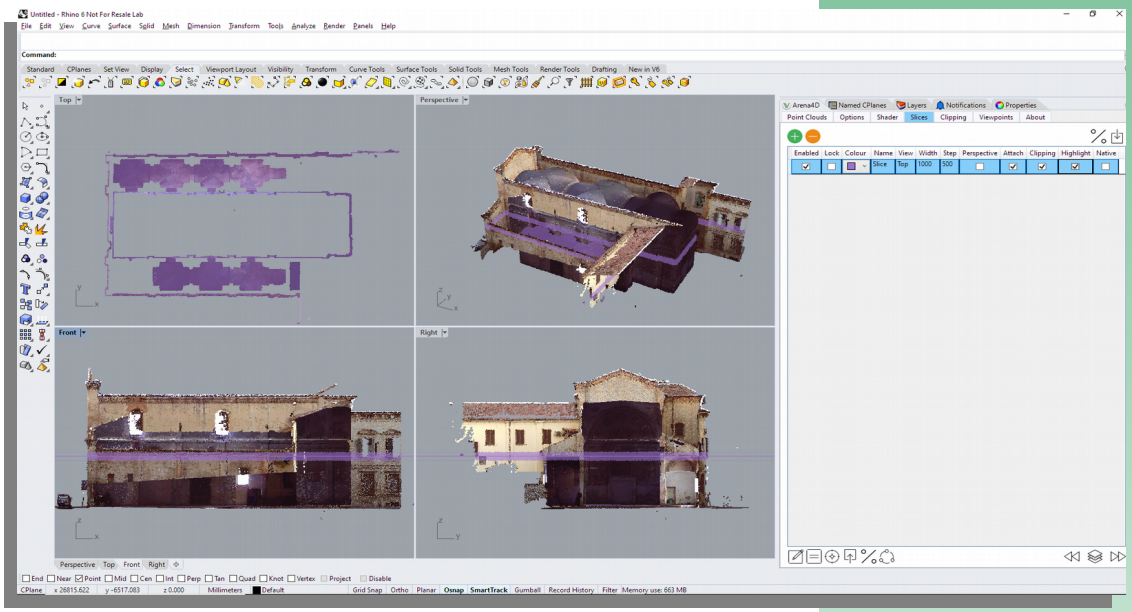
Veesus Point Clouds For Rhino

User Guide



Veesus Arena4D

Software Version 4.0.7.2

September 2021

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1 Introduction

1.1 About

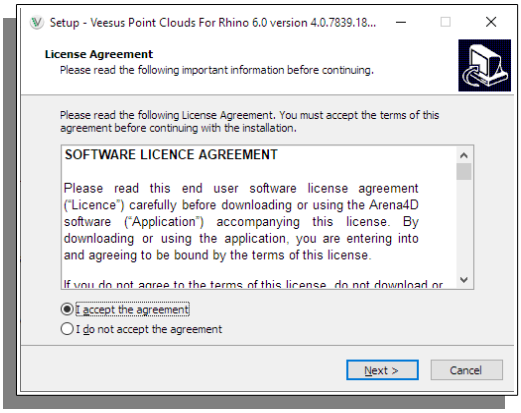
Welcome to the user guide for the Veesus Point Cloud Plugin for Rhino.

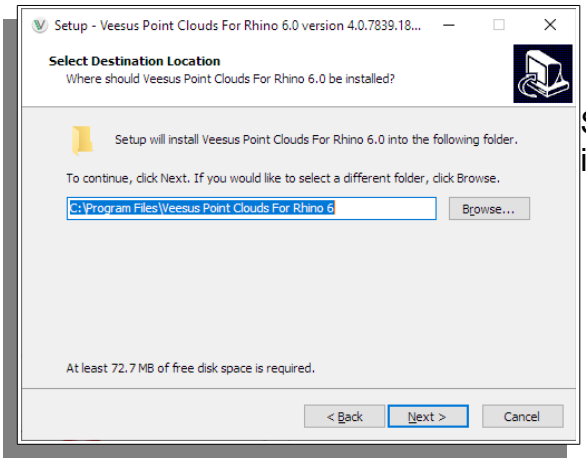
At the core of the plug-in is our unique point rendering engine that enables the rapid loading and visualisation of unlimited point cloud data sets – the XStreamEngine. The XStreamEngine powers all Veesus products, including our fully-featured standalone point cloud editing tool, Arena4D.

This user guide will help you understand how to use the features of this plug-in, which can only be used in McNeels' Rhinoceros tool. If you find you have any issues or questions which this guide doesn't answer, you can contact us at support@veesus.com.

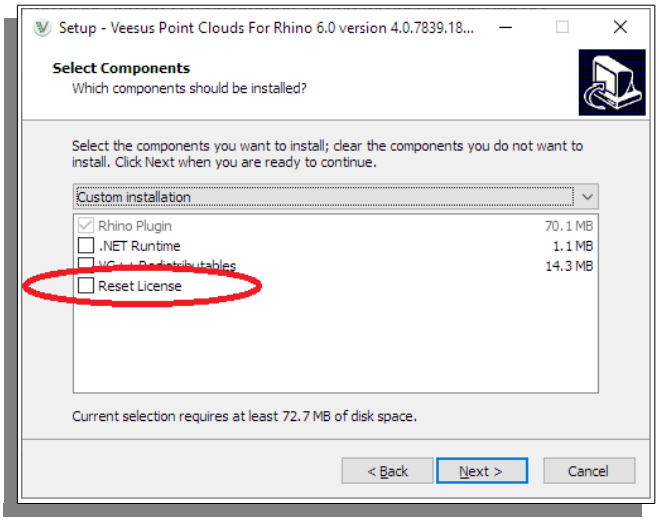
1.2 Installation

Point Clouds for Rhino is an add-in for Rhino, and therefore will not run outside of Rhino. To install the software, first run the setup wizard and follow all the steps and on-screen prompts during the installation process





Select the directory to install the software: Shown is the default for Rhino 6.



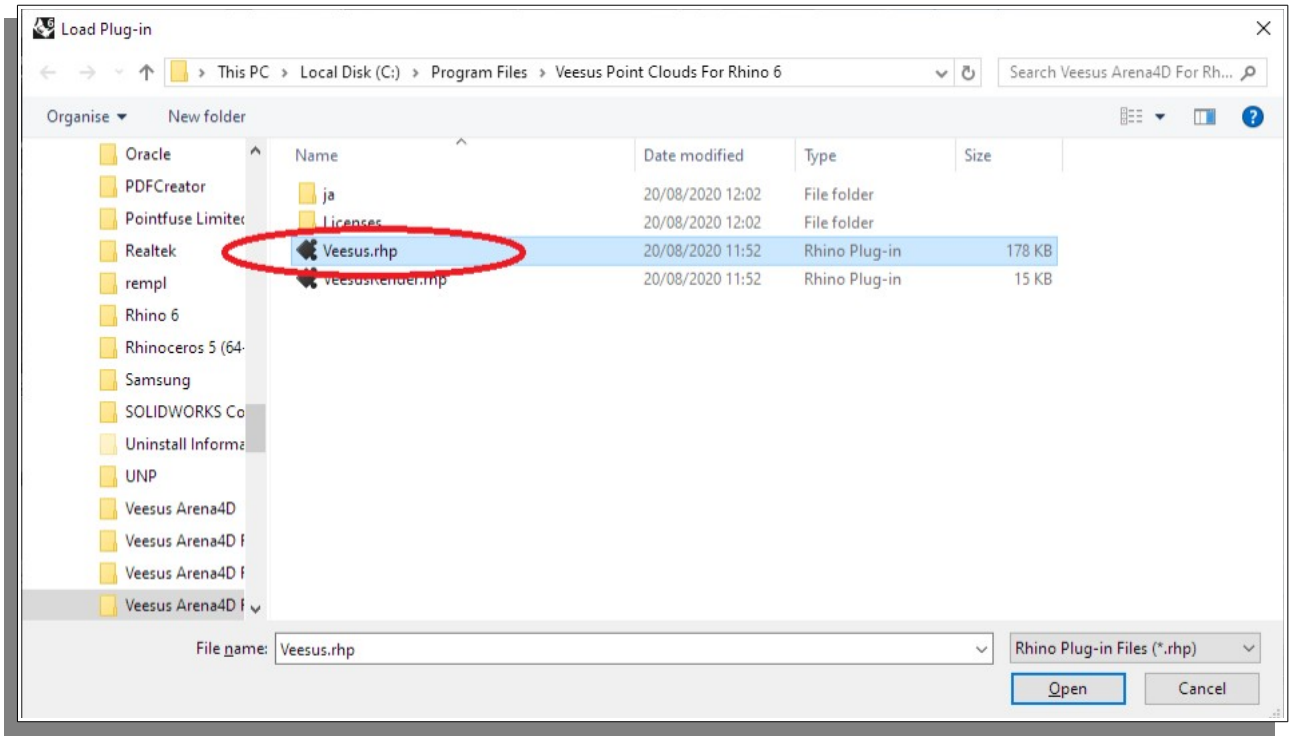
If you've previously installed a demo licence on your machine and you are now upgrading to a full licence you will still need to run the installation. When the option appears in the wizard, select "Reset Licence". **Under no other circumstances select this option.** If in doubt, continue the installation without the option selected and contact Veesus support.

. Once finished:

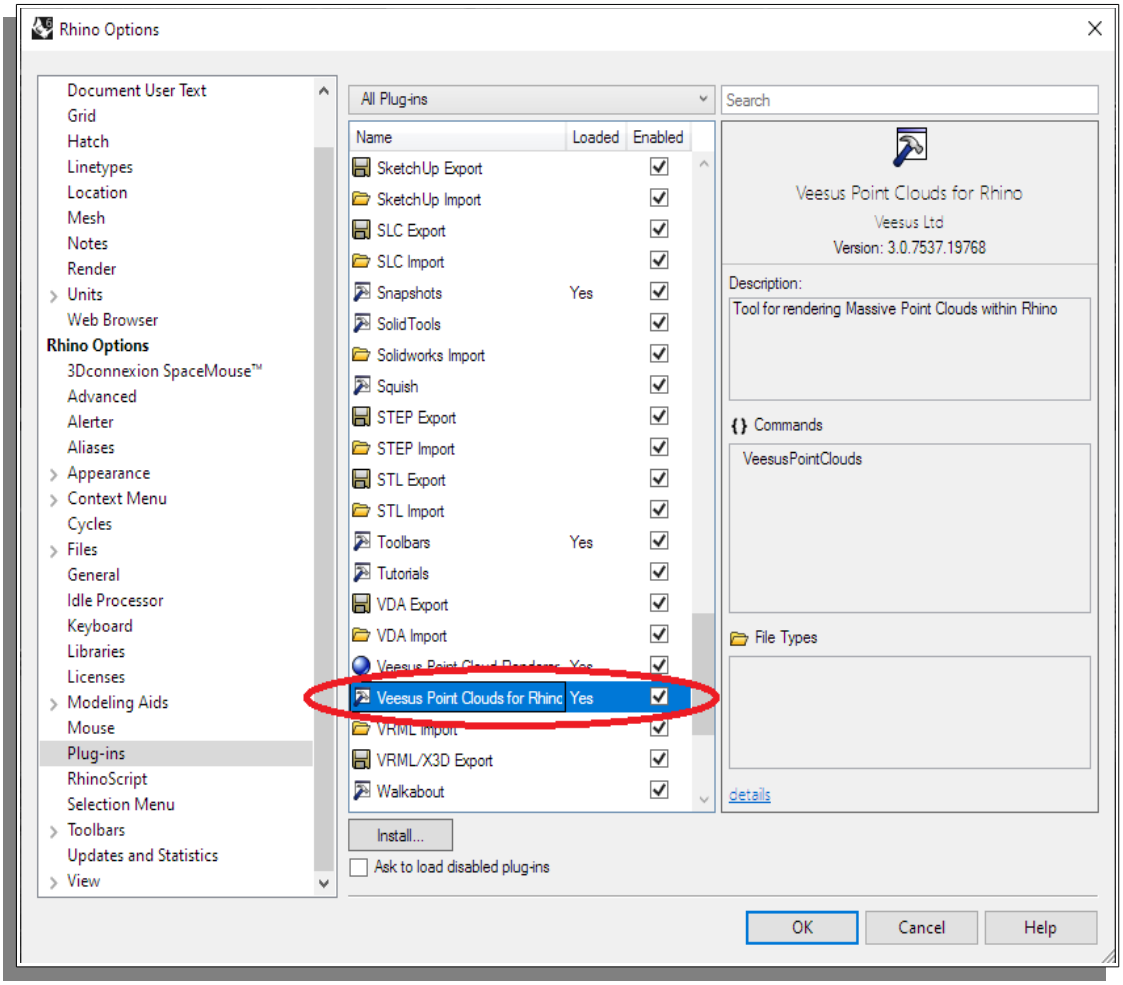
- Load Rhino
- From the "**Tools**" menu select "**Options...**"
- Select "**Plug-ins**" from options menu
- Select "**Install...**" button from plug-in list

Locate the **Veesus.rhp** file (default location is shown below):

Click "**Open**" once file is highlighted as above.

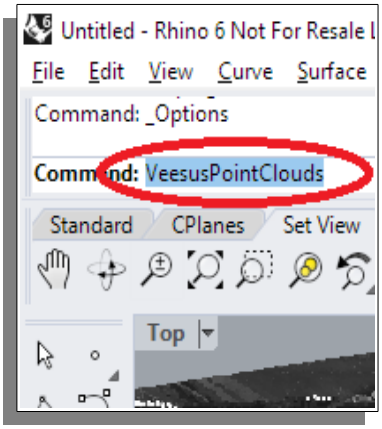


Once loaded ensure the plugin is Enable. If it is not loaded, right click on it and select "**Load Plugin**":



Select "**OK**" to close the "**Rhino Options**" menu.

Note: the above may differ slightly for Rhino 5.0 and Rhino 7.0



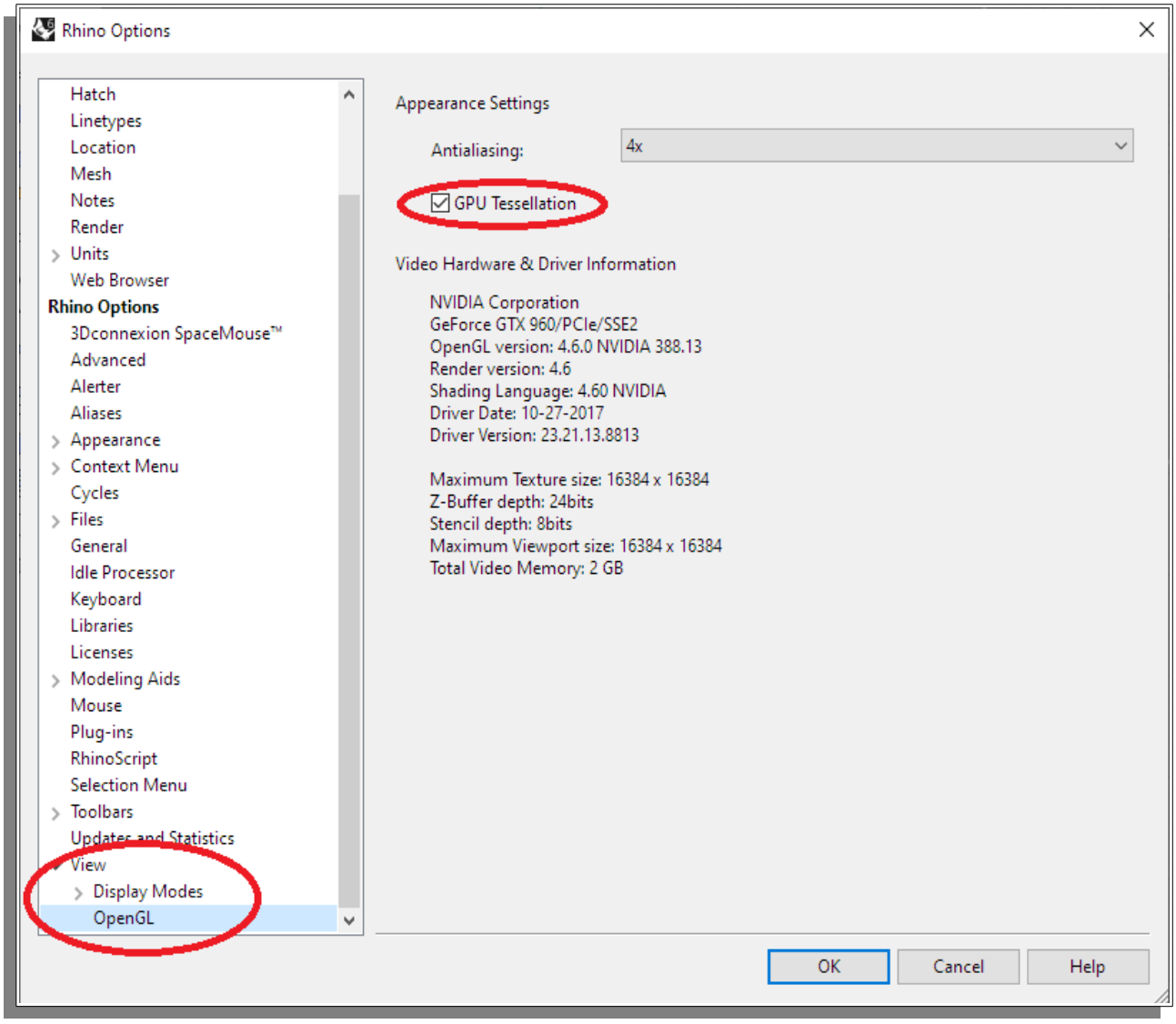
Load the Veesus Point Clouds User Interface: type "**VeesusPointClouds**" into the Rhino Command Line.

Position the loaded VeesusPointClouds window as required.

Finally restart Rhino if requested.

1.3 Rhino Settings

Arena4D makes extensive use of advanced OpenGL functions. Therefore it is important to ensure that "**Use accelerated Hardware mode**" is active under the main View options of Rhino 5, or Rhino 6 "**GPU Tessellation**":



1.4 Data Formats

Arena4D for Rhino requires point clouds data to be in the Veesus VPC format. To generate a VPC file you need to use the standalone **VPC Creator** which can be download for free from the Veesus website.

1.5 Loading & Saving

All Arena4D options are saved into the Rhino document. However the point cloud is saved as a reference, therefore if you move or delete the VPC file after saving the document it will not be loaded the next time you open it with an on screen notification.

Professional Version only in blue:

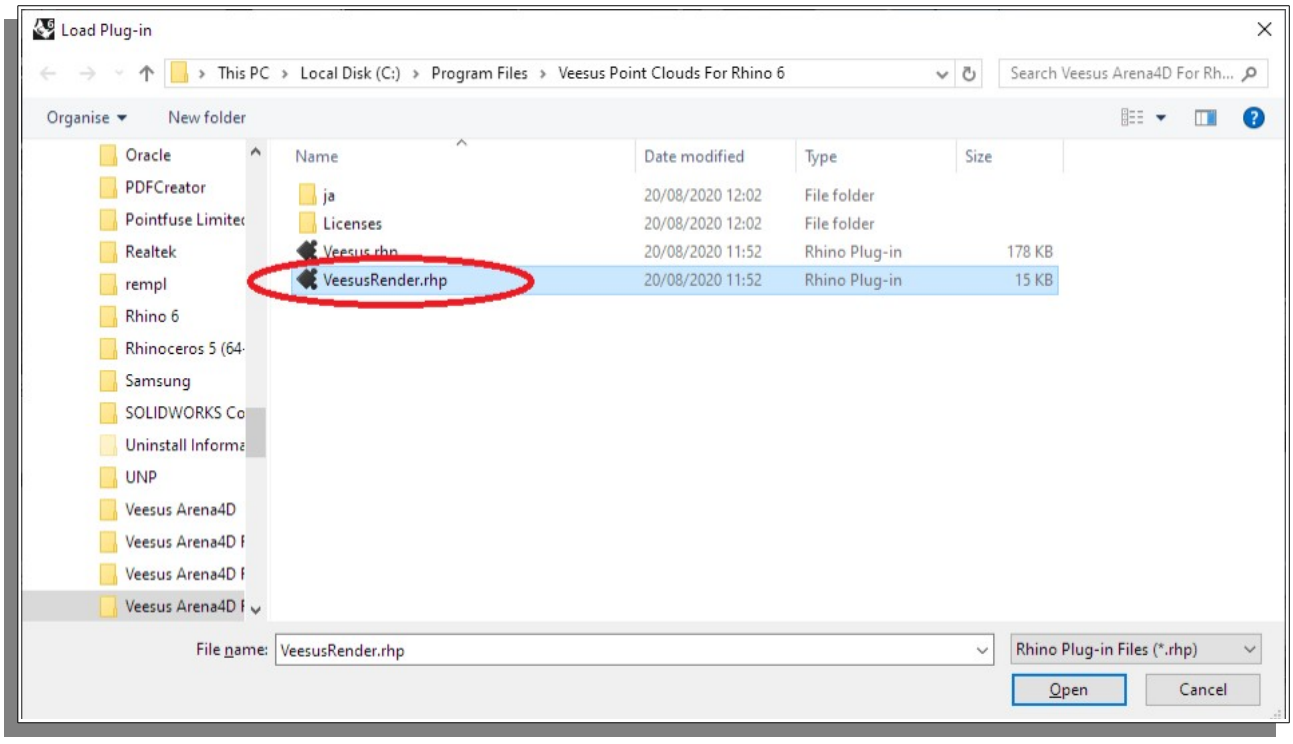
1.6 Installing Veesus Point Cloud Render Plugin

Note: the following sections only applies to the Professional version of the plugin

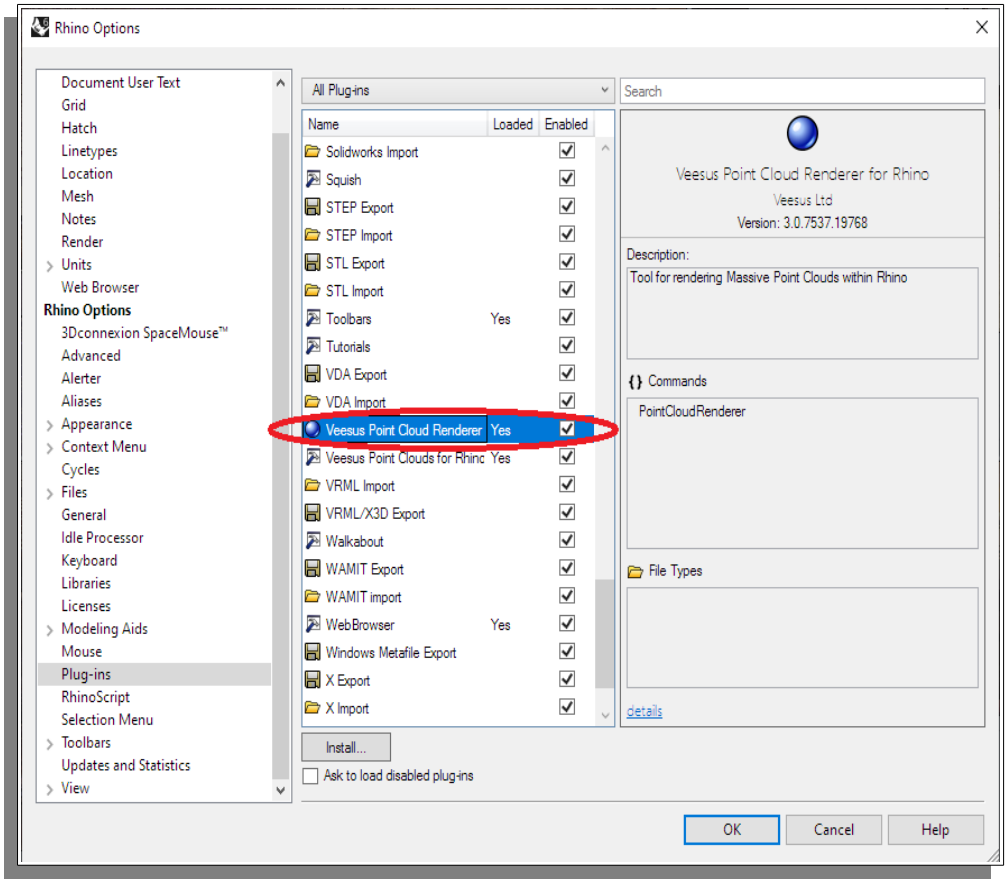
Veesus Point Cloud Render for Rhino installs as a plugin through the Rhino plugin architecture. To do this first perform steps: 1.2 Installation.

- Load Rhino
- From the "**Tools**" menu select "**Options...**"
- Select "**Plug-ins**" from options menu
- Select "**Install...**" button from plug-in list

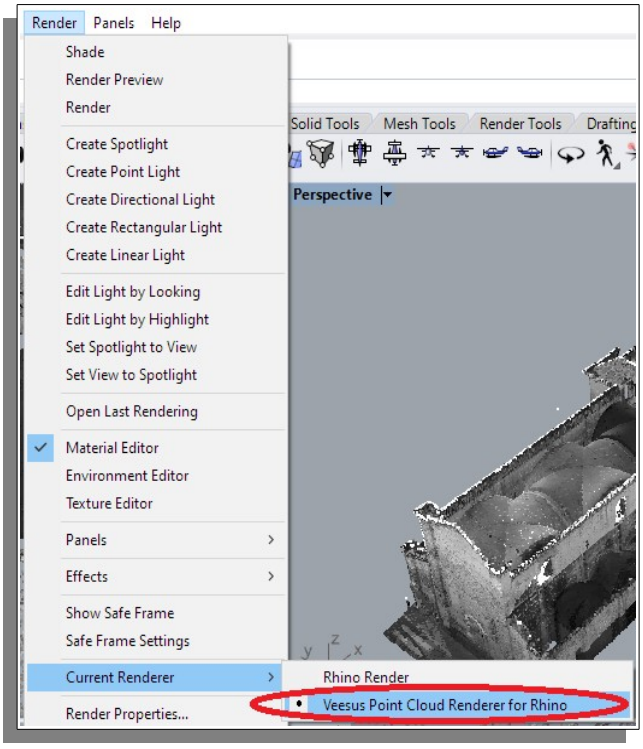
Locate the **VeesusRender.rhp** file (default location is shown below):



Once loaded ensure the plugin is Enable and Loaded. If it is not loaded, right click on it and select "**Load Plugin**":



From the "**Render**" menu select "**Current Renderer**" option followed by "**Veesus Point Cloud Render**":



2 General Work Flow

Once point cloud(s) are loaded into the Arena4D plug-in the following steps might form part of a general workflow:

- Orientate the point cloud. Section: 3.3.2 Align
- Set the point cloud Origin. Section: 3.3.1 Origin
- *Professional version only: Clean the point cloud (delete)*
- Perform a Shader for quick inspection of elevation changes. Section: 3.7 Shader
- Perform Slices and Clipping. Section: 3.5 Slices and 3.6 Clipping

3 User Interface

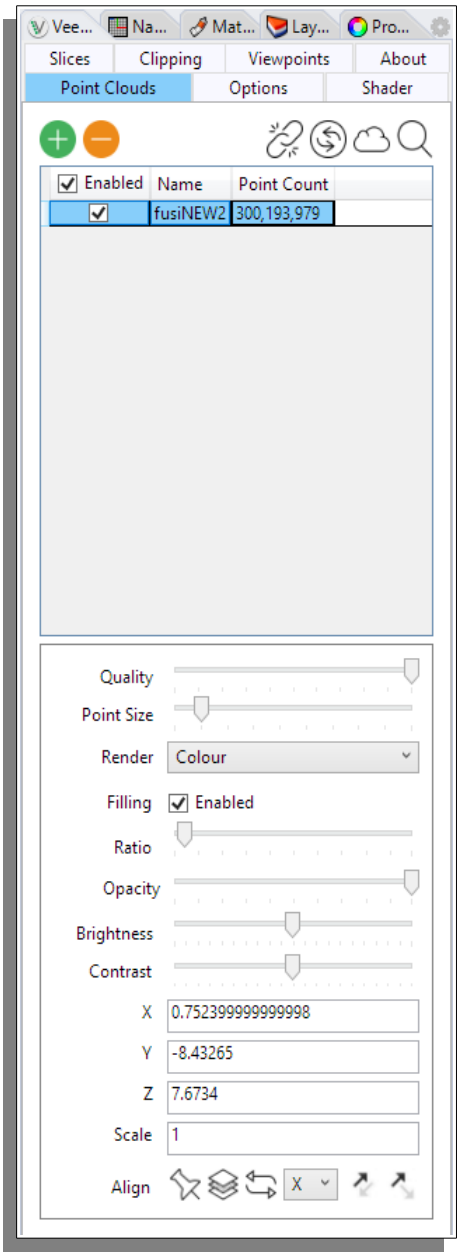
3.1 General

The Arena4D user interface is very simple and consists of a number of control tabs which separate the key functional parts of Arena4D into separate sections.

In each section there will be three common buttons.

The "**+**" button adds an item to the current list, "**-**" button removes.

3.2 Point Clouds



When a point cloud is added and selected in the displayed list, a number of options become available which control the appearance of that point cloud in the Rhino view windows.

Quality – determines the density of the rendered point cloud. The higher the quality the better the appearance, but the slower the performance.

Point Size – The size of points.

Render – Draw using Intensity, Colour or Ramp values.

Filing – Fills gaps in the point cloud data by intelligently sampling the point data.

Ratio – Controls the power of the filling setting for distance.

Opacity – The transparency of the selected point cloud(s).

Brightness – The brightness of the selected point cloud(s).

Contrast – The contrast of the selected point cloud(s).

 **Zoom** button centres the Rhino views on the currently selected point cloud(s).

 **Restore** button restores point cloud deletions.

 **Clash Detection** detect clash between point clouds and meshed surfaces see: 3.8 Clash Detection

 **Server** button see section: 5 Arena4D Point Server

X – Position of this axis

Y – Position of this axis

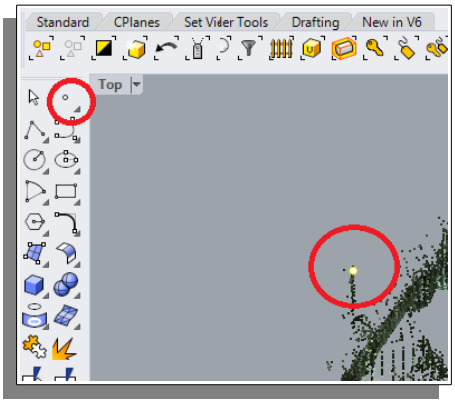
Z – Position of this axis

Scale – Adjust the displayed size of the selected point cloud(s). Can be scaled up or down.

Align – Tools used to manipulate the point cloud(s) position and rotation see: 3.3 Align

3.3 Align

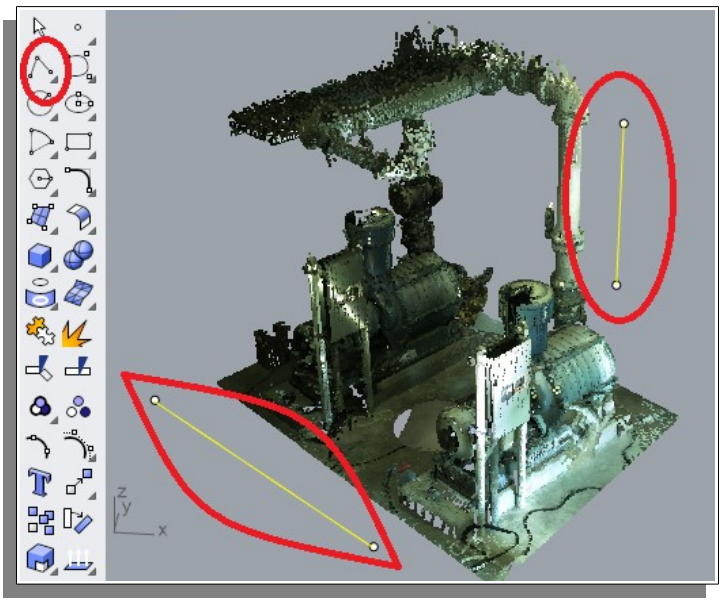
Tools used to position and rotate selected point cloud(s) within Rhinoceros own local coordinate system.



3.3.1 Origin

Position a Rhinoceros "**Single Point**" on the selected point cloud. Select the created point highlighting it yellow and select the **Origin** icon. The point cloud will be moved to X,Y,Z 0,0,0 centred on the selected point.

3.3.2 Align



Create two Polylines horizontal and vertical (**horizontal MUST be created first**) each representing a new axis for the selected point cloud. Select both polylines highlighting them yellow and select the **Align** icon. The point cloud will transition relative to the new axis.

Note: use Axis, Flip and Rotate to correct the orientation.

3.3.3 Reset Position

Resets any of the align or origin operations back to the point cloud(s) original loaded location/rotation.

3.3.4 Axis

Select which axis **Flip** and **Rotate** are applied to **X**,**Y** or **Z**.

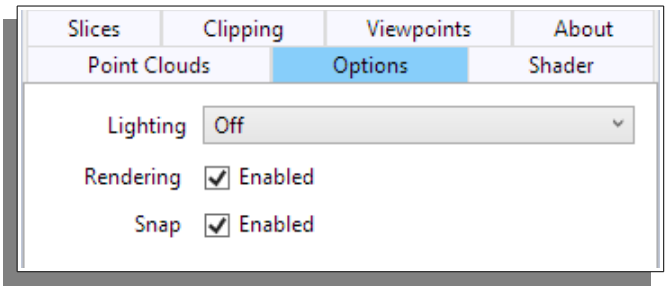
3.3.5 Flip

180° flip selected point cloud(s) around selected **axis**.

3.3.6 Rotate

90° flip selected point cloud(s) around selected **axis**.

3.4 Options



The options panel features settings that affect all point clouds.

Lighting – Adds dynamic lighting to the scene with the light source behind the current eye position.

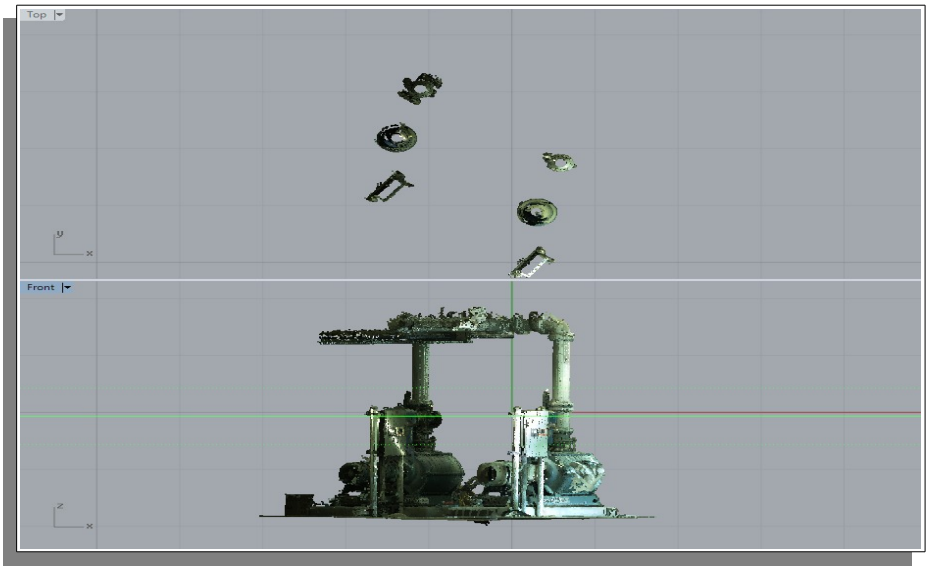
Rendering – Removes VPC point cloud(s) from the view displays.

Snap – If "**Point**" is enabled under the "**Osnap**" settings of Rhino then Arena4D will allow Rhino to snap to the closest point nearest the cursor in the point cloud.

3.5 Slices

Slices are a way to quickly visualise a section through the point cloud. *Slices can only be created on orthogonal views and not on the main perspective view unless using the Two Point Slice:* ⁰⁄₀

The slice is visualised in the viewing windows by a solid line passing through the data.

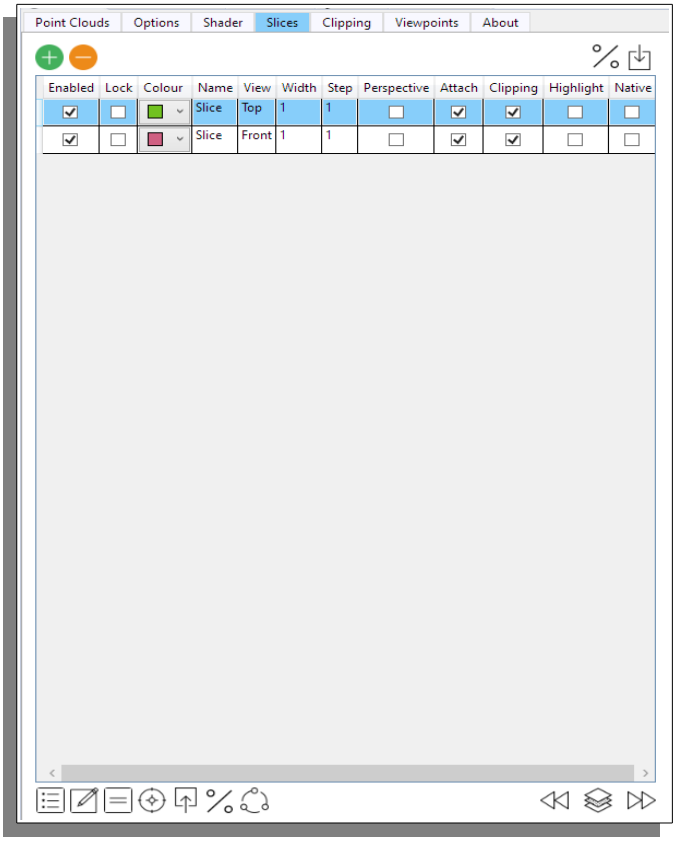


Above and below the line are dotted lines representing the width of the slice.

The slice can be manually moved by clicking and dragging the solid slice line or section: 3.5.10 Step Slice.

A slice is applied to the currently active view when added.

It is possible to have multiple slices active at any one time, so long as they are not in the same view.



Each slice has the following properties:

Lock - prevent slice from being moved.

Colour - select individual colour.

Name - meaningful names can be applied.

Width - in units of current document.

Perspective - enable whether you want the slice effect to be visible in the main perspective view.

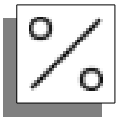
Attach - attached construction at the *Slice* when turned on. Turn off, move slice and construction will stay at previous *Slice* position.

Clipping - effect the selected points within clipping.

Highlight - whether the slice is highlighted at all times.

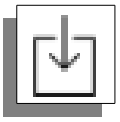
Native - allow the slice to also effect native Rhino objects.

At the top of the slice window are two buttons:

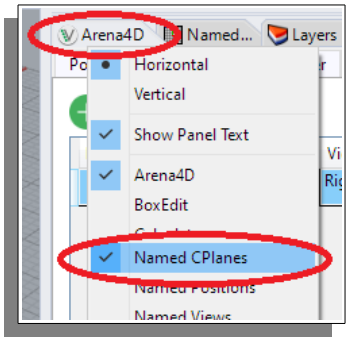


3.5.1 Two Point Slice

Creates a slice between two user points and is useful for slicing the data if not aligned to the construction plane. Click two points inline where the slice is required.

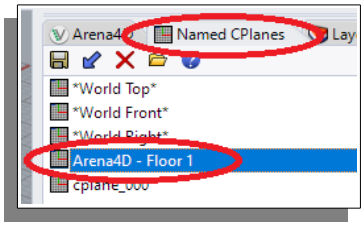


3.5.2 Slice From Plane



Adds the selected slice from the "**Named CPlanes**" tab to the Slice tab within the Arena4D plugin. First a slice must have been added to the named cplanes tab, see section: 3.5.7 Plane From Slice. Make sure Named Cplanes is turned on by right clicking on "**Arena4D**" tab and selecting "**Named Cplanes**".

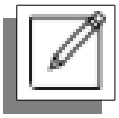
Select the "**Named Cplane**" tab followed by the Cplane slice to be added and it will be shown in the Rhino views as three axis. Now click the slice from plane icon 



At the bottom of the slice window are seven buttons:
Professional Version only in blue:

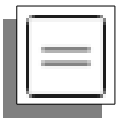
3.5.3 CSV (Plane Analysis)

Creates a text based CSV (Comma Separated Values) file containing X,Y,Z - R,G,B – Intensity - Classifications – Distance (from centre of slice outwards in both directions).



3.5.4 Vector

With a slice positioned as required, make the viewport full and select Vector. The resulting Rhino drawings will be centred around the middle of the sliced data. These drawing can then be exported from Rhino into any format you require.

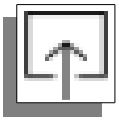


3.5.5 Outline

With a slice positioned as required, make the viewport full and select Outline. The resulting Rhino drawings will be outlined around the middle of the sliced data. These drawing can then be exported from Rhino into any format you require.

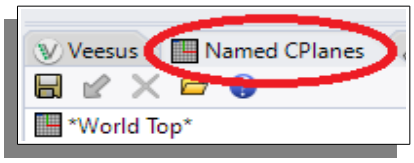
3.5.6 Position Slice

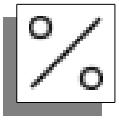
Click directly where to position the slice within the active slice.



3.5.7 Plane From Slice

Adds the currently active slice to the "**Named Cplanes**" Newly created Cplane(s) can be seen under the Named Cplanes tab.





3.5.8 Position Slice Between Two Points

Select the two outer limits of a slice to position it in the middle of those limits.

3.5.9 Align To Curve

The polyline icon allows you to convert a Slice from a traditional orthogonal slice to one that aligns with a curve. To use this feature you must have first added a curve or line to the data. Select the slice to Align then by clicking the "**Align To Curve**" button and clicking anywhere along the curve or line will align the view and slice (and optionally the construction plane) to that point on the curve. ***Note: the curve or line (any Rhino object) must NOT be selected before clicking the "Align To Curve" button.***

3.5.10 Step Slice

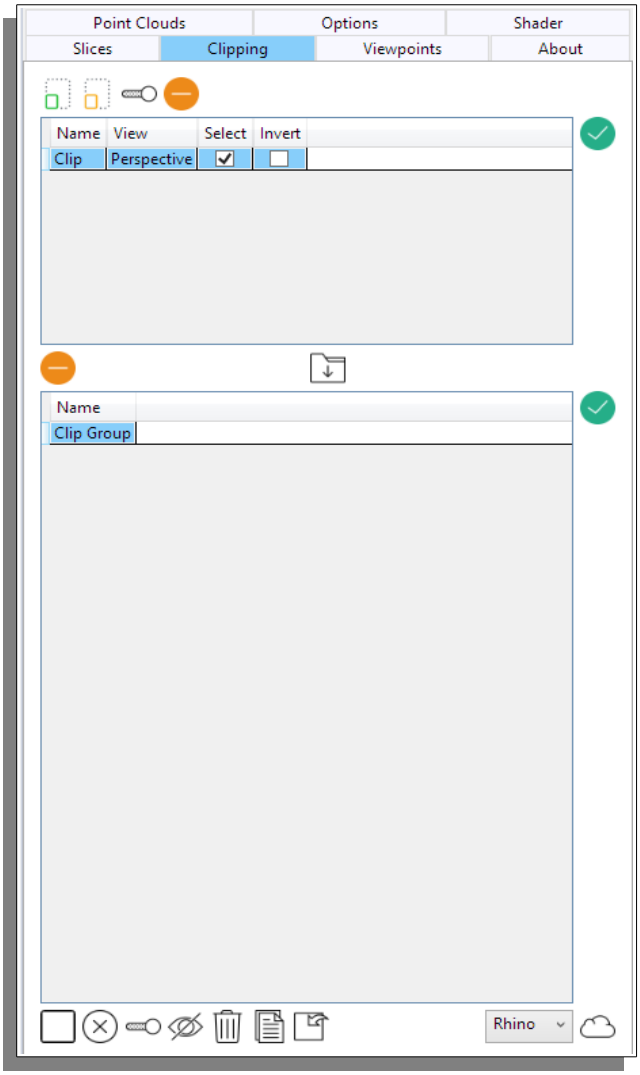
The left and right buttons step the currently selected slice by it's current step setting.

3.5.11 Attach to Plane

Aligns the view construction plane with the slice position.

“Attach To Plane” means that the construction plane in the slice view will follow the movement of the slice if enabled.

3.6 Clipping



The clipping tab is used to select areas of point data that you wish to hide or unhide.

The four main controls of the Clipping tools are *Select*, *Unselect*, *Invert* and *Remove* as represented by these icons:

Select activates the clip tool in the current active window. Use the left mouse button to add points to the clip polyline and the right mouse button to end the selection.

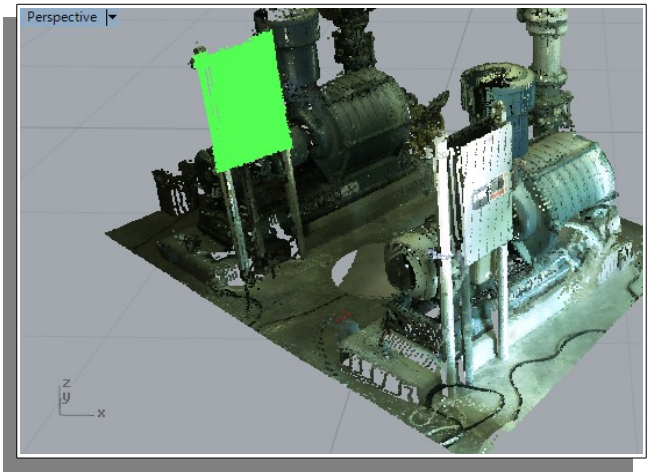
All data within the polyline will be selected.

Unselect works in the same way but unselects everything within the polyline.

Invert toggles the effect of the select and unselect tool. Instead of selecting everything within the polyline they will select everything outside the polyline.

Once data is selected it will turn green in the main viewing window.

Remove selected clip(s).



At the bottom left of the clipping panel are 7 buttons.

Select All selects all the points in the currently enabled point cloud(s).

Clear unselects all the points in the currently enabled point cloud(s).

Invert inverts the current selection.

Hide will make selected points become invisible/visible.

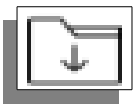
Professional Version only in blue:

Delete selected points from the point cloud (use clips to select the area).

Note: to restore the point cloud back to how it was original created with the VPC Creator see section 3.2 Point Clouds "***Restore***".

Copy selected points (use clips to select the area) to a new Veesus Point Cloud (VPC). File name will be request.

Plane Through Points adds the currently active clip to the "**Named Cplanes**" Newly created Cplane(s) can be seen under the Named Cplanes tab.



As well as creating individual clips you can group a series of clips into a clip group. For example you may have taken a number of selections to isolate a chair in a room. You can select all these clips and create one single clip group by pressing the create clip group button.

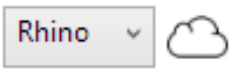
Individual clips or clip groups can be applied at any time by either double clicking them in the list, or clicking the process button opposite the table.

Delete Selected deletes all individually selected clip(s) and in the group section deletes all individually clip group(s). **Note: Does NOT unselect all the points in the currently enabled point clouds. For this to happen select the Clear button**.

3.6.1 Point Clouds

Arena4D provides the ability to convert areas of point cloud(s) from the Arena4D plugin into a native Rhino point cloud object or save as a Arena4D VPC file.

Using the clipping tool to highlight an area of interest, select either **Rhino** or **File** from the option at the bottom right of the screen and press the cloud icon.

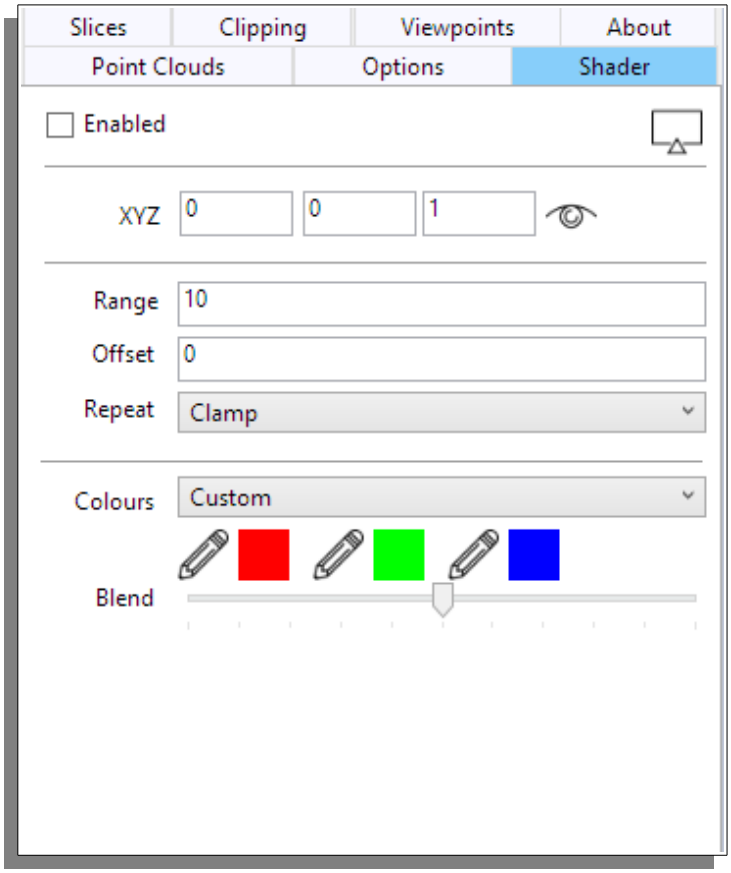


3.6.2 Clipping In Slices

If an active slice and its "***Clipping***" tick box is turned on whilst performing a clip operation, only data within that slice will be effected.

For example a slice could be cutting through the floor of a room, meaning only the floor is visible. Creating a new clip whilst this slice is active will ensure only data from the floor is selected.

3.7 Shader



The shader panel provides control over the planar shader. This is a capability which colours data along a plane normal **vector** from the **construction plane** out.

The shading is enabled per view. Once enabled/disabled in one view you can apply this to all others by clicking the four arrow button in the top right corner.

Once enabled you can change the shaders direction by changing the XYZ values of the normal vector. XYZ should add up to '**1**' so if your point cloud was aligned true to the construction plane, the value 0,0,1 would shade on the Z axis (up). If your point cloud is not true to the construction plane then values of 0.054,-0.041,0.998 for example may provide a the alignment (yours will be different).

A simpler option is to align the shader to the view direction. Pressing the eye icon will set the XYZ values for you and set the shader "**zero**" point to be your construction plane position in that view.

Range – The distance over which the shader will calculate values.

Offset – The distance from the shader zero point to start calculating from. Useful for moving the shader along the axis without changing the construction plane.

Repeat – How the shader should act once it has gone beyond either the start or end location as calculated by Range + Offset:

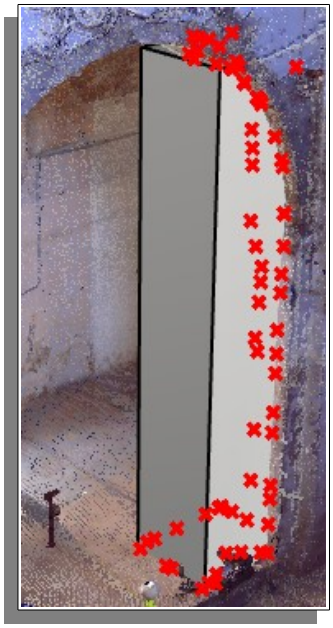
- *Clamp, continue with first/last colour.*
- *Stop, don't apply colours beyond range.*
- *Repeat, loop through colours again.*

Colours – You can chose between your own custom colour palette in the shader, or to use the entire RGB hue values.

Blend – Effect of shader on point colours.

3.8 Clash Detection

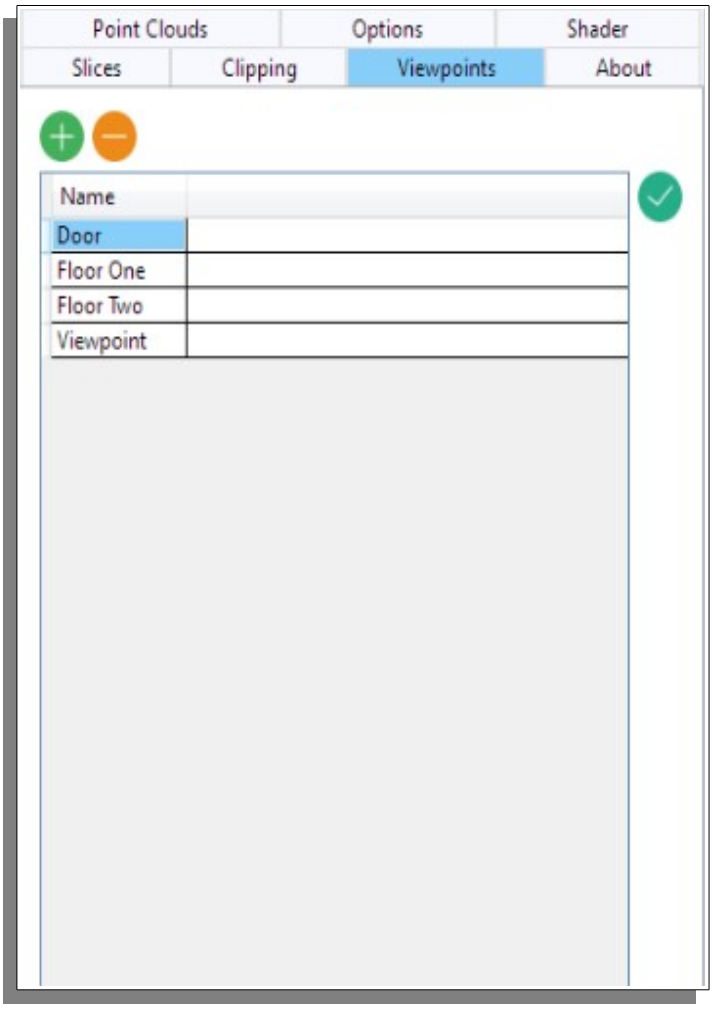
When Point Clouds and Meshed Surfaces come into contact, the clashed areas will be highlighted with a red cross.



Turning the Clash icon on/off will display or remove clashed arears.

Note: visual performance will be reduced with clash enabled.

3.9 Viewpoints



Viewpoints are a fast way of repositioning your view position in each view.

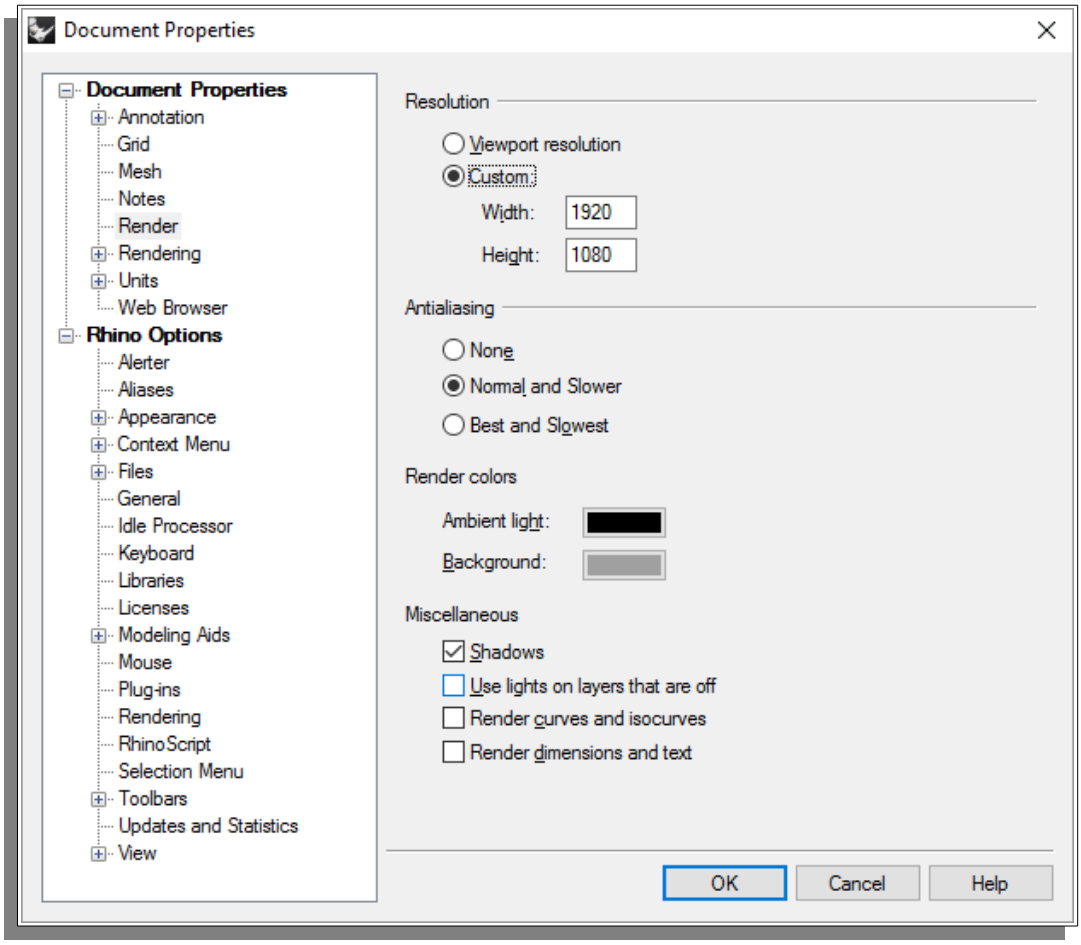
If you have a view positioned in a way you would want to recall later, click the Add button to save it.

To remove viewpoint(s) highlight and click the remove button.

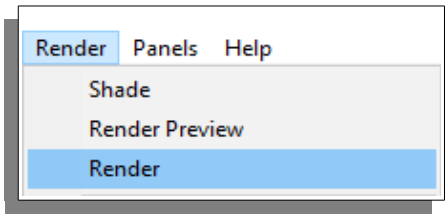
Double clicking a saved viewpoint, or selecting it and pressing the tick button will put all the views back to their saved positions.

3.10 Rendering VPC Files

Veesus Point Clouds can be rendered within Rhino using the Arena4D Render plugin. First select the **Render Properties** from the **Render** pull down menu, specify both the resolution and backgroud colour. ***Note: resolution is limited unless a licensed plugin is used.***



Selecting Render Preview will produce a quicker render of the point cloud(s) and Render will produced the most detailed render. ***Note: higher the resolution and more point cloud points the more time it will take for the rendered image to appear.***



Functions within the Render window such as Exposure and Post Effects operate in the same manor as the standard Rhino Renderer.

3.11 Point Cloud not displayed correctly

There are conditions that may stop a point cloud being displayed:

- If the point cloud is not displayed correctly in the shaded view, try turning off "*ground plane*" within Rhino.

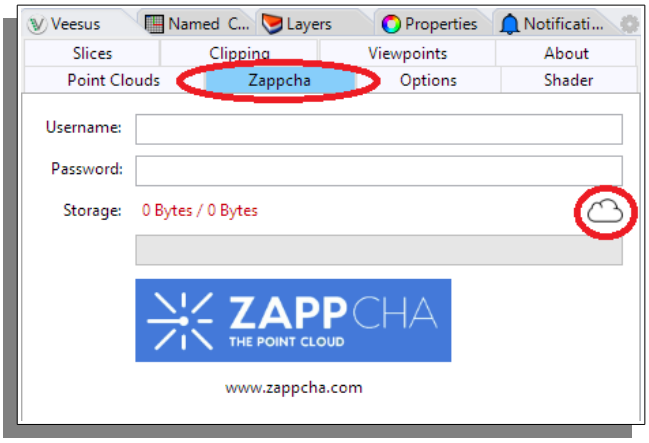
- Arena4D Data Studio is capable of generating "protected" VPC files. These disable export functions and optionally add an expiry date to the data. Once the expiry date has passed you will no longer be able to view the data.

  If your point cloud data is not visible, check with the VPC provider whether they protected and enforced an expiry data on the files you were provided.

4 ZAPPCHA

Users with access to Zappcha can stream point cloud data stored in The Zappcha Cloud to Point Clouds for Rhino. This means you can work on point clouds without having the point cloud data on your computer.

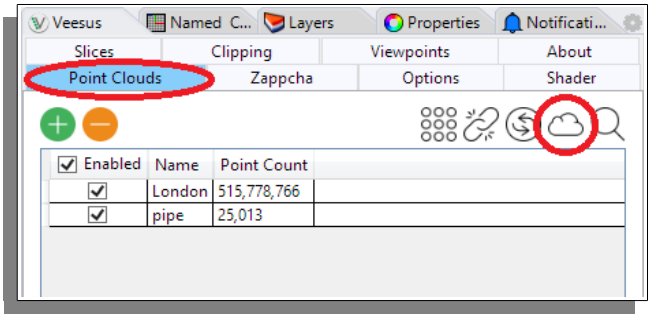
NOTE: you need an active Zappcha account to use this feature. To create your Zappcha account for free, please visit Zappcha.com.



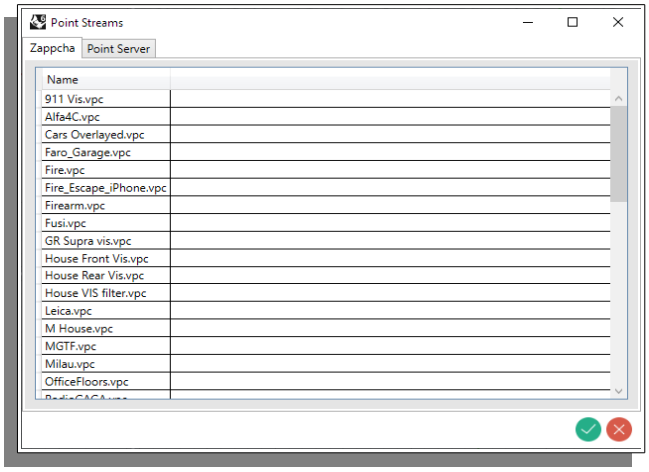
To access Zappcha, first select the Zappcha tab.

Enter your **username** and **password**.

Click the **cloud** button to log in to the Zappcha Cloud.



Moving back to the Point Clouds tab, clicking the cloud icon will launch the **Point Streams** window.



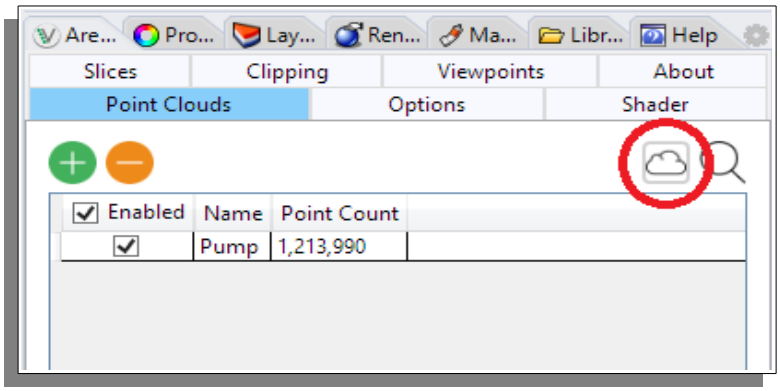
In the Point Streams window, select the **Zappcha** tab. You will see all the point clouds you have saved to your Zappcha Cloud.

Click on a point cloud in the list to select it, and simply click **Open** to start streaming that point cloud to your viewer. Once it has loaded, the point cloud can be worked on in exactly the same way as any other point cloud. The red cross button next to it closes the window.

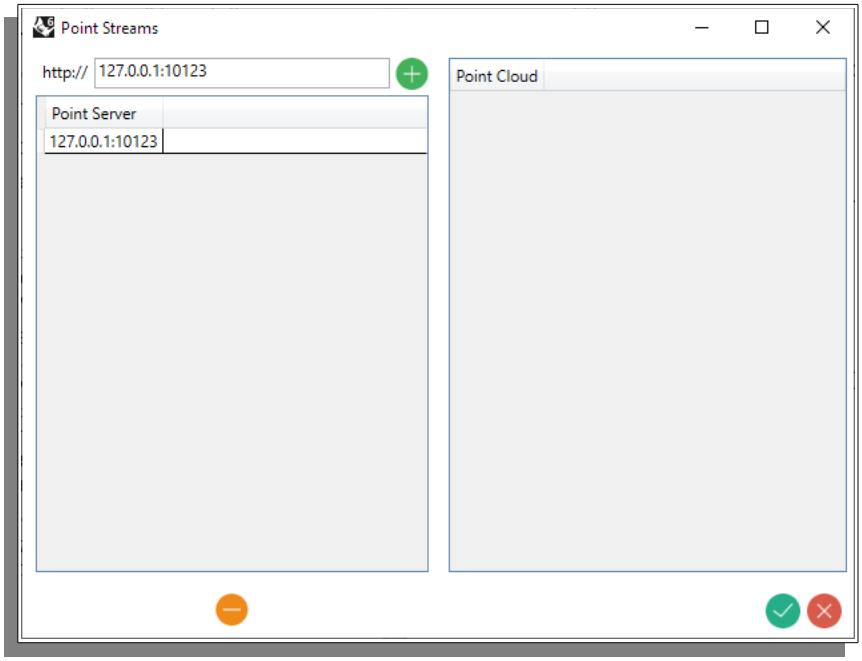
5 Arena4D Point Server

For owners of or permitted access Arena4D Point Server(s) you can stream data to Arena4D for Rhino.

To access to Arena4D Servers first select the Point Cloud tab.



Clicking the **Open Point Stream** button will launch the **Point Server Manager**



To add a new server enter the URL of the server including the port number, then click the **Add** button.

For example *127.0.0.1:10123*

Once the server is added it will appear in the list of available servers.

Selecting a server will produce a list of point clouds on that server in the right hand side. Once a point cloud is selected from the server simply click **Open** to start streaming that data to your viewer.

Streamed point clouds can be manipulated in anyway a normal point cloud file can be.

6 Scripting

It is possible to control a number of Arena4D functions via RhinoScript.

Note: Slices can be added by point or by width, to understand the difference please refer to the slicing section for more details.

```
public void SetPointCloudsVisible( bool visible)

public void AddSlice( int red, int green, int blue, double step, double
width, bool colourPoints, bool clipping, bool locked)
public void PositionSlice( bool width)
public void PositionSlicePoint( object position)
public void PositionSliceWidth( object positionList)
public void EnableSelectedSlice( bool enable)
public void MoveSlice( bool positive)
public void SetActiveSliceByView()

public void AddClip()

public void AddViewpoint()
public void SetPointSnap( bool on)

public void OpenPointCloud( string path, int pointSize, float quality, int
colourMode)
public object ListPointClouds()
public void RemovePointCloud( int index)

public object GetSelectedPoints()
public void SelectAllPoints()
public void ClearSelectedPoints()
```

Example

```
Option Explicit
Dim customobj
On Error Resume Next
Set customobj = Rhino.GetPlugInObject("{904b9f2e-f13f-4021-be5f-0318da03cc70}")
If Err Then
        MsgBox Err.Description
Else
        customobj.AddSlice
End If
```

Note: check the GUID shown above as 904******* on your specific installation of Rhino:***

Tools→Options→Plug-ins→Veesus Point Clouds for Rhino→Details: