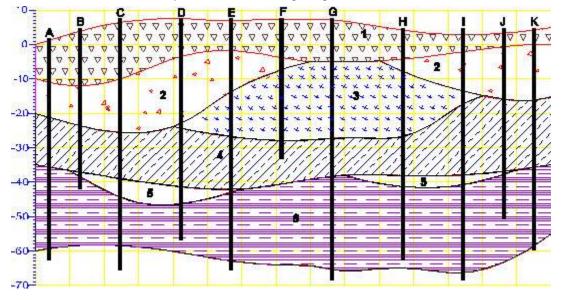
Geologic layer hierarchy requires that we treat this domain as 4 geologic layers. These layers would be

- 1. Upper Sand (0)
- 2. Clay (1)
- 3. Lower Sand (2)
- 4. Gravel (3).



If desired, both Upper and Lower Sand can have identical symbology in the final output.

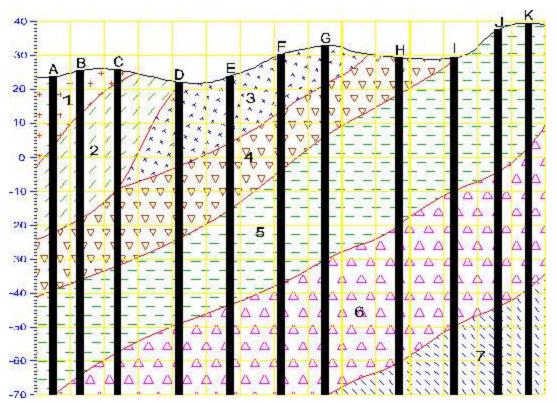
For those sites that can be described using the above method, it remains the best approach for building a 3D geologic model. Each layer has smooth boundaries and the layers (by nature of hierarchy) can be exploded apart to reveal the individual layer surface features. In the above example, the numbers represent the layer numbers for this site (even though the layers labeled 0 and 2 are both sand). Two examples of much more complex sites that are best described by this original approach are shown below.



Stratified Model Example: Sedimentary Layers and Lenses

Stratified Model Example: Outcrop of Dipping Strata

EnterVol is not limited to sedimentary layers or lenses. The figure below shows a cross-section through an outcrop of dipping geologic strata. EnterVol can easily model the layers truncating on the top ground surface.



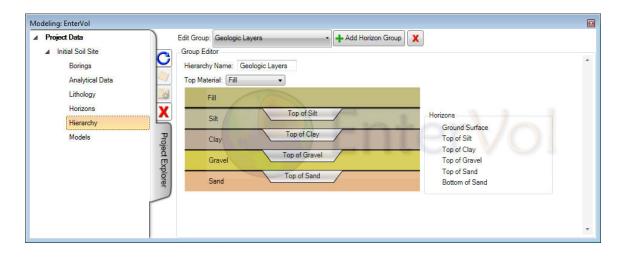
<u>Horizons</u>

Selecting Horizons under your Site in the Modeling Window will bring up the following:

▲ Project Data		Horizons			Horizo	Horizon Data			
▲ Initial Soil Site	C			Pick Data From Borings					
Borings Analytical Data		+ Add	l Horizon	X				+ Add Horizon Data	X
Lithology	30	Description	Material Below Horizon				T Depth	۲	
Horizons	X	> Ground Surface	Fill	0	>	B-30 B-31	0		_
Hierarchy	5	Top of Silt	Silt	1		B-31 B-32	0		
Models	Project Explorer	Top of Clay Clay 2 Data from Scattered Location				ocations			
	ed E	Top of Gravel	Gravel	3					
	xplo	Top of Sand	Sand	4				No Data	
	rer	Bottom of Model	Unknown	5	; conta	ins no so	attered loca	ation data. Click below to import o	r add scattered locat
		•						+ Add Horizon Point	

<u>Hierarchy</u>

Though it may seem that the settings in Hierarchy are redundant with those in Horizons, this window provides some important capabilities. The horizon ordering in Hierarchy are those that are actually used when making a Stratigraphic model. The *Hierarchy* section lists the stratigraphic layers in order and all horizons used to define stratigraphy. By selecting the horizons in the display below, you can move the order of horizons or eliminate layers in the hierarchy. Removing a horizon eliminates the layer below it.



Removing the horizon "Top of Clay" above, would eliminate clay from the hierarchy resulting in a Silt layer that extends from *Top of Silt* down to the *Top of Gravel*.

Geology: Build Stratified Grid

Once you have your data that describes stratigraphy in your site, the grid can be refined in amazing ways.

What can we do?

- Refine our 3D grid into stratigraphic layers.
- Segregate the saturated (below water table) and unsaturated (above water table) zones
- Segregate the stratigraphic layers by whether they are saturated or unsaturated
- Remove excavation pits and/or compute excavation volumes and masses

We can now take the 3D Grid which was defined from our Top surface down to the bottom of Sand and refine it to include all 5 of our stratigraphic layers.

Create a new Model:

EnterVol Ver. 1.84 Help System www.ctech.com

Model Name:	5 Layer			
Model Type:	Stratified •			

The window will now show:

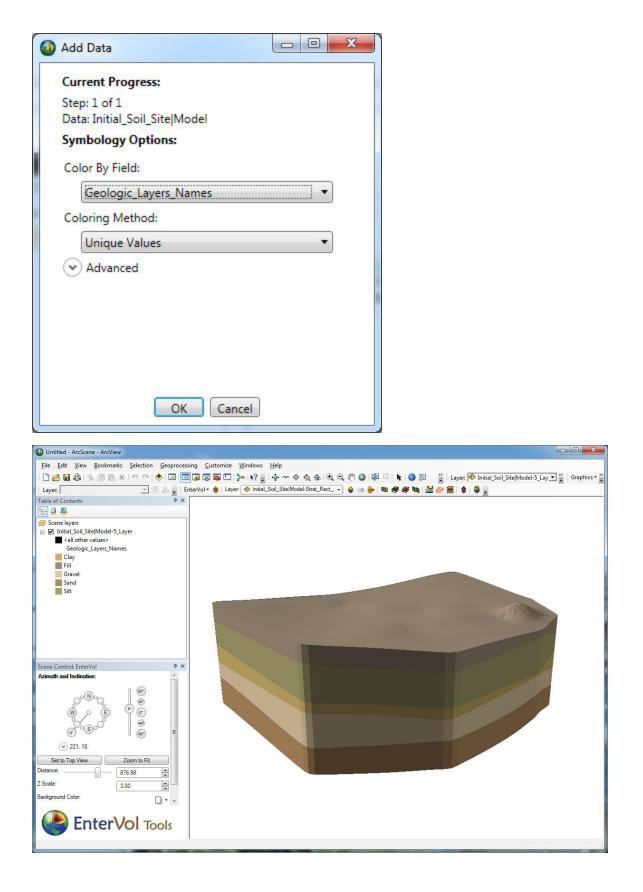
Modeling: EnterVol						
Project Data Initial Soil Site		+	X	N (Model Model:	3D Top to Sand •
Borings		Name 2D Grid CVX	T Type XY Grid	Models ۲	Horizon Group:	Geologic Layers •
Analytical Data Lithology	\geq	3D Top to Sand	3D Grid		Main Options	
Horizons	X	I 5 Layer	Stratified		Surface Priority	Top Down -
Hierarchy Models	Pro				> Model Generation Options	Update and Display Model
	Project Explorer					

Click on Update and Display Model

The window below will appear to specify symbology:

Add Data	
Current Progress:	
Step: 1 of 1 Data: Initial_Soil_Site Mode	I
Symbology Options:	
Color By Field:	
Elevation	÷
Coloring Method:	
Fixed Number of Break	:s 🔹
Number of levels:	15
Capture Full Data Range:	
Lower Breaks Bound:	-56.4884118277912
Upper Breaks Bound:	12.0704190935315
 Advanced 	
ОК	Cancel

We'll change the "Color By Field" to be our Layer names



Geology: Lithology THIS TOPIC WILL REQUIRES AN EnterVol Geology LICENSE

This geologic modeling approach uses lithology data directly to compute the probability for each material throughout the grid. This is a completely different paradigm than a stratified model which is created using geologic horizons.

With Lithology modeling, the distances to surrounding borings and the nearest materials will determine the material assignments. In contrast, Stratigraphic models assign materials based on geologic horizon surfaces. When materials should not be correlated by continuous surfaces, Lithology modeling is best.

Modeling: EnterVol								X
😤 🗣 C 🔍 📓 🛛 🗶 🤇		Add Model	X	> Models	Main Options Model:	TOTHC		•
Site: Soil Subsite 3	Drag and drop a col	umn header here to gr	oup by that col	dels	Sampling Distance:	4.20		:
Site: Soil Subsite ② Data To Edit Import Borings	2D Grid	Type XY Grid			Lithology Method:	Smooth Block		•
Borings	3D Grid	3D Grid			Estimation Options	Smooth		E Contraction of the second se
Analytical Data	Stratigraphy	Stratified			Estimation Method:		Kriging	•
Horizons	Ground Surface	Analyte Estimation Surface			Search Options Use Full Data Samp	ling		
Hierarchy	Lithology	Lithology		2	Full Data Sample Lin			\$
Models			I		Octant Search:			
Units: ft Change					Points:	20		:
Site Settings					Reach:	10,000,000	0,000.00	÷
					Horizontal/Vertical A	knisotropy: 10.00		\$
					Model Generation		d Display Model	
						i optiona		

In the Lithology modeling window above you can see the options:

Model determines which grid or existing model will be used as the foundation for adding Lithology data.

Sampling Distance is a physical distance in your site units (e.g. meters or feet) that is used to convert the intervals of lithology data into discrete points for the material assignment process. Smaller distances would generally increase accuracy, but at the expense of compute time and memory

usage. This distance should generally never be set smaller than the vertical size of your model cells.

The Lithology Method selector includes two options:

- **Block** is similar to EVS-PRO's indicator_geology module. The material having the highest probability (for an individual cell) is assigned to the cell. All of the individual material probabilities are also provided as additional cell data components. This will allow you to identify regions where the material assignment is somewhat ambiguous. The resulting model has a BLOCKY appearance because lithology is not refined to a sub-cell level.
- **Smooth** uses algorithms unique to C Tech and EnterVol. The resulting model has smooth boundaries between materials because lithology is refined to a sub-cell level. This refinement takes more time and results in increased effective resolution and greater memory requirements. The number of materials represented in your lithology has a profound affect on the model creation time and memory requirements.

The **Estimation Method** selector includes three options:

- Nearest Neighbor is a Quick Method which assigns the geologic material to the nearest geologic material (in anisotropic space) to the cells (Block method) or nodes (Smooth Method) in your grid. Smooth still refines your grid further, but not as accurately as the other two methods below which compute more accurate probabilities.
- Inverse Distance Weighted IDW provides a more rigorous (than Nearest Neighbor) probabilistic approach to lithology modeling because it computes the probabilities for each material in your lithology.
- Kriging provides the most rigorous probabilistic approach to lithology modeling because it computes the probabilities for each material in your lithology.

The **Use Full Data Sampling** toggle causes all of your data to be used for the estimation process instead of just the N nearest points. This is subject to the **Full Data Sample Limit** parameter.

The **Full Data Sample Limit** parameter is the upper limit for using all samples. Since the compute time and memory tends towards the square of the total number of points used for estimation, this parameter prevents accidentally using an option which might cause your memory or compute time to be huge. The default of 1000 is a reasonable upper limit, but values of 3000 to 5000 are occasionally justified.

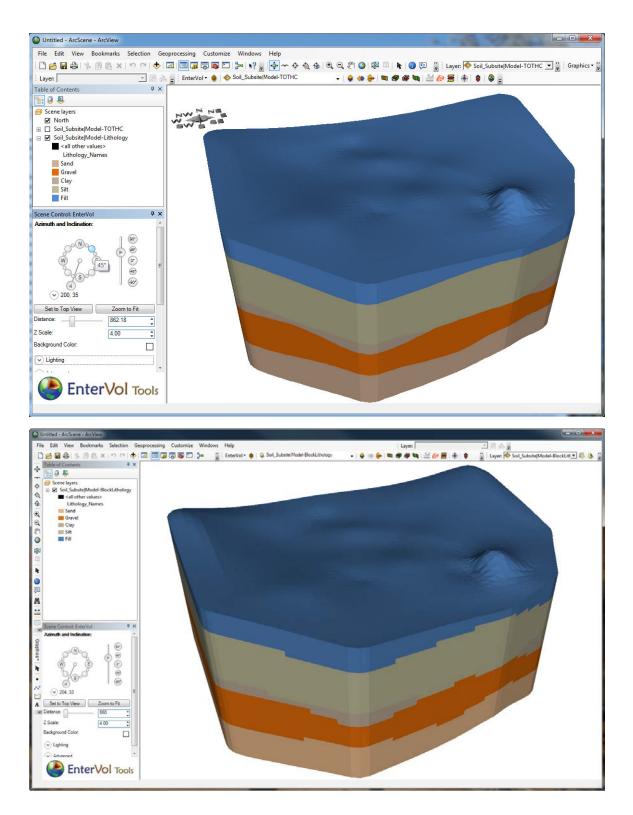
Points is the maximum number of points used for estimation, if the **Use Full Data Sampling** toggle is off. The default value for points is 20, which generally provides reasonably smooth modeled parameter distributions. The effects of decreasing and increasing the values for reach and points on the model output are somewhat similar, but for different reasons. If the data have a fairly even spatial distribution throughout the domain, then increasing these values will generally include more of the input data points that will be used to krige the value for a given model node, and thus will result in smoother modeled data distributions. Decreasing the values of reach and points (in an evenly distributed data set) results in fewer input data points being used to calculate the parameter estimates at a given model node, and result in modeled distributions with greater variations across smaller areas.

Reach is the maximum distance (in user units) from any given model node that the estimation method will look for data points to be included in the estimation of the model parameter at that node. The default value of reach is 10 billion, which results in Points being the limiting factor.

The user should consider both the spatial distribution and the range of values in the input data set when deciding upon values for the reach and points parameters. If the specified reach is too small to allow the kriging module to locate at least one point within the search area, then no kriging can be done and the module will terminate with an error message.

The *Horiz./Vert. Anisotropy Ratio* basically tells the kriging algorithm what multiplication factor should be used to apply biased weighting on data points in horizontal and vertical directions away from a given model node. The default value is 10, which allows data points in a horizontal direction away from a model node to influence the kriged value at that node 10 times more than data points an equal distance away in a vertical direction. However, the user can specify any positive number with a magnitude up to 100,000.

Below is an example of both SMOOTH and BLOCK Lithology models.



GeoStats: Analytical Data Estimation THIS TOPIC REQUIRES AN EnterVol GeoStats LICENSE

Provided that at least one 3D Grid has been created, Click on the 📥 to map (estimate) analytical data onto a 3D volumetric grid.

Model Name:	Total Hydrocarbons		
Model Type:	Analyte Estimation		

The **Estimation Method** selector includes three options:

- Nearest Neighbor is a Quick Method which assigns the data based on the nearest analyte sample (in anisotropic space) nodes in your grid.
- Inverse Distance Weighted IDW provides a more rigorous (than Nearest Neighbor) probabilistic approach to analyte modeling because it computes the probabilities for each material in your lithology.
- Kriging provides the most rigorous probabilistic approach to analyte modeling because it computes the probabilities using expert system computed weighting factors

The **Use Full Data Sampling** toggle causes all of your data to be used for the estimation process instead of just the N nearest points. This is subject to the **Full Data Sample Limit** parameter.

The **Full Data Sample Limit** parameter is the upper limit for using all samples. Since the compute time and memory tends towards the square of the total number of points used for estimation, this parameter prevents accidentally using an option which might cause your memory or compute time to be huge. The default of 1000 is a reasonable upper limit, but values of 3000 to 5000 are occasionally justified.

The Octant search toggle

Points is the maximum number of points used for estimation, if the **Use Full Data Sampling** toggle is off. The default value for points is 20, which generally provides reasonably smooth modeled parameter distributions. The effects of decreasing and increasing the values for reach and points on the model output are somewhat similar, but for different reasons. If the data have a fairly even spatial distribution throughout the domain, then increasing these values will generally include more of the input data points that will be used to krige the value for a given model node, and thus will result in smoother modeled data distributions. Decreasing the values of reach and points (in an evenly distributed data set) results in fewer input data points being used to calculate the parameter estimates at a given model node, and result in modeled distributions with greater variations across smaller areas. **Reach** is the maximum distance (in user units) from any given model node that the estimation method will look for data points to be included in the estimation of the model parameter at that node. The default value of reach is 10 billion, which results in Points being the limiting factor.

The user should consider both the spatial distribution and the range of values in the input data set when deciding upon values for the reach and points parameters. If the specified reach is too small to allow the kriging module to locate at least one point within the search area, then no kriging can be done and the module will terminate with an error message.

The *Horiz./Vert. Anisotropy Ratio* parameter allows the user to consider the effects of anisotropy in the conductivity of the soil layers. In most cases, geologic materials are deposited with platy clay minerals oriented horizontally, and thus the flow of water or contaminants in both the saturated and unsaturated zones can be slower in the vertical direction than in the horizontal direction. Also, ore deposition can occur along horizontal or vertical fault or fracture systems. Chemical constituents being transported with flowing fluids may therefore show a larger degree of spreading in one or the other direction. The Horiz./Vert. Anisotropy Ratio basically tells the kriging algorithm what multiplication factor should be used to apply biased weighting on data points in horizontal and vertical directions away from a given model node. The default value is 10, which allows data points in a horizontal direction away from a model node to influence the kriged value at that node 10 times more than data points an equal distance away in a vertical direction. However, the user can specify any positive number with a magnitude up to 100,000.

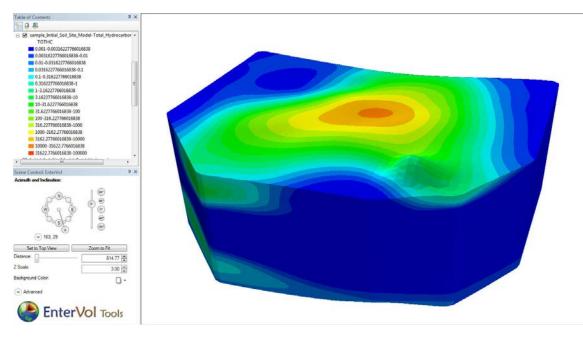
We'll choose to use all of the sample points in our kriging. With the setting shown below.

Project Data) M	lodels					
▲ Initial Soil Site	H	+	X	\odot	Main Options		
Borings			Туре Т	Models	XY Grid:	5 Layer	
Analytical Data	F	2D Grid CVX	XY Grid		Analyte:	TOTHC	
Lithology Stratigraphy		3D Flat	3D Grid		Maximum Screen Gap:	10.00	
Models	X	Topographic Surface	Surface		Estimation Method:	Ordinary Kriging	
	P	Topo Top Flat Bottom	3D Grid		Search Options		
	Ojec	Constant Thickness	3D Grid		Use Full Data Sampling:		
	Ēx	5 Layer	3D Grid		Full Data Sample Limit:	1,000	
	Project Explorer	> Total Hydrocarbons	Analyte Estimation		Reach:	100000000	
					Points:	20	
					Horizontal/Vertical Anisotropy:	10.00	
					Octant Search:		
					Kriging Options		
					Variogram Type:	Spherical	
					Nugget:	0.00	
					Automatically Compute:		
					Upda	ite Model	

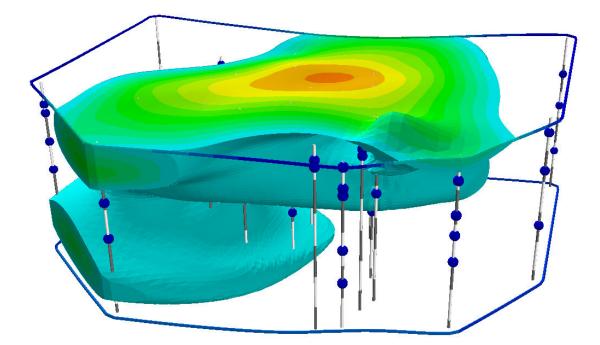
After Updating (creating) the model, we'll choose 2 intervals per decade for our Log Processed data.

Visu	alization: EnterVol		Ą
- 4	Layer Operations		
	Current Progress:		
C	Step: 1 of 1 Data: Initial_Soil_Site Model-1		1
N	Symbology Options:		
-	Color By Field:		1
4	TOTHC	•	
-	Coloring Method:		
*	Break at Even Intervals	•	
C	Intervals per decade:	2	
ľ	OK Cancel		

The resulting model is:



Adding the borings, TOTHC sample points and a plume at 0.1 mg/kg yields

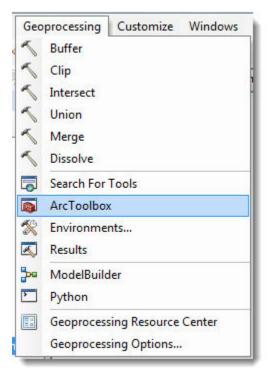


Geoprocessing Tools

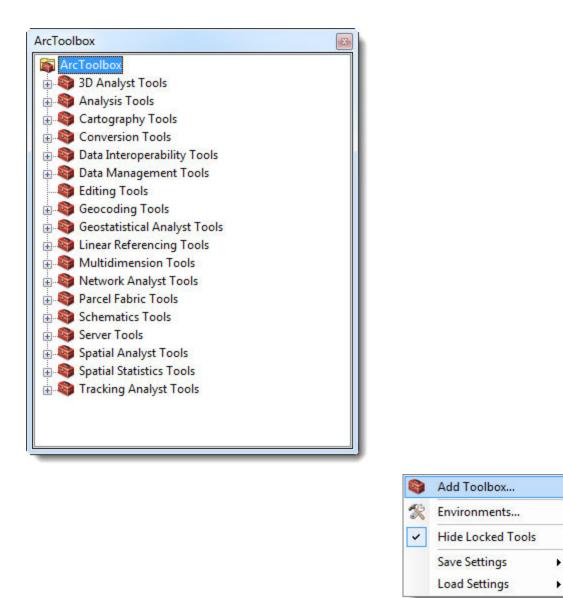
Geoprocessing Tools

EnterVol's Geoprocessing Tools menus provide an advanced method to perform the subsetting, display and scene manipulations.

First you must add these tools to ArcToolbox. The example below adds the toolbox to ArcScene. The procedure also applies to ArcMap.



The ArcToolbox window appears:

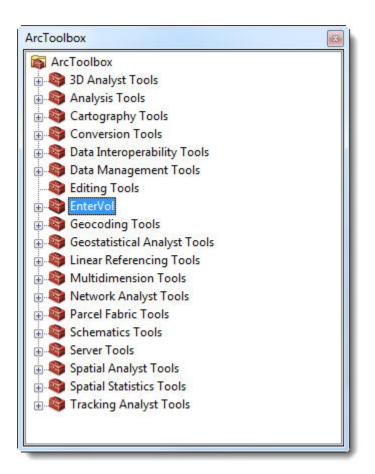


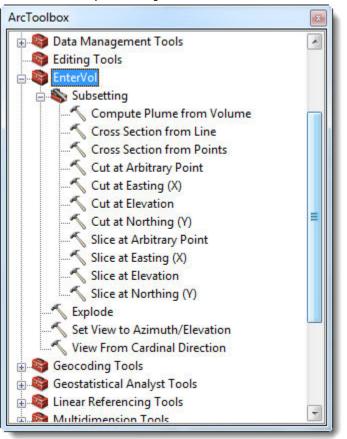
Right click in the window and select Add Toolbox:

Browse to the EnterVol install folder and choose EnterVol.tbx (do not double click or it will go into it)

Add Toolbox			X
	EnterVol Home - Documents\ArcGIS Folder Connections		866
	Program Files (x86) C Tech EnterVol Toolboxes Database Servers Database Connections		
	GIS Servers Tracking Connections Coordinate Systems		Open
Show of type		•	Cancel

This will add EnterVol





and when expanded you will see the full list

Subsetting

Compute Plume from Volume

Input parameters are:

- Input Volume
- Data to Subset
- Subset Level
- Cut Above (on) or Below (off) Level: Toggle
- Output FeatureClass

Cross Section from Line

Input parameters are:

- Input Volume
- Lines
- Attempt to vix T-splits at joints (optional): Toggle
- Straighten to 2D: Toggle
- Offset Between Straightened Cross Sections (optional)
- Output FeatureClass

Cross Section from Points

Input parameters are:

- Input Volume
- Points
- Attempt to vix T-splits at joints (optional): Toggle
- Straighten to 2D: Toggle
- Output FeatureClass

Cut at Arbitrary Point

Input parameters are:

- Input Volume
- Coordinate X
- Coordinate Y
- Coordinate Z
- Dip Value
- Dip Direction Value
- Reverse Cut: Toggle
- Output FeatureClass

Cut at Easting (X)

Input parameters are:

- Input Volume
- Coordinate X
- Reverse Cut: Toggle
- Output FeatureClass

Cut at Elevation

Input parameters are:

- Input Volume
- Coordinate Z
- Reverse Cut: Toggle
- Output FeatureClass

Cut at Northing (Y)

Input parameters are:

- Input Volume
- Coordinate Y
- Reverse Cut: Toggle
- Output FeatureClass

Slice at Arbitrary Point

Input parameters are:

- Input Volume
- Coordinate X
- Coordinate Y
- Coordinate Z
- Dip Value
- Dip Direction Value
- Output FeatureClass

Slice at Easting (X)

Input parameters are:

- Input Volume
- Coordinate X
- Output FeatureClass

Slice at Elevation

Input parameters are:

- Input Volume
- Coordinate Z
- Output FeatureClass

Slice at Northing (Y)

Input parameters are:

- Input Volume
- Coordinate Y
- Output FeatureClass

Explode tool

Input parameters are:

- Input Volume
- Method
- Distance to Explode
- Output FeatureClass

Set View to Azimuth/Inclination

This tool can only be used in ArcMap (not ArcScene) only because it rotates 3D layers making them appear more three dimensional in ArcMap maps.

It sets rotations for an individual layer (EFF) for pseudo 3D display in ArcMap. Once this tool is applied, the layer is not in its true position in your map and therefore this should be used only for annotation purposes.

Input parameters are:

- Input Volume
- Azimuth
- Inclination
- Output FeatureClass

Set View from Cardinal Direction

This tool can only be used in ArcMap (not ArcScene) only because it rotates 3D layers making them appear more three dimensional in ArcMap maps.

It sets rotations for an individual layer (EFF) for pseudo 3D display in ArcMap. Once this tool is applied, the layer is not in its true position in your map and therefore this should be used only for annotation purposes.

Input parameters are:

- Input Volume
- Direction

View from South		
View From North		
View From East		
View From West		

• Output FeatureClass