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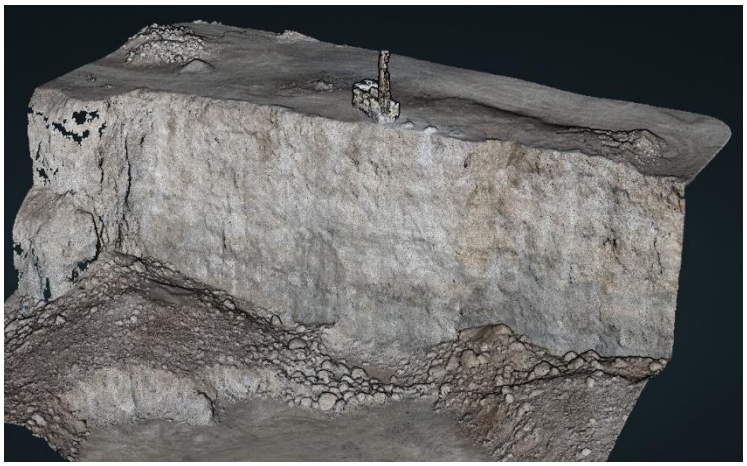
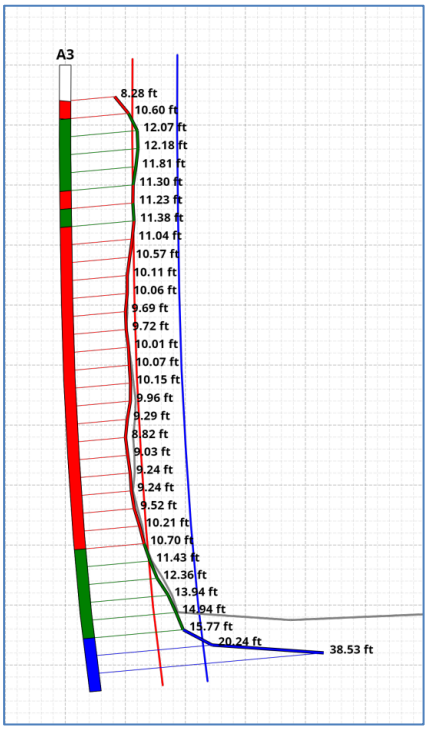
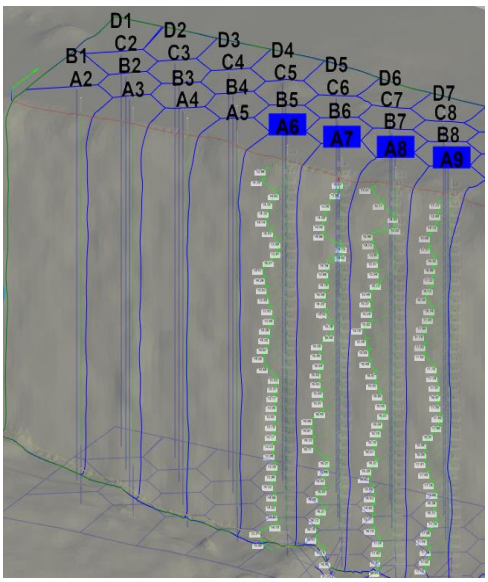
CarlsonOPS Software

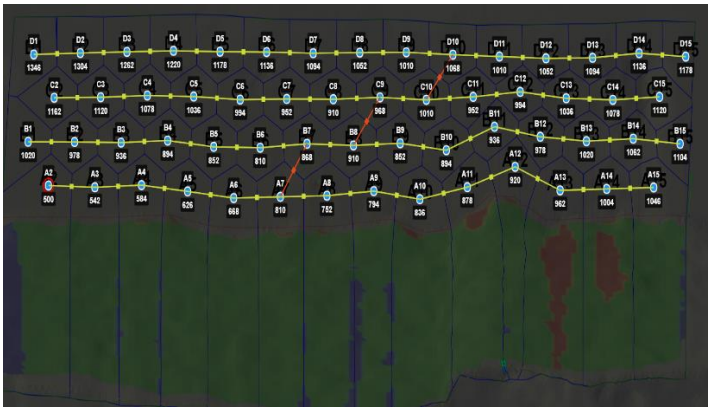
User Manual v1

For Quarryman, Boretrak and Drone Data









Contents

1 Customer information

1.1 Dear customer

CarlsonOPS is designed to be easy and intuitive to operate. However, we request that you take the time to carefully work through these operating instructions before using the software.

For any feedback or comments, or if there are questions about the software which are beyond the scope of this manual, contact Carlson support. Contact details can be found on the back cover of this manual.

Alternatively, for information on your local Carlson approved dealer, visit our website www.carlsonsw.com.

1.2 About this manual

This manual is concerned with **CarlsonOPS** software. **CarlsonOPS** is designed to process Quarryman, Boretrak and drone data for blast optimization.

Since the software is so integral to the use of the survey equipment, sections 19 of this manual details typical, software procedures.

There are companion manuals dedicated to the Quarryman and Boretrak hardware. These hardware manuals detail the system components, accessories and safety and certification information. It is important that both the hardware and software manuals are read carefully before deploying one of Carlson's scanners on site.

This **CarlsonOPS** manual has been compiled with care. However, should you discover any errors, we would be grateful if you could contact Carlson directly.

1.2.1 Version

This is version 1 of the **CarlsonOPS** manual, released in June 2020.

1.2.2 Trademarks

1.2.3 Changes to Carlson software

Carlson reserves the right to improve, change or modify its products and documentation without incurring any obligation to make changes to equipment previously sold or distributed.

1.2.4 Disclaimer

2 Introduction

Carlson designs and manufactures a range of ruggedised laser scanning systems intended for various demanding applications such as mining, quarrying, geotechnics and marine surveying.

The two scanners designed specifically for open-pit use are the Quarryman and the Boretrak. The quarryman aims to provide 3D models of the open-pit, while the Boretrak aims to provide 3d models of the borehole.

The collected point clouds can be accurately geo-referenced and multiple scans can be stitched together. The data can be plotted against design drawings or as-built data to help build an invaluable picture of the project site.

2.1 Quarryman

The Quarryman Pro is a field instrument which combines reflectorless laser 'point and shoot' measurement technology with high-speed automatic scanning. The unit can be used for conventional total station survey methods as well as 3D laser scanning. Complete scenes and objects in view at ranges of up to 750 m can be surveyed.

The instrument employs the 'time-of-flight' laser measurement technique to measure ranges to rock faces and other objects without the need to place reflectors on the target. This allows accurate measurements to be made of inaccessible points such as quarry faces and stockpiles.

Versions of the Quarryman have been used in the field for over 30 years. This experience has ensured that the instrument has been developed very specifically for its intended applications. It is designed to be very simple to use and is capable of operating in the harshest environments.

Selective use of the FastScan feature enables single or multiple high-definition scans to take place, highlighting rock features and anomalies.

The Quarryman Pro will observe 250 points per second, or up to 900,000 points per hour.

2.2 Boretrak

Carlson's Boretrak borehole deviation measurement system is a simple-to-use, portable system for measuring the deviation of boreholes.

The Boretrak is deployed and uses the probe's internal sensors to measure the borehole's deviation at fixed intervals. The output is recorded by the handheld device (CDU/PDA). From here the data can subsequently be downloaded to a PC for processing.

2.3 CarlsonOPS software

CarlsonOPS allows you to process and georeference Quarryman and Boretrak data. All data from the instruments is visualised on screen. The collected data can be edited, transformed, and combined with other datasets for further analysis.

The software allows you to layout a blast pattern in reference to the Quarryman/Drone scan. The inclusion of Boretrak data allows you to calculate the burden measurements to the blast face in order to load the holes safely. It also provides the means to create hole loading templates, and apply them to the blast pattern, before designing the timing and initiation involved with the blast.

3 CarlsonOPS software

3.1 Equipment compatibility

CarlsonOPS software is designed to work with all Quarryman and Boretrak instruments supplied by Carlson.

If you have any doubts as to the compatibility of **Carlson Scan** with your instrument, please contact Carlson for further details.

3.2 Laptop requirements and compatibility

When selecting a Windows-based laptop or desktop to run **CarlsonOPS**, consider the following points when making your choice.

CarlsonOPS runs on 64-bit Windows PCs from Windows 7 upwards.

500 MB free space is required on your tablet's hard disk to install the software.

8 GB is the minimum recommendation for RAM installed in your tablet.

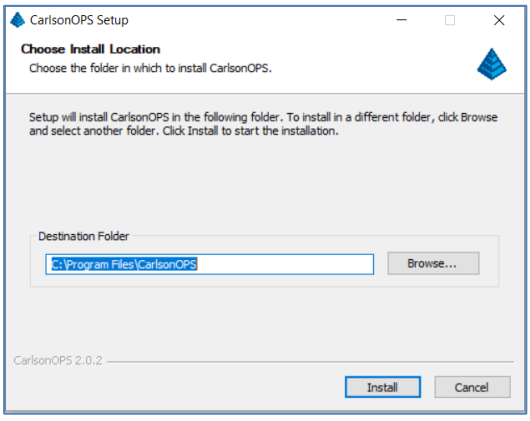
Carlson recommends that you ensure that all Windows updates are current and that the latest drivers for your graphics card are installed. Failure to update components may result in video or driver errors.

To transfer Quarryman Data, a USB port is required.

3.3 Installation

The **CarlsonOPS** installer is provided upon purchase of the software. Updates are made available online.

The installer is supplied in the form of an *.exe file. Double-click on the file to run the installer.



Click **Install**. The software and all necessary dependencies are loaded onto your tablet.

By default, **Carlson Scan** is installed at: **C:\Program Files\CarlsonOPS**.

An icon is loaded onto your desktop. Double-click to open **Carlson Scan**.

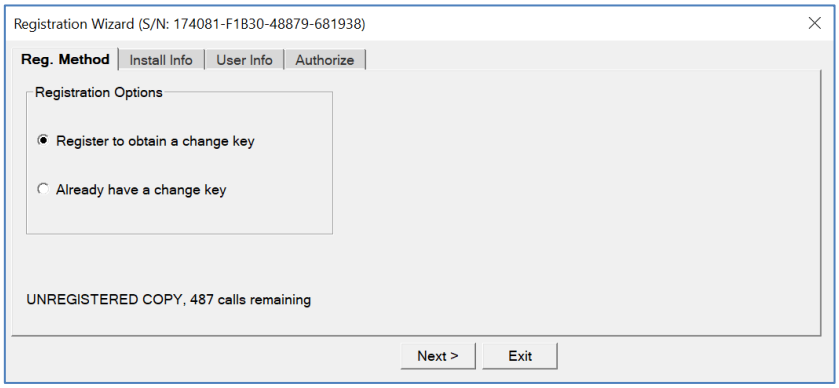
CarlsonOPS desktop icon

3.4 Licensing and registration

CarlsonOPS has a restrictive and network distribution license, so it may be installed on a singular PC or on a network.

You are encouraged to register your **CarlsonOPS** software to ensure that you can receive optimised support and updates from Carlson.

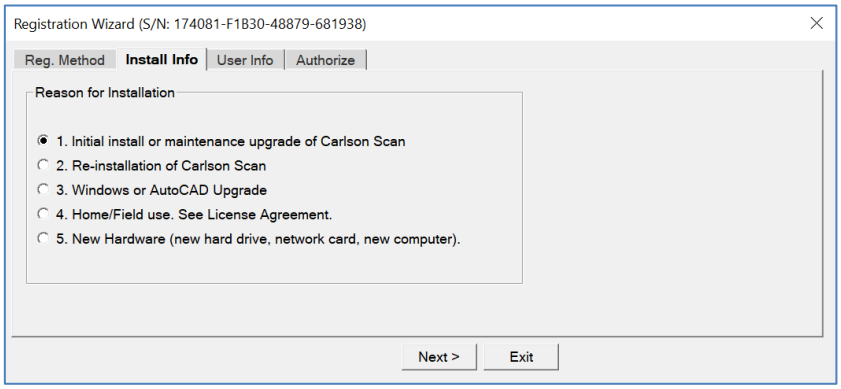
When you first run **CarlsonOPS** on your PC, a **Registration Wizard** window appears.



Registration Wizard

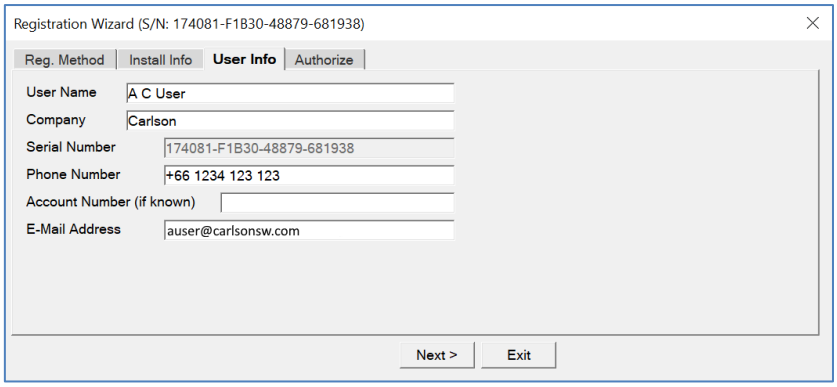
In order to register your copy of **CarlsonOPS**, your PC must be connected to the internet. If it is not connected to the internet, you can continue to use **CarlsonOPS** without registering. Tap **Exit** to escape from the **Registration Wizard**. You have 500 opportunities to use **CarlsonOPS** without registering: beyond this you must register to continue.

If you are connected to the internet and wish to register **CarlsonOPS**, select the Install Info tab and select **Initial install or maintenance upgrade of CarlsonOPS**.



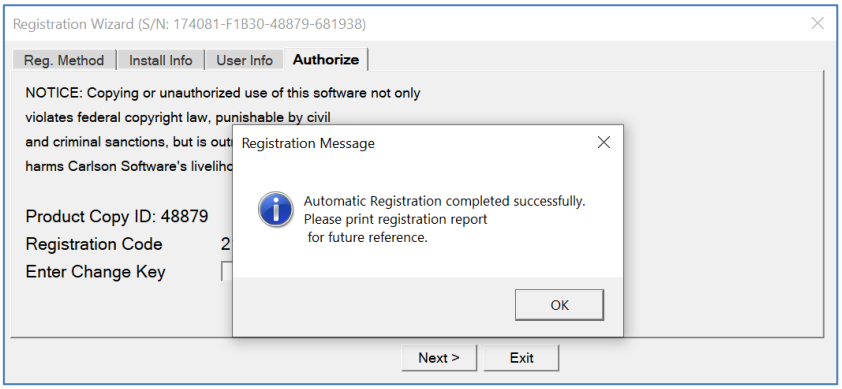
Registration Wizard - Install Info tab

Select the **User Info** tab and enter your details.



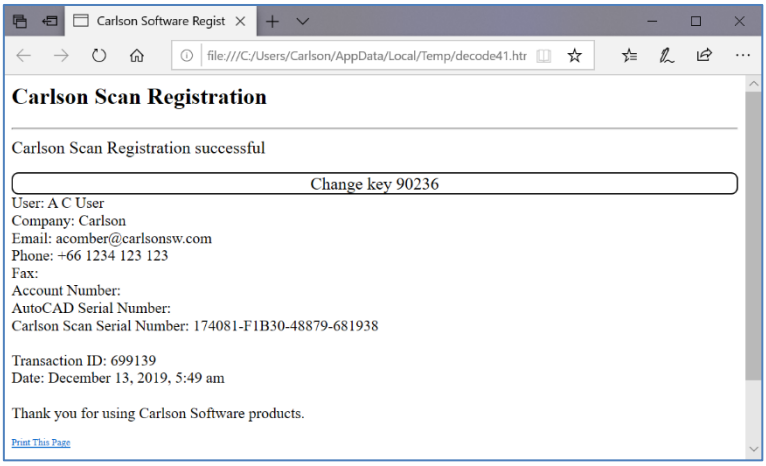
Registration Wizard - User Info tab

Click **Next**. If a connection with Carlson's servers is established, a **Registration Message** appears confirming that the registration process has been completed automatically.



Registration Wizard - registration completed

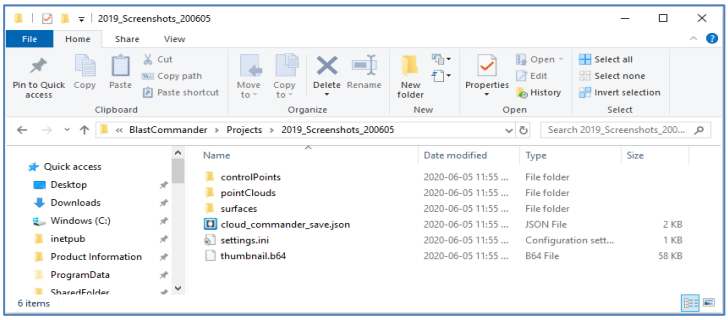
Click **OK**. A summary of the registration appears. This summary is also sent to the email address provided.



Registration summary

3.5 Data storage and file formats

By default, projects created in **CarlsonOPS** are saved in the location:
C:\Users\<username>\ProgramData\BlastCommander\Projects



A CarlsonOPS project in Windows Explorer

A dedicated folder structure is created for every **CarlsonOPS** project. All data collected in a project is stored in the project folder or sub-folders.

The main project file is saved as *.json directly in the project folder. You can open this file from within **CarlsonOPS** by selecting the previous project in the opening screen.

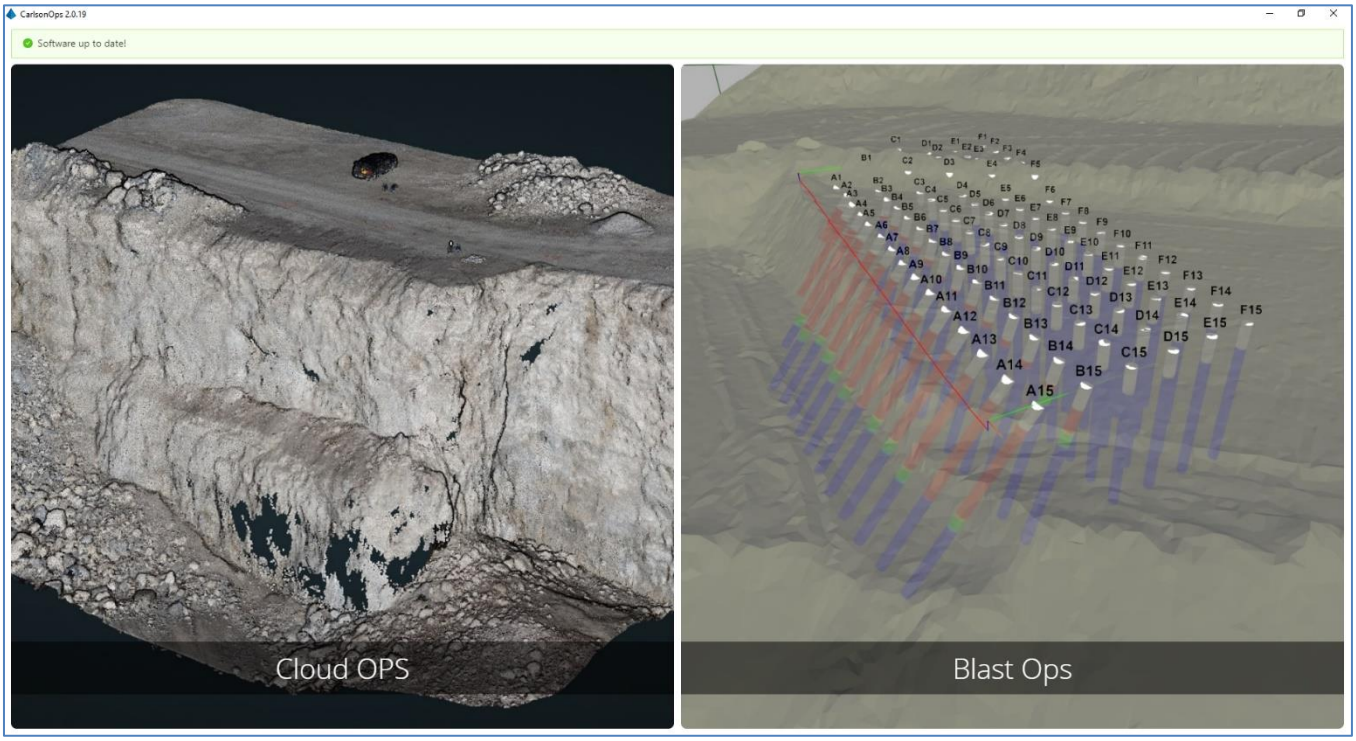
Other files are stored in sub-folders:

- **controlPoints**: when added to a project, control points are stored here and continually updated.
- **Fsc_files**: when added to a project, the parser information for the FSC file are stored here.
- **pointClouds**: when added to a project, pointcloud information is stored here.
- **surface**: when created in a project, surface information is stored here.

If problems are encountered with the hardware, software or any collected datasets, then it may be necessary to contact Carlson for support. In this case you may be requested to send the entire, zipped project folder. This will help to ensure the highest level of support.

4 Home screen

When **CarlsonOPS** is first opened, the **Home** screen appears.



Home screen

4.1 Cloud OPS

Click **Cloud OPS** to begin a new project or resume an existing project.

The project is stored in the defined project folder.

Cloud OPS handles the importation of Quarryman and drone data to display and edit the point cloud. From which a surface can be created and measurement assessments can be taken. Control points, markup, and surfaces can then be transferred to **Blast OPS**.

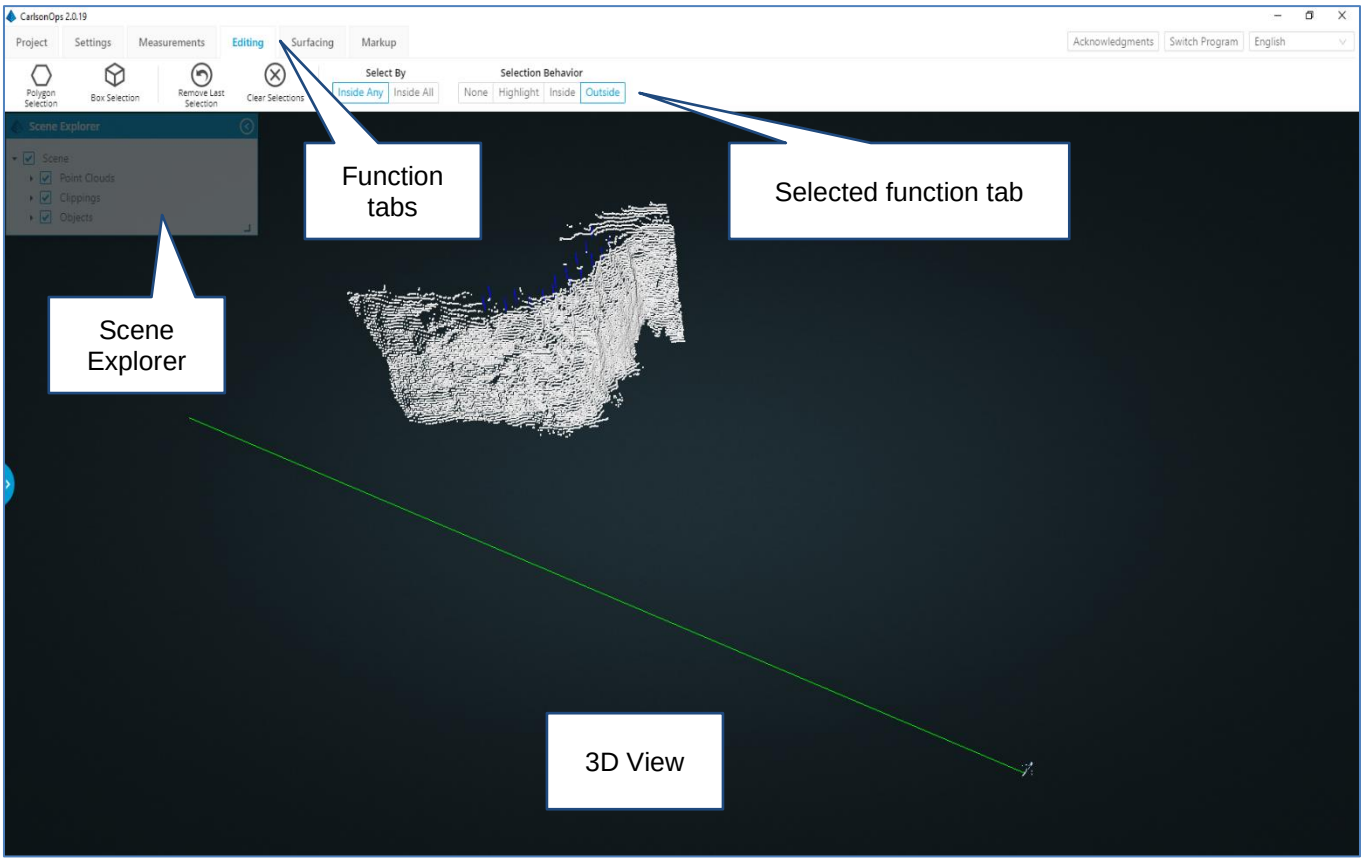
4.2 Blast OPS

Click **Blast OPS** to begin a new project or resume an existing project.

The project is stored in the defined project folder.

Blast OPS uses the previously made surface from **Cloud OPS** (can also be imported), in order to design a blast pattern. Further to this, Boretrak data can then be attached to the collar to calculate burden distances. The software can also aid in the design for hole loading, as well as timing and initation.

5 Cloud OPS



Cloud OPS - screen layout

In **Cloud OPS**, a standard screen layout is composed of the elements outlined below.

5.1 3D View

The main **3D View** window shows all data graphically. This includes scanned point clouds.

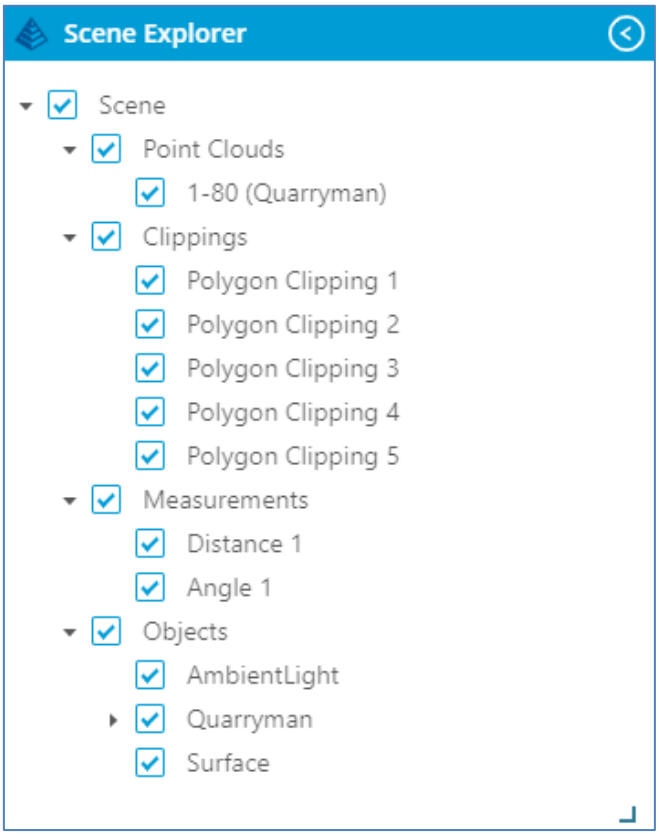
Navigation in the **3D View** is by intuitive dragging and clicking by mouse.

- **Zoom in / out**: roll the scroll wheel on a mouse.
- **Rotate**: click and drag with the left button on a mouse.
- **Pan**: click and drag with the right button on a mouse.

5.1.1 Background colour

The background colour is black by default. Change the background colour in the **Project Settings** window (see section 6.4.6).

5.2 Scene Explorer



Scene Explorer

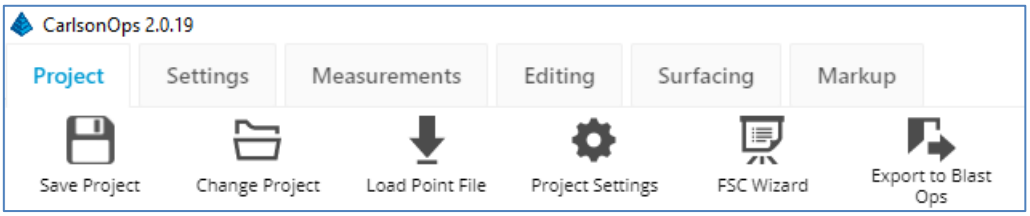
The **Scene Explorer** is responsible for what is shown in the **3D View**. It is located, by default, in the top left corner of the **3D View**. Using the button in the top right corner, the **Scene Explorer** can be docked into the west-dialog.

The **Scene Explorer** is organized as follows.

- **Point Clouds**: Quarryman point clouds are separate by their allocated code. Imported drone files are indicated by their file name.
- **Clippings**: polygon/box selections used to edit the point cloud can be found here.
- **Measurements**: measurements performed on the point cloud can be found here.
- **Objects**: ambient lighting, Quarryman model, control points, and created surfaces can be found here.

Click with the right button on a mouse to bring up a menu to in order to refocus the centre of rotation or delete selected item.

5.3 Function tabs



Function tabs

At the top of the screen, are six function tabs which allow provide control of settings, analysis and editing tools, and enables surface creation and exportation to **Blast OPS**.

Tap the required tab to make it active.

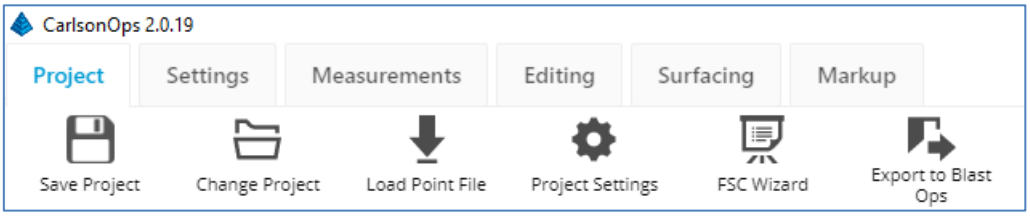
The active function tab is identified by a blue highlight.

The function tabs are each outlined in the following sections.

- **Project tab:** see section 6.
- **Settings tab**: see section 7.
- **Measurements tab**: see section 8.
- **Editing tab**: see section 9.
- **Surfacing tab**: see section 10.
- **Markup tab**: see section 11.

6 Project tab

The **Project** tab contains features which offer project level and software level functions.



Project tab

6.1 Save Project

Click **Save Project** to save the **CarlsonOPS** project.

6.2 Change Project

Click **Change Project** to switch **CarlsonOPS** projects.

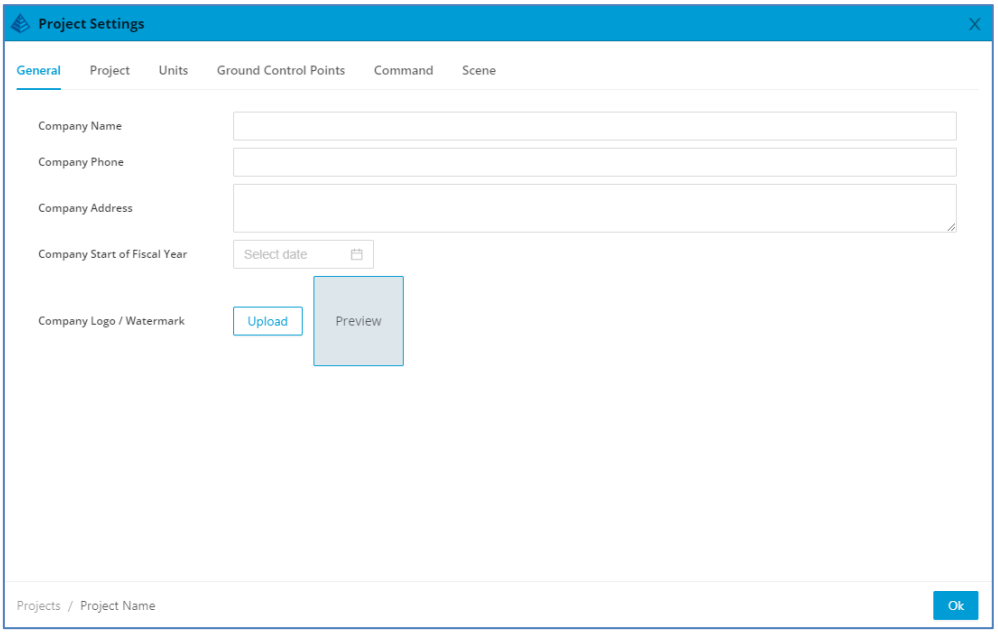
6.3 Load Point File

The **Load Point File** function can be used to import other point cloud files into your active **CarlsonOPS** project. Currently supported file types are:

- **VPC:** Project Configuration file (*.vpc)
- **JSON:** JavaScript Object Notation file (*.json)
- **LAS:** LAS file (*.las)
- **LAZ:** LAZ file (*.laz)
- **TXT:** Point cloud text file (*.txt)
- **XYZ:** Point cloud text file (*.xyz)

6.4 Project Settings

Tap **Project Settings** to open the settings in a new window.



Project Settings window > General tab

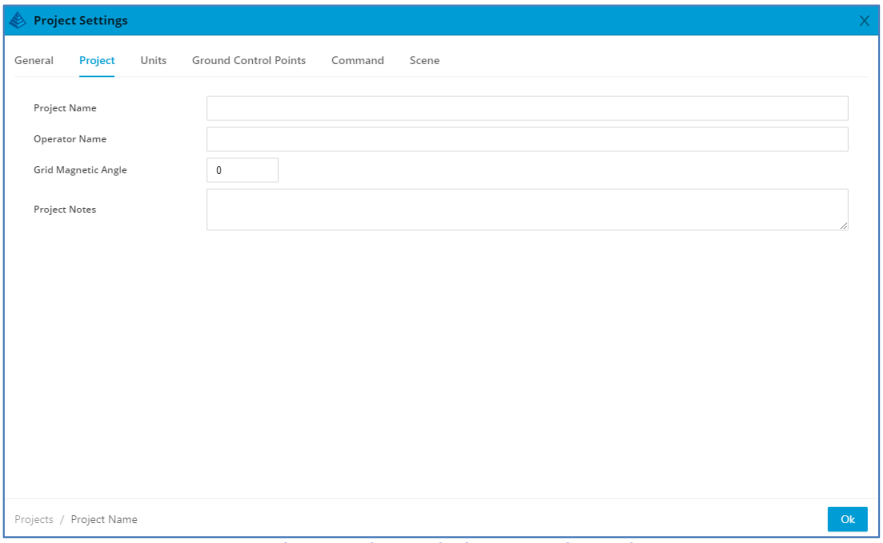
6.4.1 General tab

In the **General** tab, company information, such as name, phone, address, and logo can be entered.

6.4.2 Project tab

In the **Project** tab, the project name, operator name, and project notes can be entered.

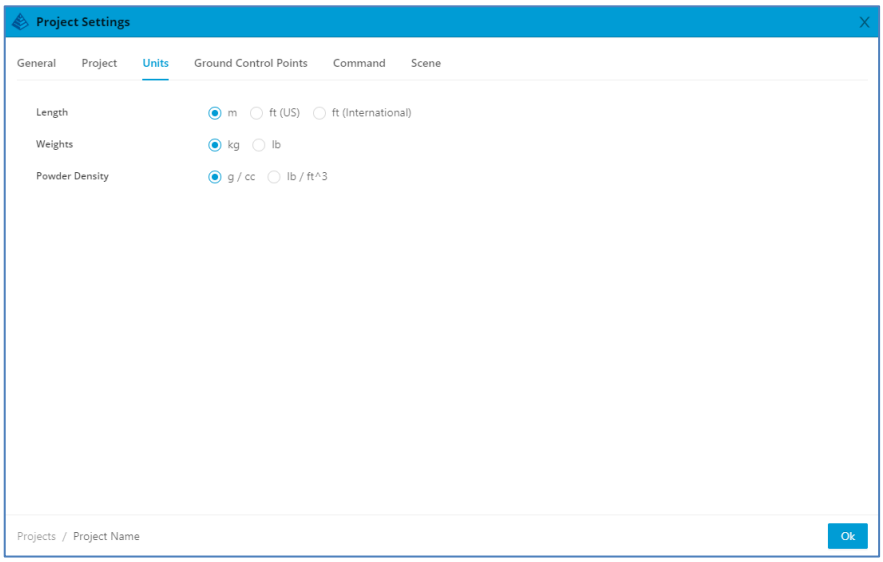
The grid magnetic angle is in regards to the magnetic declination needed to rotate the Cabled Boretrak data. This is calculated in **Blast OPS**.



Project Settings window > Project tab

6.4.3 Units tab

In the **Units** tab, the units used in the software can be indicated.



Project Settings window > Units tab

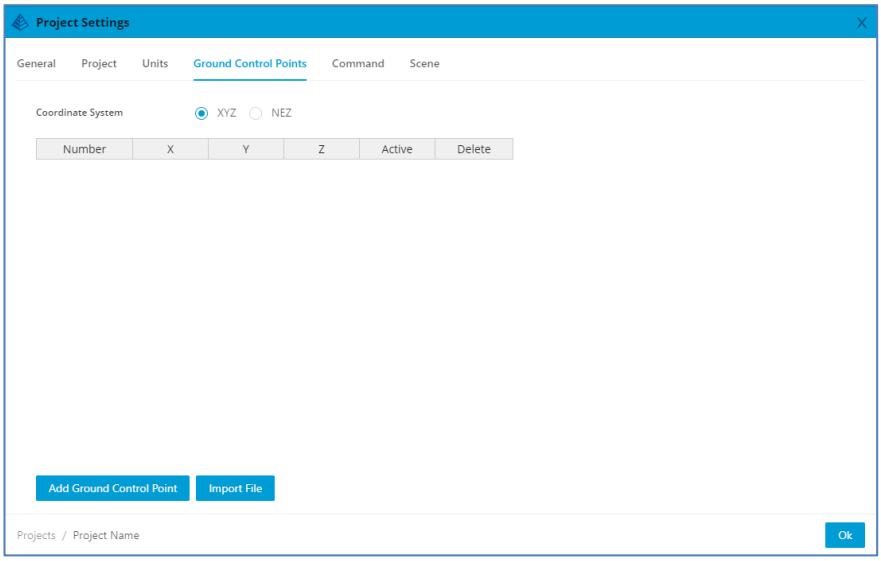
6.4.4 Ground Control Points tab

In the **Ground Control Points** tab, ground control points can be entered manually, or imported from a file.

Click **Add Ground Control Point** for manual insertion.

Click **Import File** to load in ground control points. Currently supported file types are:

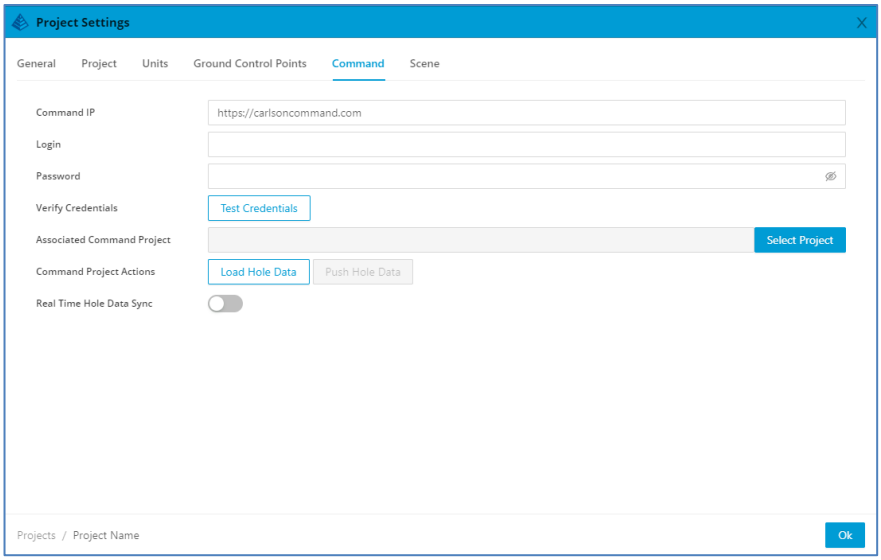
- **CSV:** Comma-separated value file (*.csv)
- **TXT:** Text file (*.txt)



Project Settings window > Ground Control Points tab

6.4.5 Command tab

In the **Command** tab, Carlson Command login information could be connected with **CarlsonOPS** in order to transfer data between the office and field.

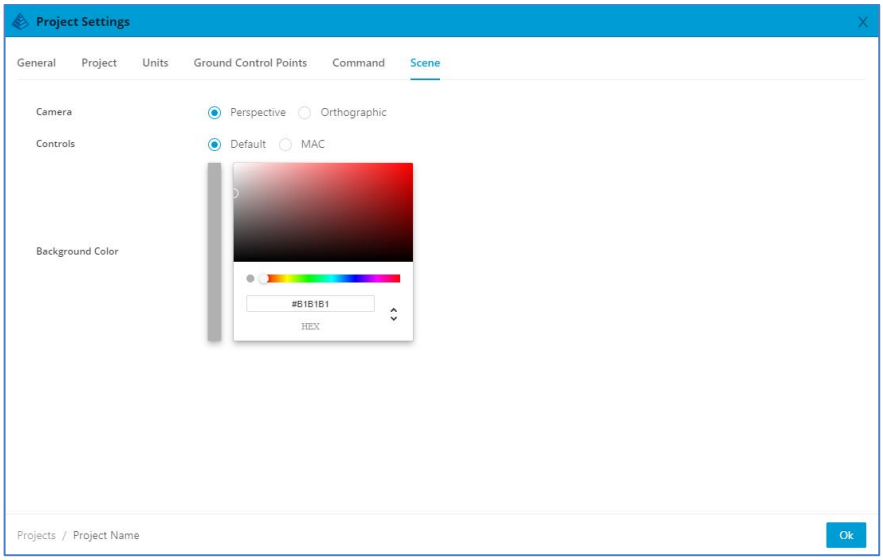


Project Settings window > Command tab

6.4.6 Scene tab

In the **Scene** tab, the camera mode can be switched between **Perspective** and **Orthographic**. The controls can be switched from **Default** (see section 5.1) to **MAC**.

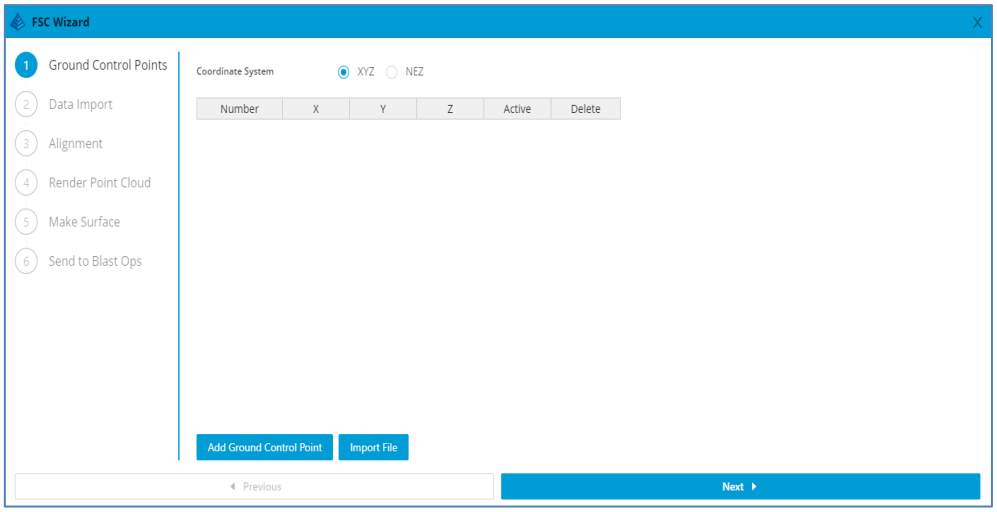
Here the background colour can also be changed.



Project Settings window > Scene tab

6.5 FSC Wizard

Tap **FSC Wizard** to open a new window that acts as a guide for importing and orienting Quarryman data.



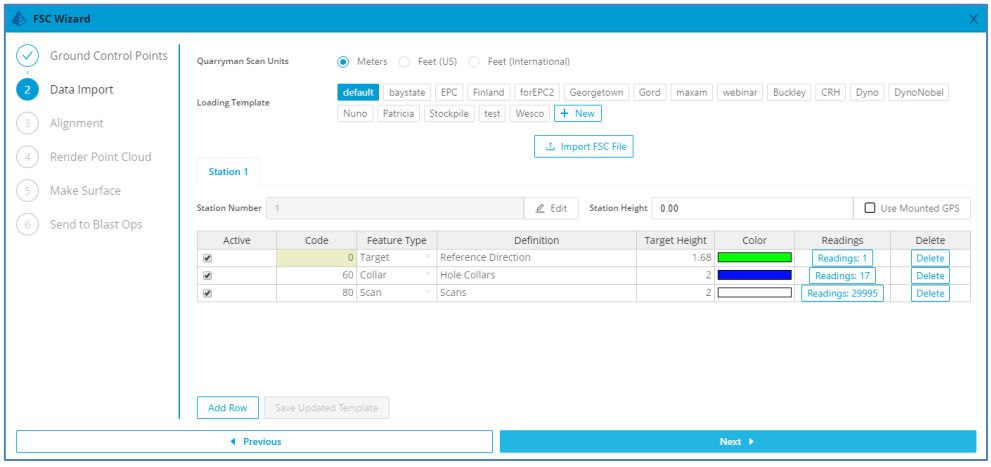
FSC Wizard window > Ground Control Points tab

6.5.1 Ground Control Points

Ground Control Points – even an arbitrary one for a local gird – must be entered or imported to local the Quarryman data (see section 6.4.4).

6.5.2 Data Import

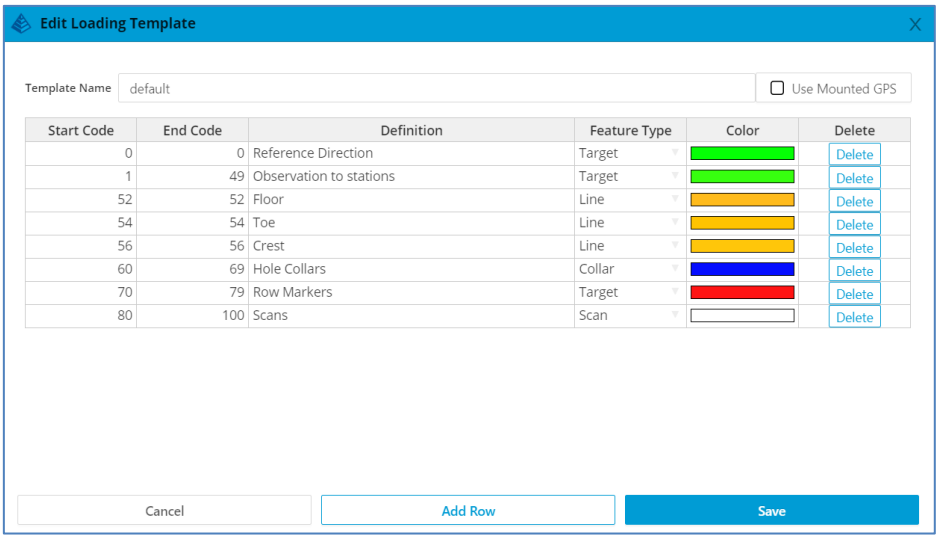
The **Data Import** tab is where the FSC file is imported.



FSC Wizard window > Data Import tab

Before importing the FSC file the **Quarryman Scan Units** must be selected. This is the units that the Quarryman used in the field.

Additionally, a **Loading Template** must be selected. This indicates what each code used in the field represents. While this is flexible, Carlson provides the following recommended template:



Carlson Recommended Loading Template

Each line of the template can be broken down into the following:

- **Start Code:** the first code number for that specific **Definition** and **Feature Type**.
- **End Code**: the last code number for that specific **Definition** and **Feature Type**.
- **Definition**: key word/phrase to let the user know what the code represents.
- **Feature Type**: there are four feature types to choose from.
    - **Target**: used to reference control/resection points, or indicate positions of other setups.
    - **Scan**: used to represent point cloud data. **Measurement Tools** (see section 8) can be used on points for analysis.
    - **Line**: used to reference lines, such as Toe and Crest.
    - **Collars**: used to represent hole collars. Boretrak Data can be combined with the collar position (see section 16.2.3).
- **Color**: color used to represent the data in the 3D View

Note that a code number cannot represent multiple features. Any errors will be highlighted in red.

Loading Templates can be applied, edited, and deleted from the **Data Import** window by simply clicking the desired template with the left button on a mouse to bring up the menu.

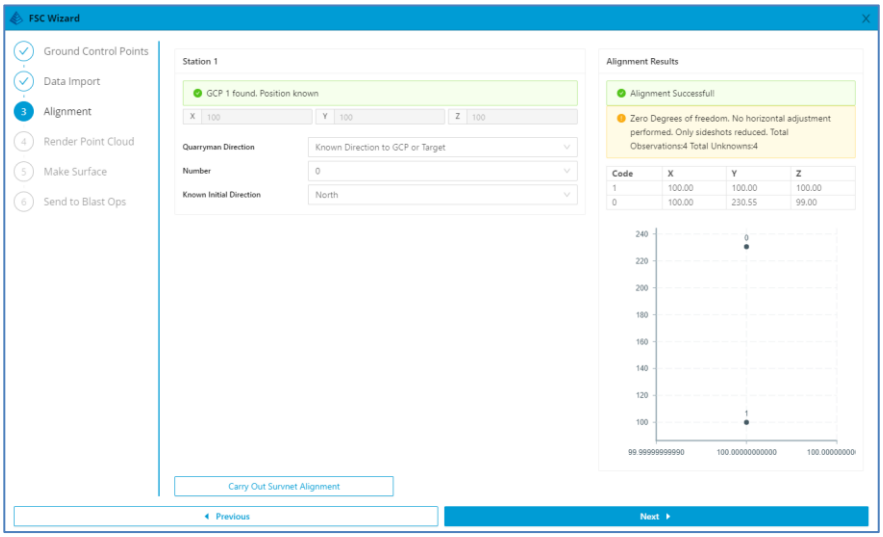
With the **Quarryman Scan Units** set, and the **Loading Template** selected, the FSC file can now be imported by clicking **Import FSC File** and selecting the desired file.

The bottom half of the window will show the data imported. Here the FSC file information can be changed. Whether it is the **Station Number**, **Station Height**, **Code**, **Feature Type**, **Definition**, or **Target Height**.

If different objects were accidentally scanned under the same code number, the **Readings** column can be selected for a specific code to show each point surveyed under that code. While all the data in the new window is editable, it is recommended to only change the **Code** number, as the rest was surveyed in using the Quarryman. Click **Save** to accept any changes.

6.5.3 Alignment tab

The **Alignment** tab, orientates the Quarryman data using the SurvNET algorithm.



Project Settings window > Alignment tab

Depending on how you are surveying, the alignment steps can vary:

- **Using GPS:** to establish the positional coordinates of the Quarryman setup, in addition to the back-sight or reference location.
- **Using Resection**: a series of survey stations established around the site, marked by a permanent target. Each target will have known coordinates (x,y,z) which will be known on either a national or local grid system. At least three visible stations are required to carry out a resection. These should ideally be fairly evenly spaced around the Quarryman setup. If they are all clustered in the same direction, the results of the resection observations may be poor.
- **Using Local Grid**: arbitrary local grid coordinates (100,100,100) for the first Quarryman setup, and establishing subsequent Quarryman setup(s) by using the Point and shoot mode. A range and bearing calculation within the software will compute the positional coordinates of the remaining setups.

Refer to section 19.1 for Alignment procedures.

For each Quarryman station, up to 3 pieces of information can be used for orientation:

- **Quarryman Direction**: there are four quarryman directions to choose from
    - **Calculate Direction**: use this when either the station location and a known point is surveyed in, or when a minimum of 3 known points are surveyed in.
    - **Backsighted to Non-Targeted GCP** (ground control point) **or Target**: use this when the station location is known, but a known point was not surveyed in. In this case, the user would need to know where the Quarryman was referenced to.
    - **Known Direction to GCP or Target**: use this when the station location is known, and a reference direction (North, South, East, West) is surveyed in.
    - **Known Direction at Startup**: use this when the station location is known, and a reference direction (North, South, East, West) was not surveyed in. In this case, the user would need to know in what direction the Quarryman was referenced to.

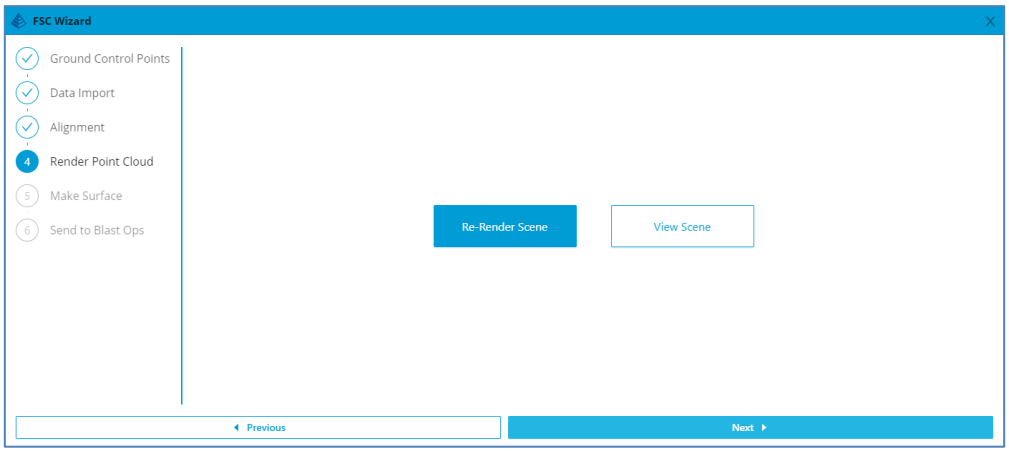
- **Number**: Either **Code** number or **Control Point** number
    - For **Backsighted to Non-Targeted GCP or Target** this would be the control point used as the reference
    - For **Known Direction to GCP or Target** this would be the code number used as the reference
- **Known Initial Direction**: North, South, East, or West
    - For **Known Direction to GCP or Target** this would be the reference direction used
    - For **Known Direction at Startup** this would be the reference direction used

Once each Quarryman station has been assigned, click **Carry Out Survnet Alignment**.

If alignment fails, review the ground control points, FSC import, and/or alignment information for any errors.

6.5.4 Render Point Cloud tab

Once in the **Render Point Cloud** tab, the software will self-render the scene.



Project Settings window > Render Point Cloud tab

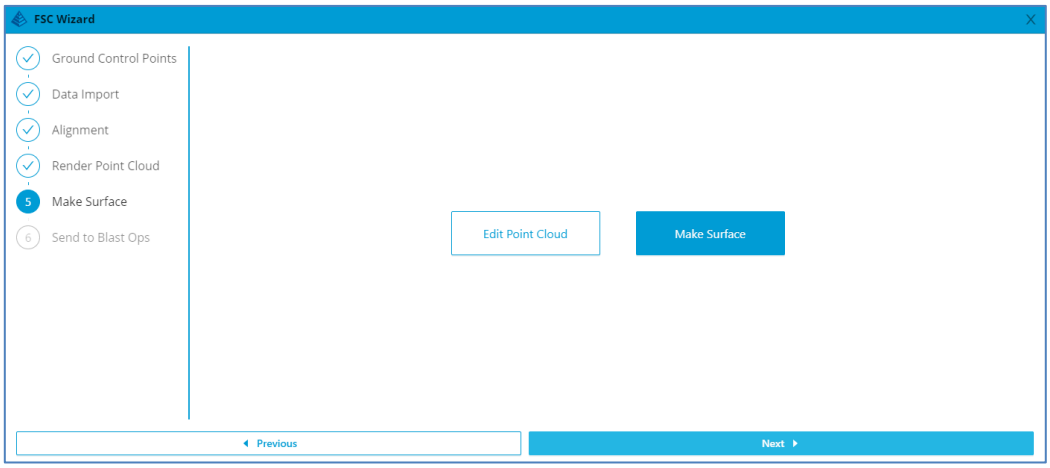
Click **View Scene** to minimize the **FSC Wizard** and view the point cloud.

If there are any errors, or you want to continue in the wizard, click **Back to FSC Wizard** from the 3D View.

If corrections to the ground control points, FSC import, and/or alignment were made, upon returning to the **Render Point Cloud** tab, you must click **Re-Render Scene** to accept those changes.

6.5.5 Make Surface tab

With the Quarryman Point Cloud imported and located correctly, the **Make Surface** tab allows you to edit the point cloud, and create a surface from it.



Project Settings window > Make Surface tab

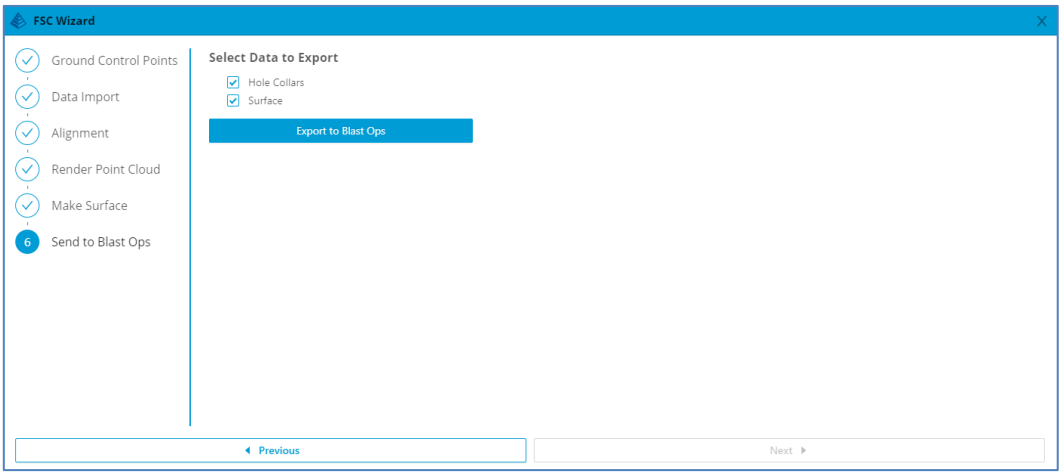
Click **Edit Point Cloud** to take you to the **Editing** tab (see section 8).

Click **Make Surface** to take you to the **Surfacing** tab (see section 9).

To continue in the wizard, click **Back to FSC Wizard** from the 3D View.

6.5.6 Send to Blast OPS tab

After importing and editing the data to create a surface, the last step is to **Send to Blast OPS**.



Project Settings window > Send to Blast OPS tab

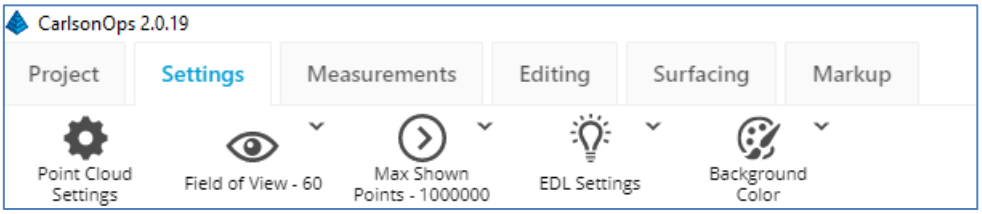
Here the data desired to be exported can be selected before clicking **Export to Blast OPS**. Note that this will take you to **Blast OPS**.

6.6 Export to Blast OPS

As an alternative to the **Export to Blast OPS** button within the FSC Wizard, there is also one under the **Projects** tab. A similar window to section 6.5.6 will appear allowing you to select the desired data before exporting.

7 Settings tab

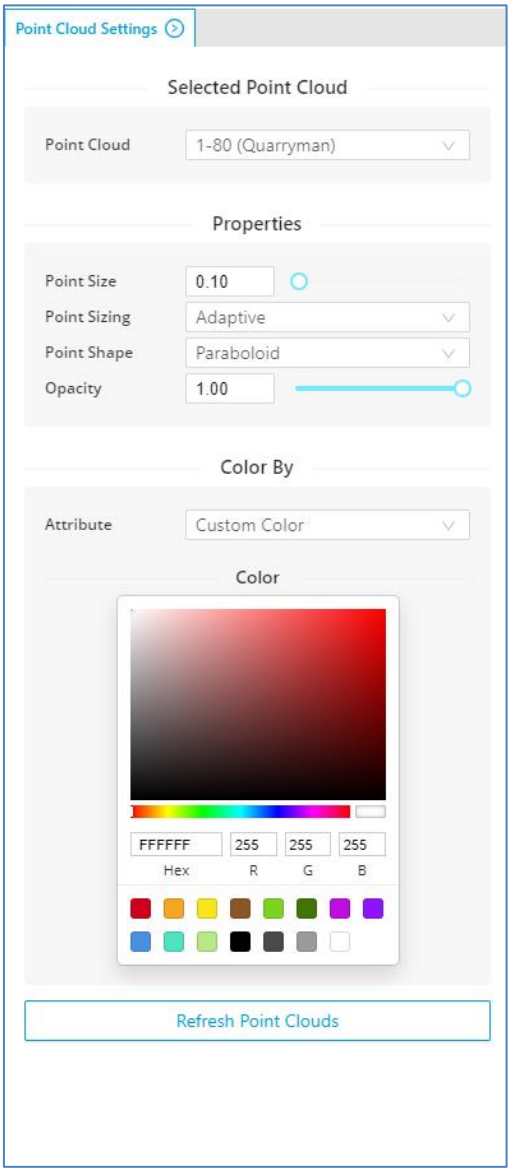
The **Settings** tab contains a number of different software settings, including settings for each point cloud.



Settings Tab

7.1 Point Cloud Settings

Point Cloud Settings is also accessible through the blue arrow midway down the left side of the screen.



Point Cloud Settings

The tools in **Point Cloud Settings** only act on the active point cloud, indicated by the **Selected Point Cloud**.

After which, the properties that can be manipulated are:

- **Point Size**: increase or decrease the point size.
- **Point Sizing**:
    - **Adaptive**: allows you to adjust the **Point Size**. When zooming in, the adaptive setting keeps the same relative size.
    - **Attenuated**: point size will be minuscule regardless of **Point Size** property.
    - **Fixed**: allows you to adjust the **Point Size**. Zooming in does not affect the relative size.
- **Point Shape**: allows you to choose between **Paraboloid**, **Circle**, and, **Square**.
- **Opacity**: allows you to change the transparency of points. This only works if the **EDL Lighting** is off (see section 7.4).
- **Color By**: allows you to choose how the point cloud is colored.
    - **Adjusted Color**: ability to choose **Gamma**, **Brightness**, and **Contrast** attributes.
    - **Elevation**: ability to set the **Elevation Range**, and **Color Scheme**.
    - **Custom Color**: ability to set a specific color.
    - **Matcap**: ability to choose a specific material color.
    - **Indices**: colors by the color index, related logarithmically to intensity.
    - **Level of Detail**: color scale based on number of nearby points in the current **3D View**.
    - **GPS Time**: color based on GPS time. The point cloud file must have this information in order to be used.
    - **Composite**: a combination of **Adjusted Color**, and **Elevation**.

7.2 Field of View

Field of View adjusts the observational area you can seen in the **3D View**.

As the value increases, the field of view becomes larger, but the ability to zoom in to points is reduced.

As the value decreases, the field of view becomes narrower, but the ability to zoom in to points is increased.

7.3 Max Shown Points

Max Shown Points adjusts the amount of points shown in the **3D View** at one time.

While the visual of a point may be omitted due to the setting, it is still used for the purposes of point cloud editing, and surface creation.

Zooming in, points outside of the current **3D View** are omitted, while the density of the points still visible can increase.

7.4 EDL Settings

EDL (Eye-Dome Lighting) **Settings** can be toggled on to further accentuate the point cloud details.

- **Radius**: adjust the search radius from each point to find neighboring points to calculate the difference in depth.
- **Strength**: adjust to emphasize the depth difference between the points.
- **Opacity**: adjust the transparency of points

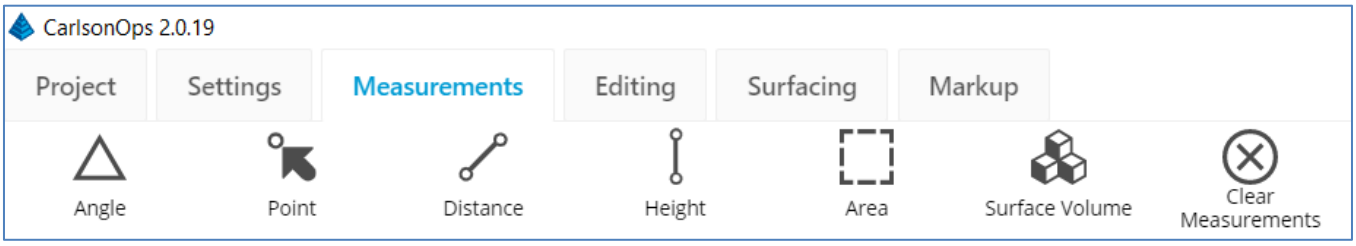
7.5 Background Color

Background Color can be alternated between **Sky Box**, **Gradient**, **Black**, **White**, and **none**.

For more options see section 6.4.6

8 Measurements tab

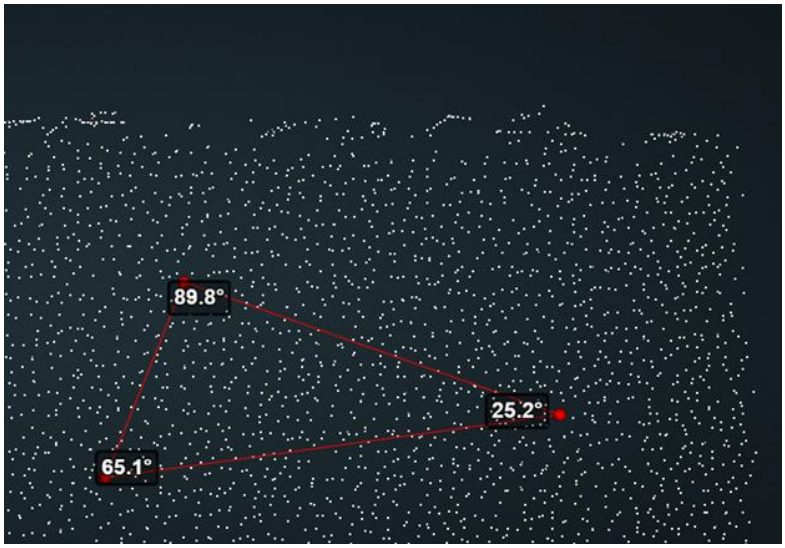
The **Measurements** tab contains a number of different tools for further analysis of a point cloud. There is also a tool to compute a volume from a created surface.



Measurements Tab

8.1 Angle

For the **Angle** measurement, three vertices must be selected by clicking the left button on a mouse to show the angles between the points.



Angle Measurement

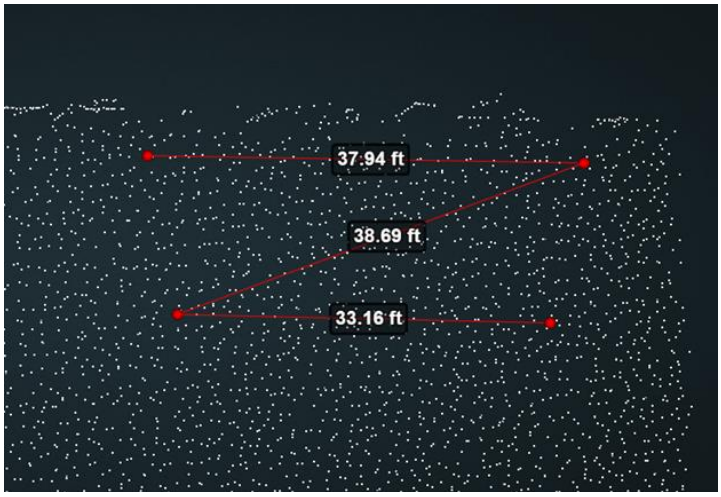
8.2 Point

For the **Point** measurement, simply clicking the left button on a point will show it's coordinates.

Point Measurement

8.3 Distance

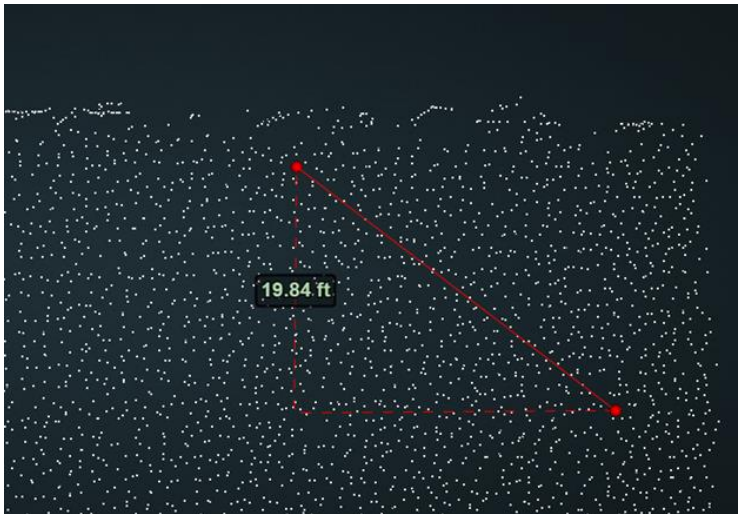
For the **Distance** measurement, a number of vertices can be selected by clicking the left button on a mouse, and show the distance between the points. End the measurement by clicking the right button on a mouse within the **3D View** or use the ENTER key.



Distance Measurement

8.4 Height

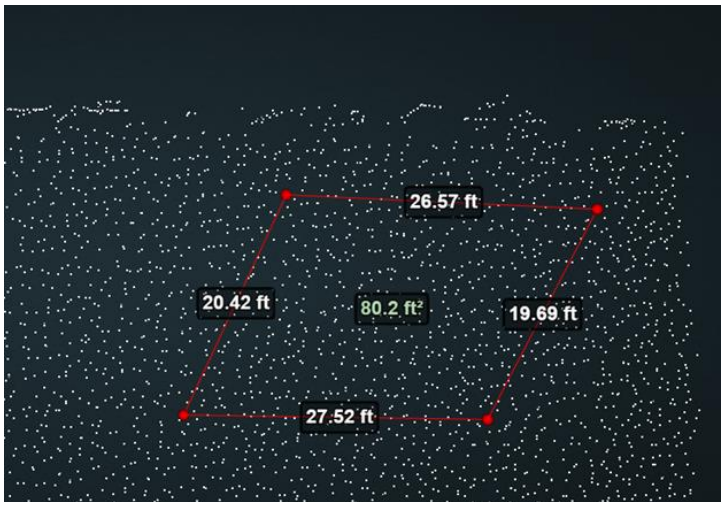
For the **Height** measurement, select two points by clicking the left button on a mouse and the vertical distance between the two will be calculated and displayed.



Distance Measurement

8.5 Area

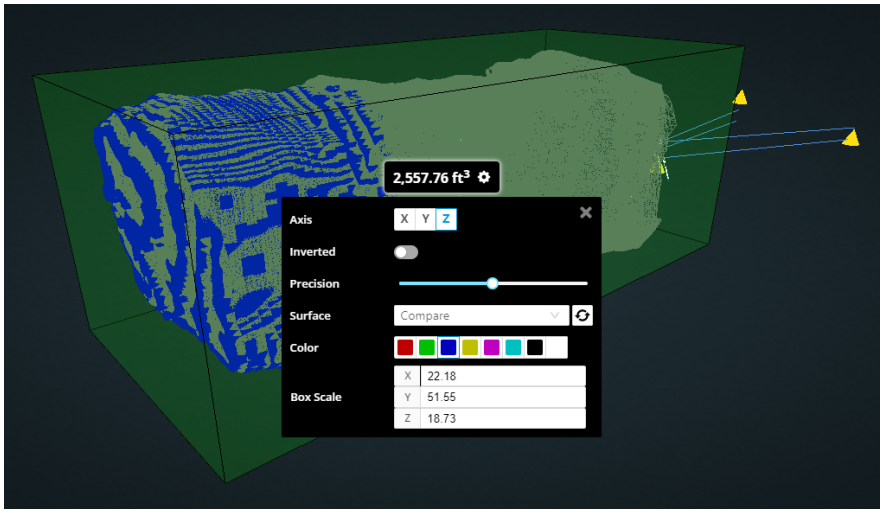
For the **Area** measurement, select the desired vertices by clicking the left button on a mouse. End the measurement by clicking the right button on a mouse within the **3D View** or use the ENTER key.



Area Measurement

8.6 Surface Volume

For the **Surface Volume** measurement, the surface must be created first (see section 10), and the point cloud must be toggled on in order to locate the bounding area of the measurement tool.



Surface Volume Measurement

Once the bounding area has been placed, the manipulation tools can be prompted by clicking the bounding area with the left button on a mouse.

The bounding area can be altered:

- **Box Extents**: using the circular icons at the box's extents, the bounding area can be reduced or enlarged.
- **Rotation**: using the quarter circles in the centre of the box, the bounding area can be rotated in that axis.
- **Translation**: using the lines in the centre of the box, the bounding area can be moved in that axis.

Further properties can be prompted using the **Sprocket Icon** next to the volume display:

- **Axis**: by selecting **X**, **Y**, or **Z** (default) the axis in which the volume is calculated can be changed.
- **Inverted**: by toggling **Inverted**, the volume calculated can alternate between above/below the surface, or inside/outside a void.
- **Precision**: determines the number of projections from the bounding area plane in order to calculate the volume.
- **Surface**: determines which surface is being used for the volume calculation.
- **Color**: selects the color of the volume area.
- **Box Scale**: allows user input for the box dimensions.

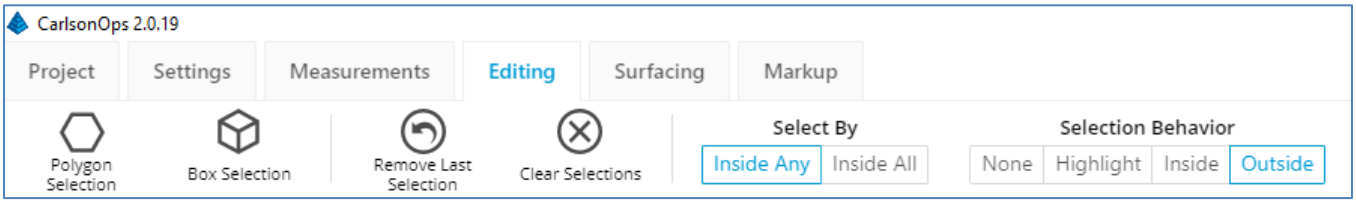
8.7 Clear Measurements

Clear Measurements would clear all the measurements calculated.

From the **Scene Explorer**, individual measurements can be deleted.

9 Editing tab

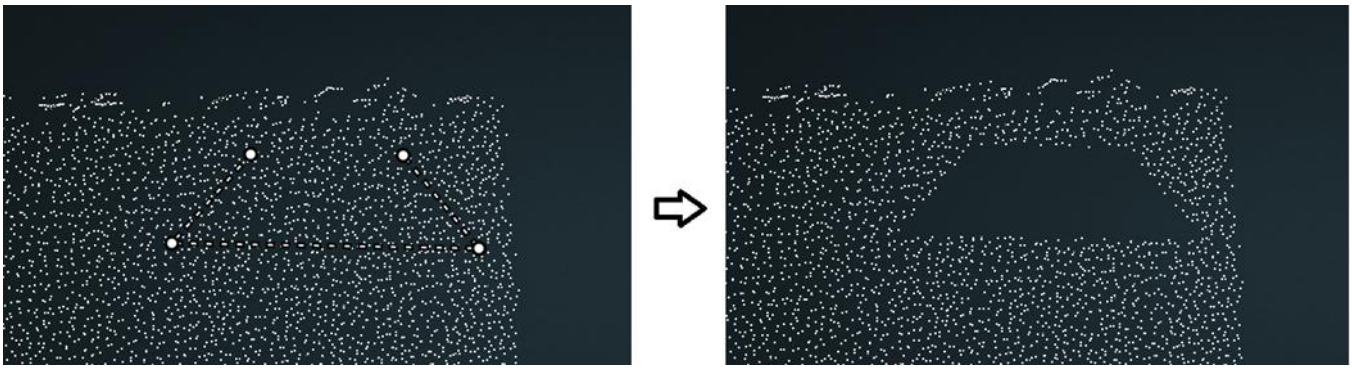
The **Editing Tab** provides tools to clean up point cloud data.



Editing Tab

9.1 Polygon Selection Tool

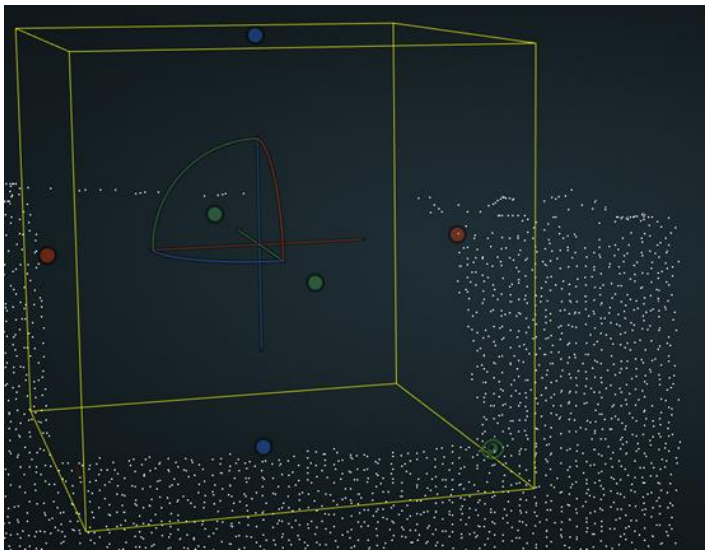
The **Polygon Selection Tool** allows for a selection of up to 8 vertices to indicate the bounding area, clicking the left button on a mouse. End the selection by clicking the right button on a mouse within the **3D View** or use the ENTER key.



Polygon Selection Tool

9.2 Box Selection Tool

The **Box Selection Tool** allows for a selection of points by using a bounding box.



Box Selection Tool

Once the bounding area has been placed, the manipulation tools can be prompted by clicking the bounding area with the left button on a mouse.

The bounding area can be altered:

- **Box Extents**: using the circular icons at the box's extents, the bounding area can be reduced or enlarged.
- **Rotation**: using the quarter circles in the centre of the box, the bounding area can be rotated in that axis.
- **Translation**: using the lines in the centre of the box, the bounding area can be moved in that axis.

9.3 Remove Last Selection

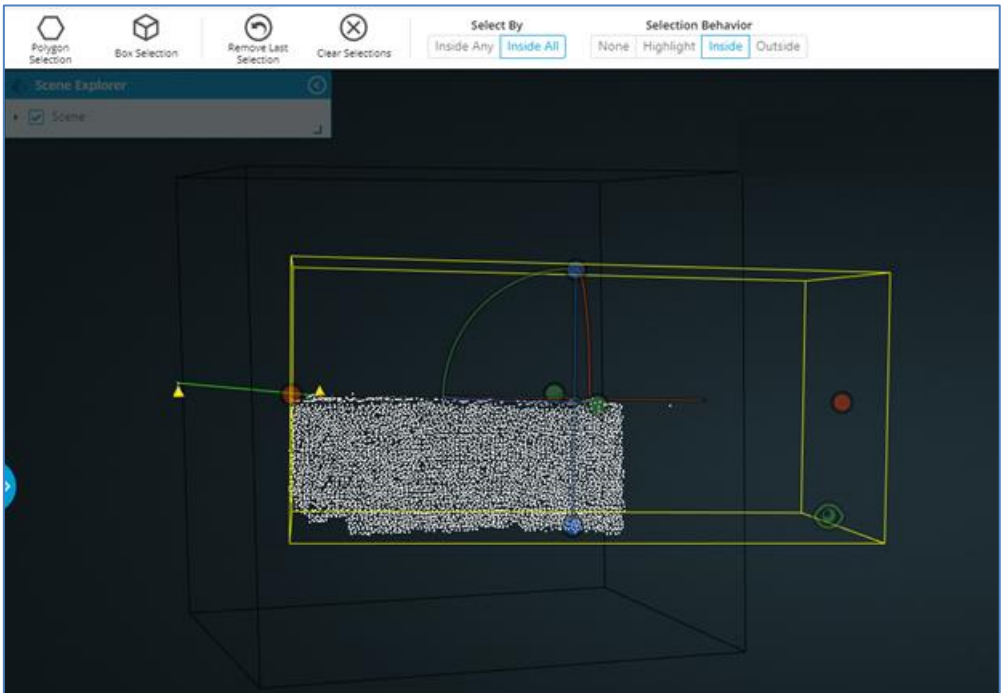
Remove Last Selection undoes the last polygon/box selection.

9.4 Clear Selections

Clear Selections clears all polygon/box selections.

9.5 Select By

Select By influences how bounding areas edit points, when **Selection Behaviour** (see section 9.6) is set to **Inside**.



Select By > Inside All

- **Inside Any**: selection areas do not need to overlap for points to be visible.
- **Inside All**: only overlapping selection areas will have visible points.

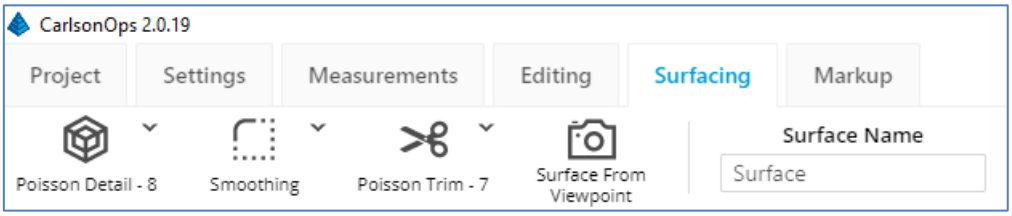
9.6 Selection Behaviour

Selection Behaviour influences how bounding areas show/hide points.

- **None**: bounding area does not affect the point cloud.
- **Highlight**: identifies the select point by a desired color(**Red**, **Green**, **Blue**).
- **Inside**: points within the bounding area will remain while the rest are hidden.
- **Outside**: points outside of the bounding area will remain while the rest are hidden.

10 Surfacing tab

The **Surfacing Tab** allows for the creation of surfaces from the visible points in the **3D View**.



Surfacing Tab

10.1 Poisson Detail

Poisson Detail will increase/decrease the number of points used for surface creation. Subsequently, this will increase/decrease the size of the triangles themselves, affecting the size of an exported surface.

This must be set before clicking **Surface From Viewpoint**.

10.2 Smoothing

Smoothing can be toggled on/off in order to create a cleaner surface.

- **Keep/Drop Spare Points**: toggle to keep or drop isolated points.
- **Smoothing Search Radius**: controls the distance at which to determine the nearest points to use for the smoothing filter.
- **Surface Complexity**: controls the complexity of the surface.
    - **1**: creates a plane between points.
    - **2** (Default): creates a curve between points.
    - **3**: creates an undulating curve between points.
    - As the value is increased, the less smooth the surface will be.

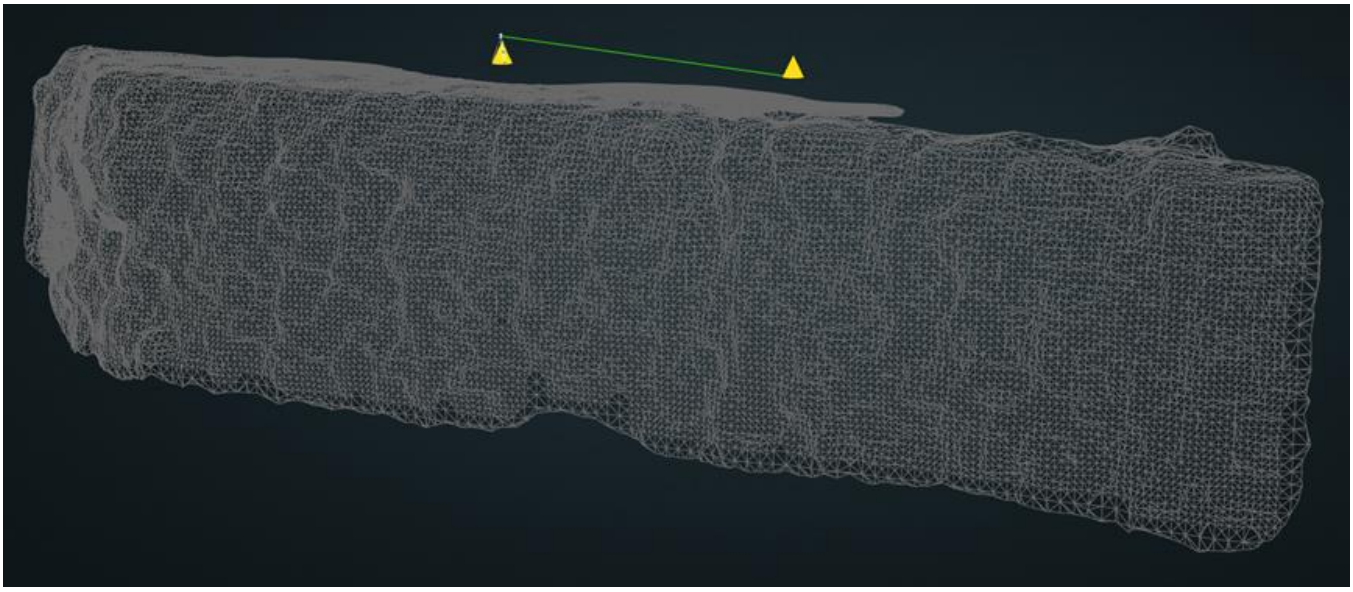
10.3 Poisson Trim

Poisson Trim will increase/decrease the distance between points the surface can stretch over. Subsequently, this can expand the surface beyond the boundary of the point cloud.

This can be set before clicking **Surface From Viewpoint**, however can be altered afterwards to update the current surface.

10.4 Surface From Viewpoint

Surface From Viewpoint will create the surface.



Created Surface

Due to the use of Poisson's Algorithm to create the surface, the quality of the surface is dependent on the viewpoint.

With the algorithm attempting to create an enclosed solid, the recommended viewpoint would be looking from within the quarry bench out, at an upwards angle if there is point cloud data for the top bench and bottom bench.

For voids, the recommended viewpoint would be within the void itself.

10.5 Surface Name

The **Surface Name** can be change from the default “Surface” to uniquely identify created surfaces.

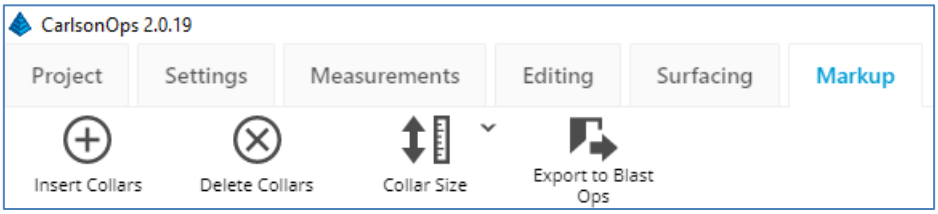
Must be named before the creation of the surface.

Surfaces can be exported from the **Scene Explorer**. Click the desired surface with the right button on a mouse. Currently supported file types are:

- **PLY:** Polygon File Format (*.ply)
- **BTIN:** Binary Triangulated Irregular Network file (*.btin)

11 Markup tab

The **Markup Tab** allows the user to locate hole collars after a surface has been created.



Markup Tab

This would primarily be used in conjunction with drone point cloud data, as the colourisation of the point cloud would allow for easy location of the hole collar locations.

11.1 Insert Collars

Insert Collars is use to place collars relative to the surface.

Until toggled off, multiple collars can be located.

11.2 Delete Collars

Delete Collars is use to remove collars relative to the surface.

Until toggled off, multiple collars can be removed.

11.3 Collar Size

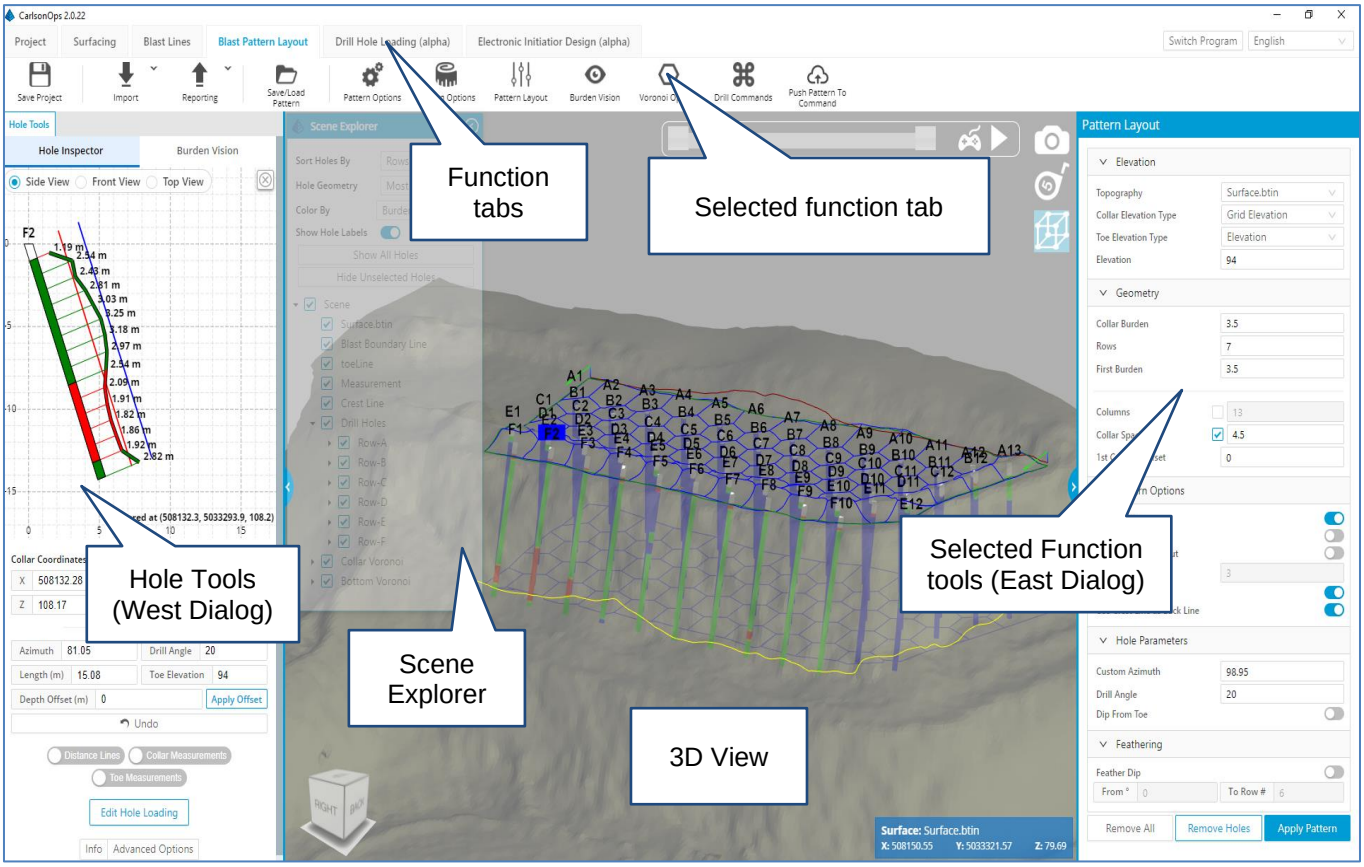
Collar Size dictates the size of the collars.

This adjust new and existing collars to make them easier to see.

11.4 Export to Blast OPS

As an alternative to the **Export to Blast OPS** button within the FSC Wizard, and under the **Projects** tab, there is another export option with the **Markup tab**. A similar window to section 6.6 will appear allowing you to select the desired data before exporting.

12 Blast OPS



Blast OPS - screen layout

In **Blast OPS**, a standard screen layout is composed of the elements outlined below.

12.1 3D View

The main **3D View** window shows all data graphically. This includes surfaces, and hole information.

Navigation in the **3D View** is by intuitive dragging and clicking by mouse.

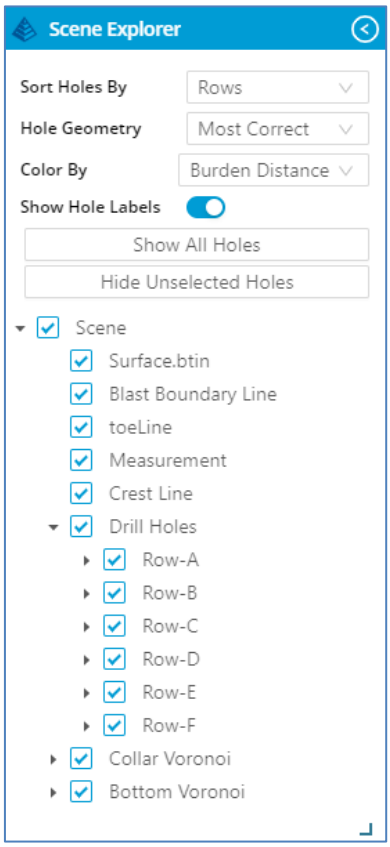
- **Zoom in / out**: roll the scroll wheel on a mouse.
- **Rotate**: click and drag with the left button on a mouse.
- **Pan**: click and drag with the right button on a mouse.

There are a few icons within the **3D View** to further help navigate:

- **3D Cube**: click for pre-set views, or click and drag to rotate the view.
- **Camara Icon**: toggles on/off additional settings.
    - **Orthographic/Perspective**: toggle between orthographic and perspective views.
    - **Controls Switch**: toggle between default and MAC controls.
    - **Cutting Planes**: slider allows you to increase/reduce the depth at which the surface can be seen.

- **Measurement Tape Icon**: enables the user to measure distances on a surface.
- **Hollow Cube**: toggles on/off the background grid.

12.2 Scene Explorer



Scene Explorer

The **Scene Explorer** is responsible for what is shown in the **3D View**. It is located, by default, in the top left corner of the **3D View**. Using the button in the top right corner, the **Scene Explorer** can be docked into the west-dialog.

The **Scene Explorer** is organized as follows.

- **Sort Holes By**: alters whether the holes are sorted by **Rows** or **Columns** within Scene Explorer
- **Hole Geometry**: alters which hole data is visible in the **3D View**.
    - **Most Correct**: shows the most accurate version of hole data. **Boretrak** > **Surveyed** > **Design**.
    - **All:** shows all the types of hole data.
    - **Design**: shows only the designed hole data.
    - **Surveyed**: shows only the imported surveyed hole data.
    - **Boretrak**: shows only the imported boretrak hole data.
- **Color By**: changes how the hole data is colored in the **3D View**.
    - **Burden Distance**: colors the hole data based on the **Burden Measurements** parameters within **Burden Options** (see section 16.5).

- **Identifying Color**: colors the hole data based on the **Color Options** parameters within **Pattern Options** (see section 16.4).
- **Hole Loading**: colors the hole data based on the **Hole Loading** template applied (see section 17.4).

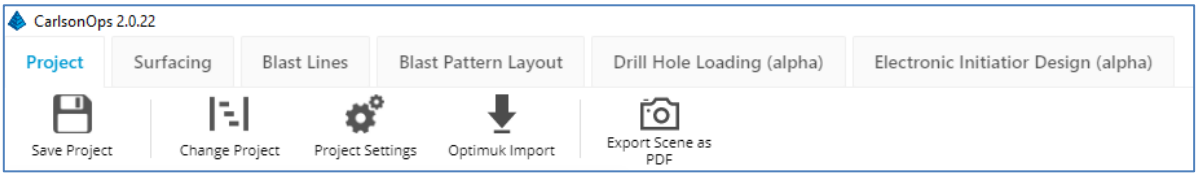
- **Show Hole Labels**: toggles on/off the hole labels in the **3D View**.
- **Show All Holes**: makes all holes visible in the **3D View**.
- **Hide Unselected Holes**: holes selected in the **Scene Explorer** or in the **3D View** will remain, while the rest are hidden.

Unfurling the **Scene Arrow** shows what is available to be viewed in the **3D View**.

- **Surfaces**
- **Linework**
- **Drill Holes**
- **Measurement Tools**

Click with the right button on a mouse to bring up a menu to in order to refocus the centre of rotation, delete the selected item, or view its properties.

12.3 Function tabs



Function tabs

At the top of the screen, are six function tabs which provide control of settings, surface importation, drawing of linework, blast pattern layout, drill hole loading, and timing and initiation.

Click the required tab to make it active.

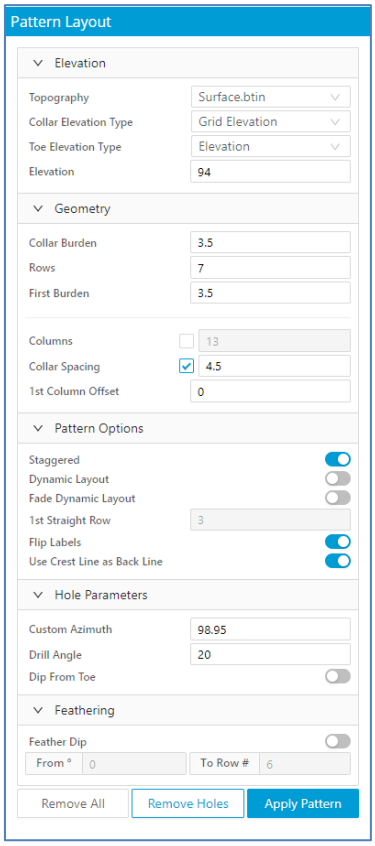
Click active function tab is identified by a blue highlight.

Click function tabs are each outlined in the following sections.

- **Project tab:** see section 13.
- **Surfacing tab**: see section 14.
- **Blast Lines tab**: see section 15.
- **Blast Pattern Layout tab**: see section 16.
- **Drill Hole Loading tab**: see section 17.
- **Electronic Initiator Design tab**: see section 18.

12.4 East Dialog

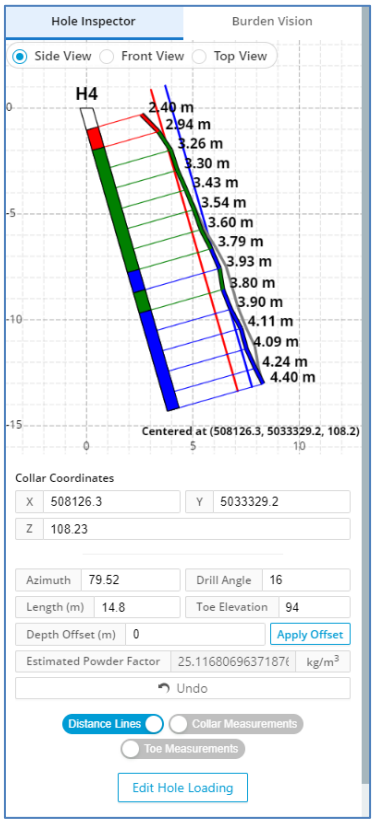
The **East Dialog** contains parameters and features specific to the selected function tool.



Blast Pattern Layout > Pattern Layout > East Dialog

12.5 West Dialog (Hole Tools)

The **West Dialog** contains parameters and features specific to the selected hole collar.



West Dialog (Hole Tools)

After selecting the desired hole(s), analysis measurements can be toggled on, design hole parameters can be changed, and different 2D views can be looked at.

The 2D views are broken down as follows:

- **Hole Inspector**: Options for **Side View**, **Front View**, and **Top View**.
- **Burden Vision**: If the **Burden Vision** feature has been used, the matrix table can be seen here (See section 16.8).

For design collars, the position and associated parameters can be altered:

- **Collar Coordinates**: specific values can be entered for **X**, **Y**, and **Z**.
- **Azimuth**: the value for the drill azimuth.
- **Drill Angle**: the inclination of the drill hole.
- **Length**: the length of the hole (will change automatically if **Toe Elevation** is changed).
- **Toe Elevation**: the specific elevation of the bottom of the hole (will change automatically if **Length** is changed).
- **Depth Offset**: the desired offset (sub-drill) from the indicated **Length** or **Toe Elevation** parameter.

- **Estimated Powder Factor**: With a **Boundary Line** drawn (see section 15.3), and a **Hole Loading Template** applied (see section 17.4), the **Estimated Powder Factor** for the selected hole will be displayed.
- **Undo**: undoes the previous change to the design parameters.

Analysis measurements can be toggled on and off:

- **Distance Lines**: burden measurements to the face. This is color coded based on the desired **Burden** and **Tolerance** inputted in **Burden Options** (see section 16.5).
- **Collar Measurements**: measurements between the hole collar position(s). The **Number of holes** or **Distance** to which the measurements are visible are based on the input values in **Drill Commands** (see section 16.9).
- **Toe Measurements**: measurements between the hole toe position(s). The **Number of holes** or **Distance** to which the measurements are visible are based on the input values in **Drill Commands** (see section 16.9).

Hole loading can also be edited through **Hole Tools**. This would open the design window for hole loading (see section 17.3)

The **Info** button at the bottom shows further information about a hole:

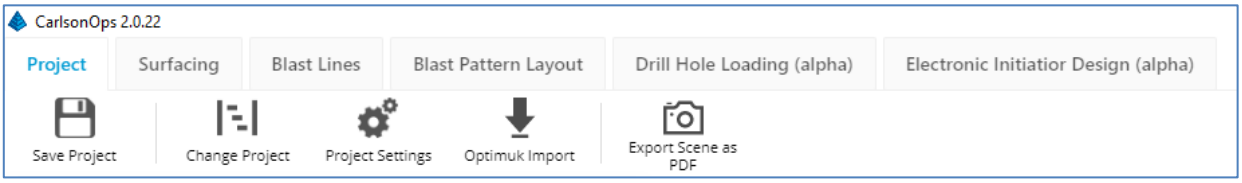
- **Label**: allows you to change the identifier of the hole.
- **Type**: shows whether it is a design (**1**), surveyed (**2**), or boretraked (**3**) hole.
- **Description**: allows description input for the hole.
- **Voronoi Volume**: shows the associated **Voronoi Volume** if used (see section 16.8).

To move design hole locations using the arrow keys, the mouse cursor cannot be within a text box. To ensure this is the case, click within the **3D View. Advanced Options** controls the movement of holes, and azimuth at which to view the **Distance Lines**. To

- **Parallel Step**: indicates the unit movement using the left and right arrows to position the hole.
- **Perpendicular Step**: indicates the unit movement using the up and down arrows to position the hole.
- **Search Angle Override**: indicates the search azimuth for the **Distance Lines**. Only applicable when using **Straight Measurement** within **Burden Options** (see section 16.5).
- **Blast Cylinders**: toggles on and off the associated **Blast Cylinders** for the selected holes.

13 Project tab

The **Project** tab contains buttons which offer project level and software level functions.



Project tab

13.1 Save Project

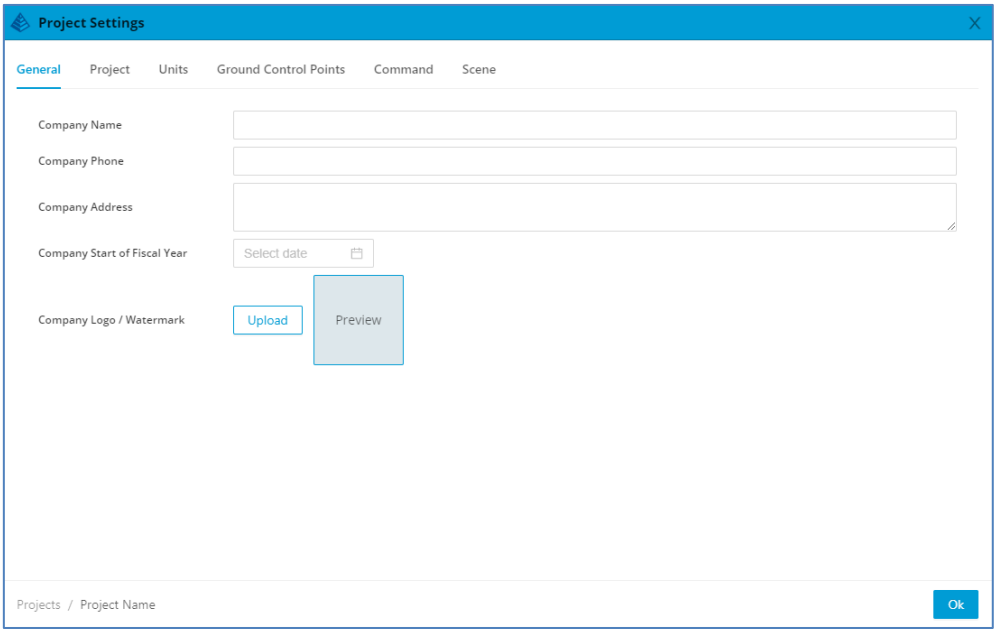
Click **Save Project** to save the **CarlsonOPS** project.

13.2 Change Project

Click **Change Project** to switch **CarlsonOPS** projects.

13.3 Project Settings

Click **Project Settings** to open the settings in a new window.



Project Settings window > General tab

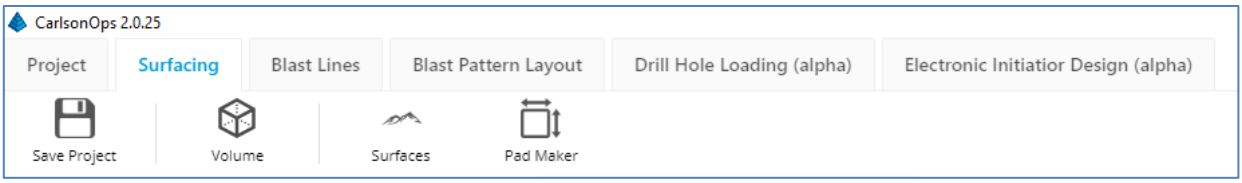
Refer to section 6.4 for more information about **Project Settings**.

13.4 Export Scene as PDF

Click **Export Scene as PDF** to create a pdf of the **3D View**.

14 Surfacing tab

The **Surfacing** tab allows you to import existing surface, create a pad for reference, and offers planar volumetric calculation tools.



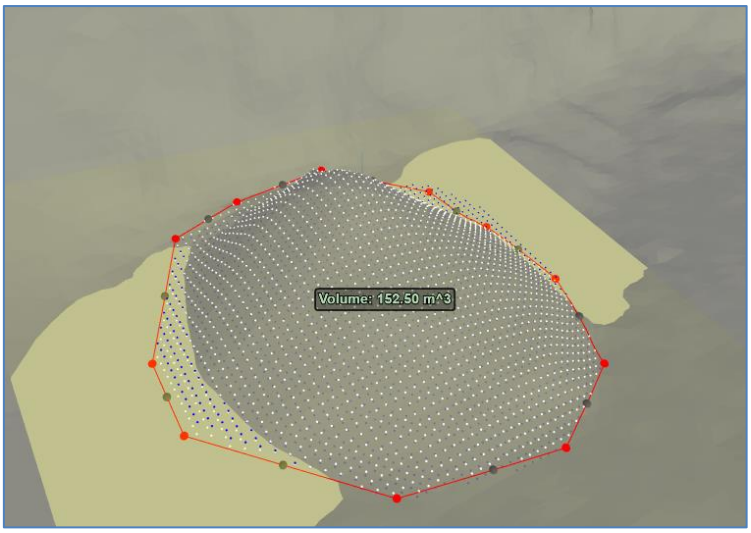
Surfacing tab

14.1 Save Project

Click **Save Project** to save the **CarlsonOPS** project.

14.2 Volume

Click **Volume** to commence using the line tool to calculate the volume using a planar base.



Volume Tool

Ensure to position the **3D View** so that you can easily encompass the desired area, as the view locks upon clicking the **Volume** tool.

Use the left button on the mouse to indicate the vertices of the enclosure. Use the right button on the mouse to finish the selection.

At this point the **3D View** can be moved again, and the enclosure line can be edited:

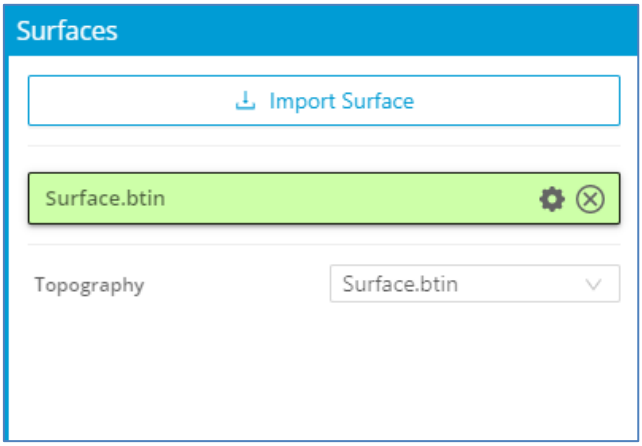
- **Red Nodes**: the originally vertices laid out. Can be moved by holding down the left button on the mouse and dragging.
- **Grey Nodes**: centre points between vertices. By moving this node, it will become a vertex, and create 2 additional centre points on both sides of the node.

Further editing tools, such as inserting additional vertices to the front or back, toggling the coordinates, toggling whether the line is draped to the surface, deleting the line, and toggling the ability to edit the line can be prompted

by clicking the line using the right button on the mouse.

14.3 Surfaces

Click **Surfaces** to open the corresponding **East Dialog** Surfaces tools.

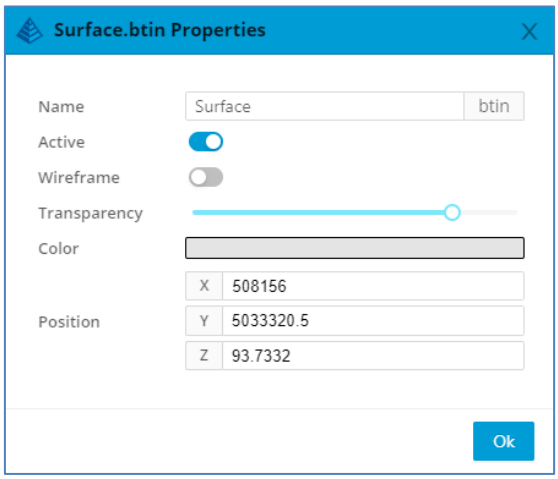


Surfaces Tools

The **Import Surface** function can be used to import other surface files into your active **CarlsonOPS** project. Currently supported file types are:

- **BGRD:** Binary Surfer Grid file (*.bgrd)
- **GRD:** Surfer Grid file (*.grd)
- **TIN:** LAS Triangulated Irregular Network file (*.tin)
- **BTIN:** Binary Triangulated Irregular Network file (*.btin)

Available surfaces are listed below, and are highlighted green if they are being used in the **3D View** or highlighted white when they are not. The **x** icon will delete the surface from the project, while the sprocket icon will prompt the surface's properties menu.



Surface Properties

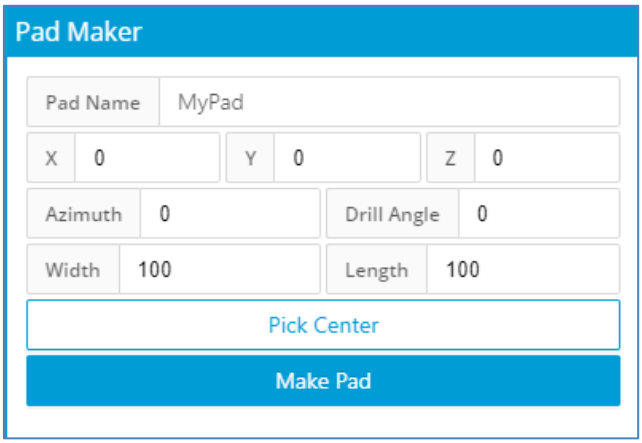
- **Name**: change the name of the surface.
- **Active**: toggles the surface on/off in the **3D View**.

- **Wireframe**: toggles between a solid surface or a wireframe representation.
- **Transparency**: slider bar to alter the transparency of the surface.
- **Color**: change the color of the surface.
- **Position**: change the centre point position of the surface.

If there are multiple surfaces in the project for analysis and design, one of the surfaces will have to be set as the **Topography** surface. This will indicate that the selected surface is to be used for placement of the blast pattern, and the burden measurements from the drill holes.

14.4 Pad Maker

Click **Pad Maker** to open the corresponding **East Dialog** Pad Maker tools.



Pad Maker Tools

Through the inputs in the **East Dialog** a pad can be created to be used as a reference when designing the blast pattern, or the drill hole loading template:

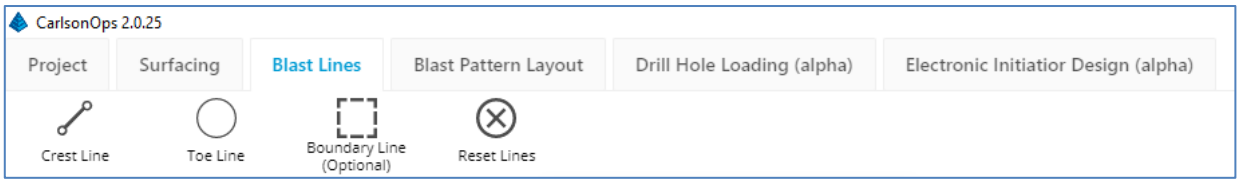
- **Pad Name**: change the name of the pad.
- **X, Y, Z**: inputs for the centre point of the pad.
- **Azimuth**: input for the direction of the pad.
- **Drill Angle**: input for the inclination of the pad.
- **Width/Length**: inputs for the size of the pad.

Pick Center allows you to locate the **X**, **Y**, and **Z** coordinates for the pad in the **3D Viewer**. This must intersect with another surface, or hole for placement, and by using the left button on the mouse to locate the coordinate. After which, changes can be made to the inputs as required.

Make Pad will then create the surface in the **3D View**, and add it to the **Surfaces East Dialog**, as well as the **Scene Explorer**.

15 Blast Lines

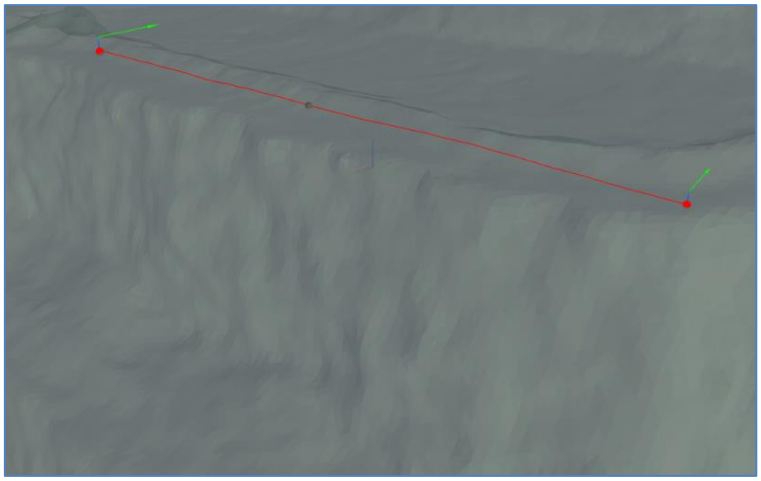
The **Blast Lines** tab requires you to draw the **Crest** and **Toe** line at the minimum in order to advance to **Blast Pattern Layout**.



Blast Lines tab

15.1 Crest Line

Click **Crest Line** to commence using the line tool to layout the desired crest. The crest line can also be used as the back line.



Crest Line Tool

Ensure to position the **3D View** so that you can easily layout the crest, as the view locks upon clicking the **Crest Line** tool.

Use the left button on the mouse to indicate the vertices of the line. Use the right button on the mouse to finish the selection.

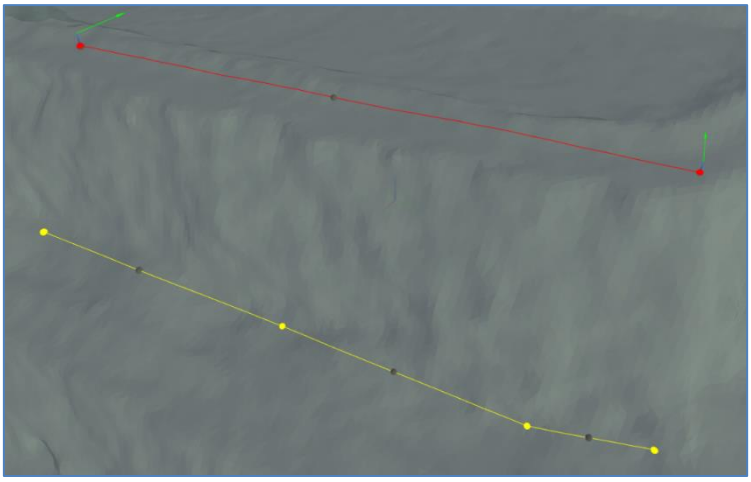
At this point the **3D View** can be moved again, and the line can be edited:

- **Red Nodes**: the original vertices laid out. Can be moved by holding down the left button on the mouse and dragging.
- **Grey Nodes**: centre points between vertices. By moving this node, it will become a vertex, and create 2 additional centre points on both sides of the node.
- **End Vertices**: the green arrow indicates the direction in which the pattern will be laid out. By clicking an end vertex using the left button on the mouse, a quarter circle will appear. Left click and drag to rotate the green arrow.

Further editing tools, such as inserting additional vertices to the front or back, toggling the coordinates, resetting the direction of the green arrow, toggling whether the line is draped to the surface, deleting the line, and toggling the ability to edit the line can be prompted by clicking the line using the right button on the mouse.

15.2 Toe Line

Click **Toe Line** to commence using the line tool to layout the desired toe.



Toe Line Tool

Ensure to position the **3D View** so that you can easily layout the toe, as the view locks upon clicking the **Toe Line** tool.

Use the left button on the mouse to indicate the vertices of the line. Use the right button on the mouse to finish the selection.

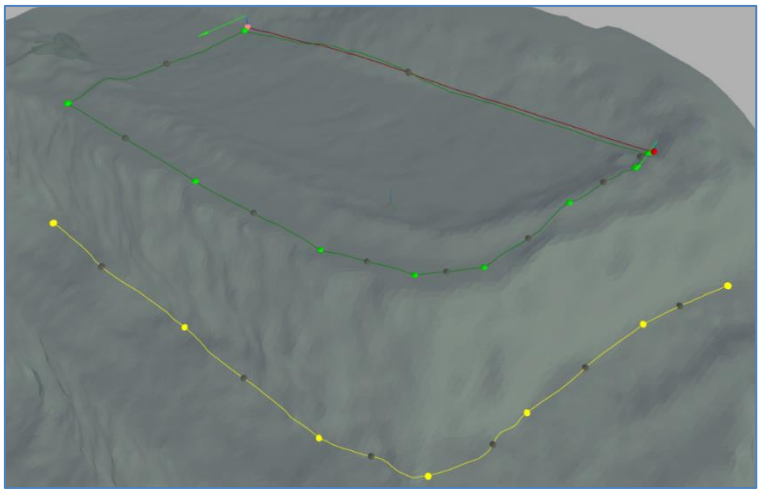
At this point the **3D View** can be moved again, and the line can be edited:

- **Yellow Nodes**: the original vertices laid out. Can be moved by holding down the left button on the mouse and dragging.
- **Grey Nodes**: centre points between vertices. By moving this node, it will become a vertex, and create 2 additional centre points on both sides of the node.

Further editing tools, such as inserting additional vertices to the front or back, toggling the coordinates, toggling whether the line is draped to the surface, deleting the line, and toggling the ability to edit the line can be prompted by clicking the line using the right button on the mouse.

15.3 Boundary Line (Optional)

Click **Boundary Line (Optional)** to commence using the line tool to indicate the bounding area for where the blast pattern will be laid out.



Boundary Line Tool

Ensure to position the **3D View** so that you can easily encompass the desired area, as the view locks upon clicking the **Boundary Line** tool.

Use the left button on the mouse to indicate the vertices of the enclosure. Use the right button on the mouse to finish the selection.

At this point the **3D View** can be moved again, and the enclosure line can be edited:

- **Green Nodes**: the originally vertices laid out. Can be moved by holding down the left button on the mouse and dragging.
- **Grey Nodes**: centre points between vertices. By moving this node, it will become a vertex, and create 2 additional centre points on both sides of the node.

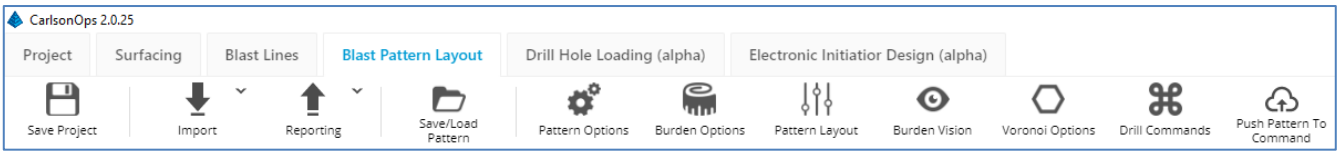
Further editing tools, such as inserting additional vertices to the front or back, toggling the coordinates, toggling whether the line is draped to the surface, deleting the line, and toggling the ability to edit the line can be prompted by clicking the line using the right button on the mouse.

15.4 Reset Lines

Click **Reset Lines** to delete the **Crest Line**, **Toe Line**, and **Boundary Line** simultaneously.

16 Blast Pattern Layout

The **Blast Pattern** tab allows you to design blast patterns, import surveyed or boretraked data, and create reports related to design and analysis.



Blast Pattern Layout tab

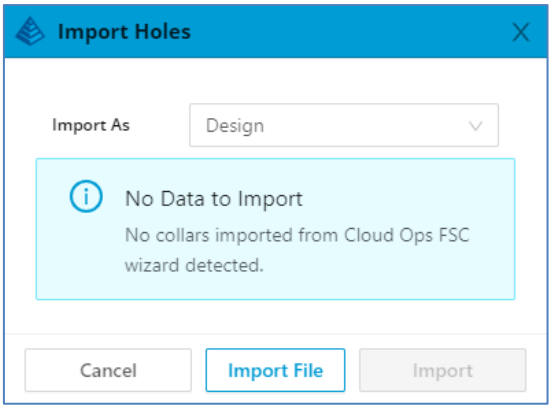
16.1 Save Project

Click **Save Project** to save the **CarlsonOPS** project.

16.2 Import

Click **Import** for a drop-down menu to import hole data.

If collar positions were observed with the Quarryman, and processed through the **FSC Wizard**, the collar file will show in the importer window.

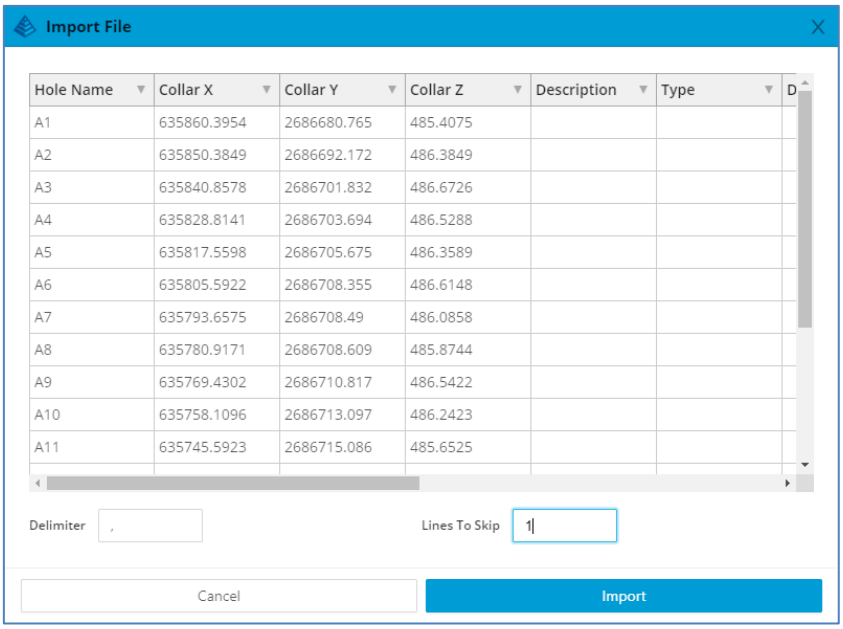


Design/Surveyed Import window

Otherwise, the hole data can be imported separately. Currently supported file types are:

- **CSV:** Comma-separated value file (*.csv)
- **TXT:** Text file (*.txt)

After selecting the file, the delimiter can be specified, the columns identified, and the number of rows to skip indicated.



File Customization Window

16.2.1 Design

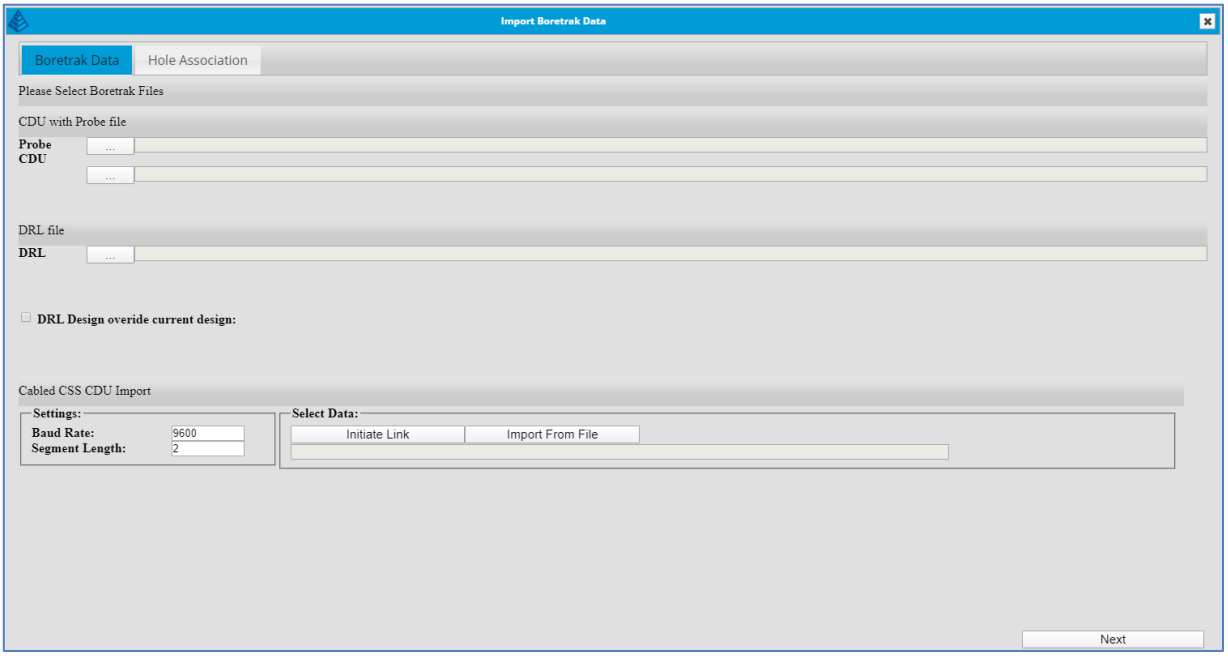
By importing **Design** hole data, you have the ability to move the collar locations, and change each hole's parameters.

16.2.2 Surveyed

By importing **Surveyed** hole data, the position and hole parameters are fixed and cannot be changed.

16.2.3 Boretrak

In order to import Boretrak Data, **Surveyed** hole data must be imported first to locate the hole positions. Click the **Boretrak** import to prompt the following screen:



Boretrak Import

From here, the **Legacy Rodded Boretrak .dat** files can be selected for import. Additionally, the **Carlson Rodded Boretrak .drl** files can be selected for import.

For the Cabled Boretrak, the **.dat** files can also be imported via the **Import From File** button. The data can also be downloaded directly from the CDU by connecting it to the PC, checking to ensure the **CDU Baud Rate** matches the **PC Baud Rate**, and checking that the **Segment Length** is correct. After this, click **Initiate Link** to which the text box should result in:

CDU Successfully Connected. Click the download button on the CDU!

At which point, start the download process from the **CDU**, until the message “File Received” is displayed.

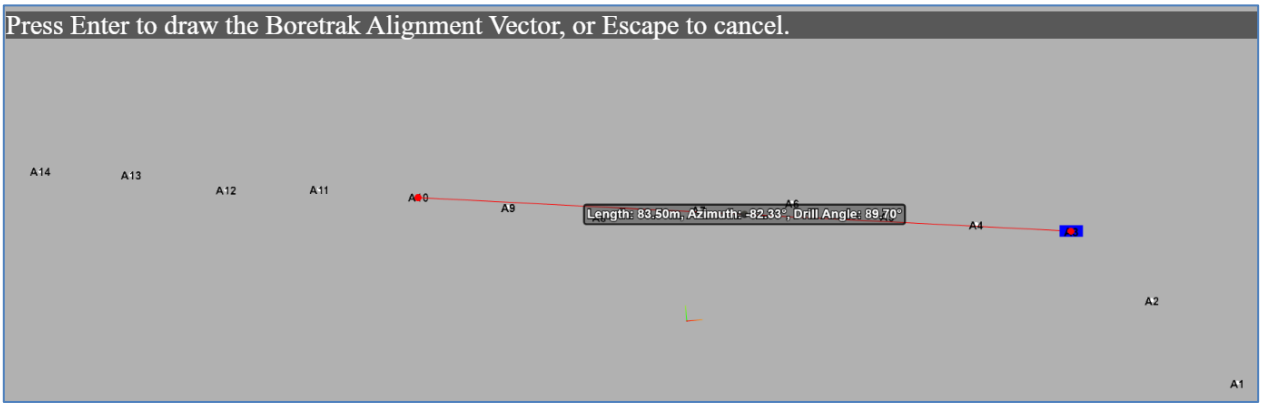
Continue by clicking **Next**.

In the next window, the **Boretrak** data must be matched with **Surveyed** data. This can be completed manually using the check boxes, or by using the **Matching Options**:

- **Match By Row/Col**: this matches the data based on the **Row** and **Col** columns. It is possible to toggle the **Row** and **Col** information by switching the **Row Identified By** to either **Numbers** or **Letters**.
- **Match by Name**: this matches the data based on the hole **Name**.

Pairs can be unmatched through the **Paired** list on the right-hand side.

Solely for the Cabled Boretrak, is the need to calculate the **Magnetic Angle** to ensure the data aligns with the surface data. In the field, a known baseline would have been observed using the boretrak probe, as indicated by the **Baseline Magnetic Angle** value. Click **Boretrak Alignment Vector** to return to the **3D View** temporarily:



Design/Surveyed Import window

Ensure to position the **3D View** so that you can easily replicate the sighted baseline in the view, as the view locks upon hitting **ENTER** to prompt the line tool.

Click using the left button on the mouse to indicate the starting point of the baseline. Hit **ESC** if the selection was incorrect. Then click to indicate the end point of the baseline, returning you to the **Boretrak** import screen. The **Grid Angle** value will now show the azimuth of the line just drawn, and the **Magnetic Angle** will show the rotation needed to align the data.

Click **Finish** to conclude the import.

A **Confirm Settings** window will appear to quickly check whether the **Assumed Stemming Length,** the **Measurement Interval**, and the desired **Burden Distance** logically make sense with the data just imported. Changing these values will recalculate the validation, show whether validation is successful, or fails. Click **Finish** once satisfied.

16.2.4 DRL

Carlson's Machine Control **.drl** file can be imported using the **DRL** input.

16.3 Reporting

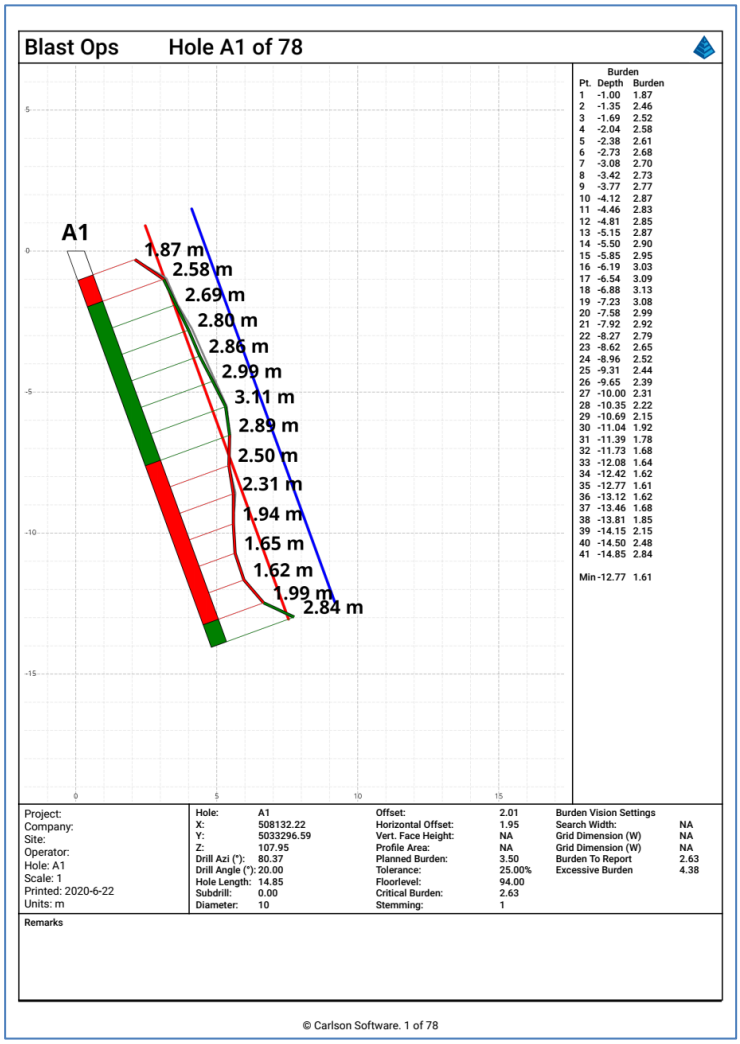
Click **Reporting** for a drop-down menu to create PDF Reports.

Currently supported report types are:

- **Burden Report**: 2D profiles illustrating the burden distance between the drill hole and the topographic surface.
- **Plan View Report**: Aerial view of the blast pattern illustrating collar distances and directions of drill holes.
- **Drillers Report**: Tabular information of drill hole location and parameters.

16.3.1 Burden Report

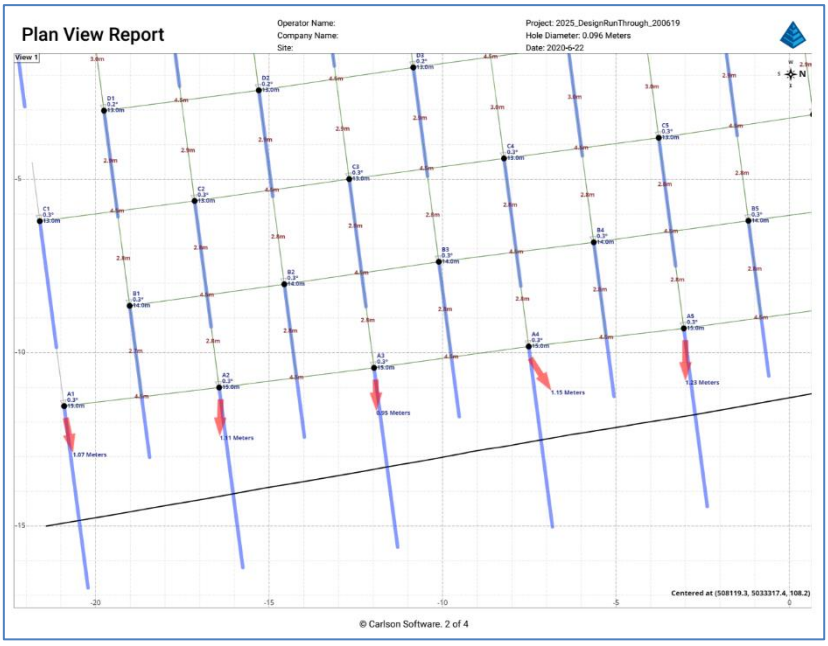
A hole by hole breakdown showing critical burdens, and overburdens based on inputted parameters.



Reporting > Burden Report

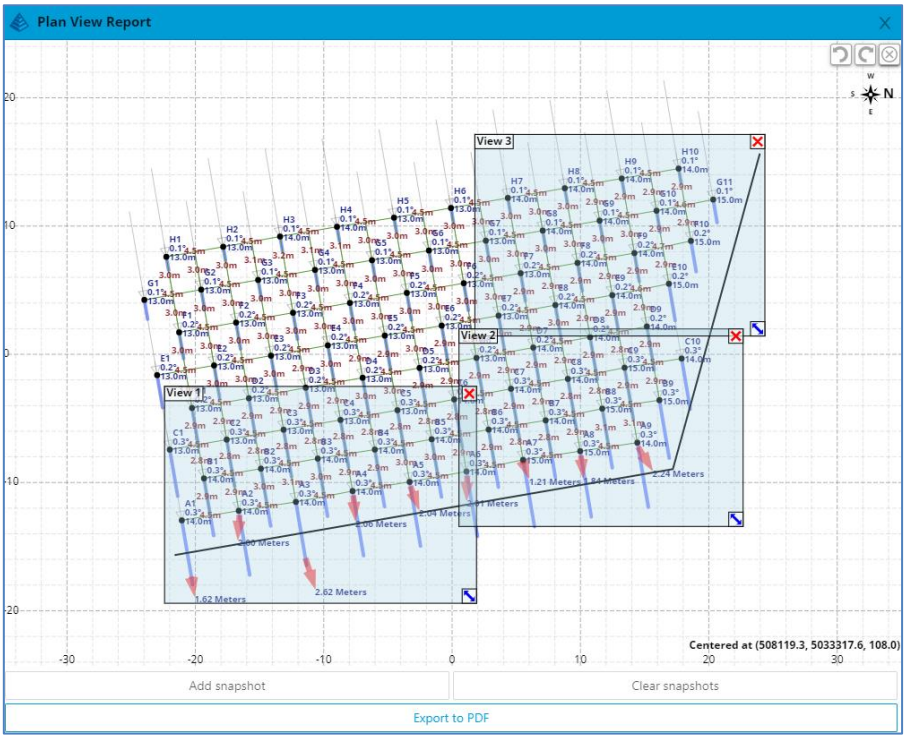
16.3.2 Plan View Report

An overview of the collar positions, showing the distance between collars, and the direction of the drill holes.



Reporting > Plan View Report

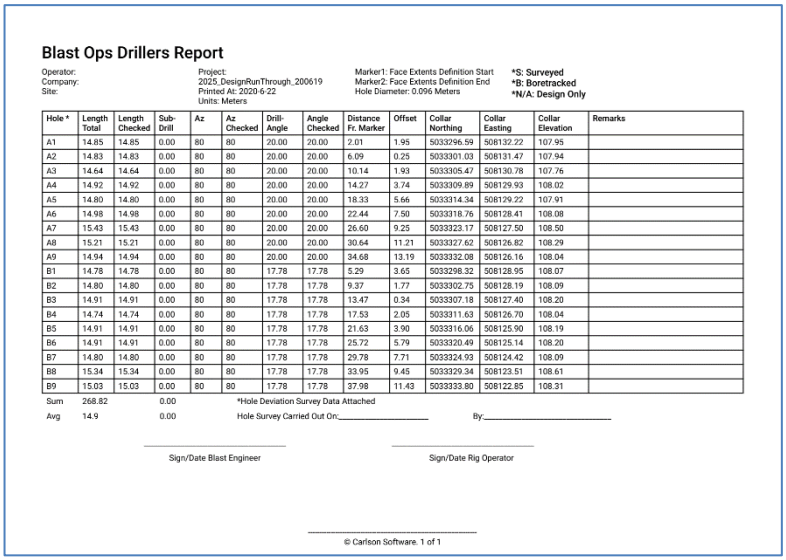
Upon clicking **Plan View Report**, a new window appears to allow you to rotate the view, and add snapshots so that additional pages will be created with a closer view of those areas.



Plan View Report Interface

16.3.3 Drillers Report

A tabular format detailing the specifics related to each hole, a comparison between design and surveyed/boretrak information to highlight the differences, and a sum and average of the hole lengths.



Blast Ops Drillers Report

Operator:
Company:
Site:

Project:
2025_DesignRunThrough_200619
Printed At: 2020-6-22
Units: Meters

Marker1: Face Extents Definition Start
Marker2: Face Extents Definition End
Hole Diameter: 0.096 Meters

*S: Surveyed
*B: Boretracked
*N/A: Design Only

Hole *	Length Total	Length Checked	Sub-Drill	Az	Az Checked	Drill-Angle	Angle Checked	Distance Fr. Marker	Offset	Collar Northing	Collar Easting	Collar Elevation	Remarks
A1	14.85	14.85	0.00	80	80	20.00	20.00	2.01	1.95	5033296.59	508132.22	107.95	
A2	14.83	14.83	0.00	80	80	20.00	20.00	6.09	0.25	5033301.03	508131.47	107.94	
A3	14.64	14.64	0.00	80	80	20.00	20.00	10.14	1.93	5033305.47	508130.78	107.76	
A4	14.92	14.92	0.00	80	80	20.00	20.00	14.27	3.74	5033309.89	508129.93	108.02	
A5	14.80	14.80	0.00	80	80	20.00	20.00	18.33	5.66	5033314.34	508129.22	107.91	
A6	14.98	14.98	0.00	80	80	20.00	20.00	22.44	7.50	5033318.76	508128.41	108.08	
A7	15.43	15.43	0.00	80	80	20.00	20.00	26.60	9.25	5033323.17	508127.50	108.50	
A8	15.21	15.21	0.00	80	80	20.00	20.00	30.64	11.21	5033327.62	508126.82	108.29	
A9	14.94	14.94	0.00	80	80	20.00	20.00	34.68	13.19	5033332.08	508126.16	108.04	
B1	14.78	14.78	0.00	80	80	17.78	17.78	5.29	3.65	5033298.32	508128.95	108.07	
B2	14.80	14.80	0.00	80	80	17.78	17.78	9.37	1.77	5033302.75	508128.19	108.09	
B3	14.91	14.91	0.00	80	80	17.78	17.78	13.47	0.34	5033307.18	508127.40	108.20	
B4	14.74	14.74	0.00	80	80	17.78	17.78	17.53	2.05	5033311.63	508126.70	108.04	
B5	14.91	14.91	0.00	80	80	17.78	17.78	21.63	3.90	5033316.06	508125.90	108.19	
B6	14.91	14.91	0.00	80	80	17.78	17.78	25.72	5.79	5033320.49	508125.14	108.20	
B7	14.80	14.80	0.00	80	80	17.78	17.78	29.78	7.71	5033324.93	508124.42	108.09	
B8	15.34	15.34	0.00	80	80	17.78	17.78	33.95	9.45	5033329.34	508123.51	108.61	
B9	15.03	15.03	0.00	80	80	17.78	17.78	37.98	11.43	5033333.80	508122.85	108.31	
Sum	268.82		0.00										
Avg	14.9		0.00										

*Hole Deviation Survey Data Attached

Hole Survey Carried Out On:_____ By:_____

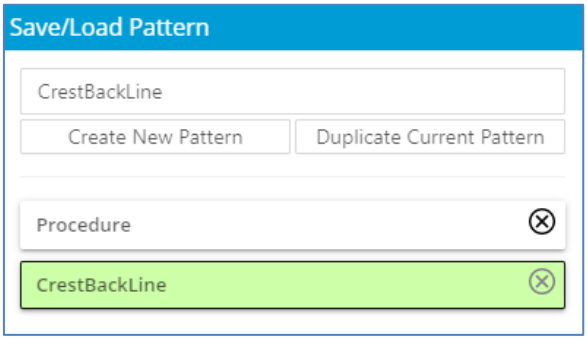
Sign/Date Blast Engineer

Sign/Date Rig Operator

Reporting > Drillers Report

16.4 Save/Load Pattern

The **Save/Load Pattern** tab allows you to save the current pattern, duplicate it, or create a new pattern.

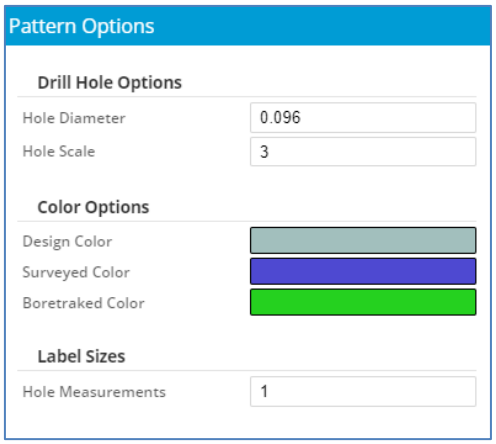


Blast Pattern Layout > Save/Load Pattern

Available patterns are listed below, and are highlighted green if they are being used in the **3D View** or highlighted white when they are not. The **x** icon will delete the surface from the project.

16.5 Pattern Options

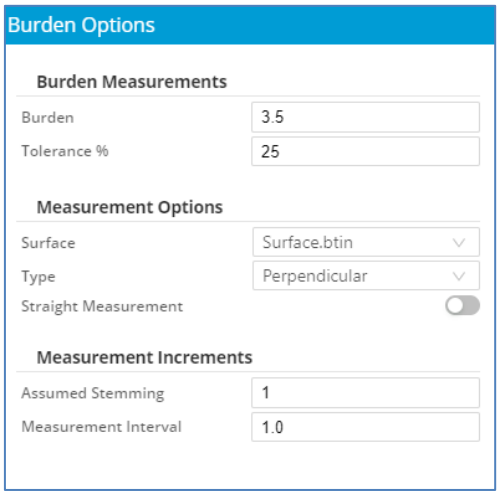
The **Pattern Options** tab allows you to input the **Hole Diameter**, **Hole Scale**, the color scheme based on the type of hole, and the size of the hole measurement labels.



Blast Pattern Layout > Pattern Options

16.6 Burden Options

The **Burden Options** tab allows you to input the desired **Burden** and its **Tolerance**, and configure how the burden is measured.



Blast Pattern Layout > Burden Options

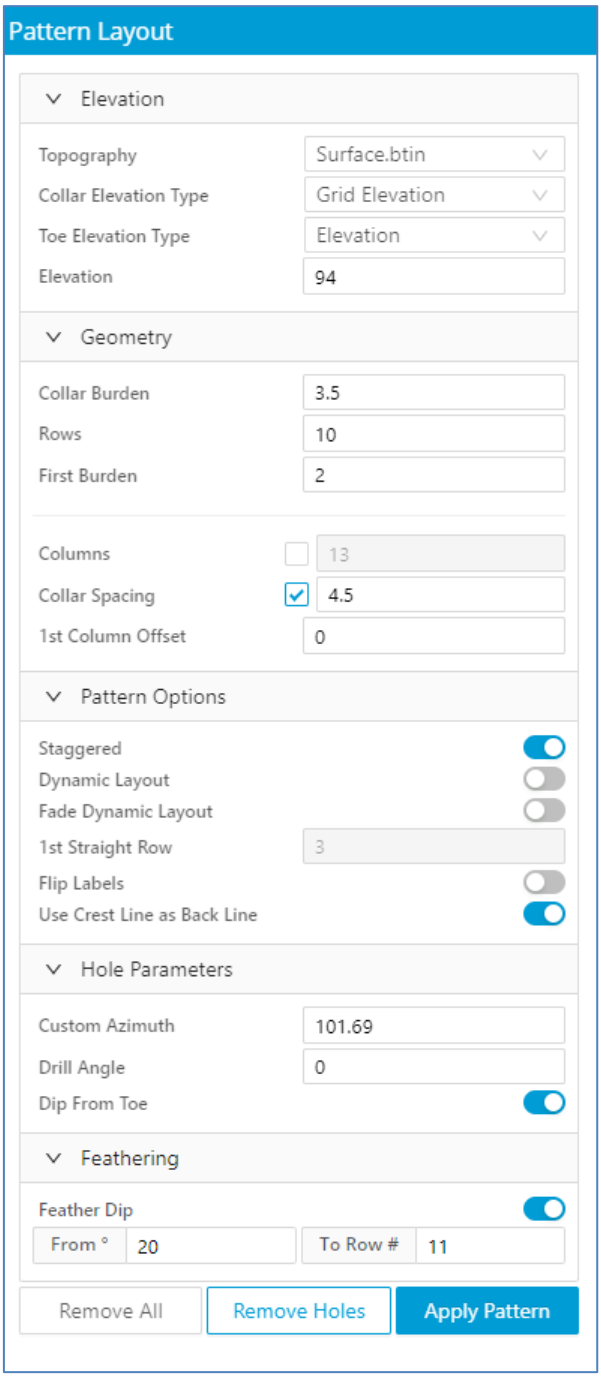
Measurement options and increments controls the topographic surface, how the burden is measured, and also how often:

- **Surface**: topographic surface to which burden measurements are measured.
- **Type**: logic for how burden measurements are calculated
    - **Perpendicular**: uses the inclination of the hole to then measure perpendicularly from it.
    - **Constant Z**: measures the burden from the hole to the surface using a constant elevation.
    - **3D**: regardless of whether the weakest burden is to the left or right, upwards or downwards, **3D** will locate the closest intersection of the face from the hole.
- **Straight Measurement**: toggle on/off whether to measure the burden using a set azimuth direction from the hole, or allow for an undefined azimuth to find the weakest burden. Only for **Perpendicular** and **Constant Z** type measurements.

- **Assumed Stemming**: sets the amount of stemming (indicated as white in the **3D View**) for which no burden measurements are calculated.
- **Measurement Interval**: the interval frequency at which the burden measurement is calculated to the surface.

16.7 Pattern Layout

The **Pattern Layout** tab allows you to input the desired parameters to automatically position and incline holes.



Blast Pattern Layout > Pattern Layout

16.7.1 Elevation

The **Elevation** parameters dictates the collar and toe elevations:

- **Topography**: topographic surface for which the blast pattern is being designed on.
- **Collar Elevation Type**: how the algorithm chooses the **Collar Elevation**.
    - **Grid Elevation**: this matches the collar elevation to the topographic surface. This requires the surface to extend where the holes are being designed.
    - **Highwall Elevation**: this uses the crest line to indicate the elevation of the collars. Typically used with Quarryman scans where only the face profile was surveyed and not the top bench.
- **Toe Elevation Type**: chooses which algorithm to be used when locating the hole toe.
    - **Length**: the absolute length of the hole (inclined or vertical).
    - **Depth**: the elevation difference between the collar and toe.
    - **Elevation**: the absolute elevation to which the holes will be designed.
    - **Surface**: if a pad was created, or a surface imported for design purposes, it can be used so that the hole toe will always extend to the selected surface.
- **Length** / **Depth** / **Elevation**: the value for the chosen **Toe Elevation Type**:

If **Surface** is selected for the **Toe Elevation Type**, the **Bottom Surface** must be chosen. An **Offset** can also be inputted if there is a desire to extend below the **Bottom Surface**.

16.7.2 Geometry

The **Geometry** parameters dictates the row and column spacing and the offsets from the **Crest Line**.

- **Collar Burden**: the spacing between rows.
- **Rows**: the desired number of rows.
- **First Burden**: the offset from the crest line to the first row.
- **Columns** / **Collar Spacing**: spacing for the columns can be set by the number of columns, or the spacing between columns.
    - **Columns**: the desired number of columns. Automatically calculates the spacing needed between columns.
    - **Collar Spacing**: the spacing between columns. Automatically calculates the number of columns.
- **1st Column Offset**: the offset from the left marker of the crest line to the first column.

16.7.3 Pattern Options

The **Pattern Options** parameters gives further options to influence the pattern layout.

- **Staggered**: toggle **Off** for a square pattern, where the columns are in a straight line, or toggle **On** for a staggered pattern, where on alternate rows, the columns are offset by half the column spacing between the current and consecutive column.
- **Dynamic Layout**: toggle **Off** for straight rows between the starting and finishing **Crest Line** markers, or toggle **On** for the rows to follow the exact shape of the **Crest Line**.

- **Fade Dynamic Layout**: toggle **Off** for all the rows to continue having the same shape as the **Crest Line**, or toggle **On** to fade the shape of the **Crest Line** to a straight row. **Dynamic Layout** must be turned on to use this feature. Note that due to the fading of the **Crest Line** to a straight back row, the spacing parameters indicated in **Geometry** will be adjusted for this feature.

- **1st Straight Row**: with **Fade Dynamic Layout** toggled **On**, this indicates at which row the pattern should be straight. The lower the value, the more extreme the fade will occur, whereas the high the value, the more gradual the fade.

- **Flip Labels**: toggle **Off** to have the **1st Column** start at the **Crest Line** left marker, or toggle **On** to have the **1st Column** start at the **Crest Line** right marker.

- **Use Crest Line as Back Line**: if the crest line is used to indicate the back line of the pattern, this feature should be toggled **On** in order to inverse the azimuth of the drill hole (as indicated in **Hole Parameters**).

16.7.4 Hole Parameters

The **Hole Parameters** dictate azimuth of the drill hole, the inclination of the drill hole, and whether or not to use the desired **Collar Burden** as spacing from the collar or toe.

- **Custom Azimuth**: the azimuth of the drill hole. Automatically calculated to be in the direction of the **Crest Line**'s green directional arrow – or inversed when the Use **Crest Line as Back Line** is toggled **On**.

- **Drill Angle**: the inclination of the drill holes. 0 is vertically pointed down.

- **Dip From Toe**: toggle **Off** to have row spacing dictate the placement of the collars, or toggle **On** to have the row spacing dictate the placement of the toes. This is typically used in conjunction with **Feathering** (see section 16.7.5).

16.7.5 Feathering

The **Feathering** parameters gives the option to gradually change the inclination of each row.

- **Feather Dip**: toggle **Off** to maintain the inclination input from **Hole Parameters**, or toggle **On** to gradually change the inclination from row to row.

- **From**: the desired inclination for the **To Row**.

- **To Row**: the desired row at which the inclination input in **From** will occur.

Referencing the **Pattern Layout** screenshot (section 16.7), the crest line was used as a back line, and so the back(first) row starts off at 0°. However, due to the inclination of the face, the front(eleventh) row also must be inclined to be within the desired **Burden** and **Tolerance**. In this case, the inclination adjusts by 2° every row, until the front row has an inclination of 20°.

16.7.6 Remove/Apply

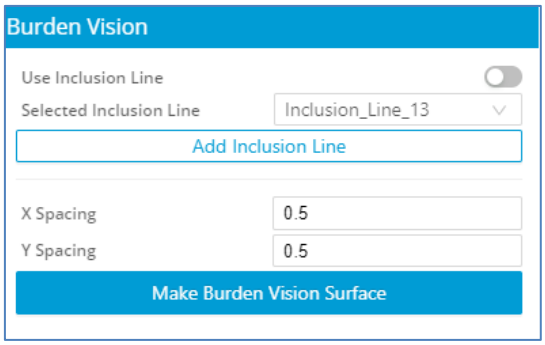
- **Remove All**: deletes all holes and **Blast Lines**.

- **Remove Holes**: deletes all holes. **Blast Lines** remain.

- **Apply Pattern**: uses the inputted parameters to layout the pattern.

16.8 Burden Vision

The **Burden Vision** tab allows you to sub-sample the surface and see how all the holes are affecting the blast face.



Blast Pattern Layout > Burden Vision

- **Use Inclusion Line**: once drawn, the inclusion line can be used to indicate the area to which the burden measurements are limited (I.e. even though the distance from the interval after stemming to the top bench is closer, with **Use Inclusion Line** toggled **On**, the burden measurement will only measure to the encompassed area instead).

- **Selected Inclusion Line**: if multiple inclusion lines are drawn, the **Selected Inclusion Line** is the line used to create the sub-sampled surface.

- **Add Inclusion Line**: click to commence using the line tool to indicate the inclusion area for the **Burden Vision** surface. Ensure to position the **3D View** so that you can easily encompass the desired area, as the view locks upon clicking the **Add Inclusion Line**. Use the left button on the mouse to indicate the vertices of the enclosure. Use the right button on the mouse to finish the selection. At this point the 3D View can be moved again, and the enclosure line can be edited:

    - **Red Nodes**: the originally vertices laid out. Can be moved by holding down the left button on the mouse and dragging.

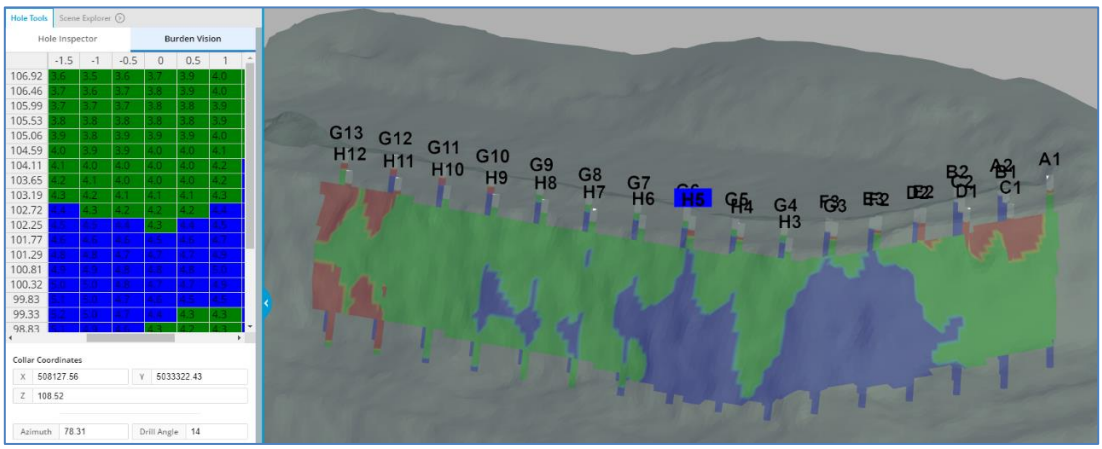
    - **Grey Nodes**: centre points between vertices. By moving this node, it will become a vertex, and create 2 additional centre points on both sides of the node.

    - Further editing tools, such as inserting additional vertices to the front or back, toggling the coordinates, toggling whether the line is draped to the surface, deleting the line, and toggling the ability to edit the line can be prompted by clicking the line using the right button on the mouse.

- **X Spacing** / **Y Spacing**: the spacing of gridlines used to create the surface, and perform the distance calculations.

- **Make Burden Vision Surface**: uses the inputted parameters to create the **Burden Vision** surface.

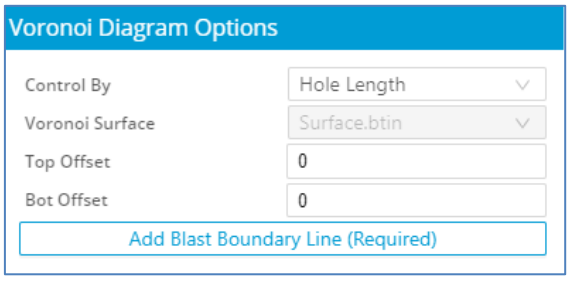
The measurements can be seen from the **West Dialog (Hole Tools)** by selecting **Burden Vision**, rather than **Hole Inspector**.



Burden Vision Surface and Table

16.9 Voronoi Options

The **Voronoi Options** tab allows you to alter how the **Voronoi Volume** is calculated. Note that the **Blast Boundary Line** (see section 15.3) must be used for this feature to work.

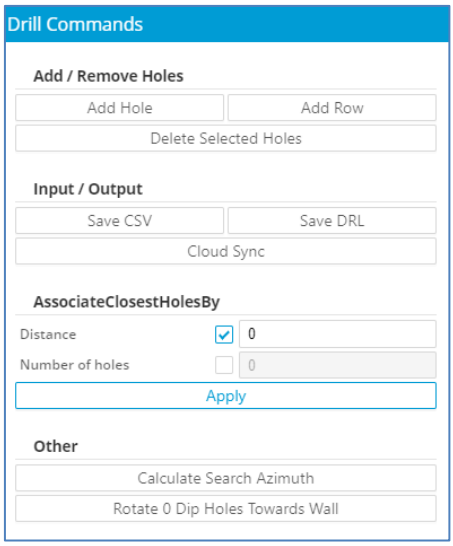


Blast Pattern Layout > Voronoi Options

- **Control By**: determines how the **Voronoi Volume** is calculated.
    - **Hole Length**: calculates the **Voronoi Volume** based on the hole length.
    - **Surface**: if a pad was created, or a surface imported for design purposes, it can be used as the bottom control of the **Voronoi Volume**.
- **Voronoi Surface**: the surface to be used for the **Voronoi Volume** calculation when **Surface** is selected for the **Control By**.
- **Top Offset**: optional offset for the collar top control of the **Voronoi Volume**.
- **Bot Offset**: optional offset for the bottom control, whether hole toe or control surface, of the **Voronoi Volume**.
- **Add Blast Boundary Line (Required)**: if a **Blast Boundary Line** has not been laid out by this point, click to commence using the line tool to indicate the bounding area. Ensure to position the **3D View** so that you can easily encompass the desired area, as the view locks upon clicking the **Boundary Line** tool. Use the left button on the mouse to indicate the vertices of the enclosure. Use the right button on the mouse to finish the selection. At this point the **3D View** can be moved again, and the enclosure line can be edited:
    - **Green Nodes**: the originally vertices laid out. Can be moved by holding down the left button on the mouse and dragging.
    - **Grey Nodes**: centre points between vertices. By moving this node, it will become a vertex, and create 2 additional centre points on both sides of the node.
    - Further editing tools, such as inserting additional vertices to the front or back, toggling the coordinates, toggling whether the line is draped to the surface, deleting the line, and toggling the ability to edit the line can be prompted by clicking the line using the right button on the mouse.

16.10 Drill Commands

The **Drill Commands** tab has additional features for pattern design, hole parameters, and exports.



Blast Pattern Layout > Drill Commands

The **Add / Remove Holes** section is responsible for modifying the pattern without changing the **Pattern Layout** parameters:

- **Add Hole**: click to toggle on/off the ability to add holes in the **3D View**, where a surface must be present in order to locate the new location.
- **Add Row**: adds an additional row after the current last row.
- **Delete Selected Holes**: deletes the selected highlighted holes.

The **Input / Output** section is responsible for exporting files, or pushing the pattern to **Carlson Command**. Currently supported file types are:

- **Save CSV:** Comma-separated value file (*.csv)
- **Save DRL:** Text file (*.drl)
- **Cloud Sync**: uses the **Carlson Command** login (see section 6.4.5) to sync with the cloud.

When using the **Collar Measurements** and/or **Toe Measurements** in the **West Dialog (Hole Tools)**, the **Distance** at which holes are associated by, or the **Number of holes** to associate with can be dictated by the **AssociateClosestHolesBy** dialog.

The **Other** section can update the hole(s) parameters:

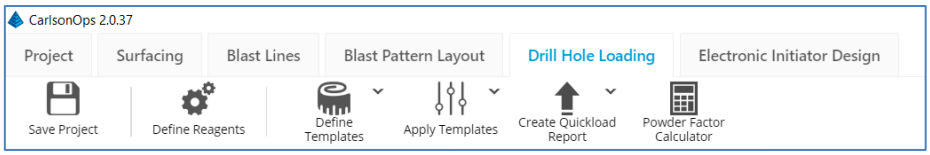
- **Calculate Search Azimuth**: used to automatically find the search azimuth of hole(s) with the weakest burden. Typically, only used if **Straight Measurement** is toggled on in **Burden Options** (see section 16.6).
- **Rotate 0 Dip Holes Towards Wall**: used to automatically find the drill azimuth of vertical hole(s) to find the closest wall.

16.11 Push Pattern To Command

The **Push Pattern To Command** tab uses the **Carlson Command** login (see section 6.4.5) to sync with the cloud.

17 Drill Hole Loading

The **Drill Hole Loading** tab allows you to design hole loading templates, apply them to the pattern, and print out reports to show the breakdown of quantities.



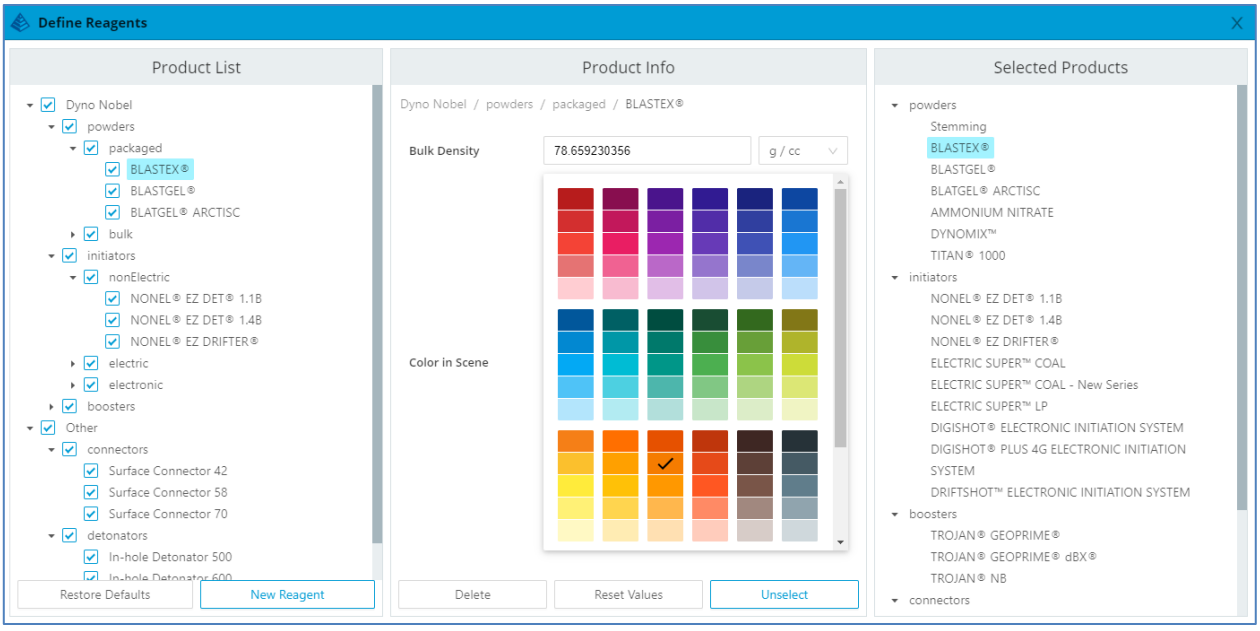
Drill Hole Loading tab

17.1 Save Project

Click **Save Project** to save the **CarlsonOPS** project.

17.2 Define Reagents

Click **Define Reagents** to open a new window listing the reagents available, and allow for new reagent additions.



Define Reagents window

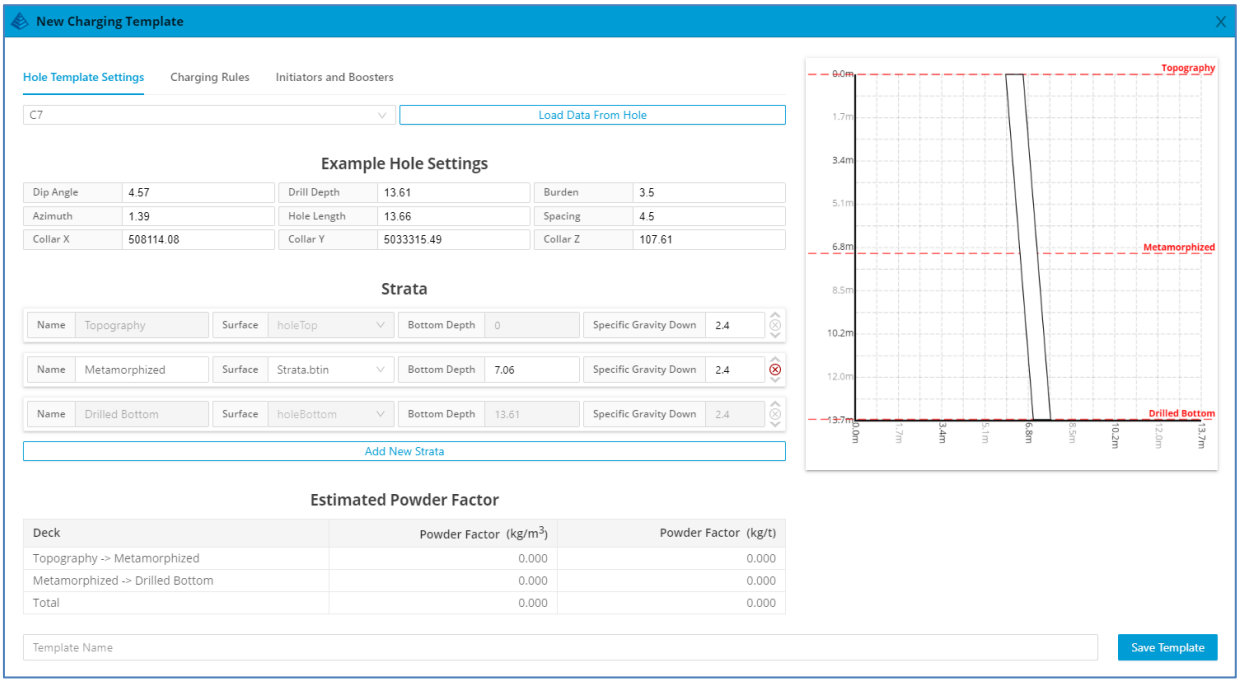
The left panel is the **Product List**, sorted by **Manufacturer**, **Type**, and **Sub Type**. Products can be reset using the **Restore Defaults** button at the bottom. New products can be added in using **New Reagent**. This opens a new window to define the reagent:

- **Reagent Name**: the name to identify it in the **Product List**.
- **Manufacturer**: the name of the manufacturer to organize the **Product List**. There is the option of **Other**, as required, as well as the option to add a **New Manufacturer**.
- **Type**: the type of product to identify where the product is shown during the template design. Options are **Powders**, **Initiators**, **Boosters**, **Connectors**, and **Detonators**.
- **Sub Type**: the sub-type of the product to further sort the **Product List**. Only applicable for **Powders** and

Initiators. Powders can be sub-categorized as **Packaged** or **Bulk**, while Initiators can be sub-categorized as **Electric**, **Electronic Initiator Design**, or **Non-Electric**.

17.3 Define Templates

Click **Define Reagents** for a drop-down menu listing previous created hole loading templates, and the option to create a new template. Click **New** to open a new window to design the hole loading template.



Hole Template Settings window

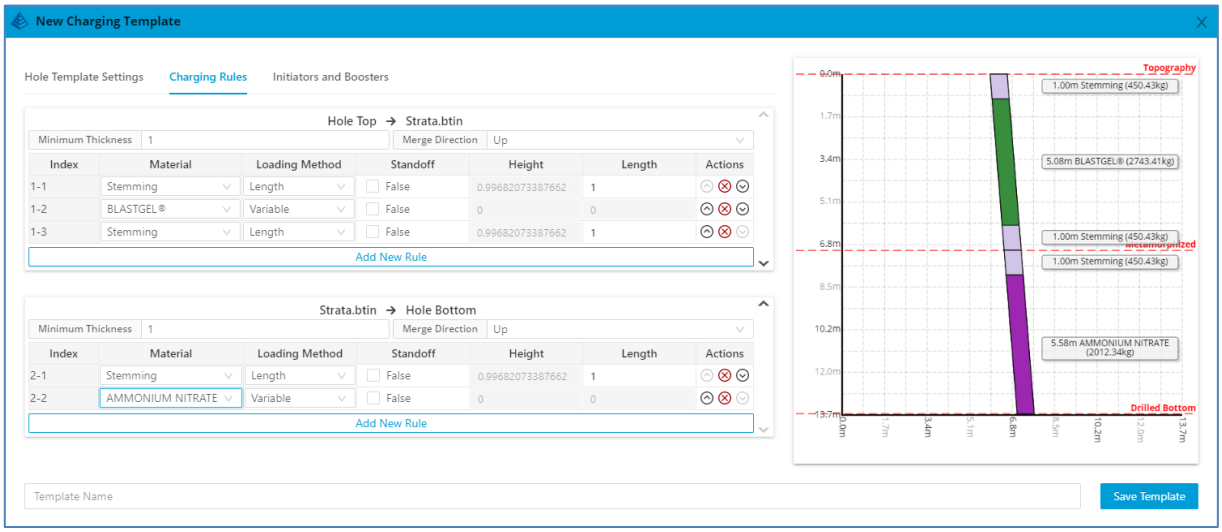
The first step for creating a template is establishing the **Hole Template Settings**. Specific holes can be loaded from selecting the desired hole from the drop-down menu, and clicking **Load Data From Hole**, tabulating its hole parameters.

The **Strata** section lists the surfaces to be used to limit the extent of the template. While the **Hole Top** and **Hole Bottom** is the simplest version to use for designing the template, additional imported surfaces or created pads can be used to define different strata layers, and further segregate the hole loading template. This is done by clicking **Add New Strata**, and using the **Surface** drop down menu to select the desired surface, and optionally, give the strata a **Name**.

As seen in the screenshot above, a surface was used to indicate a metamorphized strata. The illustration on the right shows the inclination of the hole, as well as the intersection of the created strata.

An **Estimated Powder Factor** for the specified hole can be seen, which is broken down by the strata levels. Once the **Charging Rules** and **Initiators and Boosters** have been chosen, the table will populate.

The second step for creating a template is defining the **Charging Rules**. With a straight forward **Hole Top** and **Hole Bottom** limitation, there will only be a singular rule set to define. If a strata level is added in there will be a second set of rules to define.



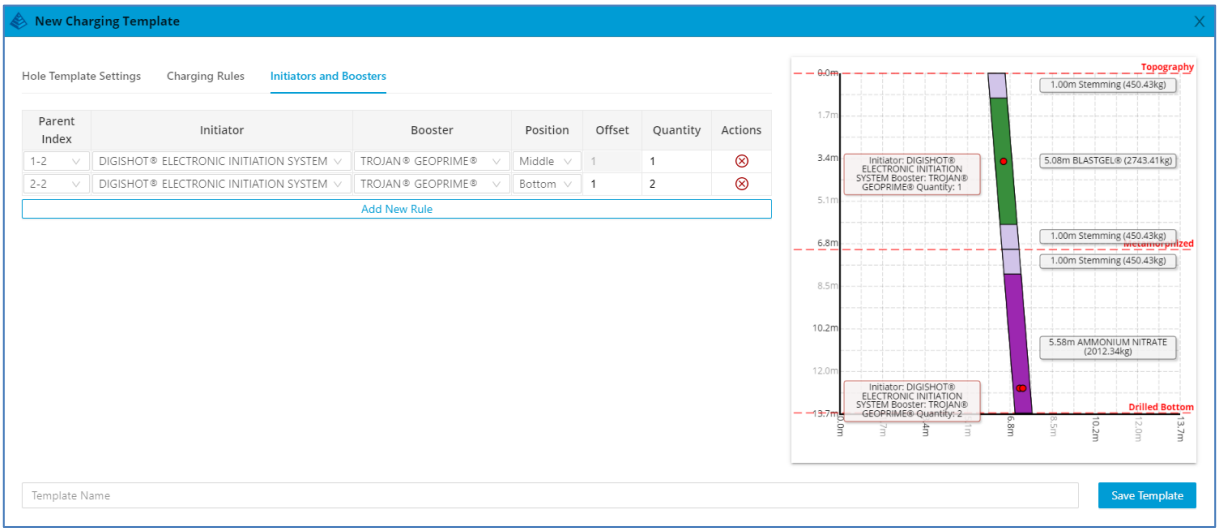
Charging Rules window

Click **Add New Rule** to add a new index to the list:

- **Material**: a drop-down menu listing the available powders and bulk materials from the **Defined Reagents** window can be chosen here.
- **Loading Method**: options of **Length**, **Height**, and **Variable**. One index must be listed as **Variable**.
    - **Length**: the absolute length along the hole (inclined or vertical).
    - **Height**: the elevation difference along the hole.
    - **Variable**: fills the remaining length of the hole.
- **Standoff**: if **False**, the index will remain within the designated limitation of the surfaces. If **True**, the index will populate outside of the designated limitation of the surfaces.
- **Height** / **Length**: unit value determining the occupancy relative to the hole.
- **Actions**: gives the ability to move the **Index** up or down, as well as deletion.

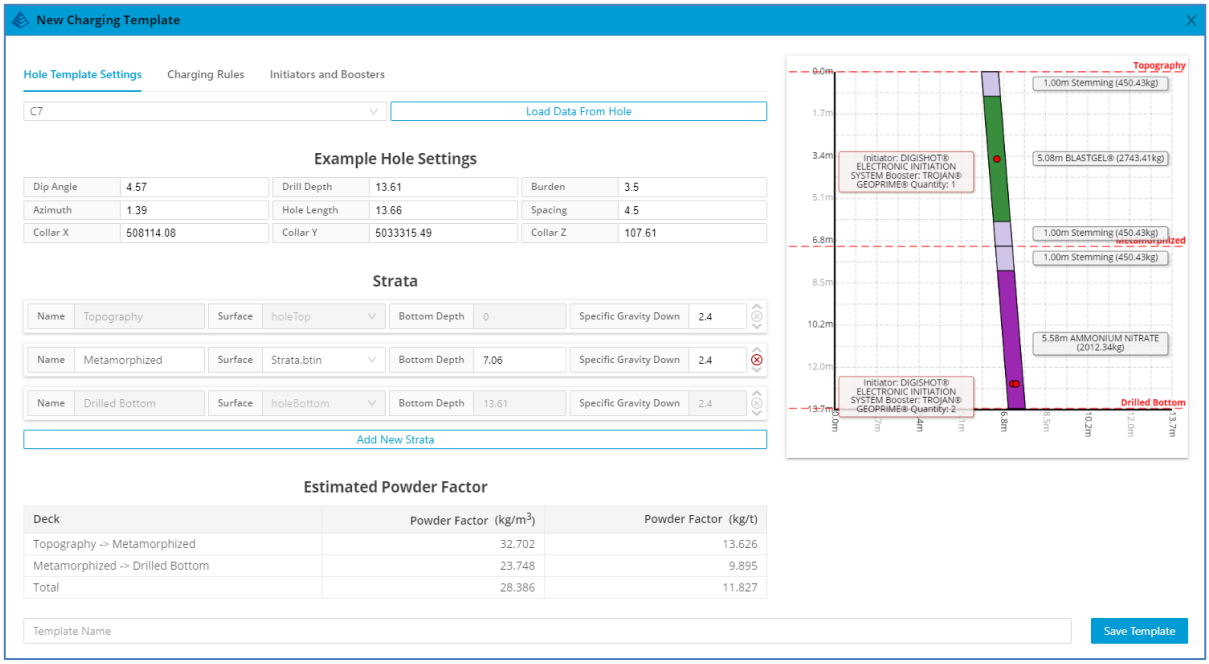
There is also the option to provide a **Minimum Thickness** related to pinch outs. If an index is less than the minimum thickness, it will get merged either up or down. Whether it gets merged up or down is controlled by the **Merge Direction**.

The third and final step for creating a template is defining the **Initiators and Boosters**. Similar to the charging rules, **Add New Rule** adds a new line, where the **Index**, **Initiator**, **Booster**, **Position**, **Offset** (if applicable), and **Quantity** can be selected.



Initiators and Boosters window

With the template complete, returning to **Hole Template Settings** tab shows the **Estimated Powder Factor** table filled out.

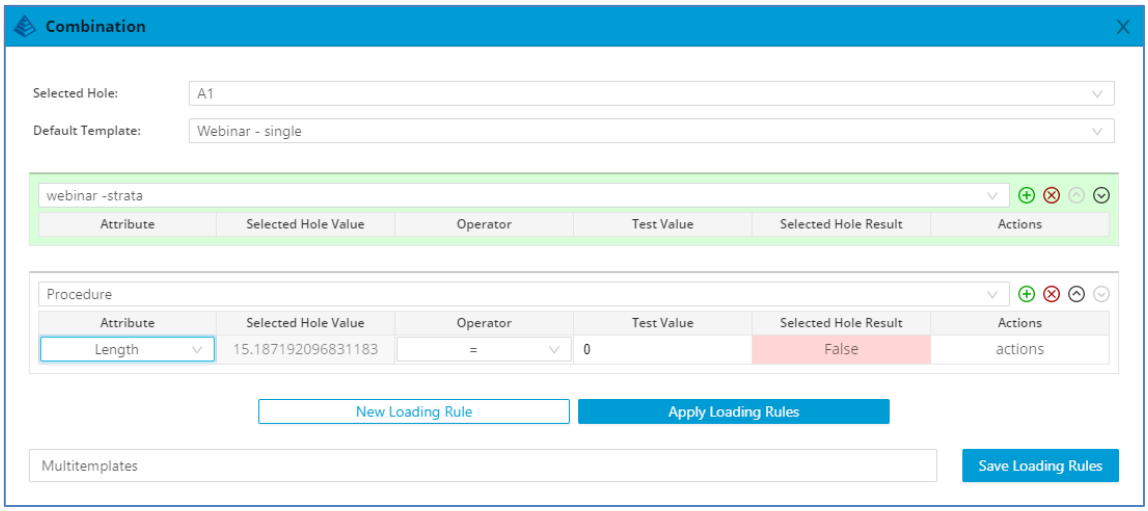


Estimated Powder Factor Table

Before closing the window, the template must be saved. After a template name is entered at the bottom, click **Save Template**.

17.4 Apply Templates

Click **Apply Templates** a drop-down menu listing previous created template loading rules, and the option to create a new template. Click **New** to open a new window to design the loading rules.



Apply Templates window

At the minimum a **Default Template** must be selected that will apply to all holes, before clicking **Apply Loading Rules**. The template must have a name before **Save Loading Rules** is clicked, and the window is closed.

There is also the option to add another loading rule. Click **New Loading Rule** where a second **Defined Template** can be applied. As per the screenshot above, the **Default Template** has a simple loading template of stemming and a singular packaged product. A second template is added to check for any holes intersecting a designated strata level, and applies that specific template that has stemming surrounding the strata, and packaged products on either side.

Additional rules can be created, and further hole attributes can be used to determine which template is applied to each specific hole. On the right side of each loading rule, a new specific **Attribute** can be added using the **green plus icon**. Use the **red 'x' icon** to delete the loading rule. The **arrow icons** move the rules up or down, deciding their priority.

In the event that a specific **Attribute** is required, the rules can be broken down as follows:

- **Attribute**: attribute used to determine the validity of the loading rule. Options are **Azimuth**, **Bottom Easting**, **Bottom Elevation**, **Bottom Northing**, **Collar Easting**, **Collar Elevation**, **Collar Northing**, **Depth**, **Drill Angle**, **Hole Name**, **Length**, **Type**, and **Visible**.
- **Selected Hole Value**: this shows the associated value for the **Selected Hole** at the top of the window.
- **Operator**: choose whether the attribute could be **Greater Than (<)**, **Greater Than or Equal To (<=)**, **Equal To (=)**, **Less Than or Equal To (>=)**, **Less Than (>)**, or **Does Not Equal (=/=)**.
- **Test Value**: the desired value to be compared to the associated value for the hole.
- **Selected Hole Result**: shows whether or not the attribute rule is **True** or **False** for the **Selected Hole**.

Multiple templates, as well as multiple attributes could be used to determine the hole loading of the blast pattern.

The template must have a name before **Save Loading Rules** is clicked, and the window is closed.

Once the template has been applied, individual hole loading templates can be edited through the **West Dialog** (Hole Tools) (see section 12.5). If the **Boundary Line** (see section 15.3) was used as part of pattern design or to calculate the surveyed hole's associated **Voronoi Volume**, this is also taken into account when calculating the **Estimated Powder Factor** displayed in the **West Dialog**.

17.5 Create Quickload Report

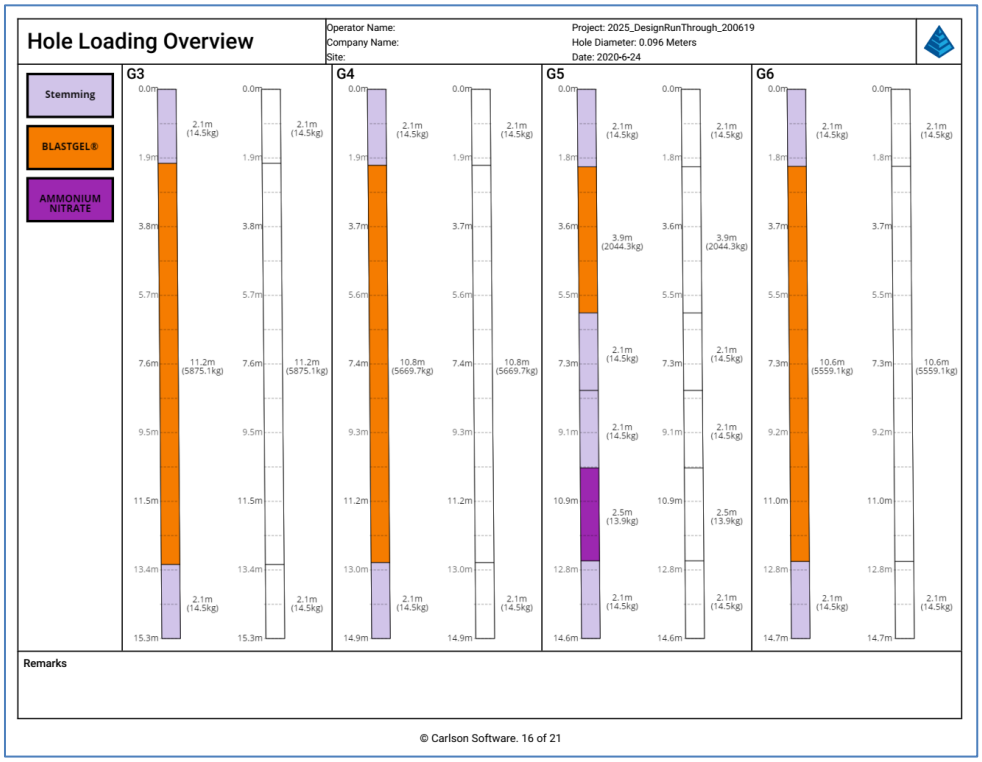
Click **Create Quickload Report** for a drop-down menu to create PDF Reports.

Currently supported report types are:

- **Overview PDF**
- **Detailed PDF**
- **Detailed CSV**

17.5.1 Overview PDF

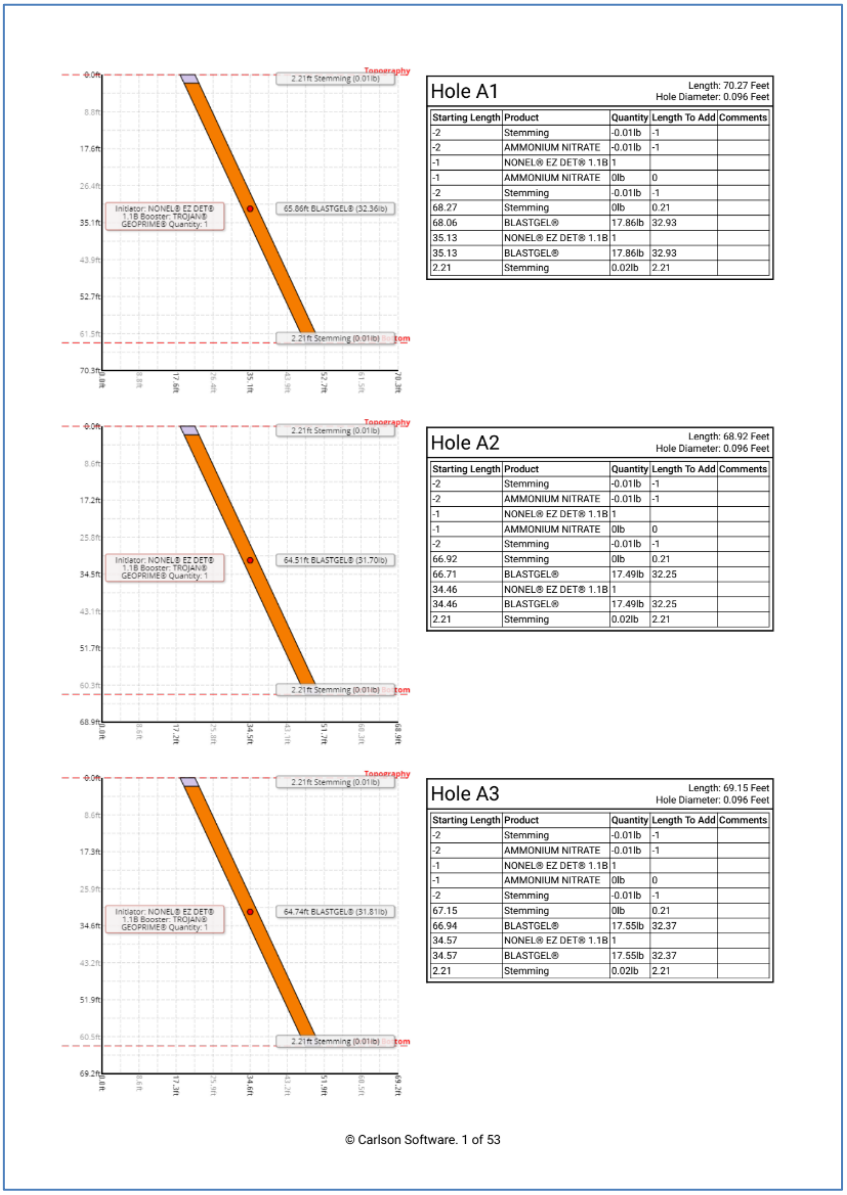
Multiple holes on a single page, breaking down the hole loading template, and associated quantities in the illustration.



Create Quickload Report > Overview PDF

17.5.2 Detailed PDF

Multiple holes on a single page, breaking down the hole loading template in an illustration, with associated quantities broken down in a tabular format.



Hole A1

Length: 70.27 Feet
Hole Diameter: 0.096 Feet

Starting Length	Product	Quantity	Length To Add	Comments
-2	Stemming	-0.01lb	-1	
-2	AMMONIUM NITRATE	-0.01lb	-1	
-1	NONEL® EZ DET® 1.1B	1		
-1	AMMONIUM NITRATE	0lb	0	
-2	Stemming	-0.01lb	-1	
68.27	Stemming	0lb	0.21	
68.06	BLASTGEL®	17.86lb	32.93	
35.13	NONEL® EZ DET® 1.1B	1		
35.13	BLASTGEL®	17.86lb	32.93	
2.21	Stemming	0.02lb	2.21	

Hole A2

Length: 68.92 Feet
Hole Diameter: 0.096 Feet

Starting Length	Product	Quantity	Length To Add	Comments
-2	Stemming	-0.01lb	-1	
-2	AMMONIUM NITRATE	-0.01lb	-1	
-1	NONEL® EZ DET® 1.1B	1		
-1	AMMONIUM NITRATE	0lb	0	
-2	Stemming	-0.01lb	-1	
66.92	Stemming	0lb	0.21	
66.71	BLASTGEL®	17.49lb	32.25	
34.46	NONEL® EZ DET® 1.1B	1		
34.46	BLASTGEL®	17.49lb	32.25	
2.21	Stemming	0.02lb	2.21	

Hole A3

Length: 69.15 Feet
Hole Diameter: 0.096 Feet

Starting Length	Product	Quantity	Length To Add	Comments
-2	Stemming	-0.01lb	-1	
-2	AMMONIUM NITRATE	-0.01lb	-1	
-1	NONEL® EZ DET® 1.1B	1		
-1	AMMONIUM NITRATE	0lb	0	
-2	Stemming	-0.01lb	-1	
67.15	Stemming	0lb	0.21	
66.94	BLASTGEL®	17.55lb	32.37	
34.57	NONEL® EZ DET® 1.1B	1		
34.57	BLASTGEL®	17.55lb	32.37	
2.21	Stemming	0.02lb	2.21	

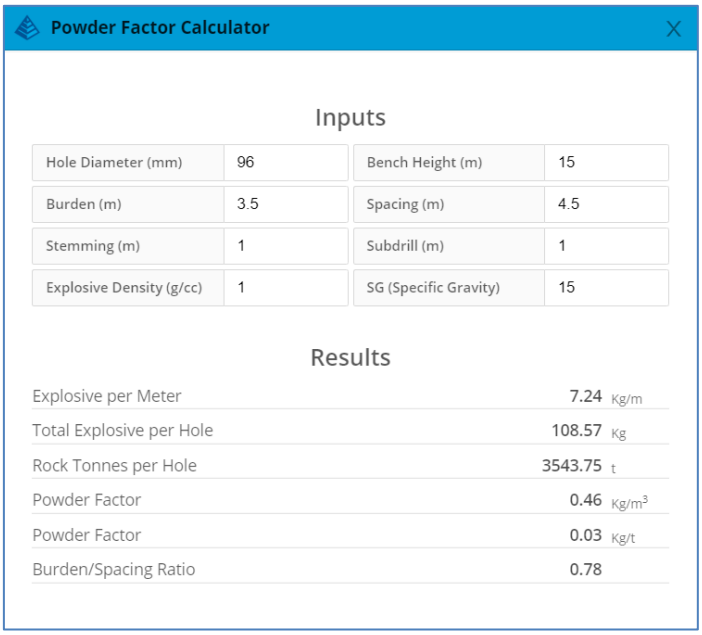
Create Quickload Report > Detailed PDF

17.5.3 Detailed CSV

Similar to the **Detailed PDF**, just in a **CSV** format. No illustrations are available.

17.6 Powder Factor Calculator

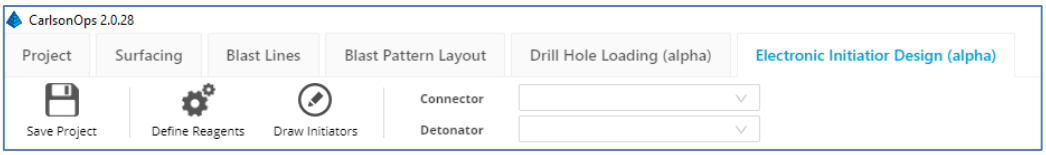
Click **Powder Factor Calculator** to open a new window where inputs related to the calculation can be modified, with the results showing below:



Powder Factor Calculator window

18 Electronic Initiator Design

The **Electronic Initiator Design** tab allows you to design tie-ups for the blast pattern, for timing and initiation purposes.



Electronic Initiator Design tab

18.1 Save Project

Click **Save Project** to save the **CarlsonOPS** project.

18.2 Define Reagents

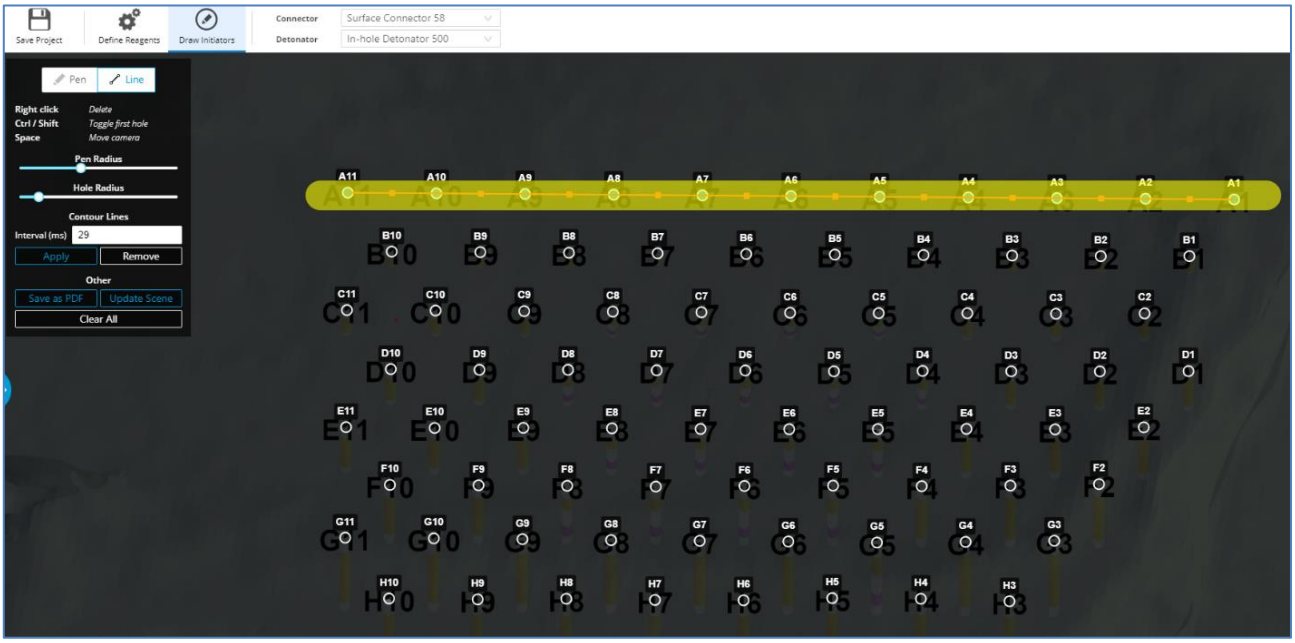
Identical to the **Define Reagents** feature in **Drill Hole Loading** (see section 17.2).

18.3 Draw Initiators

Before **Draw Initiators** can be selected, a **Connector** and a **Detonator** must be selected on the right. These can be defined using **Define Reagents**. Once in the **Draw Initiators** feature, the **Connector** and **Detonator** can be changed as needed.

Ensure to position the **3D View** so that you can easily see the blast pattern in order to design the tie-ups. Once in the **Draw Initiators** feature, holding down the **SPACEBAR** will allow for movement of the **3D View**.

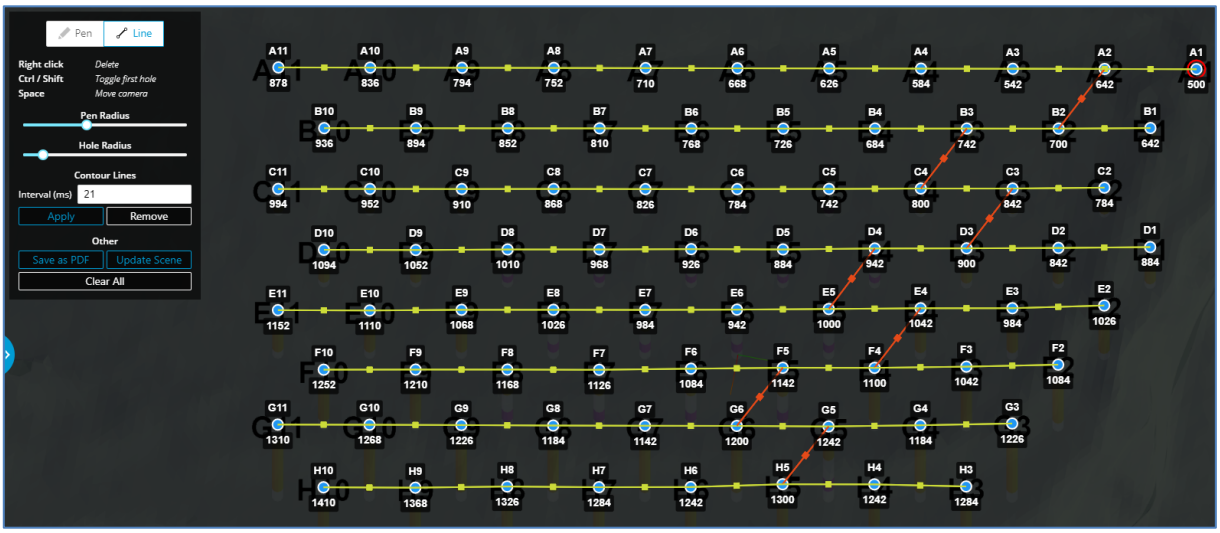
Upon selecting the **Draw Initiators** function, the screen will change to the following:



Draw Initiators screen

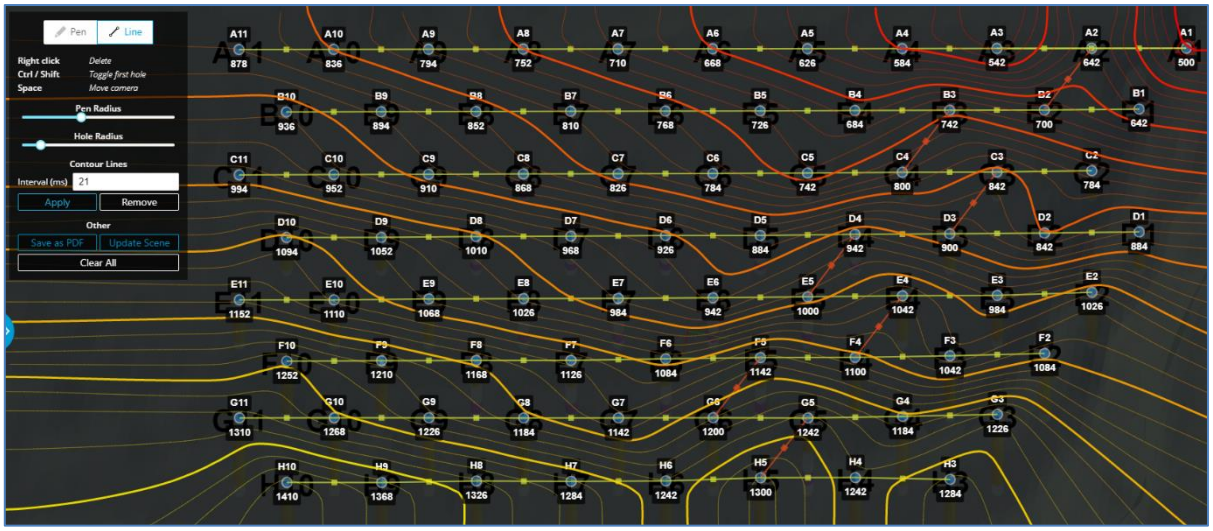
With the selected **Connector** and **Detonator**, the **Pen** or **Line** option can be used. Click, hold, and drag the left button on the mouse to connect the desired holes. Click, hold, and drag the right button on the mouse to delete the connections. There are options to increase/decrease the **Pen/Line Radius** and **Hole Radius** to make it easier to draw the connections.

After the tie-ups are completed, the last step is to choose the starting hole. This is accomplished by holding down **Crtl** or **Shift** while clicking with the left button on the mouse. This will populate the timing on screen:



First Hole Selection and Timing Results

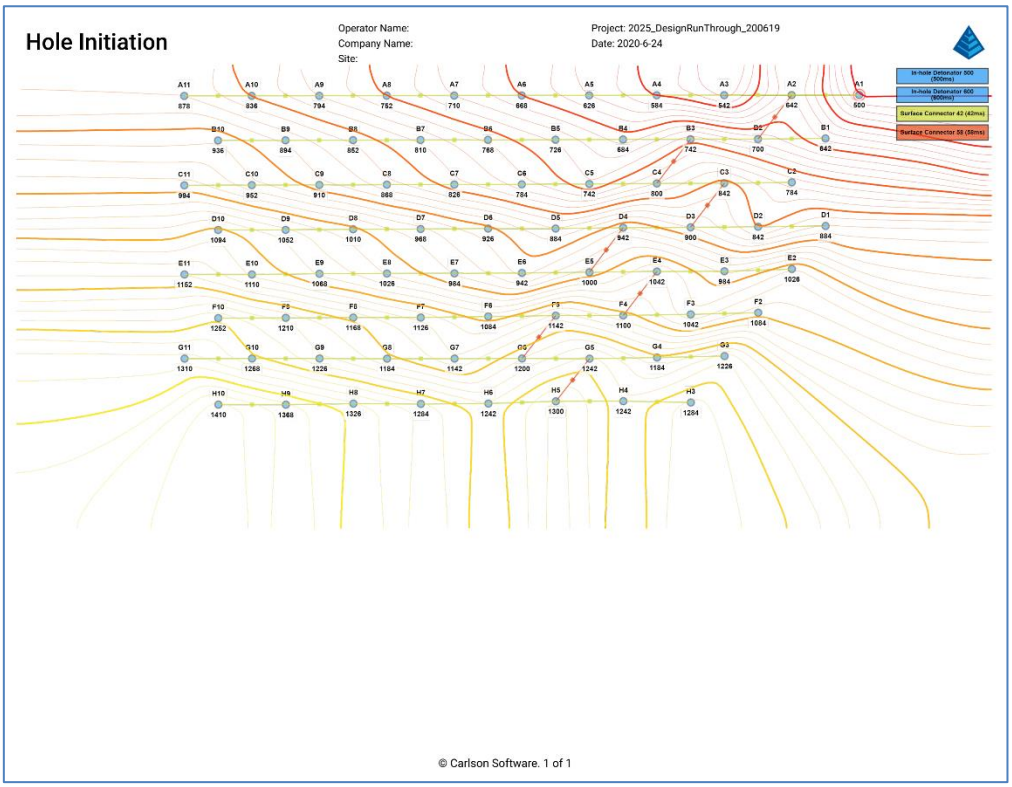
By entering a desired **Interval (ms)** and clicking **Apply**, **Contour Lines** will appear on the screen. These can be deleted using **Remove**.



Contour Lines

Once satisfied with the results, click **Update Scene** to save the **Connectors** and **Detonators** in the **3D View**.

A plan view report of the **Electronic Initiator Design** can be saved as a PDF, using the **Save as PDF** button:



Electronic Initiator Design PDF

The **Electronic Initiator Design** can be cleared using **Clear All**.

19 Procedural Guides

Below are some workflow guides to help navigate the software.

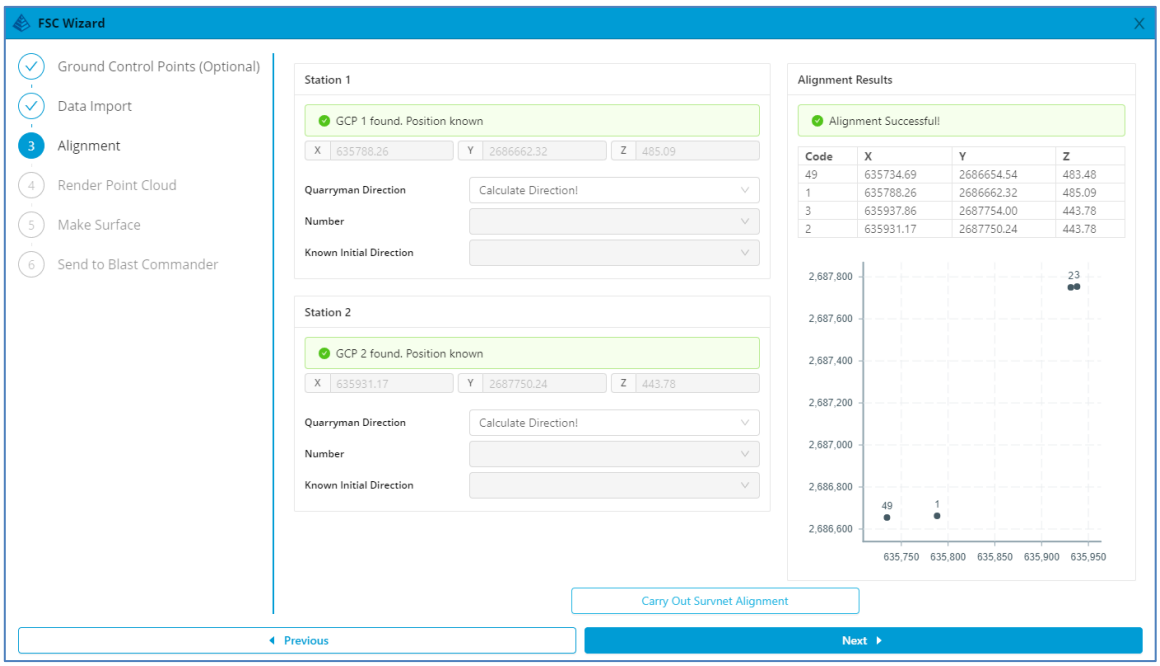
19.1 Quarryman Alignment

19.1.1 Using GPS

The use of the GPS with the Quarryman simplifies the procedure enormously by enabling the user to find the coordinates of any position. These would have been imported during the first step of the FSC Wizard, **Ground Control Points**.

For the simplest alignment, it is recommended that, in addition to the shot taken to determine the initial 0.00° position of the horizontal encoder, the user would have also entered **Point and Shoot** mode to take a recorded reading of the back-sight. Since the Quarryman setup has a known position, and a recorded reading to the back-sight, the **Quarryman Direction** will be left as **Calculate Direction**.

If no recorded reading was taken to the back-sight, **Backsighted to Non-Targeted GCP or Target** must be selected. The **Number** associated with the back-sight that was used to determine the initial 0.00° position, would have to be selected. Once each station has been modified as needed, click **Carry Out Surveynet Alignment** to see the results of the alignment.



Quarryman Alignment > Using GPS

Check over the **Alignment** results. If there are any discrepancies, review the **Ground Control Points**, **Data Import**, and **Alignment** steps to ensure there are no errors. Click **Carry Out Surveynet Alignment** to recalculate any changes.

19.1.2 Using a Resection

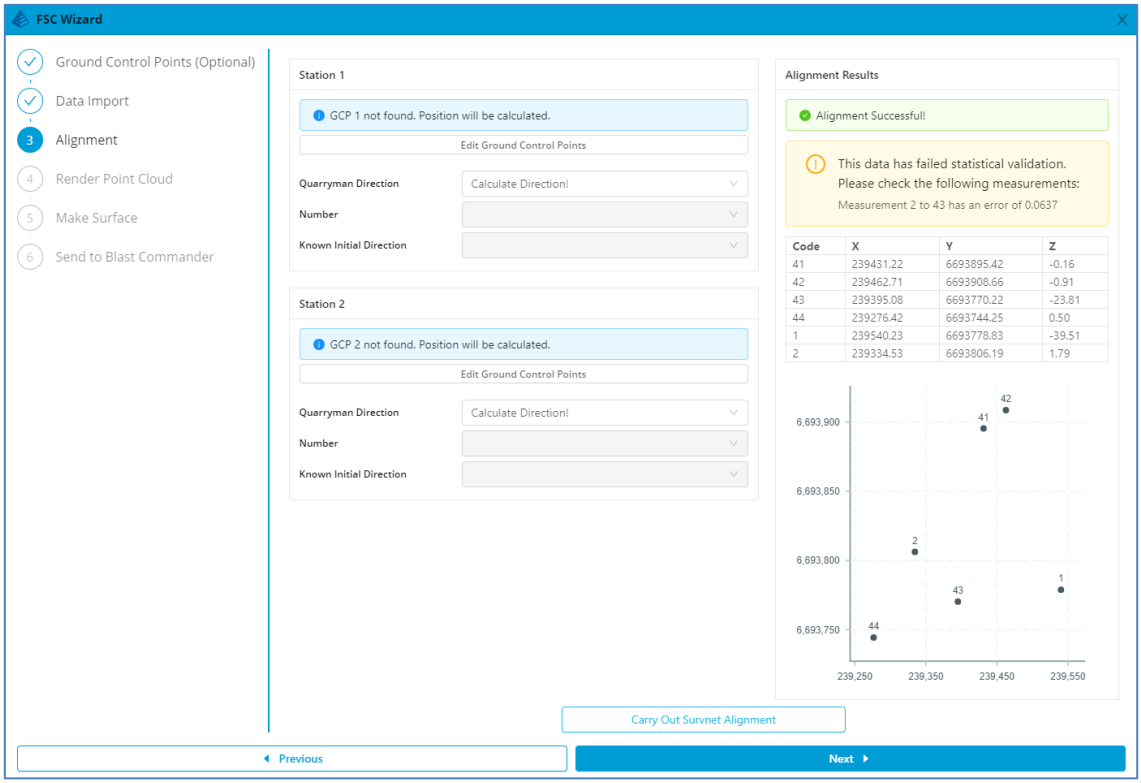
With known coordinates of the survey stations established around the site, these would have been imported during the first step of the FSC Wizard, **Ground Control Points**.

With observations taken to at least 3 survey stations, the **Quarryman Direction** will be left as **Calculate Direction**.

If subsequent Quarryman setup(s) were established using **Point and shoot** mode, and a recorded reading to the back-sight for the previous setup was taken, the **Quarryman Direction** will also be left as **Calculate Direction**.

If no recorded reading was taken to the back-sight, **Backsighted to Non-Targeted GCP or Target** must be selected. The **Number** associated with the back-sight that was used to determine the initial 0.00° position would have to be selected.

Once each station has been modified as needed, click **Carry Out Surveynet Alignment** to see the results of the alignment.



Quarryman Alignment > Using Resection

Check over the **Alignment** results. If there are any discrepancies, review the **Ground Control Points**, **Data Import**, and **Alignment** steps to ensure there are no errors. Click **Carry Out Surveynet Alignment** to recalculate any changes.

19.1.3 Using a Local Grid

For a Local Grid, the first Quarryman setup would be assigned arbitrary coordinates. This would have been entered in manually during the first step of the FSC Wizard, **Ground Control Points**.

In this case, the first Quarryman setup must be orientated using a known direction. This would have been observed using the **Code ID 0**. In this instance, the **Quarryman Direction** will be switched to **Known Direction to GCP or Target**, selecting **0** for the **Number**, and specifying the **Known Initial Direction** as **North**, **South**, **East**, or **West**.

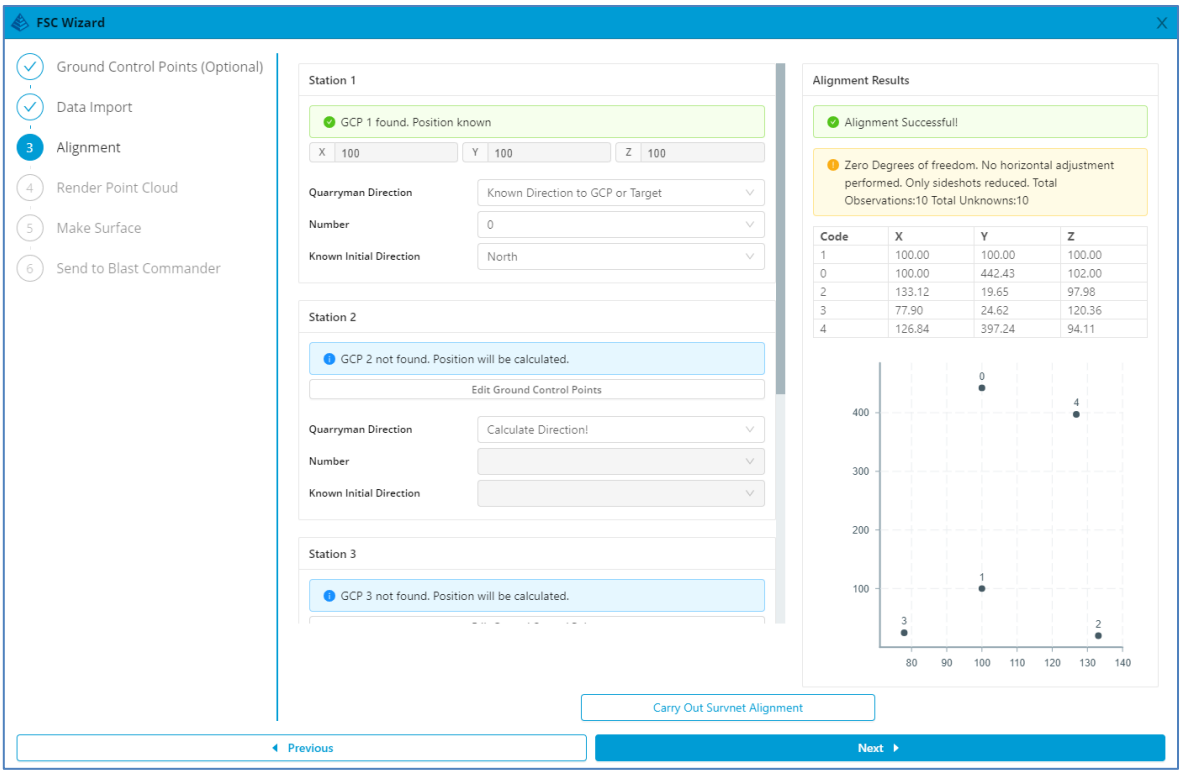
If a recorded reading for the known direction was not taken, the **Quarryman Direction** will be set as **Known**

Direction of Startup, and selecting **North**, **South**, **East**, or **West** as the **Known Initial Direction**.

If subsequent Quarryman setup(s) were established using **Point and shoot** mode, and a recorded reading to the back-sight for the previous setup was taken, the **Quarryman Direction** will also be left as **Calculate Direction**.

If no recorded reading was taken to the back-sight, **Backsighted to Non-Targeted GCP or Target** must be selected. The **Number** associated with the back-sight that was used to determine the initial 0.00° position would have to be selected.

Once each station has been modified as needed, click **Carry Out Surveynet Alignment** to see the results of the alignment.



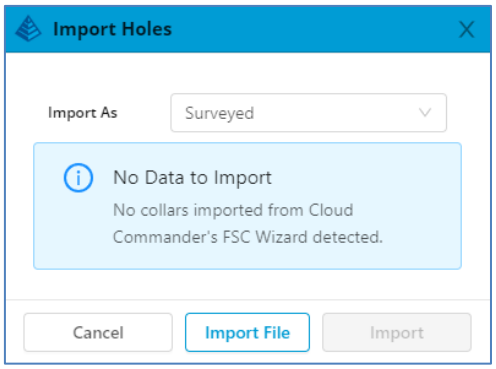
Quarryman Alignment > Using a Local Grid

Check over the **Alignment** results. If there are any discrepancies, review the **Ground Control Points**, **Data Import**, and **Alignment** steps to ensure there are no errors. Click **Carry Out Surveynet Alignment** to recalculate any changes.

19.2 Collar Importation

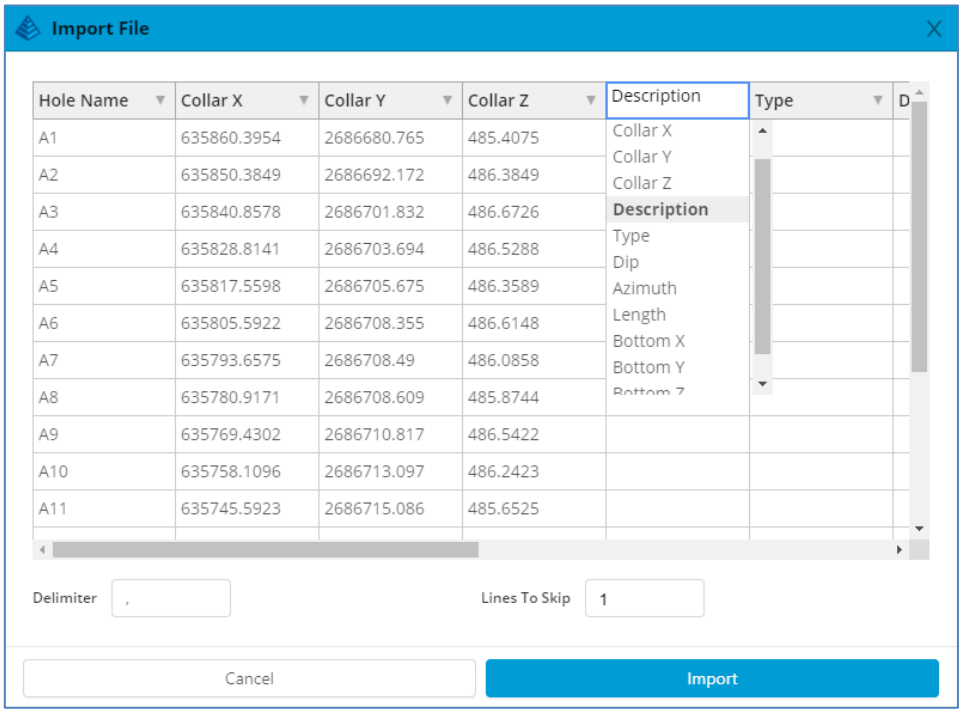
19.2.1 Using GPS

If a GPS was used to collect the collar locations, the following window will appear.



Collar Import > Using GPS

In this case, a csv or txt file would have to be imported using **Import File**. After selecting the txt, or csv file containing the collars, the column headers, delimiter, and lines to skip can be manipulated to work with the file being imported.



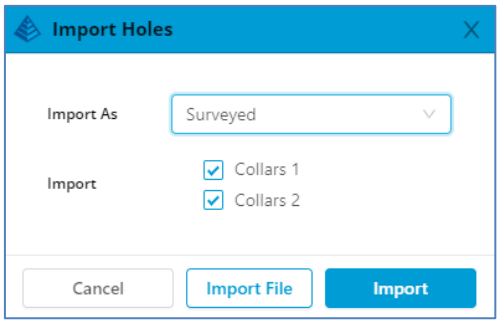
Collar Import > CSV / TXT Files

If more information than just the collar information is available, this can also be imported. Click **Import** when finished.

This will bring you back to the initial window. Ensure **Import As** is allocated as **Surveyed**, and the correct csv or txt file is checked off (if there are multiple files to choose from).

19.2.2 Using Quarryman

If a Quarryman was used to collect the collar locations, the following window will appear.



Collar Import > Using Quarryman

In the screenshot above, the collars were surveyed in from 2 different Quarryman setups. Both can be imported simultaneously, though some of the collar names may have to be relabeled, as the second set of collars will be imported under a different row. This can be done through the **Hole Tools** window in the **West Dialog**.

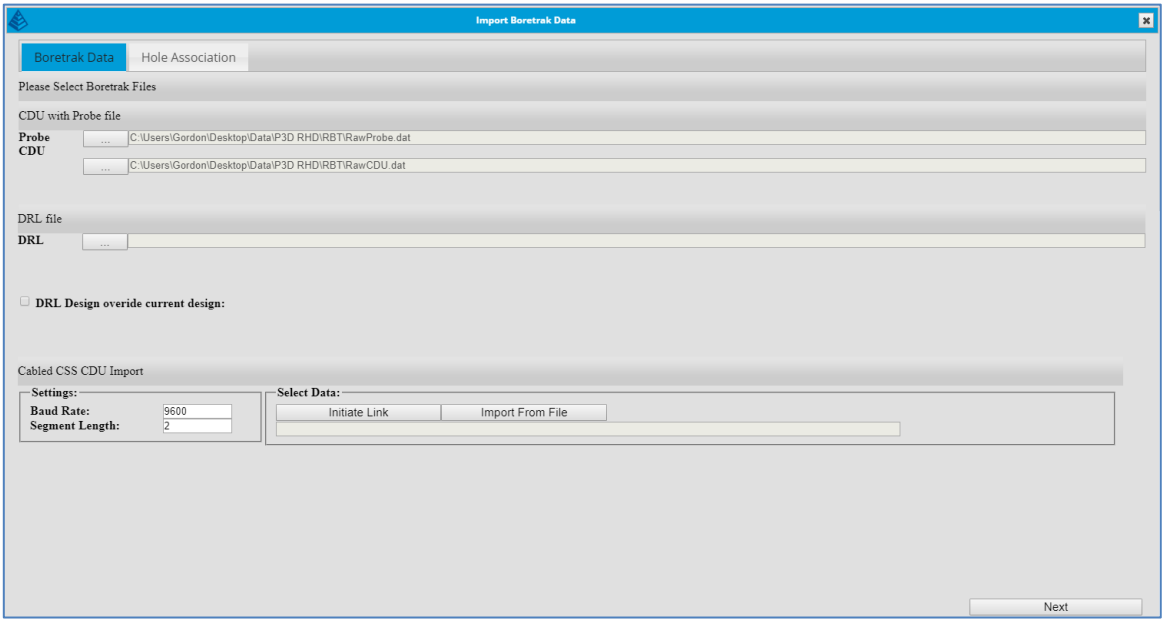
Ensure **Import As** is allocated as **Surveyed**, and the correct collar file(s) are checked off.

19.3 Boretrak Importation

19.3.1 Legacy Rodded Boretrak

For the Legacy Rodded Boretrak, the raw dat files would have to be extracted. This can be done through Carlson's Boretrak Viewer (P3D).

Once the dat files are available, click on the box next to **Probe** to attach the probe's raw data. Then click on the box next to **CDU** to attach the CDU's raw data.



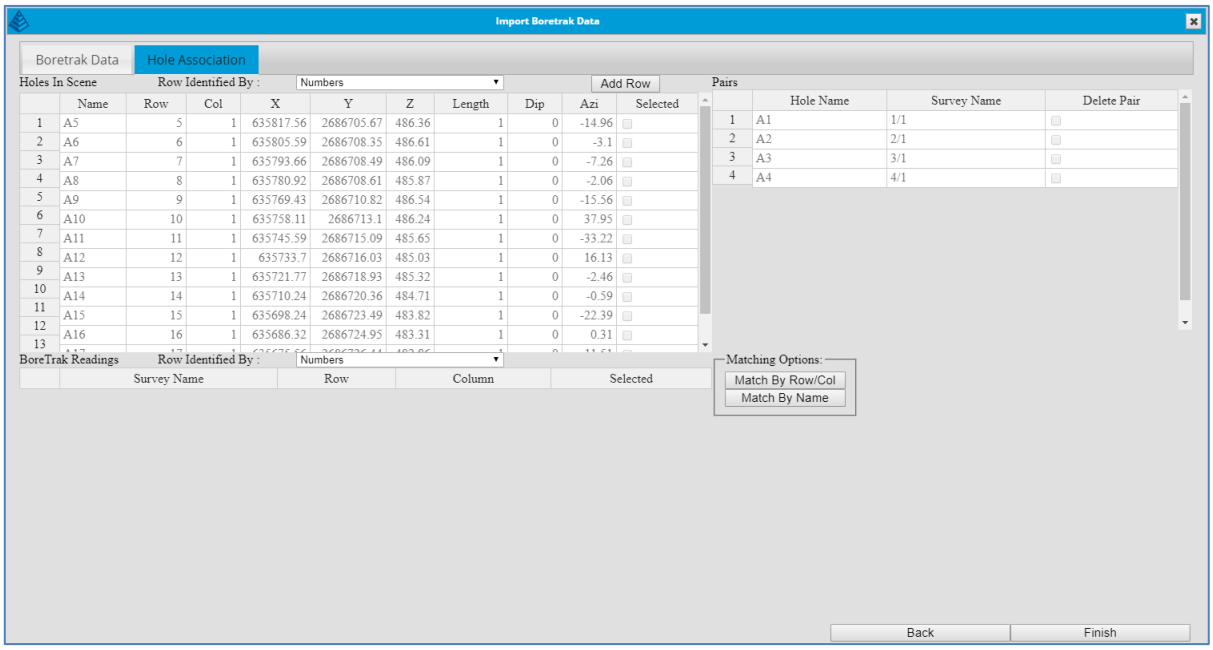
Boretak Import > Legacy Rodded Boretrak

Click **Next**.

The next step is the **Hole Association Screen**. Here the Boretrak hole data needs to be matched with the collars. This can be done manually one at a time, by selecting one hole in the **Holes In Scene**, then the corresponding hole in **Boretrak Readings**.

Alternatively, there is a **Match by Row/Col**, or **Match By Name**.

Once combined, the pairs will be shown on the left, and any data that is left over will remain in their respective lists.

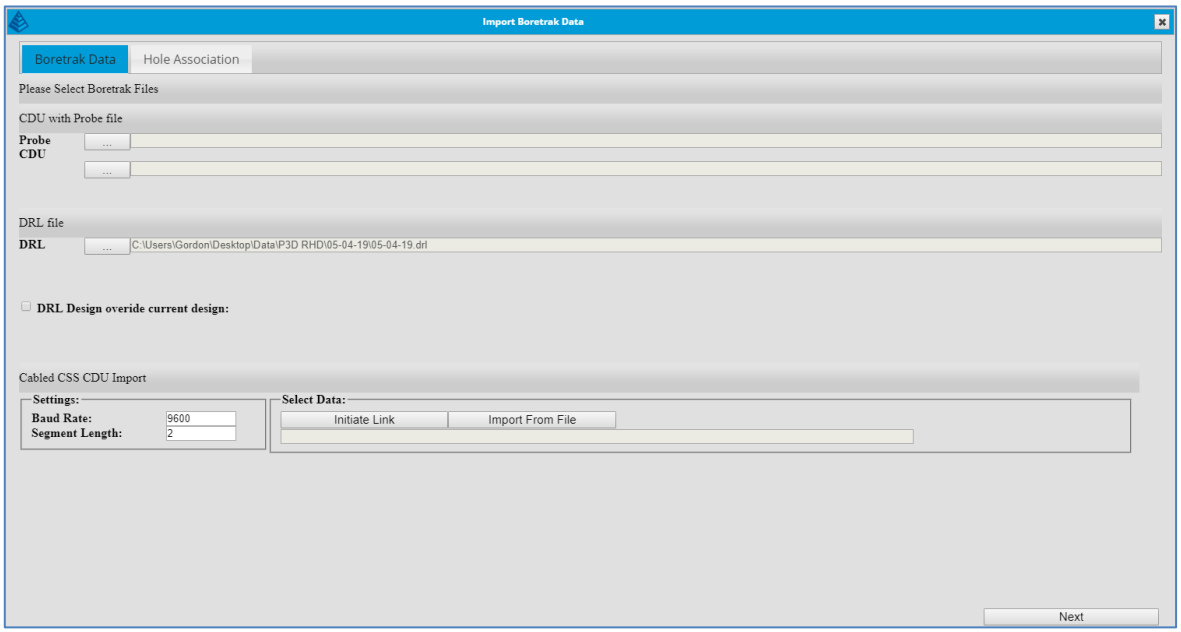


Boretak Import > Hole Association

Click **Finish** to import the Boretrak Data.

19.3.2 Carlson Rodded Boretrak

For the Carlson Rodded Boretrak that uses the PDA to collect the data, the drl file created by Boretrak Mobile would simply have to be transferred to the computer and selected.



Boretak Import > Carlson Rodded Boretrak

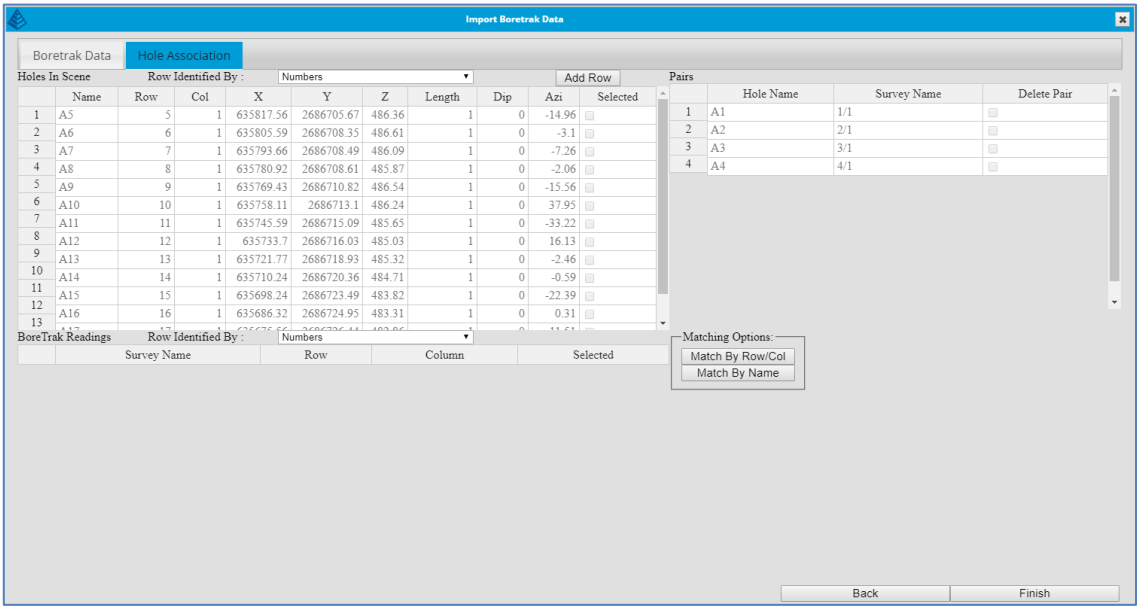
Click **Next**.

The next step is the **Hole Association Screen**. Here the Boretrak hole data needs to be matched with the collars.

This can be done manually one at a time, by selecting one hole in the **Holes In Scene**, then the corresponding hole in **Boretrak Readings**.

Alternatively, there is a **Match by Row/Col**, or **Match By Name**.

Once combined, the pairs will be shown on the left, and any data that is left over will remain in their respective lists.



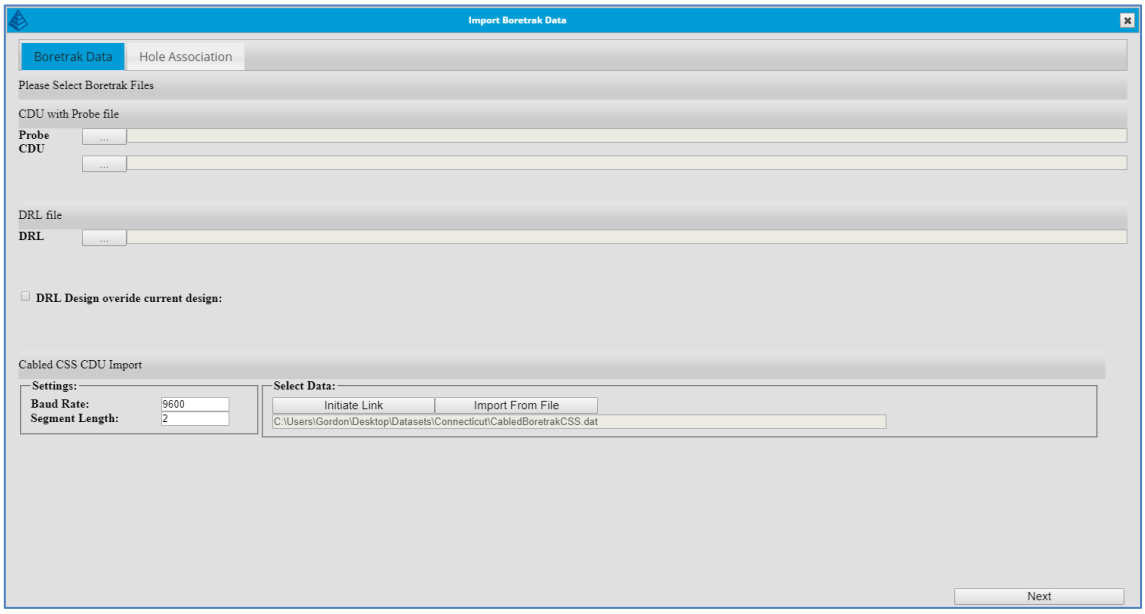
Boretak Import > Hole Association

Click **Finish** to import the Boretrak Data.

19.3.3 Cabled Boretrak

For the Cabled Boretrak there are two ways to import the data.

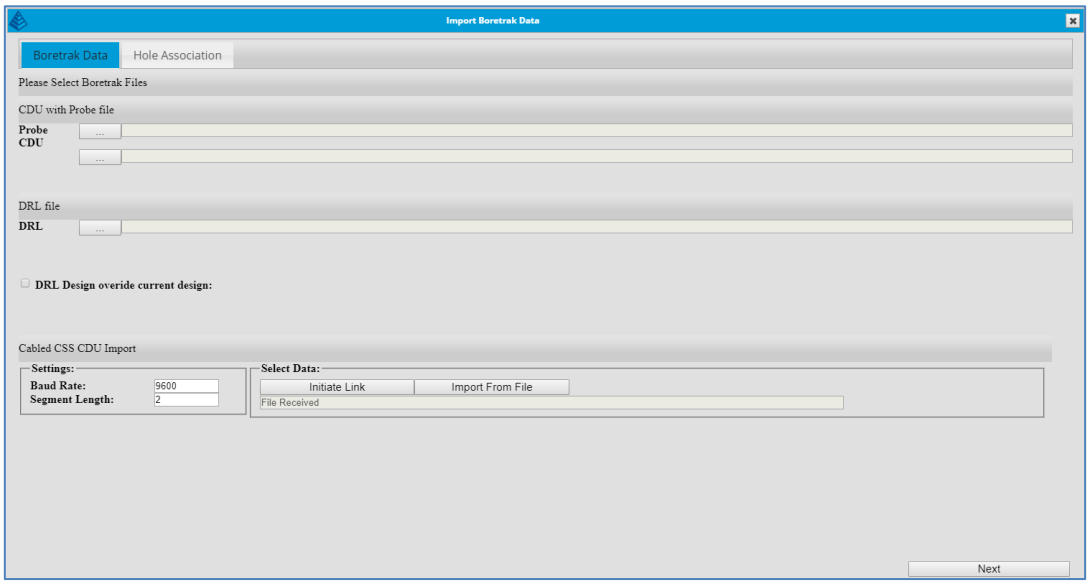
Similar to the Legacy Rodded Boretrak, the raw dat file can be extracted from Carlson's Boretrak Viewer (P3D). **Import From File** would be used in this case.



Boretak Import > Cabled Boretrak File

It is also possible to connect the CDU to the computer and download the data through the software. Check that the **Baud Rate** matches with the Baud Rate from the Boretrak (this can be found from **1. Settings** on the CDU). Also check that the **Segment Length** matches the segment length used in the field.

Click **Initiate Link** to connect to the CDU. The message below will say **CDU Successfully Connnected**. At this point, return to the CDU, go to **5. Download** and press any button to start the download. The message below will change to **File Received**.



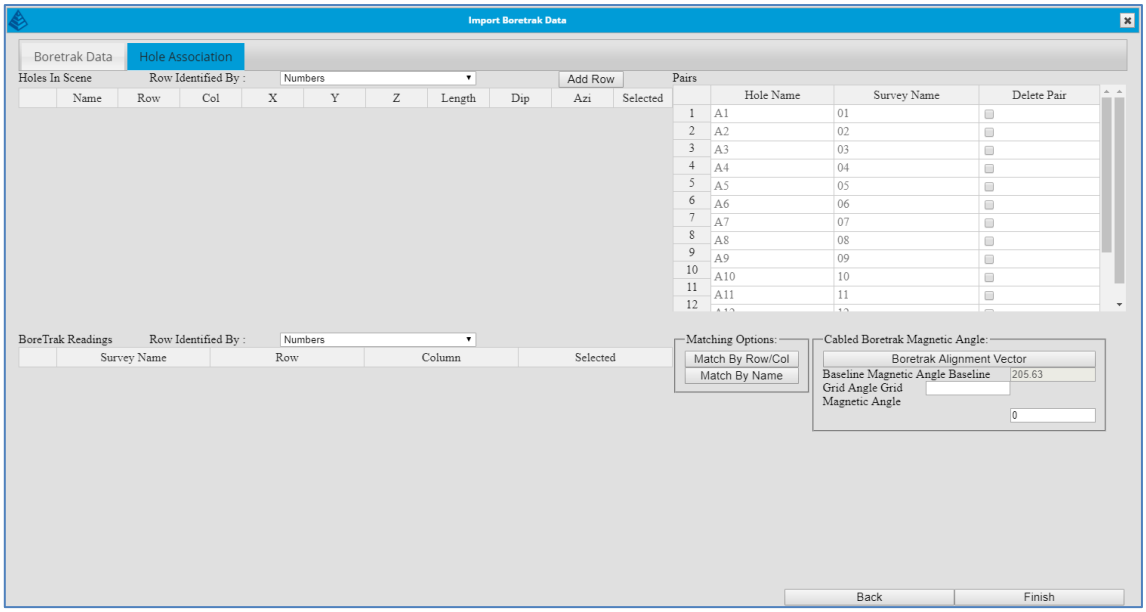
Boretak Import > Cabled Boretrak File

Click **Next**.

The next step is the **Hole Association Screen**. Here the Boretrak hole data needs to be matched with the collars. This can be done manually one at a time, by selecting one hole in the **Holes In Scene**, then the corresponding hole in **Boretrak Readings**.

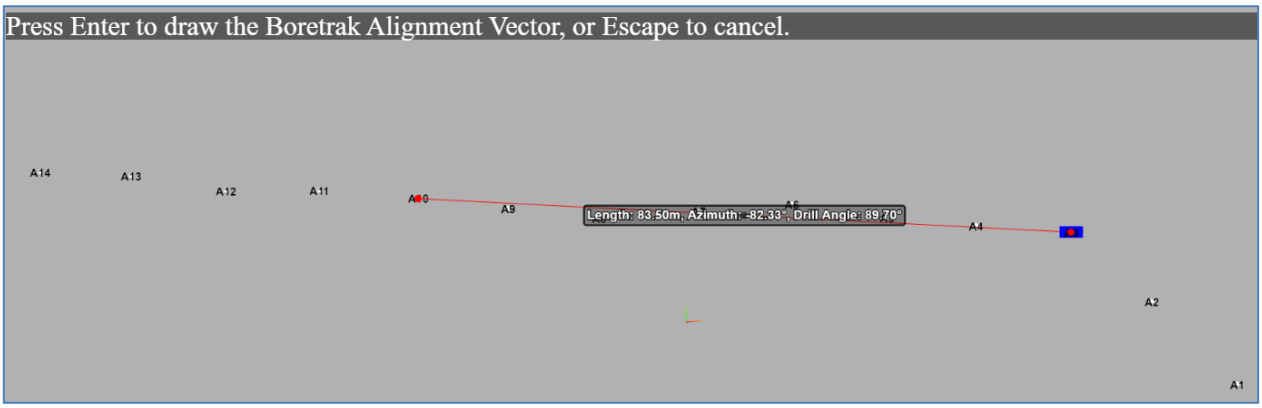
Alternatively, there is a **Match by Row/Col**, or **Match By Name**.

Once combined, the pairs will be shown on the left, and any data that is left over will remain in their respective lists.



Boretak Import > Hole Association

With the Cabled Boretrak, there is the need to calculate the **Magnetic Angle** to ensure the data aligns with the surface data. In the field, a known baseline would have been observed using the boretrak probe, as indicated by the **Baseline Magnetic Angle** value. Click **Boretrak Alignment Vector** to return to the **3D View** temporarily:



Design/Surveyed Import window

Ensure to position the **3D View** so that you can easily replicate the sighted baseline in the view, as the view locks upon hitting **ENTER** to prompt the line tool.

Click using the left button on the mouse to indicate the starting point of the baseline. Hit **ESC** if the selection was incorrect. Then click to indicate the end point of the baseline, returning you to the **Boretrak** import screen. The **Grid Angle** value will now show the azimuth of the line just drawn, and the **Magnetic Angle** will show the rotation needed to align the data.

Click **Finish** to import the Boretrak Data.

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