Hemisphere®

875-0439-10

Operator Guide

Revision: **B1**

July 29, 2022

GradeMetrix™

Machine Control & Guidance Software

Table of Contents

Device Compliance, License and Patents

Device Compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
This device may not cause harmful interference, and
this device must accept any interference received, including interference that may cause undesired operation.

This product complies with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be consulted at HTTPS://HEMISPHEREGNSS.COM/ABOUT-US/QUALITY-COMMITMENT.

E-Mark Statement: This product is not to be used for driverless/autonomous driving.

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6501346	7277792	7460942	8102325
6539303	7292185	7689354	8138970
6549091	7292186	7808428	8140223
6711501	7373231	7835832	8174437
6744404	7388539	7885745	8184050
6865465	7400294	7948769	8190337
8214111	8217833	8265826	8271194
8307535	8311696	8334804	RE41358

Australia Patents	
2002244539	2002325645
2004320401	

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Device Compliance, License and Patents, Continued

Notice to Customers

Contact your local dealer for technical assistance. To find the authorized dealer near you:

Hemisphere GNSS, Inc
8515 East Anderson Drive
Scottsdale, AZ 85255 USA

Phone: (480) 348-6380
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Hemisphere GNSS, Inc.
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Scottsdale, AZ 85255 USA

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Terms and Definitions

Introduction

The following table lists the terms and definitions used in this document.

Terms & Definitions

Term	Definition
Activation	Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see Subscription.
BeiDou	BeiDou is a global navigation satellite system deployed and maintained by China.
DTM	Digital Terrain Model – the 3D grading of a job.
Ellipsoid	Ellipsoidal elevation refers to your height above the WGS84 ellipsoid.
Flat Pad	A set elevation that you grade to over the entire job site, regardless of design elevation.
Galileo	Galileo is a global navigation satellite system implemented by the European Union and European Space Agency.
Geoid	A model representing the shape of the earth, represented by mean sea level.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System deployed and maintained by Russia.
GNSS	Global Navigation Satellite System (GNSS) is a system that provides an autonomous 3D position (latitude, longitude, and altitude) and accurate timing globally by using satellites.
GPS	Global Positioning System (GPS) is a global navigation satellite system deployed and maintained by the United States.
Heading	The vector is created from the primary to the secondary antenna. It points to the direction that the receiver is facing.
Latitude	A measure of how far north or south you are on the earth. Uses degrees, with the equator at 0 degrees and the poles at 90 degrees (north or south).

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Terms and Definitions, Continued

Terms & Definitions, continued

Term	Definition
Longitude	A measure of how far east or west you are on the earth. Uses degrees with the prime meridian at 0. Positive degrees are east of the prime meridian and negative degrees west.
NEZ	Refers to Northing, Easting, and Elevation.
Point of Interest (POI)	The point from which the cut/fill and NEZ information is derived.
Subscription	A subscription is a feature that is enabled for a limited time. Once the end date of the subscription has been reached, the feature will turn off until the subscription is renewed.

Chapter 1: Introduction

Overview

Introduction

This Operator Guide provides information to help you quickly set up your GradeMetrix application software for machine operations.

Contents

Product Overview

Product Overview	GradeMetrix is a machine guidance solution for different machine types of all sizes ranging from compact to large, packed with industry-leading technology. The GradeMetrix system is designed to fit seamlessly into your existing site infrastructure using the same design file formats and base station corrections.

Key Features

GradeMetrix Key Features

GradeMetrix software features:

- Rugged Hardware
- Easy to Install
- Simplified User Interface
- Dynamic Cut/Fill
- Supports industry standard files
- Build flat pads
- Build single, dual, or multiple slopes
- Stake points

For excavators:

- Optional laser receiver kit
- Optional tilt bucket accessory kit

Chapter 2: Getting Started with GradeMetrix

Overview

Introduction

The information in this chapter shows you how to install the GradeMetrix software and provides an overview of GradeMetrix functions.

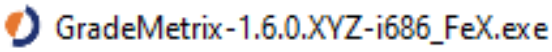
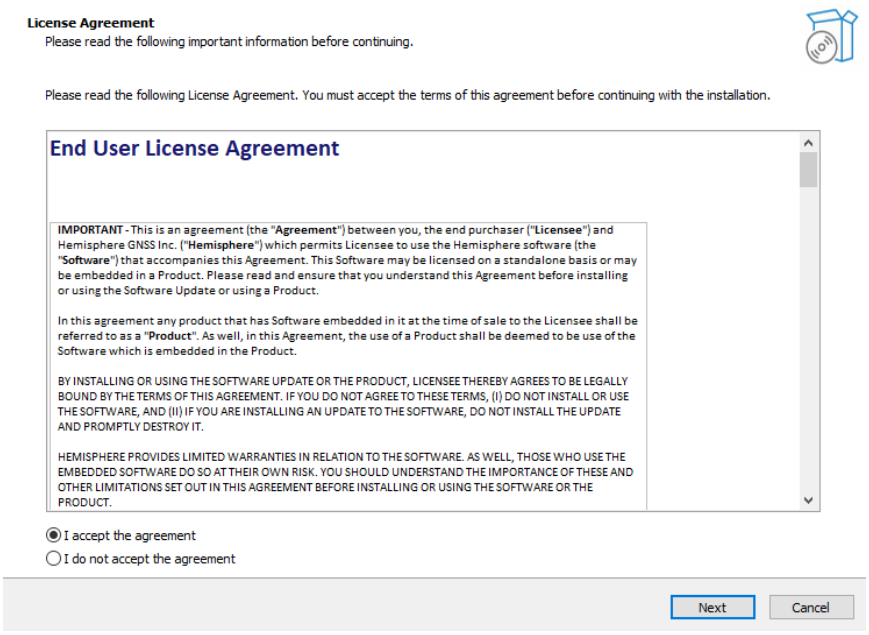
Contents

Software Installation

Install GradeMetrix Software

To install your GradeMetrix software, complete the following steps:

Table 1-1: Software Installation

Step	Action
1	Click the **Install** file.  After reading and understanding the **End User License Agreement** (the End User License Agreement can also be found at the end of this User Guide), click to select **I accept the agreement** and then **Next** to accept End User License Agreement. 

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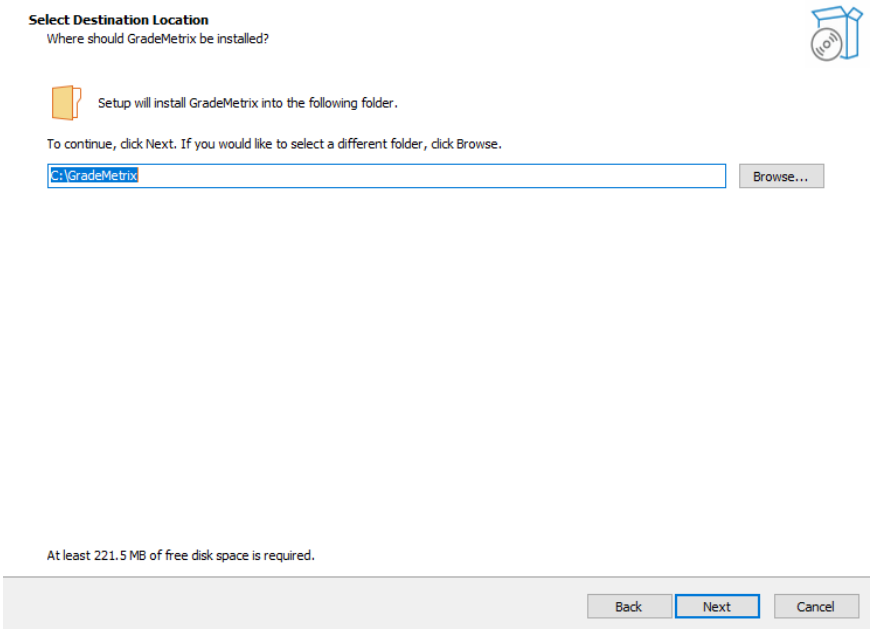
Install GradeMetrix Software, continued

Table 1-1: Software Installation (continued)

Step	Action
2	The **Select Destination Location** screen displays. Verify the location is correct or click **Browse** to select another file location. Once the location is verified, select **Next** to continue. 

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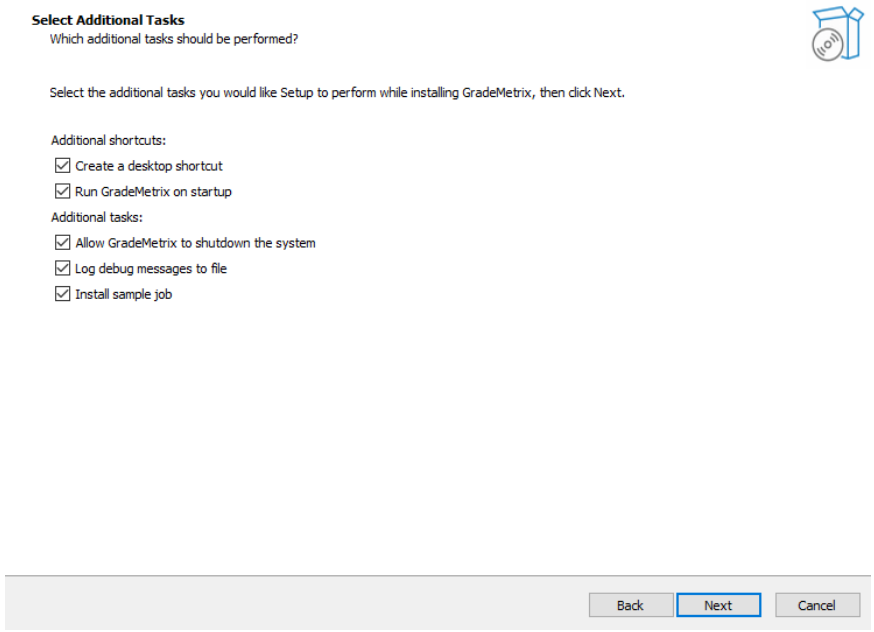
Install GradeMetrix Software, continued

Table 1-1: Software Installation (continued)

Step	Action
3	The **Select Additional Tasks** screen displays. Notice the option to **Create a desktop shortcut** is selected and click **Next**. 

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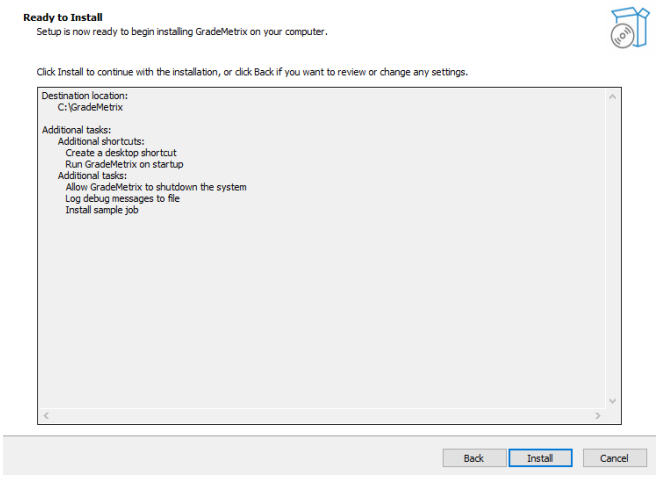
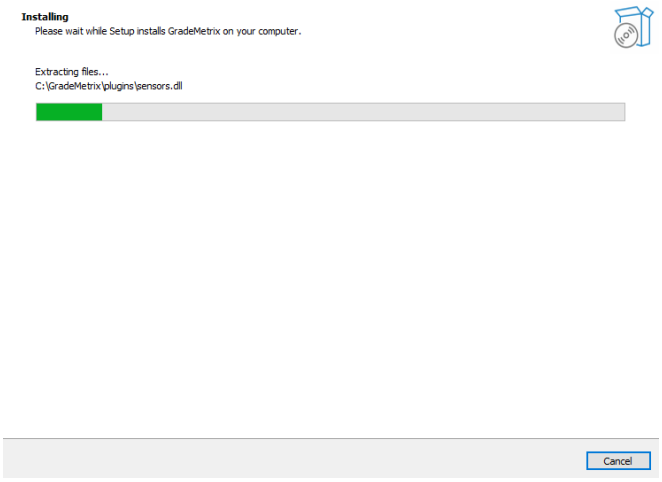
Install GradeMetrix Software, continued

Table 1-1: Software Installation (continued)

Step	Action
4	The **Ready to Install** screen will display, please review the settings selected for installation. When ready to continue with the installation, click **Install**.  The GradeMetrix software installation begins on your computer. 

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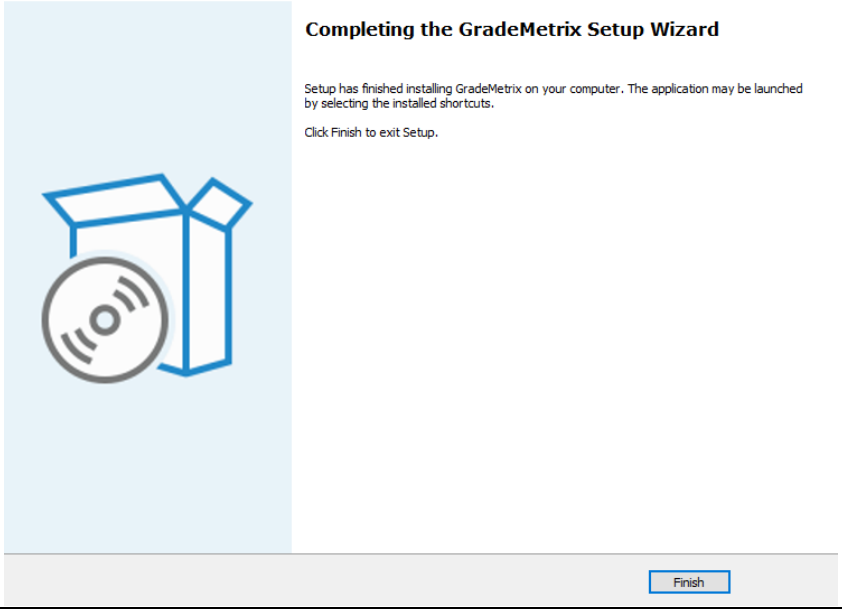
Install GradeMetrix Software, continued

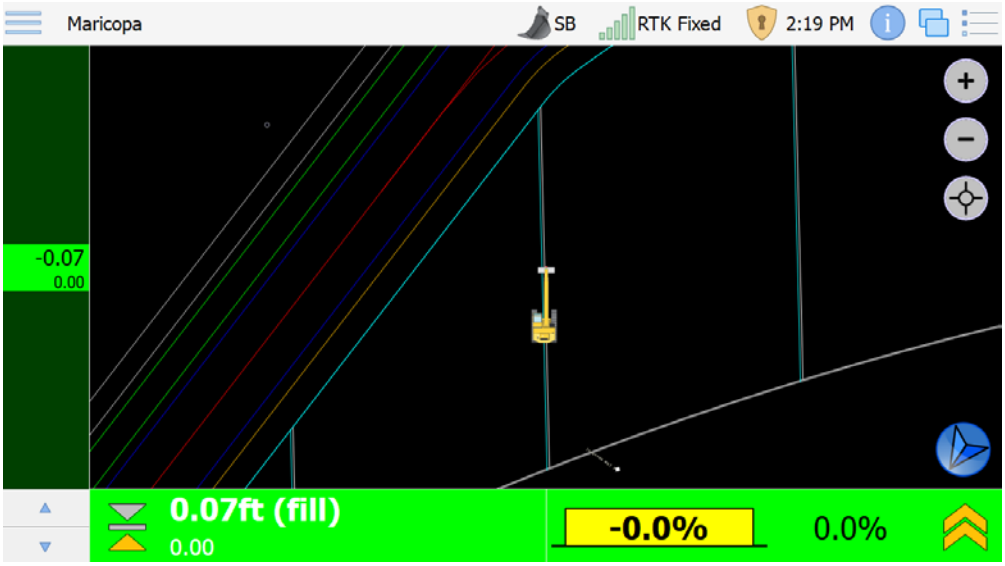
Table 1-1: Software Installation (continued)

Step	Action
5	When the installation process is completed, the **Completing the GradeMetrix Setup Wizard** screen will display. To exit the Setup, select **Finish**. 

Plan View

GradeMetrix is designed to open automatically when the terminal starts up. When the software opens, you are brought directly to the **Plan View**. The **Plan View** has a variety of customizable views shown in the next section.

The **Plan View** has a variety of features.



Vertical Offset

Use the arrows on the bottom-left to add or subtract a vertical offset. For instance, in the example above, a -0.07 ft cut/fill with a 0.00 vertical offset is shown. Clicking on the up arrow increases the vertical offset and the down arrow decreases the vertical offset. The amount of increase/decrease is preset to .10. The amount can be edited as shown on the next page.

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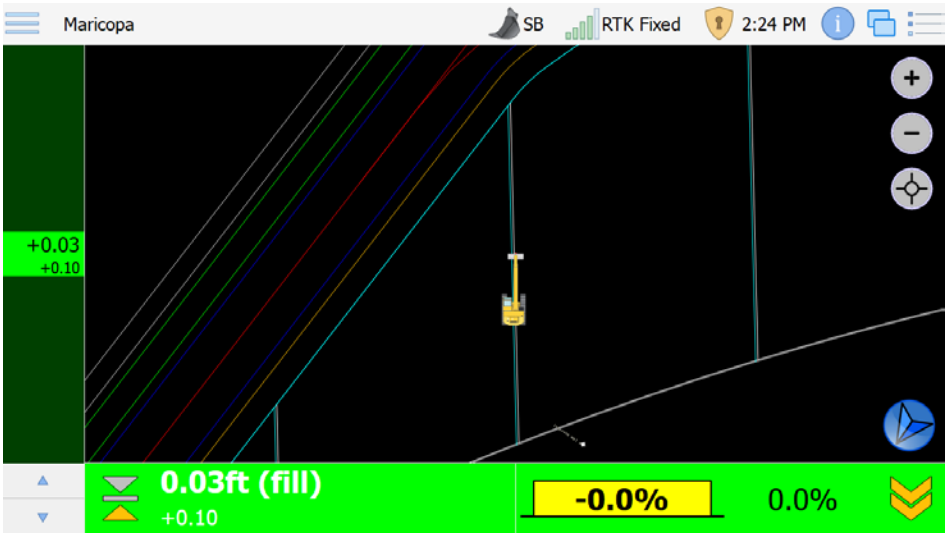
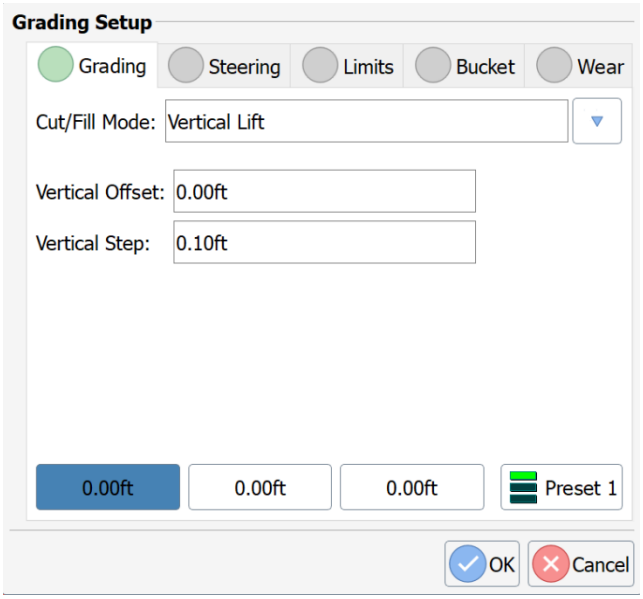
Vertical Offset, continued



To add a specific vertical offset, or adjust the step size, click and hold the Cut/Fill arrow. The following dialogue window appears:



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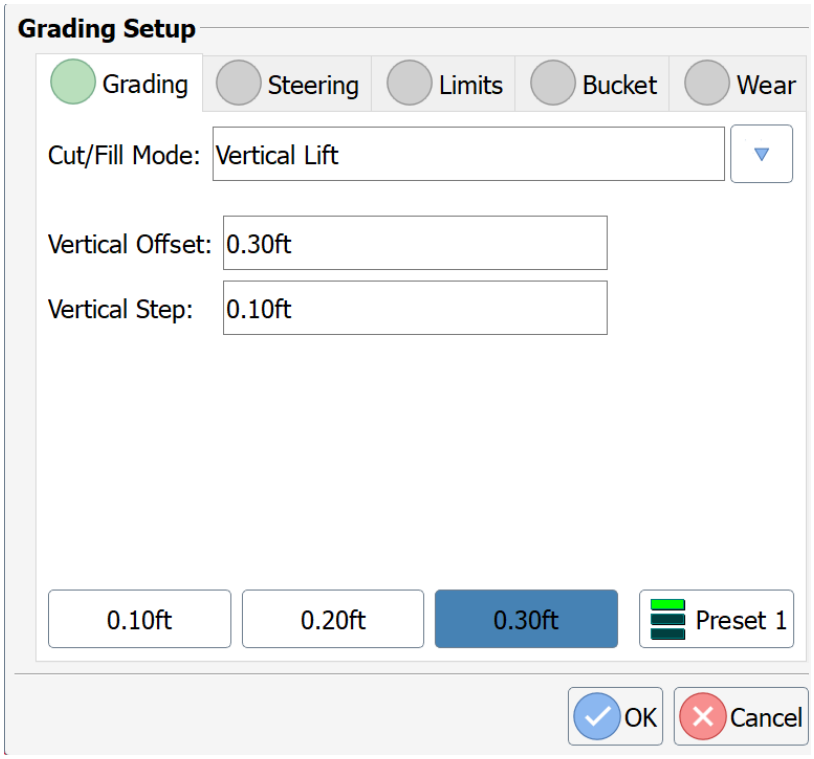
Vertical Offset, continued

The **Cut/Fill Mode** has two settings: **Perpendicular Lift** and **Vertical Lift**. **Perpendicular Lift** measures Cut/Fill as the closest distance from the point-of-interest (i.e., left bucket tooth, center blade, etc.) to the surface. **Vertical Lift** measures Cut/Fill as the vertical distance from the point-of-interest to the design surface directly below.

You can enter a specific offset in the **Vertical Offset** field. The **Vertical Step** field configures how much the vertical offset changes each time you press the arrows that are below the Cut/Fill bar.

To add **Preset** values, type a value in the **Offset** field. Next, click and hold one of the three values shown at the bottom. In the example below, **Preset 1** has values of 0.10 ft, 0.20 ft, and 0.30 ft.

To toggle between three independent sets of values, click **Preset 1**.



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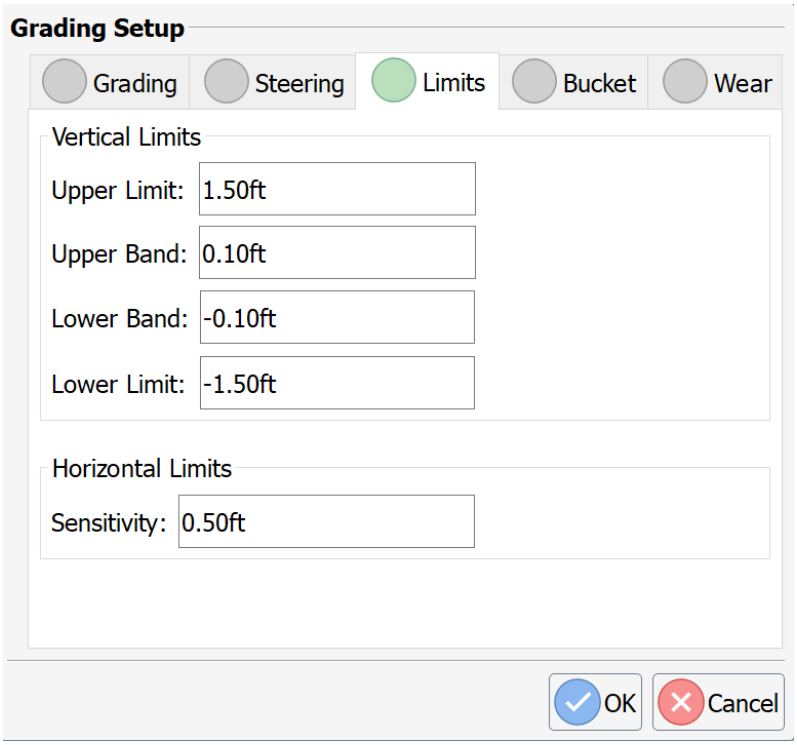
Cut/Fill Bar

The **Cut/Fill** bar shown on the left side of the screen displays a red arrow when in a cut, a blue arrow when in fill, and a green band when on grade, this is referred to as the **Cut/Fill** bar.

The deadband is configurable. Click and hold the arrow. Click **Limits**. The following dialogue displays:



The **Upper Band** and **Lower Band** are “On Grade” tolerances. Any value between these two values (in the above example: -0.10 ft. and 0.10 ft.) is considered on grade.

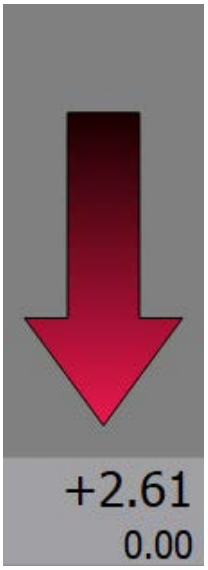
Continued on next page

Cut/Fill Bar, continued

The **Upper Limit** and **Lower Limit** affect the graphical scaling of the **Cut/Fill** arrow.

If you set the **Upper Limit** to 5.0 ft, when you have a 5 ft. cut, the cut/fill arrow displays at the top of the dialogue window.

In the following example, the **Upper Band** is set to 5 ft. Therefore, a cut of 2.61 ft. scales the arrow to about half the size of the dialogue window.



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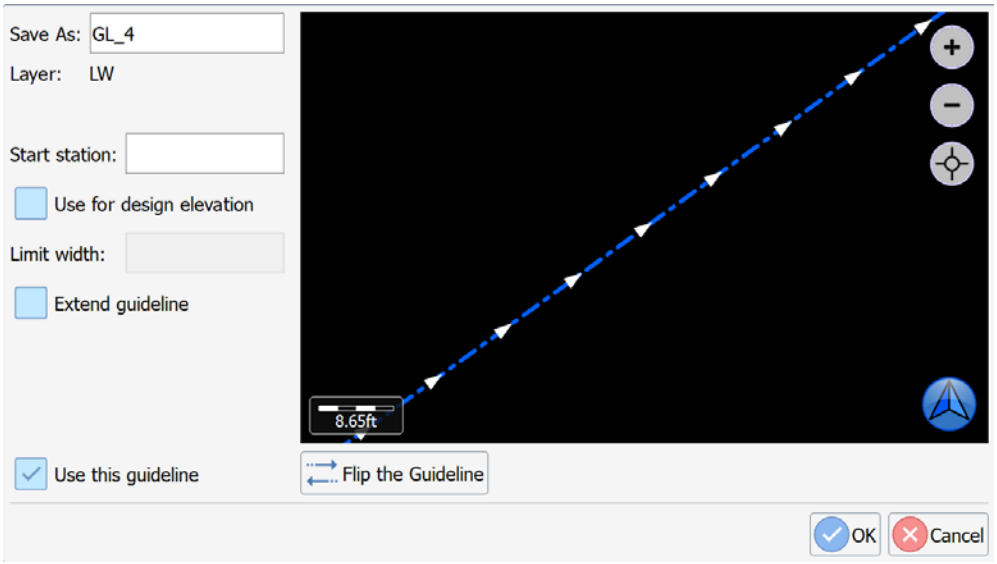
Guidelines

To select a guideline, click on a polyline. The following dialogue displays:



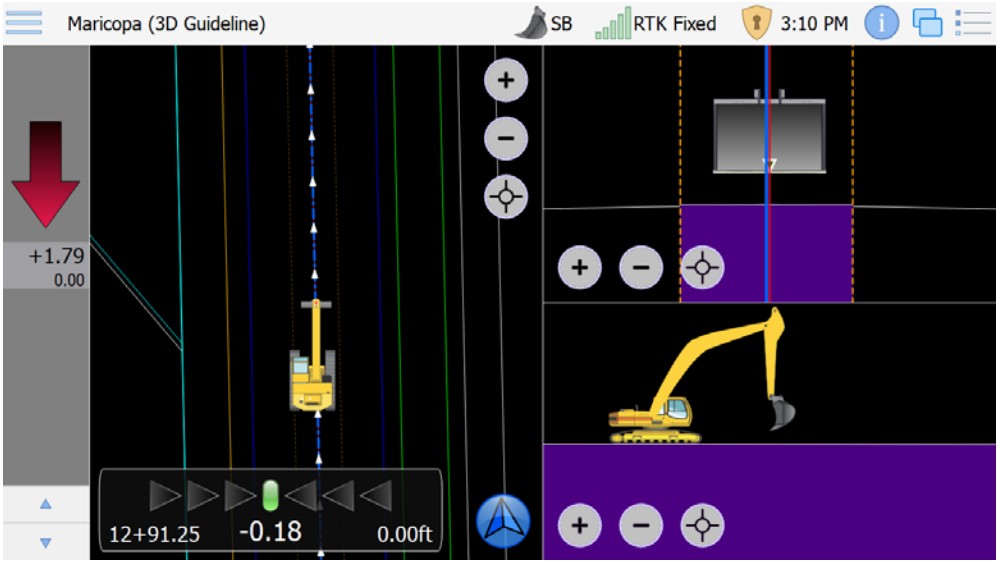
You can create and save a filename or use the default filename. To select the station, enter a value in **Start station**. To change the direction, click **Flip the Guideline**. Click to select **Use this guideline** and click **OK**. **Extend guideline** will extend the guideline. The azimuth at the end of the guideline is used and the guideline is projected out infinitely long.

You can grade to the elevation associated with the line by selecting **Use for design elevation**.

Continued on next page

Guidelines, continued

The surface is shown in purple. Choosing to grade to the elevation associated with a polyline will supersede any design surface that you have loaded. You will instead grade to the elevation associated with the line. The top-left of the screen will show "(3D Guideline)" next to the project name indicating you are grading to the elevation of the line and not a DTM.



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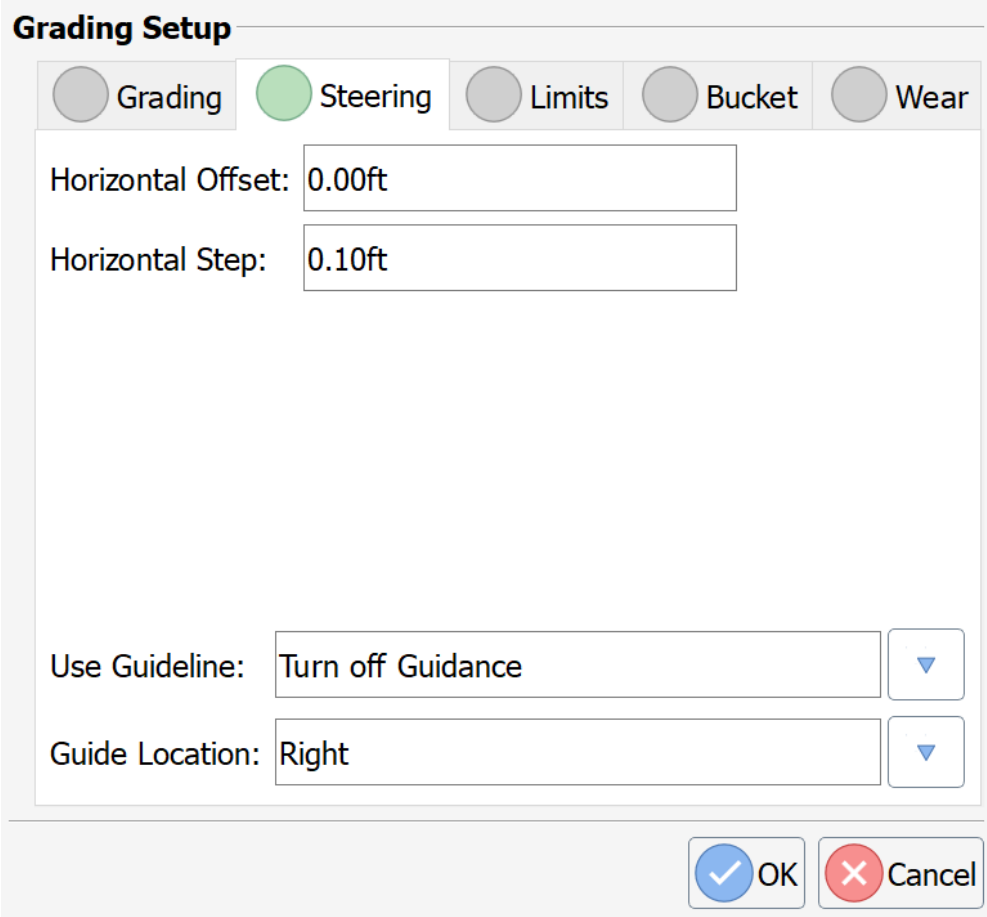
Guidelines, continued

To configure the **Guideline**, click and hold the **Cut/Fill** arrow.

Click the **Steering** tab. You can use this dialogue to create an offset, adjust the step, and change the **Guide Location** (change the query point from the left/center/right of the working tool).



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Top Panel Icons

The top panel icons display a variety of options. The icons are shown below, and each option is described.

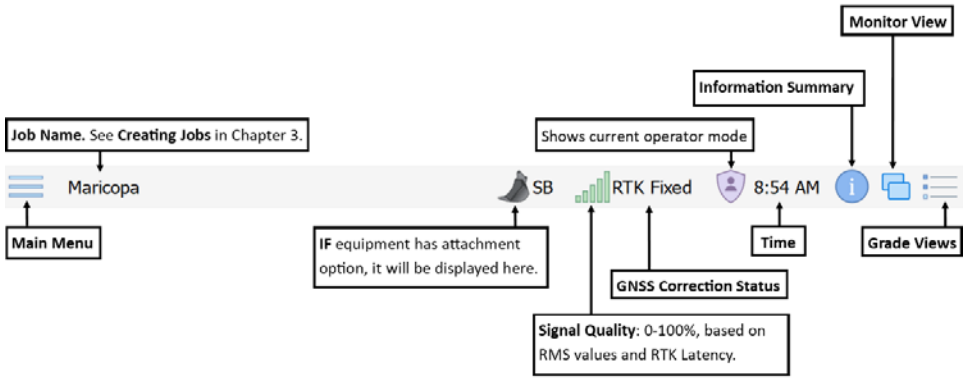


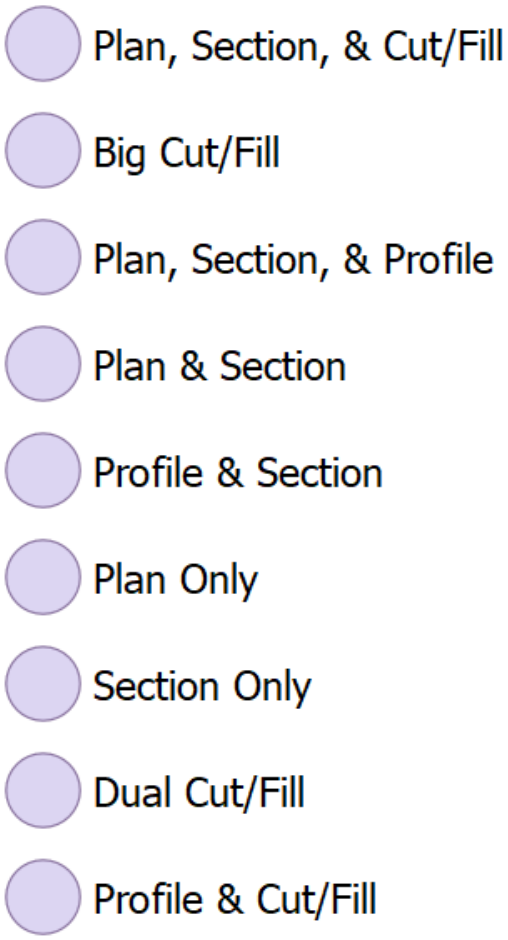
Figure 2-1: Top Panel Icons

Grade Views

Select View

To select a different view, click the  icon (upper right corner of the screen). Examples of each view are shown in this section.

The pop-up window displays a list of options:



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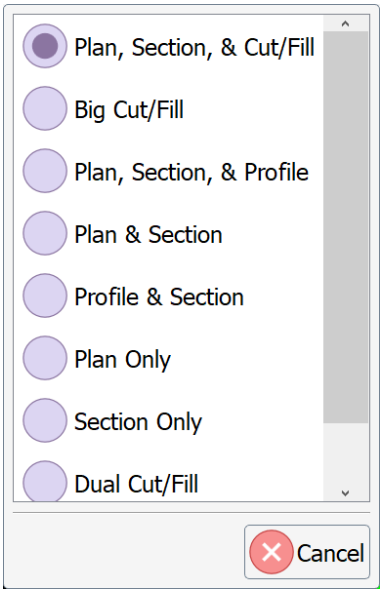
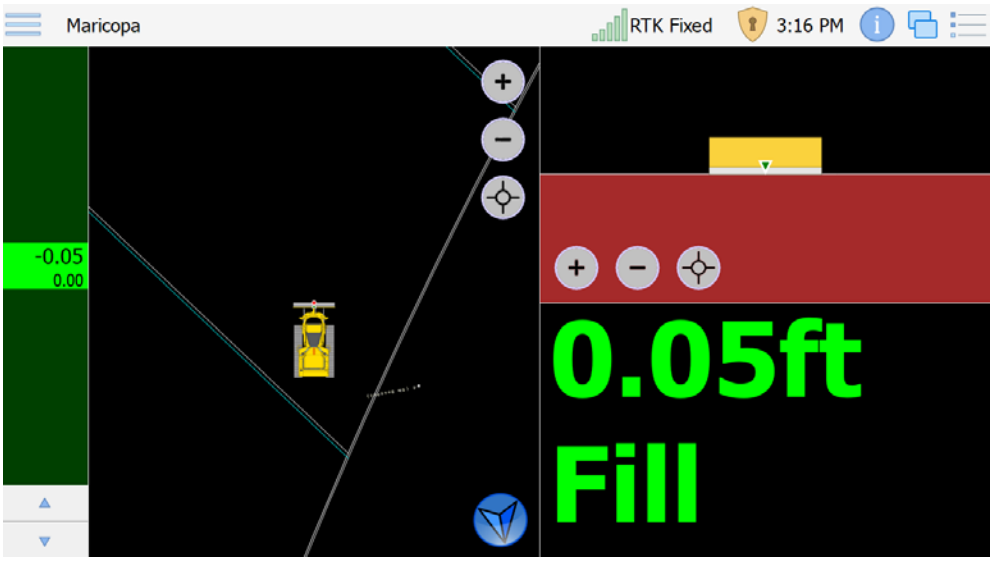
Grade Views, Continued

Plan, Section, Cut/Fill view



The **Plan, Section, & Cut/Fill** view shows the **Plan** view on the left half of the screen. The right half of the screen is split showing both a **Section** view of the tool (along with the surface) and a **Cut/Fill** value (0.05 ft. in the example below).



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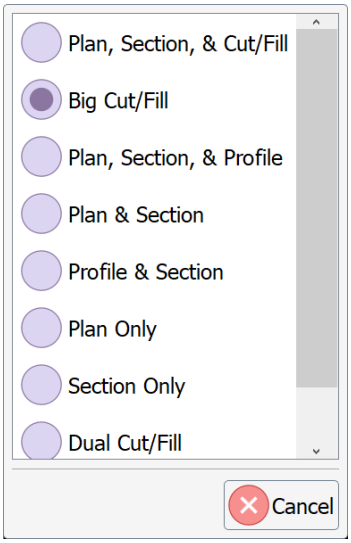
Grade Views, Continued

Big Cut/Fill view



The **Big Cut/Fill** view displays the cut/fill value only.

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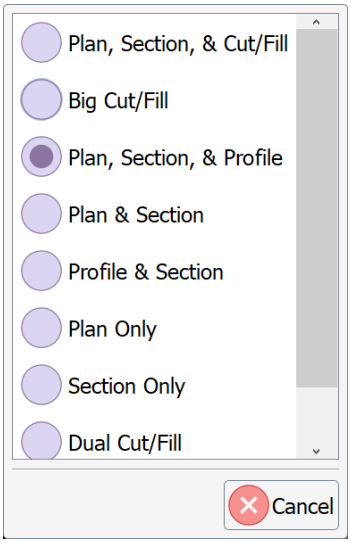
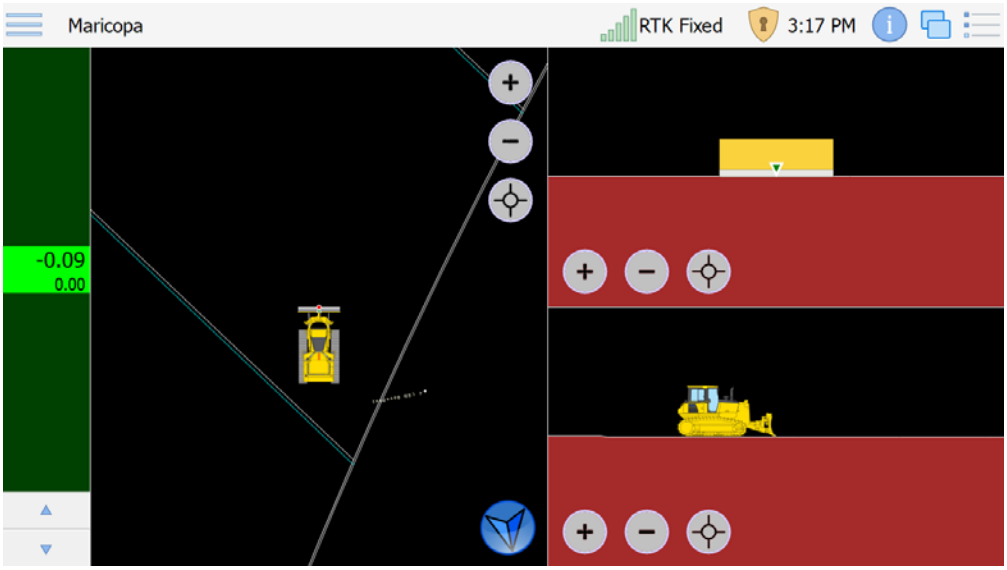
Plan, Section, & Profile view



The **Plan, Section, & Profile** view shows the **Plan** view on the left side of the screen. The right side of the screen is split between a **Section** view of the tool (and design surface) and a **Profile** view of the machine (and design surface).



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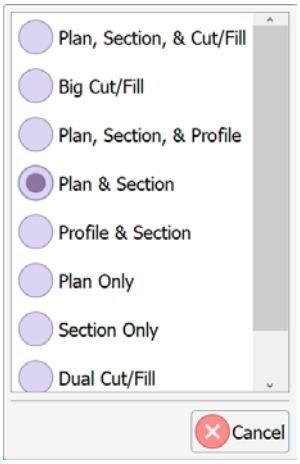
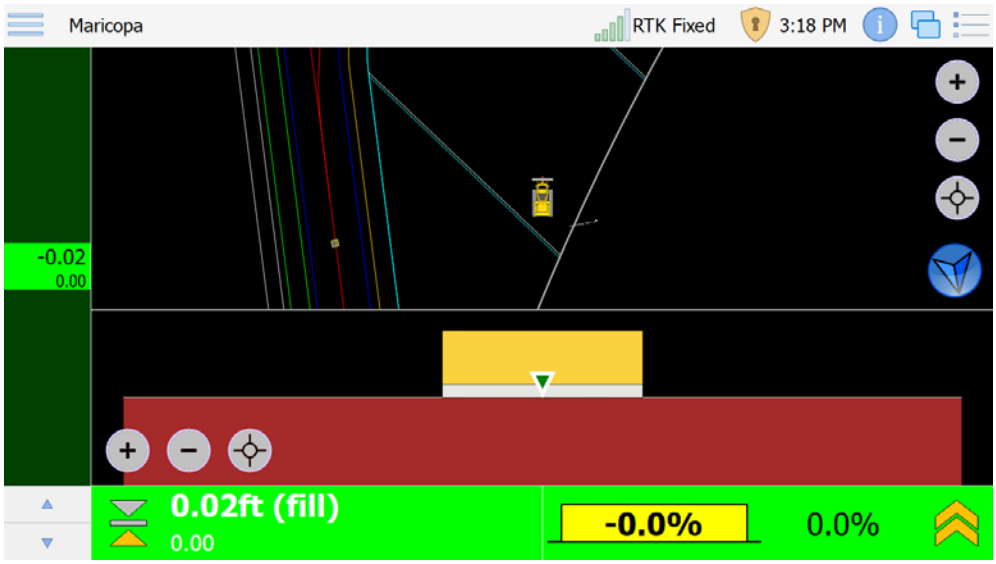
Grade Views, Continued

Plan & Section view



The **Plan & Section** view shows the **Plan** view on the top of the screen, and the **Section** view of the tool on the bottom half of the screen (with the design surface).

The bottom of the screen is divided into two sections. The left section shows the cut (or fill) with an arrow pointing down (cut) or up (fill). Additionally, the vertical offset (0 in this example) is shown. The right section shows the cross slope of the cutting edge (in this example, 0.0%).



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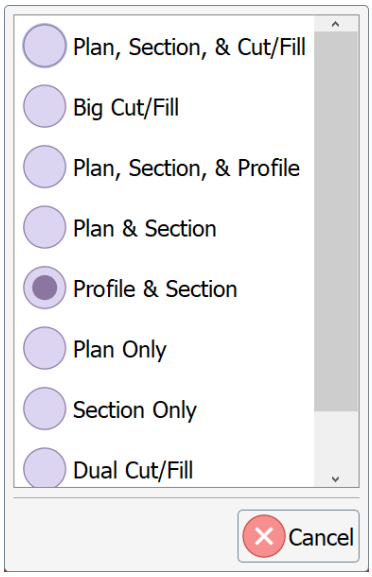
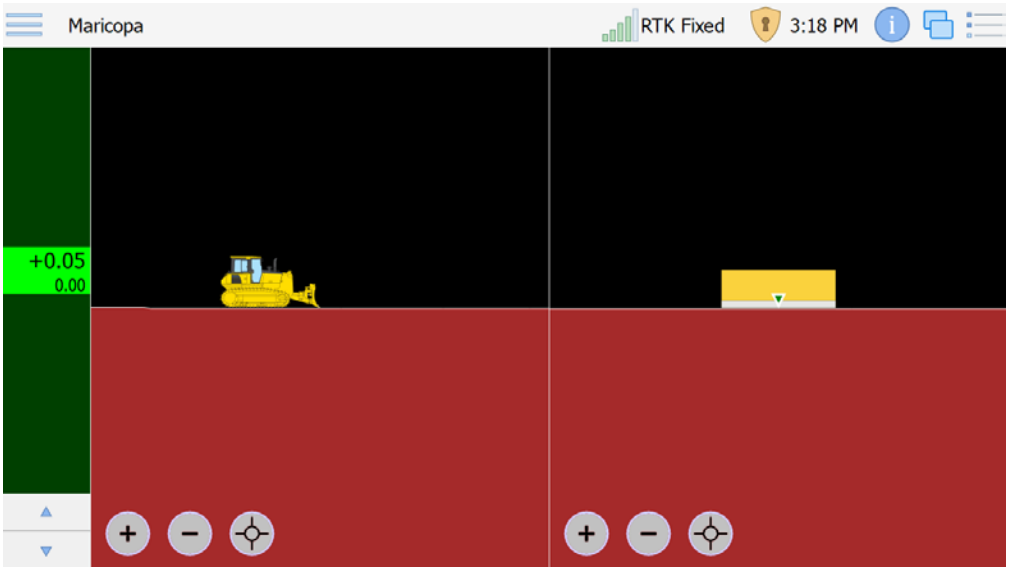
Profile & Section view



The **Profile & Section** view shows the **Profile** view on the left of the screen, and the **Section** view of the tool on the right half of the screen (with the design surface).



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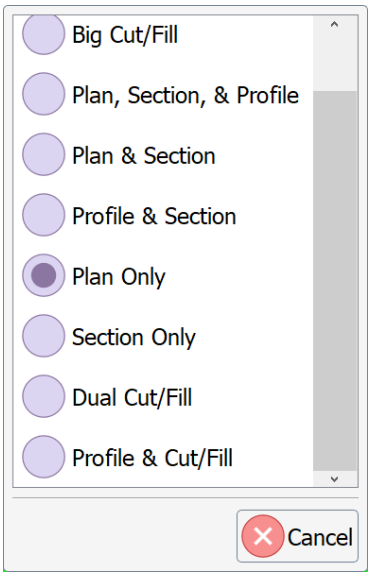
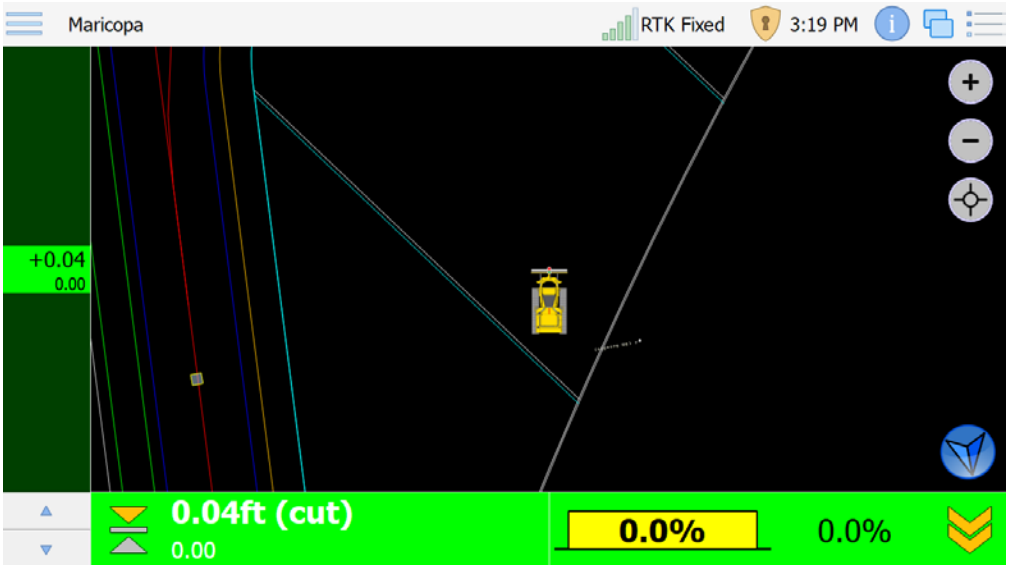
Grade Views, Continued

Plan Only view



The **Plan Only** view shows the machine on the linework with the Cut/Fill arrow on the left. The design surface is not shown in this view.



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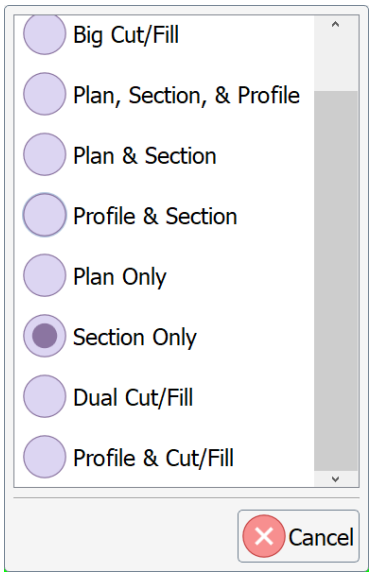
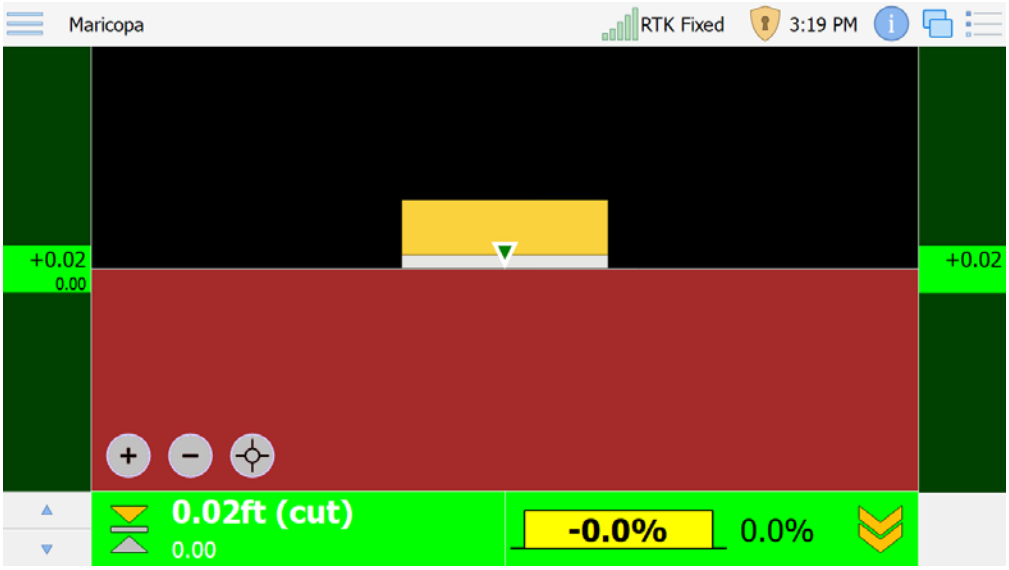
Grade Views, Continued

Section Only view



The **Section Only** view shows the section view of the tool with the design surface, and the Cut/Fill arrow on both sides of the screen.

The Cut/Fill bar on the left shows the Cut/Fill value for the left side of your tool, and the Cut/Fill bar on the right shows the Cut/Fill value for the right side of the tool.



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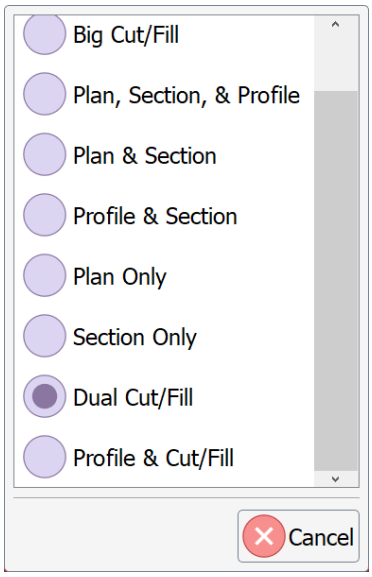
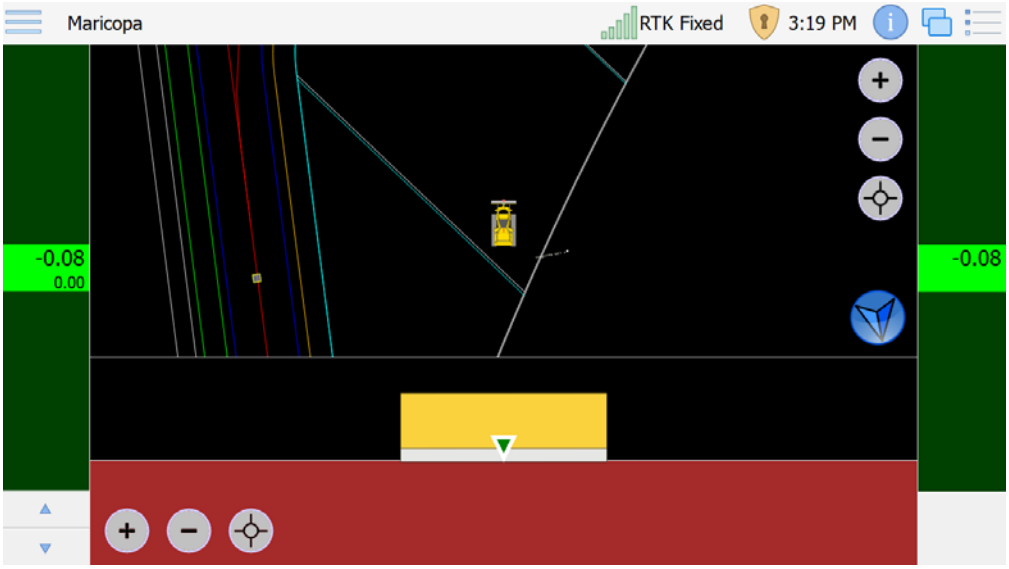
Grade Views, Continued

Dual Cut/Fill view



The **Dual Cut/Fill** screen displays the Plan & Section view, with a cut/fill value on both sides of the screen.

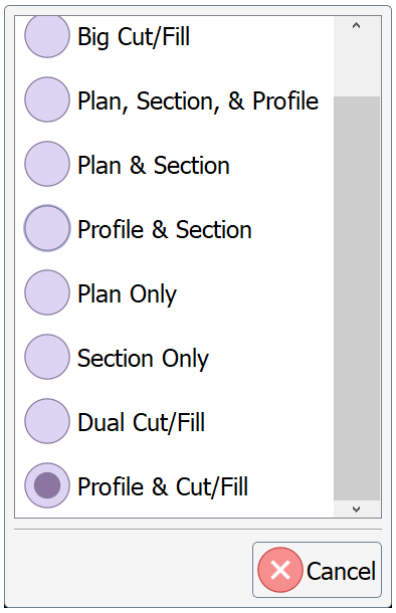
The Cut/Fill bar on the left shows the Cut/Fill value for the left side of your tool, and the Cut/Fill bar on the right shows the Cut/Fill value for the right side of the tool.



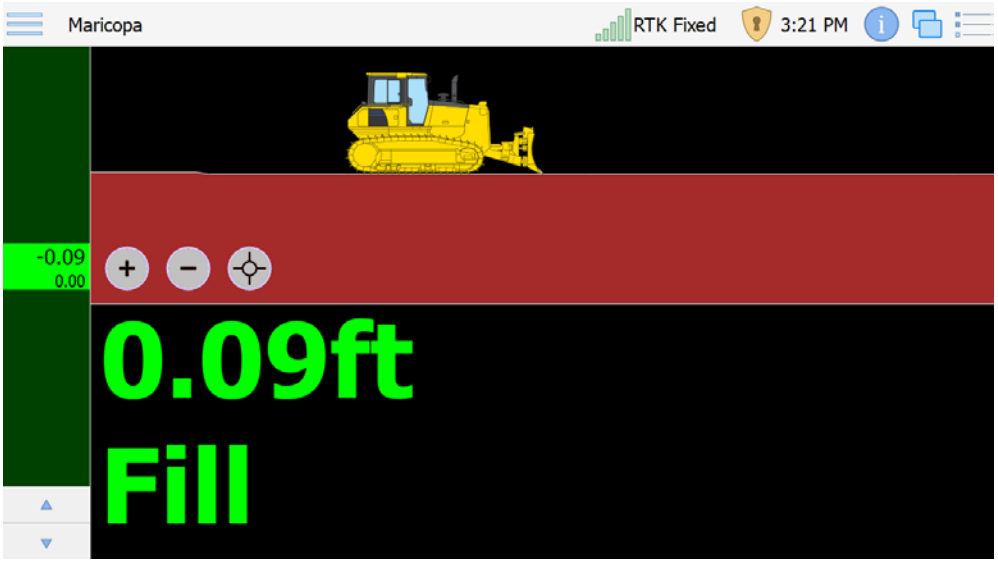
Continued on next page

Grade Views, Continued

Profile & Cut/Fill view



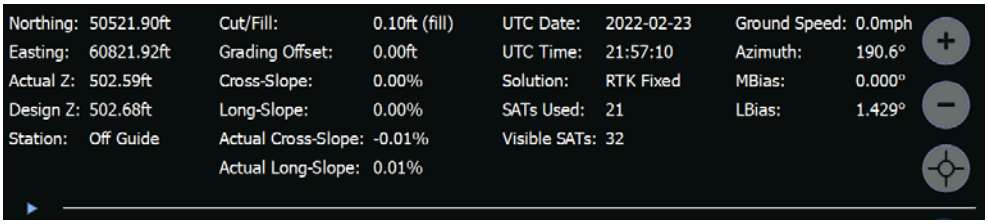
The **Profile & Cut/Fill** view displays the Profile view on the top of the screen, and the large Cut/Fill view on the bottom half.



Information Summary

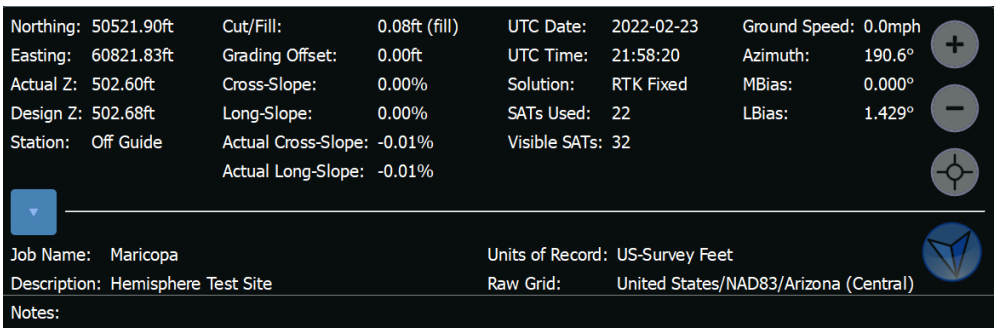
Information Summary

In the top panel icons, click the blue **Information ("i")** icon to view configurable text options, such as position and number of satellites in use.



(Press anywhere in the pop-down screen to hide the menu.)

If the blue arrow in the bottom left corner of the **Information Summary** menu is pressed, it will open information associated with the current **Job**.



See **Table 2-1** for terms and definitions found in the **Information Summary ("i")** menu.

Continued on next page

Information Summary, Continued

Information Summary, continued

Table 2-1: Information Summary Menu

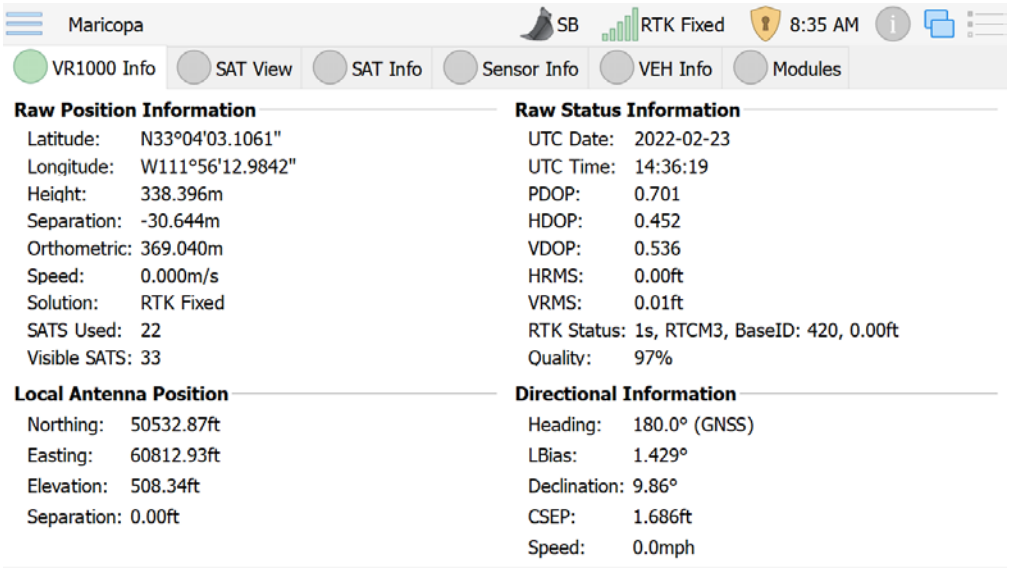
Term	Definition
Northing	The Northward-measured distance from the origin, or the “Y”-axis.
Easting	The Eastward-measured distance from the origin, or the “X”-axis.
Actual Z	The local height above the origin of the local coordinate system. Actual Z is the elevation or the “Z” axis.
Design Z	The design elevation (Actual Elevation – Design Elevation = Cut Value (if negative-Fill Value).
Station	If using a guideline, indicates the current station on the guideline.
Cut/Fill	The difference between the target elevation and the actual elevation.
Grading Offset	A small offset (positive or negative) to the Cut/Fill value.
Cross slope	The angle made between the left and right sides of the tracks and a horizontal plane (also known as roll).
Long slope	An angle made between the front and back of the machine and a horizontal plane (also known as pitch).
UTC Date	The date based on UTC (Coordinated Universal Time) time zone.
UTC Time	Coordinated Universal Time zone.
Solution	The solution should read “RTK Fixed”.
SATs Used	The number of satellites the GNSS receiver is using in the position algorithm.
Visible SATs	The number of satellites tracked by the GNSS receiver.
Ground Speed	The speed of the machine travel based on position data.
Azimuth	The angular measurement between the vector created from the back of the machine to the front of the machine and north.
MBIAS	An offset in heading resulting in GNSS antenna placement. For instance, if the machine is facing north (azimuth = 0 degrees) and the receiver reports 358 degrees, there is an MBIAS of -2 degrees (assuming LBIAS is 0. See LBIAS).
LBIAS	The angle between Site North and WGS84 North. For instance, the point located at Northing = 1000, Easting = 500, Elevation = 200 is directly north of a point located at Northing = 500, Easting = 500, Elevation = 200. However, if there is a rotation in the localization, this may not equal true north. **Azimuth (of the machine) = Heading (from GNSS receiver) – MBIAS – LBIAS.**

Monitor View

Monitor View

Click the  icon in the upper-right corner to view the **Monitor View** screen.

Note: The **Information** screen icon is disabled when the **Monitor View** menu is displayed. Turn off the **Monitor View** menu to enable the icon.



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Antenna Info

The **VR1000 Info (or VR500 Info, depending on the system in use)** tab provides the following information:

- **Raw Position Information** –raw position and GNSS quality information from the GNSS receiver.
- **Raw Status Information** –additional GNSS status information (i.e., dilution of precision, RMS values, RTK latency, and UTC) from the receiver.
- **Local Antenna Position** –the Northing, Easting, Height (NEZ) in local project coordinates.
- **Directional Information** – the GNSS heading as well as an indicator (if GNSS), or course over ground heading. It also gives the declination and speed. *Troubleshooting Tip: Heading should always read "GNSS." If you do not have a Cut/Fill value, check to see if this value reads "Course over Ground." See more information in the **Troubleshooting** section of this manual.*

The **Raw Position Information** displays the current plan values for:

- Latitude
- Longitude
- Height (orthometric height)
- Separation (geoid separation)
- Ellipsoid (ellipsoid elevation)
- Speed
- Solution
- SATS Used
- Visible SATS

Note: The **Local Antenna Position** displays the projected coordinates at the GNSS antenna.

Note: To change latitude/longitude to a military grid or UTM (Universal Transverse Mercator) See **Settings -> Format**.

Continued on next page

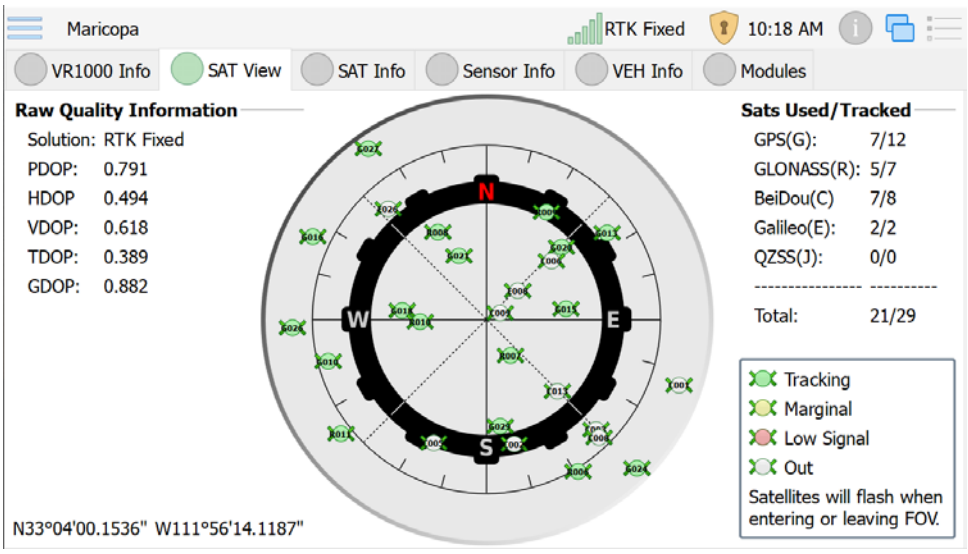
SAT View

The **SAT View** tab displays the available satellites. The strength of each satellite signal is color-coded.

Table 2-2: Satellite Signal Strength Indicators

Color	Description
Green	Strong signal. SNR > 32 dB
Yellow	SNR is greater than or equal to 27 dB, but less than 32 dB
Red	SNR is greater than or equal to 25 dB, but less than 27 dB
White	SNR is less than 25 dB

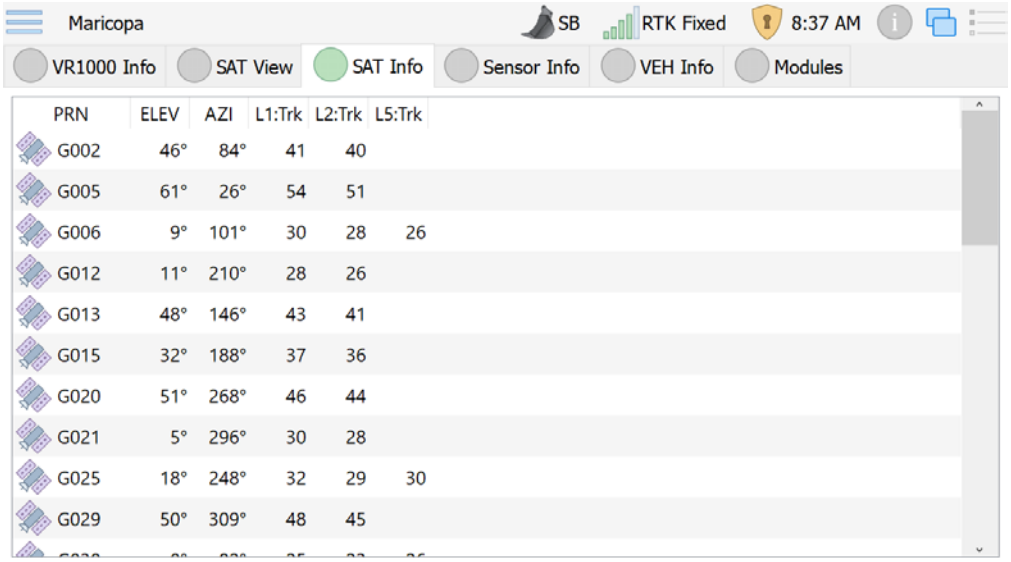
Satellites that are blinking have an elevation of 3 degrees or less.



Continued on next page

SAT Info

The **SAT Info** tab displays data-driven detail about each satellite used in the solution.



PRN	ELEV	AZI	L1:Trk	L2:Trk	L5:Trk
G002	46°	84°	41	40	
G005	61°	26°	54	51	
G006	9°	101°	30	28	26
G012	11°	210°	28	26	
G013	48°	146°	43	41	
G015	32°	188°	37	36	
G020	51°	268°	46	44	
G021	5°	296°	30	28	
G025	18°	248°	32	29	30
G029	50°	309°	48	45	

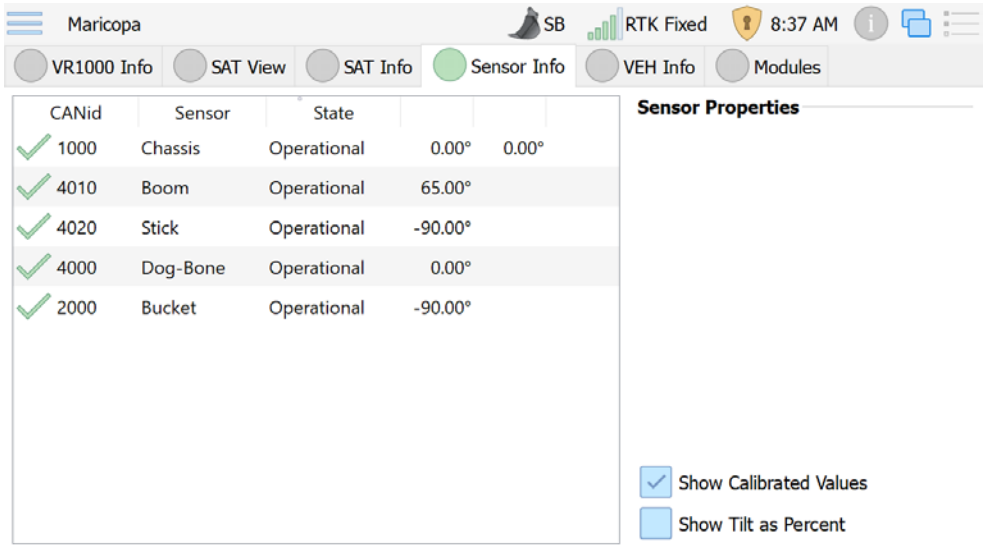
Continued on next page

Sensor Info

The **Sensor Info** tab displays all the configured sensors. You can check the sensor operation and the pitch and roll.

Click **Show Calibrated Values** to view the calibrated (rather than raw) tilt sensor value.

The green check mark indicates a sensor is connected. If you do not have a cut/fill value and you see a sensor that is not connected, there may be a failed sensor or cable. See section for more information.



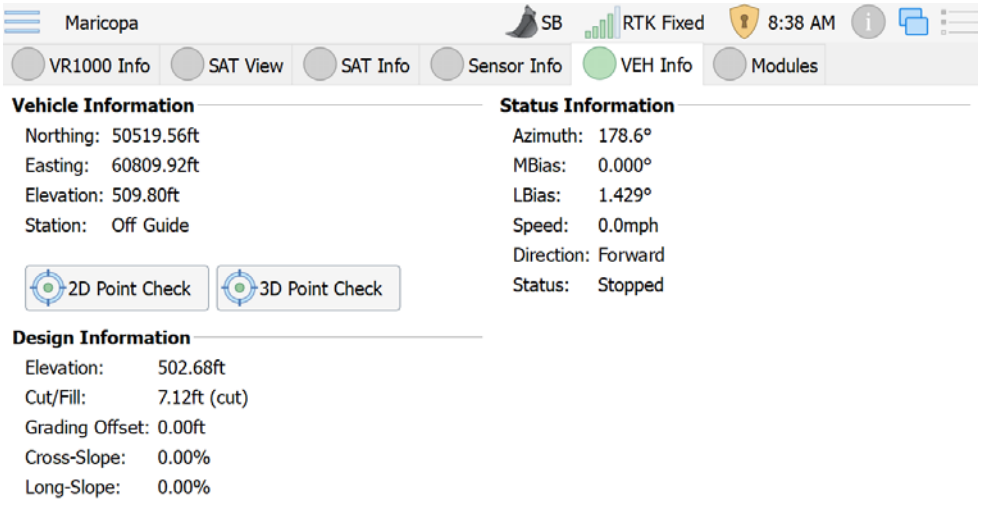
Continued on next page

VEH Info

The **VEH Info** tab displays the following information:

- **Vehicle**-Northing, Easting, Elevation, and Station
- **Status**-Azimuth, MBias, LBias, Speed, Direction, Status
- **Design**-Elevation, Cut/Fill, Grading Offset, Cross-Slope, Long-Slope

The **2D Point Check** and **3D Point Check** are critical features to diagnose errors and check the quality of a calibration. For more information regarding those features, please consult the HGNSS GradeMetrix Installation Guide.

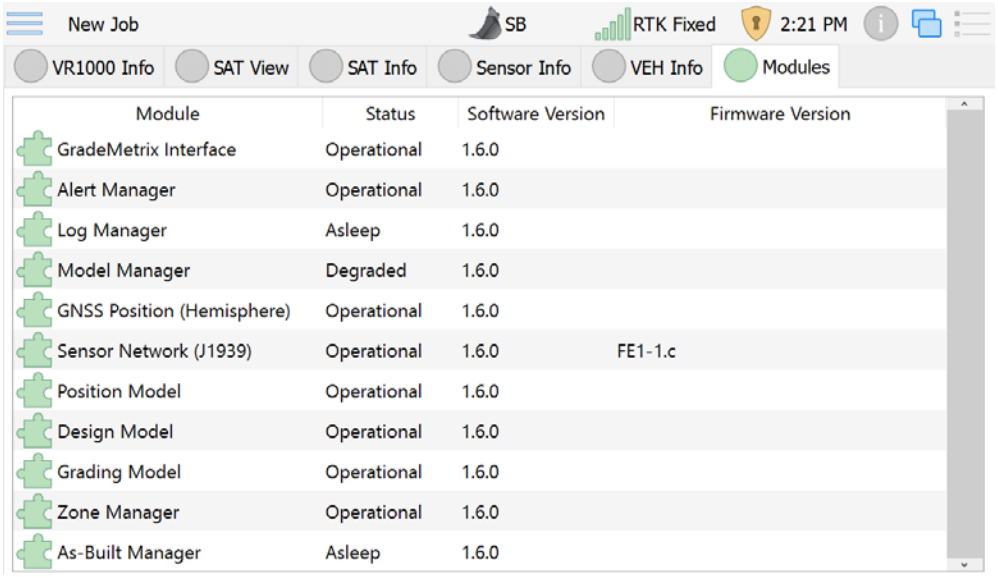


Continued on next page

Monitor View, Continued

Modules

The **Modules** tab displays a listing of modules used and the status of each module.



Module	Status	Software Version	Firmware Version
GradeMetrix Interface	Operational	1.6.0	
Alert Manager	Operational	1.6.0	
Log Manager	Asleep	1.6.0	
Model Manager	Degraded	1.6.0	
GNSS Position (Hemisphere)	Operational	1.6.0	
Sensor Network (J1939)	Operational	1.6.0	FE1-1.c
Position Model	Operational	1.6.0	
Design Model	Operational	1.6.0	
Grading Model	Operational	1.6.0	
Zone Manager	Operational	1.6.0	
As-Built Manager	Asleep	1.6.0	

Return to Grade View screen

Click the  icon to de-select and return to the GradeMetrix **Grade View** screen.

Continued on next page

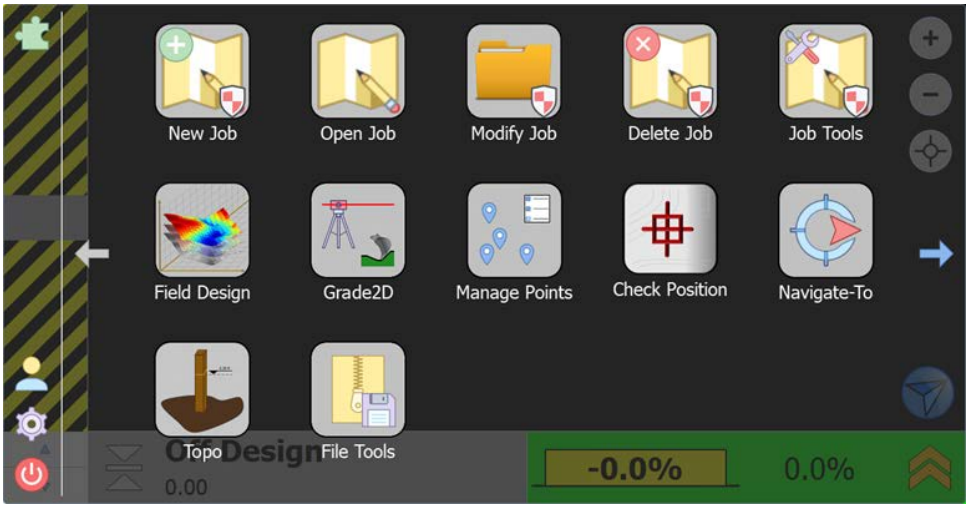
Main Menu

Main Menu

Click the icon on the top-left to enter the **Main Menu**.

The GradeMetrix **Main Menu** displays the following. (The arrows on the left and the right of the screen are used to scroll between screens 1 and 2.)

Some of the icons will display “greyed out” if not allowed access. To access, see Authorization.



Screen 1

Screen 2

Continued on next page

Main Menu, continued

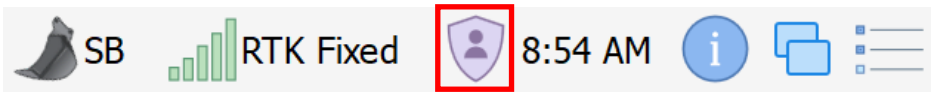
If either of the symbols shown below appears on an icon, it is only accessible by the correlating authorization level or above. If there is not a symbol on the icon it is accessible by all levels.

 - Power User

 - Administrator

Note: For more information on Authorization access, see Authorization.

On the Top Panel, the current operator mode will be displayed.



 - Operator Mode

 - Supervisor Mode

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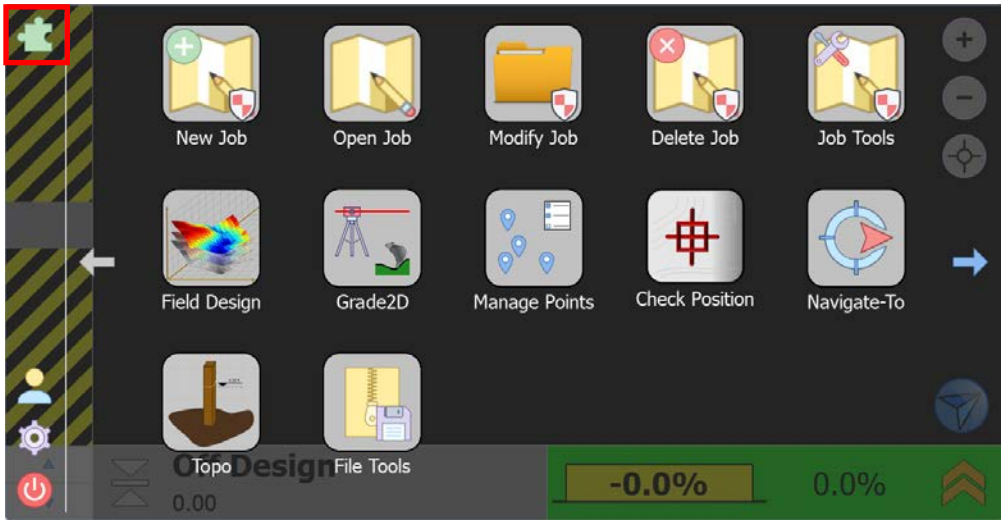
About

The **About** icon () located in the upper left corner, is where you can find information on the GradeMetrix License.



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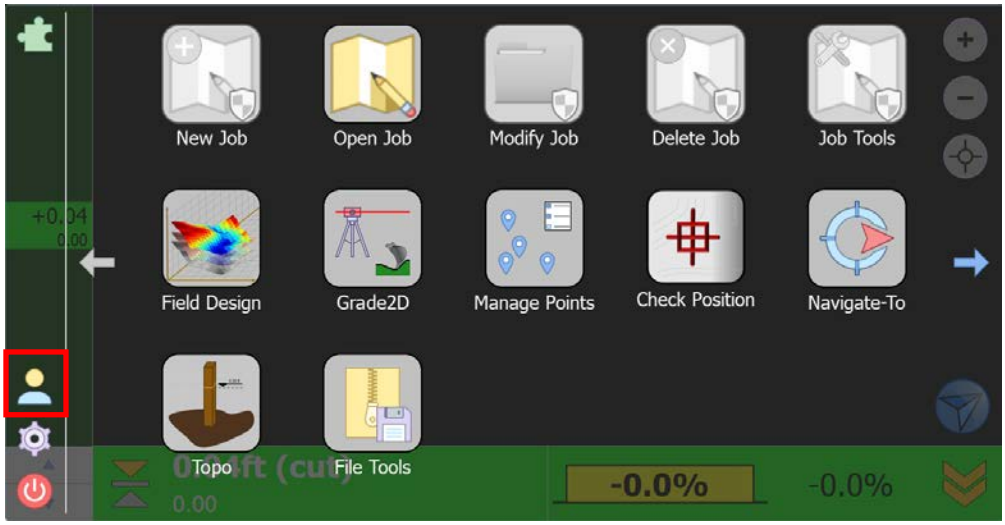
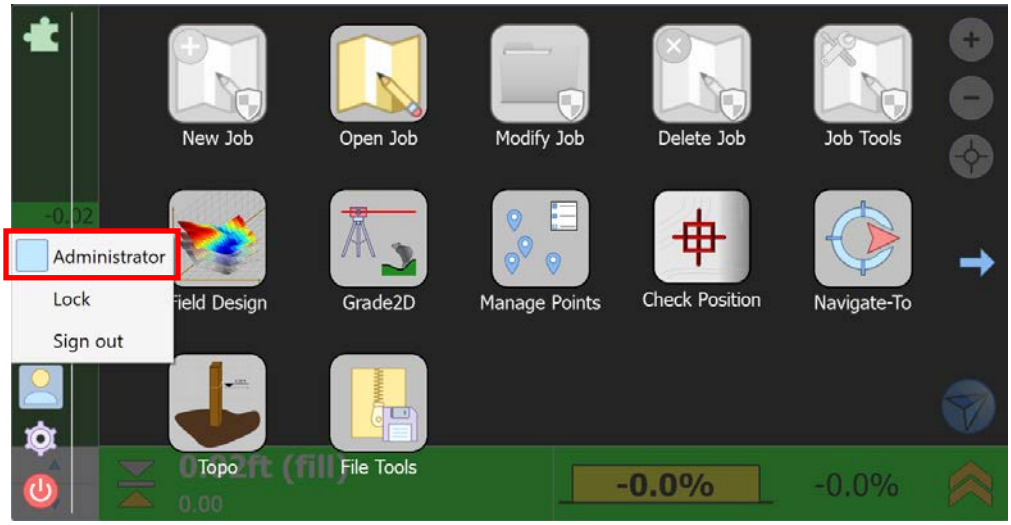
Administrator Settings

To enable **Administrator** permissions, click the figure icon on the bottom left side of the GradeMetrix **Main Menu**.



A pop-up window displays. Click to select the **Administrator** checkbox.



For information on the **Administrator** function, including setting password and permissions, see **Authorization**.

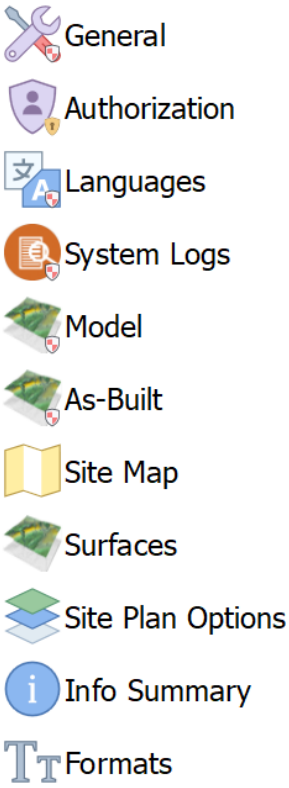
Continued on next page

Settings

On the lower-left portion of the GradeMetrix **Main Menu**, click the gear icon to access **Settings**.

Note: You must be logged on as an **Administrator** to make changes to some GradeMetrix **Settings**.

The left navigation menu lists the GradeMetrix **Settings** options:



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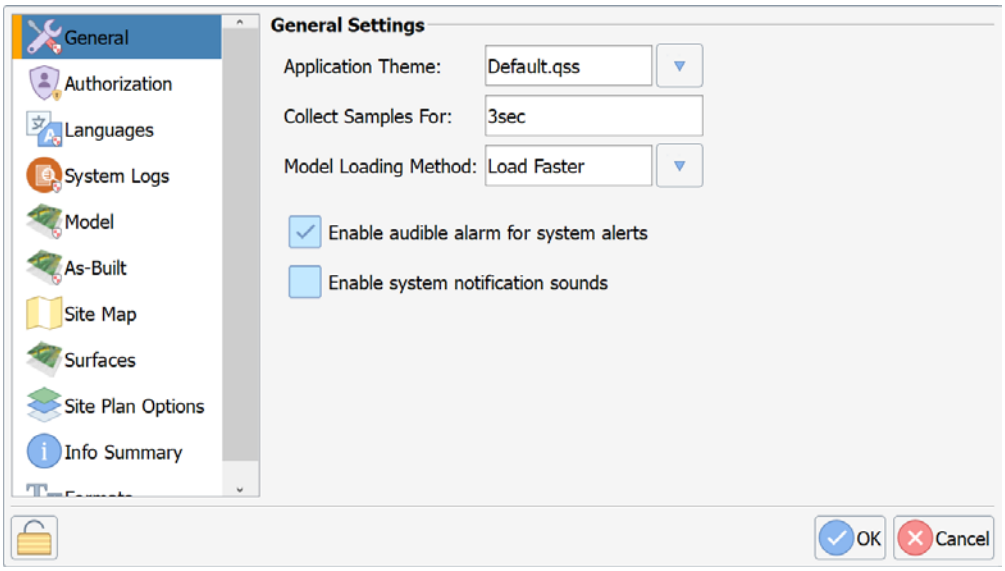
General Settings

The **Application Theme** can be changed. Click the drop-down arrow to select from default or pre-set custom views.

Click in the **Collect Samples For** box and type in the desired value in seconds.

The **Model Loading Method** can be changed between: Save Memory or Load Faster. Click the drop-down arrow to select the desired option. **Load Faster** loads the entire design file into memory. The **Save Memory** option traverses a TIN file to remove duplicate vertices.

To save your settings, click **OK**. To cancel your changes, click **Cancel**.



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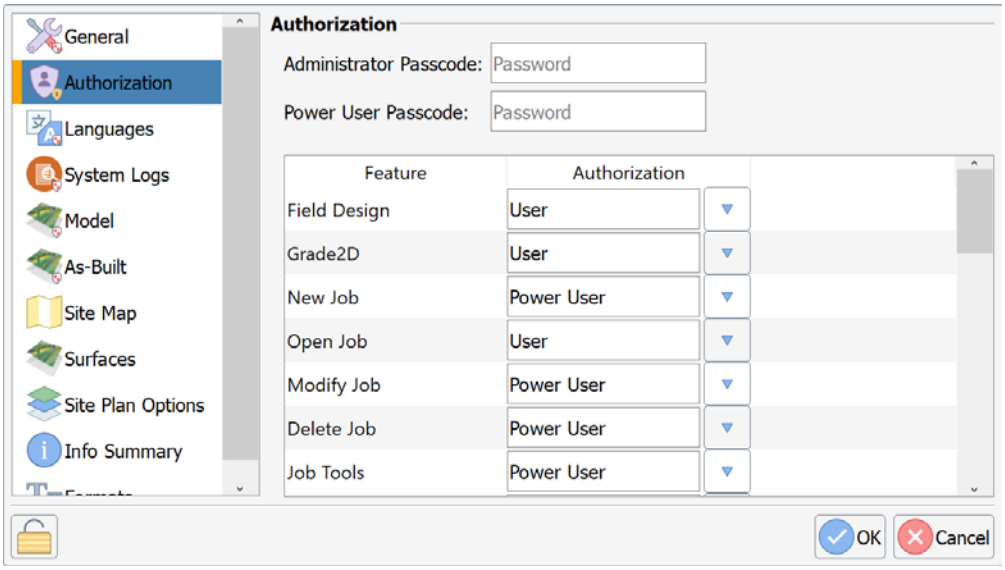
Authorization

In the **Authorization** settings, the **Passcode** can be set for Administrator and Power User.

To save your settings, click **OK**. To cancel your changes, click **Cancel**.



Continued on next page

Authorization, Continued

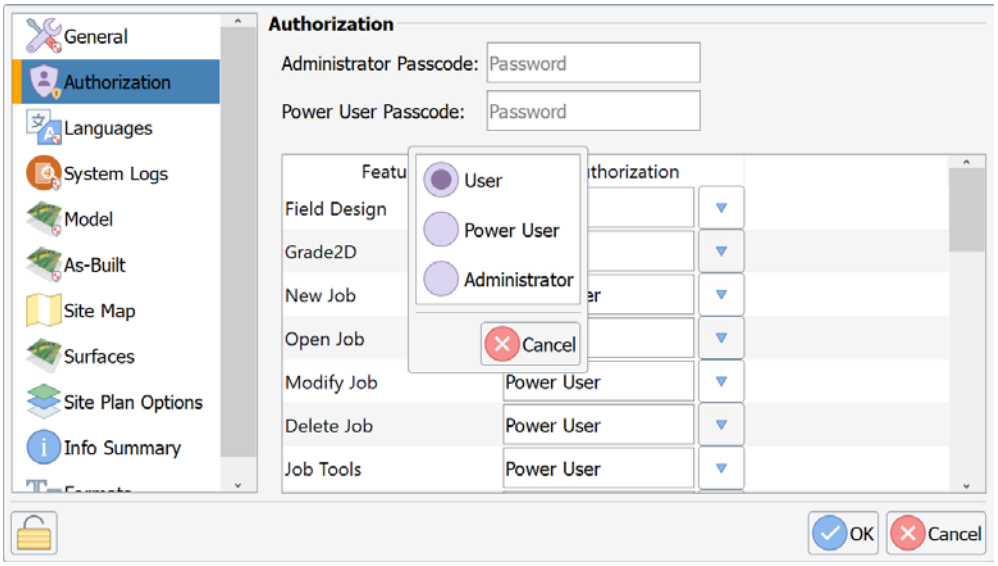
The authorization level can be adjusted for the following applications:

Field Design
Grade2D
New Job
Open Job
Modify Job
Delete Job
Job Tools
Localization
Mapping
Equipment Setup
3D Calibration
RTK Source Configuration
Radio Channel
Receiver Configuration
Calibrate Sensors
Quick Calibrate
File Tools
Update Firmware
Topo
Check Position
Navigate-To
Stake-Out
Manage Points
Quick Pole
Tool Selection
Pole/Truck

Continued on next page

Authorization, Continued

To adjust the authorization level for a feature, select the drop-down arrow, and select the desired level of authorization.



To save your settings, click **OK**. To cancel your changes, click **Cancel**.

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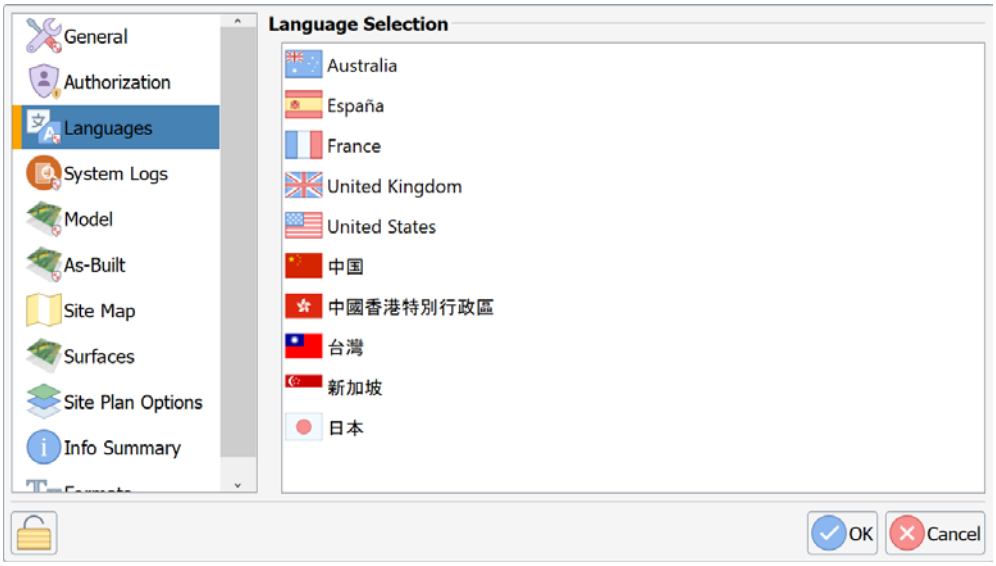
Languages

GradeMetrix supports English (American, British, and Australian), Spanish, French, Chinese (Hong Kong, Taiwan, and Singapore), and Japanese languages.

Click to highlight your desired language.

To save your settings, click **OK**. To cancel your changes, click **Cancel**.

If you change the language, a message will display indicating a restart is required for the change to take effect. Select **OK**, to continue and the software will restart.



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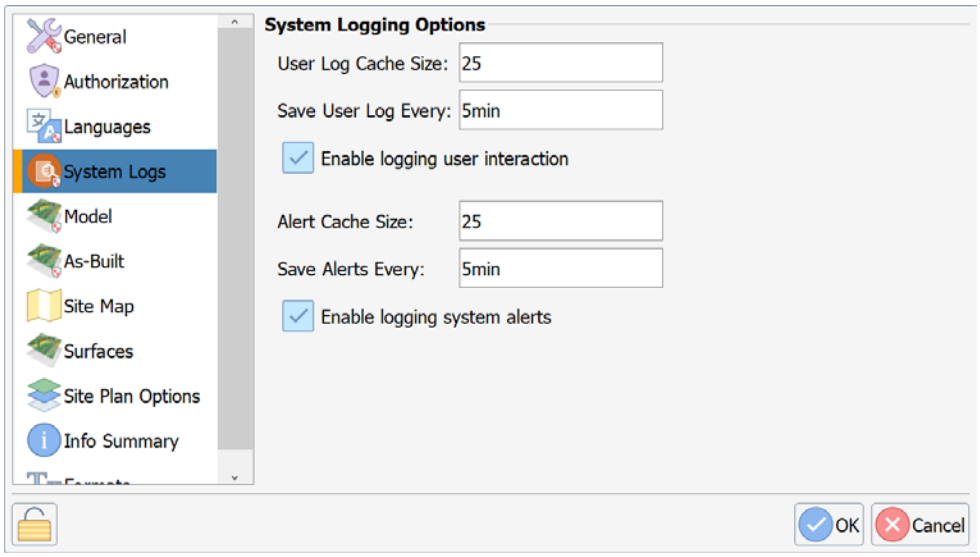
System Logs

In the **System Logs** screen, click in the field to set the system logging options.

Table 2-3: System Logs

Option	Function
User Log Cache Size	Determines the number of logs held in memory before flushing them to a disk.
Save User Log Every	Performs an autosave to disk.
Enable logging user interaction	Logs all user interactions.
Alert Cache Size	Determines the number of logs held in memory before flushing them to a disk.
Save Alerts Every	Performs an autosave to disk.
Enable logging system alerts	Saves error messages (GPS errors, sensor errors, etc.).

To save your settings, click **OK**. To cancel your changes, click **Cancel**.



Continued on next page

Model

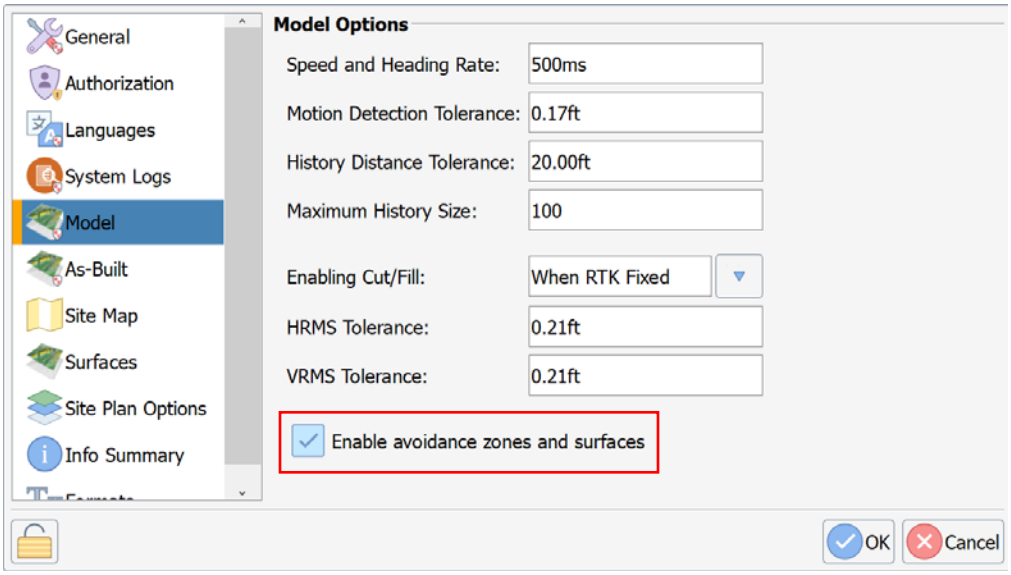
On the **Model Options** screen, you can check and edit the location settings for your GradeMetrix job in the **Model** screen. Click to select/edit the following fields:

Table 2-4: Model Options

Option	Description
Speed and Heading Rate	The rate at which the reverse state is determined.
Motion Detection Tolerance	GradeMetrix uses your GNSS position to determine motion. **Note:** A change in position is required for GradeMetrix to set the machine from moving to a stopped position.
History Distance Tolerance	Records the cumulative history movement and sets a history marker.
Maximum History Size	The number of history markers stored for your previous points.
Enabling Cut/Fill	The default (and suggested) setting is **When RTK Fixed**. If the GNSS receiver loses an RTK Fix, Cut/Fill will no longer display. If set to **Allow aRTK Fixed**, Cut/Fill will display if the receiver drops into an aRTK™ Fix. If **Allow Atlas** is selected, the receiver will show Cut/Fill when Atlas® is converged, the receiver is aRTK Fixed, and the receiver is RTK Fixed. If set to Always Show, Cut/Fill will always display (even when RTK is not available).
HRMS Tolerance	Sets the Horizontal RMS thresholds for when an alert will occur.
VRMS Tolerance	Sets the Vertical RMS thresholds for when an alert will occur.

Continued on next page

Model, continued



Click to select the checkbox to select **Enable avoidance zones and surfaces**. If the module is built with avoidance zones, an alarm will sound when entering those zones.

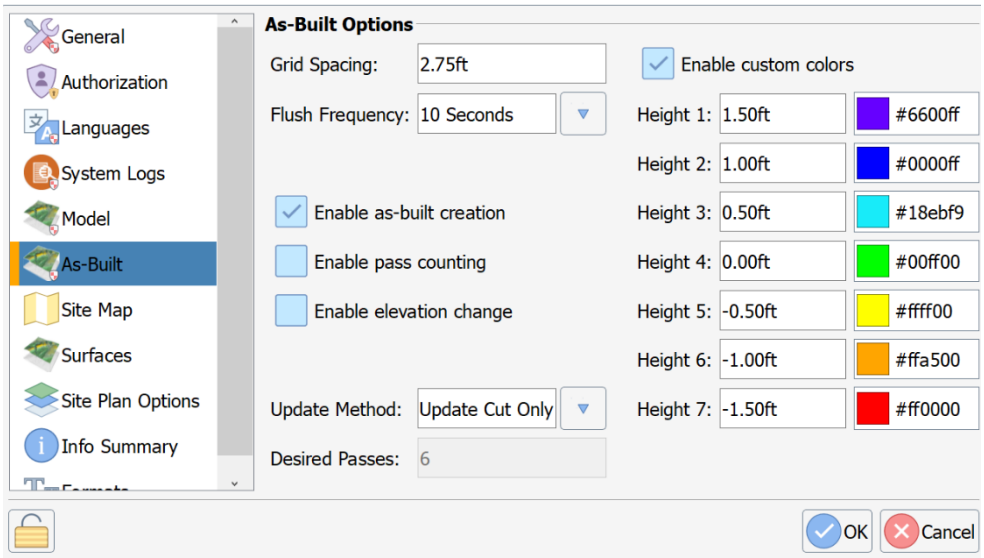
To save your settings, click **OK**. To cancel your changes, click **Cancel**.

Continued on next page

As-Built

The **As-Built** option tracks job progress and can be configured for pass counts or Cut/Fill.

If showing surface as Cut/Fill, you can enable custom colors to configure the color (and threshold) the as-built grids are drawn based on current cut/fill value.

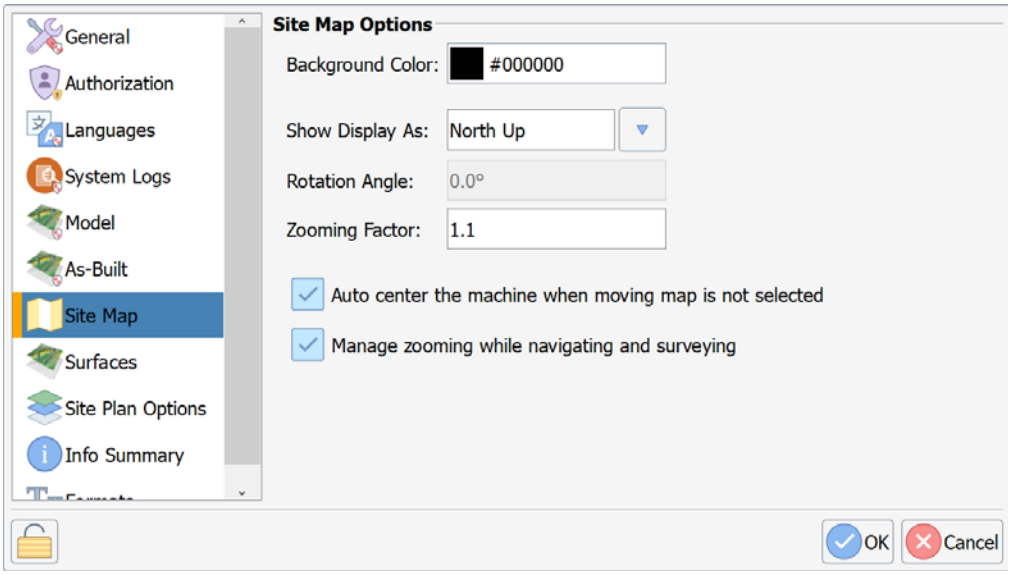


To save your settings, click **OK**. To cancel your changes, click **Cancel**.

Continued on next page

Site Map

Use the **Site Map** screen to set display and zooming views for your GradeMetrix job.



The **Background Color** option allows the color of the background to be changed by pressing in the box and then selecting the desired color from the pop-up screen.

Click the down-arrow to select any of the following options from the pop-up window.

Show Display As: There are three display options to view your machine as the map rotates:

1. **Moving Map**-The dozer always faces the top of the screen as the map rotates.
2. **Fixed Rotation**-The excavator stays in a static position and the map will point toward the specified direction (i.e., north, south, east, west).
3. **North Up**-the top of the map is always north.

Continued on next page

Site Map, continued

Click the box to the right of the following fields.

- **Rotation Angle:** only available if using fixed rotation, enter the degrees to rotate the map clockwise.
- **Zooming Factor:** set the numeric value to zoom on the right side of the plan view (The greater the value set, increases the zoom in/out amount for each button press.)

Select the checkbox to the left of the following fields to enable/disable.

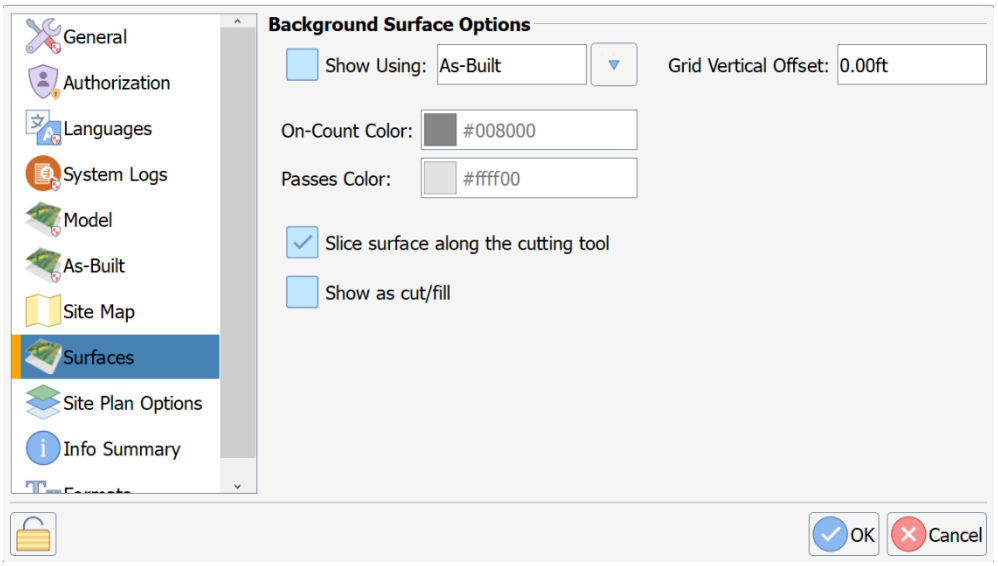
- **Auto center the machine when the moving map is not selected:** the view adjusts as your machine moves to prevent your machine from driving off the screen.
- **Manage zooming while navigating and surveying** allows adjusts map view adjustments while moving.

To save your settings, click **OK**. To cancel your changes, click **Cancel**.

Continued on next page

Surfaces

The **Surfaces** option enables/disables the background surfaces shown on the plan view.



Select from these options:
- Show Using
- On-Count Color
- Passes Color

Show Using has the following options
- As-Built
- Design
- Pass Count

Only if using **Pass Count**, the **On-Count Color** and **Passes Color** can be adjusted by selecting the correlating box and selecting the desired color from the pop-up screen.

Show Cut/Fill-select the box to display Cut/Fill surfaces on the **Plan View** and color the grid based upon the Cut/Fill value.

Continued on next page

Surfaces, continued

Grid Vertical Offset – when generating an as-built surface some machines can only update the surface while cutting. If you do not load an existing surface file and need a null surface generated, enter a Grid Vertical Offset. This will generate an existing surface at this distance above the design surface.

Slice surface along the cutting tool – when this is checked, the section and profile views are drawn along the azimuth of the cutting tool, instead of perpendicular to machine azimuth.

Note: This option is only available if an existing surface file is loaded.

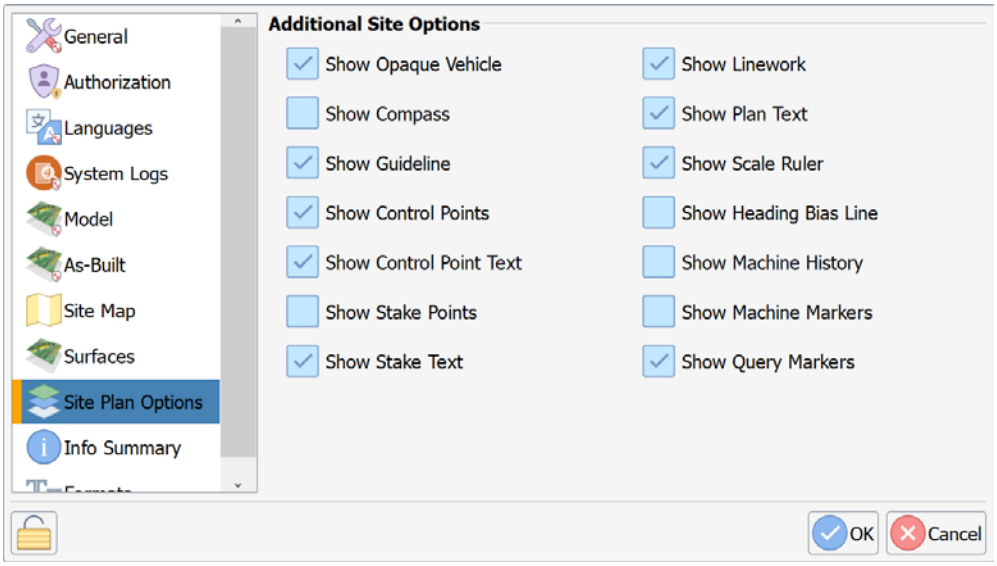
To save your settings, click **OK**. To cancel your changes, click **Cancel**.

Continued on next page

Site Plan Options

The **Site Plan Options** can be enabled/disabled to show on the **Plan View**.

Refer to **Table 2-5: Site Plan Options and Views** for a description of each option according to the view you select.



To save your settings, click **OK**. To cancel your changes, click **Cancel**.

Continued on next page

Site Pan Options, continued

Table 2-5: Site Plan Options and Views

Site Plan Option	Selected	Not Selected	View
Show Opaque Vehicle	X		The chassis of the excavator will be filled in.
		X	The excavator chassis will be transparent, allowing for better viewing of the linework.
Show Compass	X		A compass is shown on the **Plan View**.
Show Guideline	X		This option must be checked for the guideline to display.
Show Control Points	X		Each control point in the topo file you have loaded will be shown with a marker on the **Plan View**.
Show Control Point Text	X		The Control Points shown on the screen will have the point number displayed on the screen next to the point marker.
Show Stake Points	X		Each Stake point in the topo file you have loaded will be shown with a marker on the **Plan View**.
Show Stake Text	X		The Stake points shown on the screen will have the point number displayed on the screen next to the point marker.
Show Linework		X	The linework from your **Plan View** file will not display on the screen.
Show Plan Text	X		Text on the **Plan View** will display.
Show Scale Ruler	X		A distance scale will display in the **Plan View**.
Show Heading Bias Line	X		Two lines will be drawn on the excavator. The angle between those two lines is equal to the MBIAS of your machine.

Continued on next page

Site Plan Options, continued

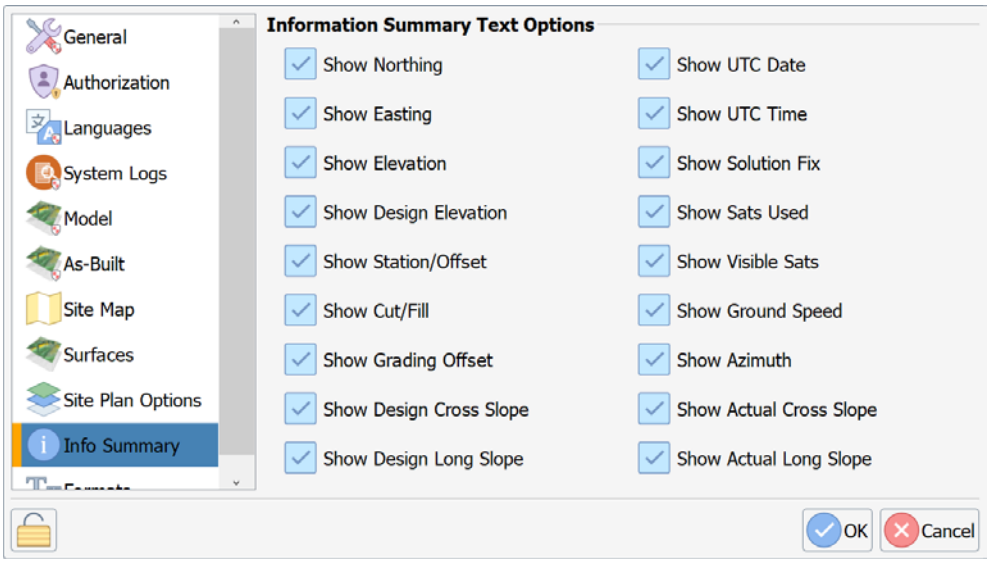
Table 2-5: Site Plan Options and Views (continued)

Site Plan Option	Selected	Not Selected	View
Show Machine History	X		Breadcrumbs display on the screen indicating the machine path. Go to the **Model** tab to configure how many markers are stored and at what distance interval they are to be stored.
Show Machine Markers	X		Circles will be drawn on both sides of the bucket, the boom pin, and the primary antenna. This only affects the overhead view.
Show Query Markers	X		The guideline location query location is shown on the excavator as a red circle and the cut/fill location is shown as a green triangle.

Continued on next page

Info Summary

The **Info Summary** screen displays the list of text options to display on the **Quick Info** screen. Click to select the options you wish to display. To de-select an option, click the box and the checkmark will be removed.



To save your settings, click **OK**. To cancel your changes, click **Cancel**.

See **Table 2-1** for information on the different options that can be displayed in the **Information Summary**.

Continued on next page

Formats

The **Display Format Options** screen lists the format options that can be displayed for a job. Click the down-arrow to the right of each field to change a selection.

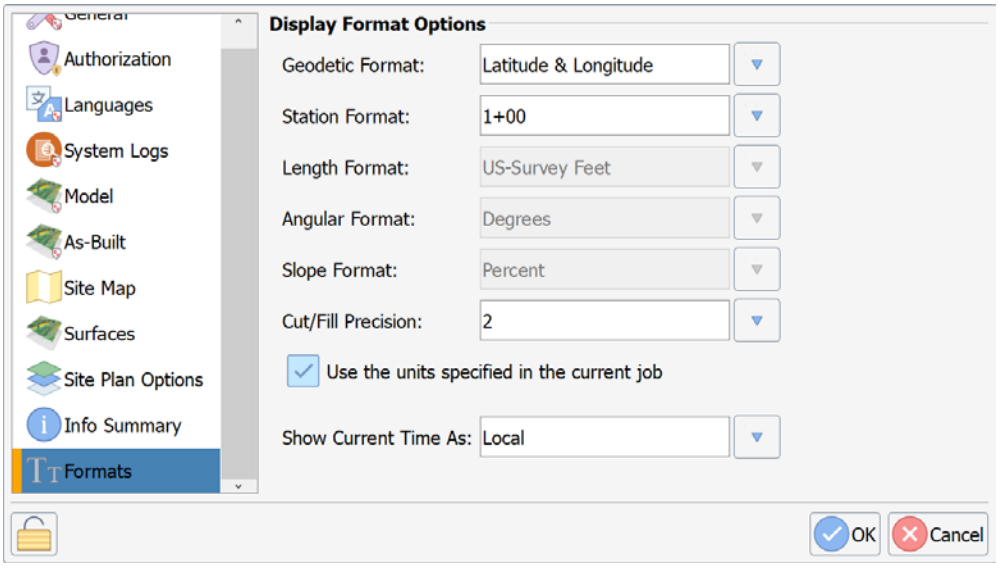
- **Geodetic Format -** Displays latitude/longitude, UTM, or military grid.
- **Station/Chainage Format -** Selects format to show stationing and offset.
- **Length Format -** Selects the unit of measure for northing, easting, and elevation.
- **Angular Format -** Selects between Degrees and Gradians,
- **Slope Format -** Selects between percent and degrees.

Note: If "**Use the units specified in the current job**" is selected, you will not be able to modify **Length Format**, **Angular Format**, or **Slope Format** since job units will be used.

- **Cut/Fill Precision -** Use the drop-down arrow to select the number of decimal places displayed on the Cut/Fill.

- **Show Current Time As -** Use the drop-down arrow to select **Local**, **UTC**, or **Do Not Show**.

To save your settings, click **OK**. To cancel your changes, click **Cancel**.



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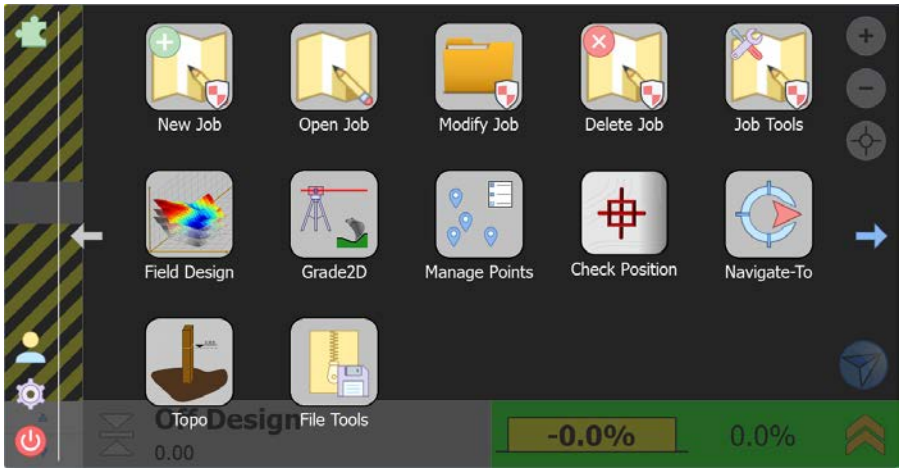
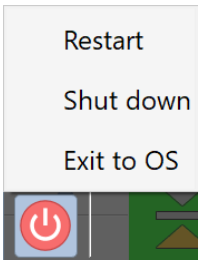
Exit GradeMetrix

To exit GradeMetrix, click the red power icon in the lower-left side of the GradeMetrix **Main Menu**.



After selecting the power icon, the following popup window will display.



Power Option	Result
Restart	Saves your work, exits the program, and restarts the terminal. (External components stay powered on)
Shut down	Saves your work, exits the program, and shuts down the system.
Exit to OS	Saves your work and exits the program. (**Requires Administrator level to use.**)

After selecting either **Restart** or **Shut down**, click **Yes** to continue with restarting/powering down. You can select **No** to cancel and return to the Main Menu.

Chapter 3: Working with GradeMetrix Jobs

Overview

Introduction

This chapter covers the information you need to create, modify, delete, and design jobs in GradeMetrix.

Contents

Menu Icons

Menu Icons

The following icons are used to perform job functions in GradeMetrix.

Table 3-1: Main Menu Icons-Job Functions

Icon Name	Icon	Description
New Job		Create a new job. *
Open Job		Open an existing or saved job.
Modify Job		Edit an existing or saved job. *
Delete Job		Delete a created job. *
Job Tools		Export a job file to an external storage or rename a job. *
File Tools		Has several functionalities: backup job settings, restore job settings (from a backup file), and export grid, tin, and topo.

***Note:** *must be accessed by Administrator or Power User.*

New Job

Overview

Before creating a job in GradeMetrix, review the files and file formats supported by GradeMetrix.

Files and Formats Used in GradeMetrix

Various files are loaded into GradeMetrix on specific, recommended directories on the Control Panel using two different methods:

1. Manually selecting files in GradeMetrix from memory sticks (USB drives, thumb drives, etc.) or
2. Using Windows Explorer to copy files.

GradeMetrix can support the following files and file formats:

- Site Plan File: DWG, DXF, LandXML
- Surface Model File: DWG, DXF 3D face triangles or polylines, TIN, FLT, GRD, LandXML, and LandXML Grid
- Survey Topo File: TOPO, CSV
- Tin File: MESH, TIN, NTR, DXF, DWG, FLT
- Geoid File: BIN, ASC, BYN, GGF, GSF, GTX, and TIF.
- Localization File: LOCAL (SiteMetrix™ Grade), LOC (SiteMetrix), .COT (SiteMetrix Survey)

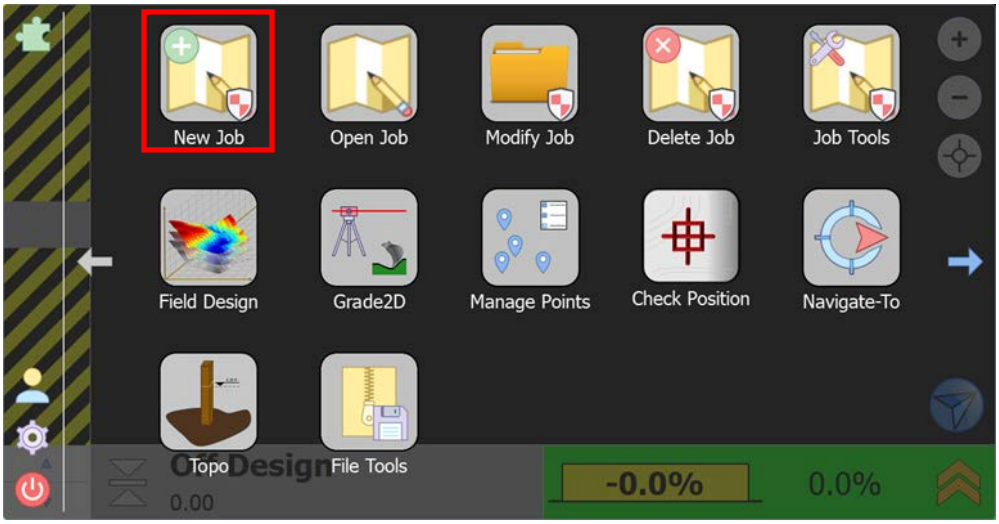
Continued on next page

New Job, Continued

New Job

To create a new job, on the GradeMetrix **Main Menu** (screen 1), click **New Job**. The **Job Basics** screen displays.

Note: You must be logged in as an **Administrator** to create a new job in GradeMetrix. The **New Job** icon is disabled for all other users. See Authorization for more information.



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New Job, Continued

Job Basics

Press inside any of the text boxes and type the job name, description, and job notes.

The job name is required to create a new job. The description and notes are not required. If it is named the same as an existing job, the new job will replace it, after confirmation.

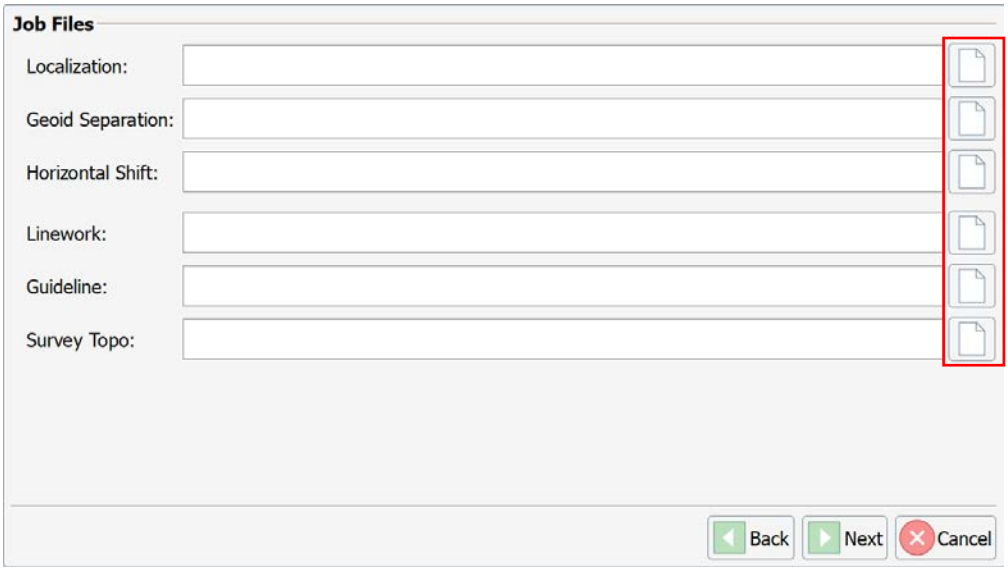
Once information is completed, click **Next** to continue or **Cancel** to cancel new job creation.

Continued on next page

Job Files

Click the document icon to the right of each field to add files to the GradeMetrix job:

- Localization
- Geoid Separation
- Horizontal Shift
- Linework
- Guideline
- Survey Topo



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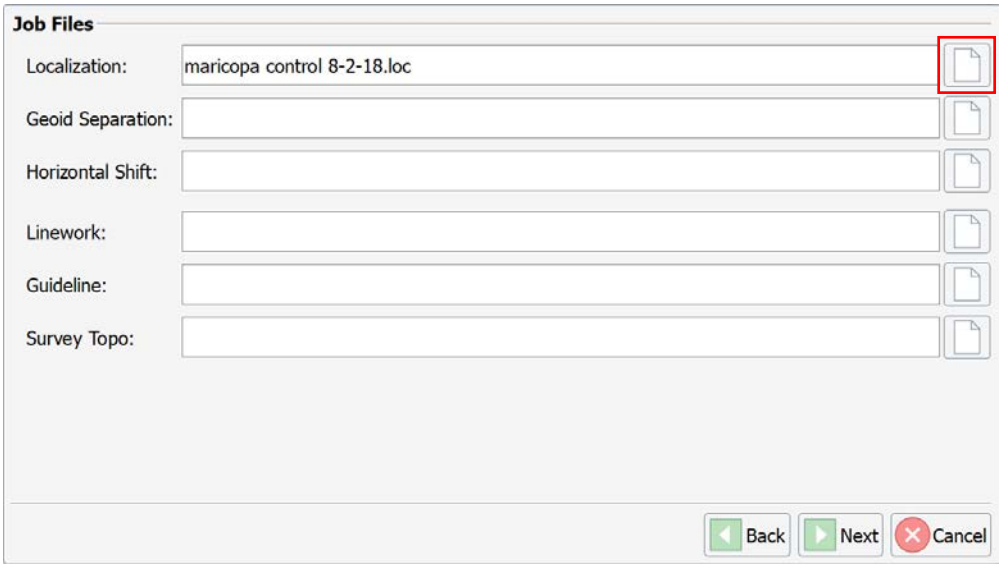
Job Files, continued

To add Job Localization, click the document icon to the right of the **Localization** field.



To add **Geoid Separation**, **Horizontal Shift**, **Linework**, **Guideline**, and **Survey Topo**, click the document icon to the right of that field.

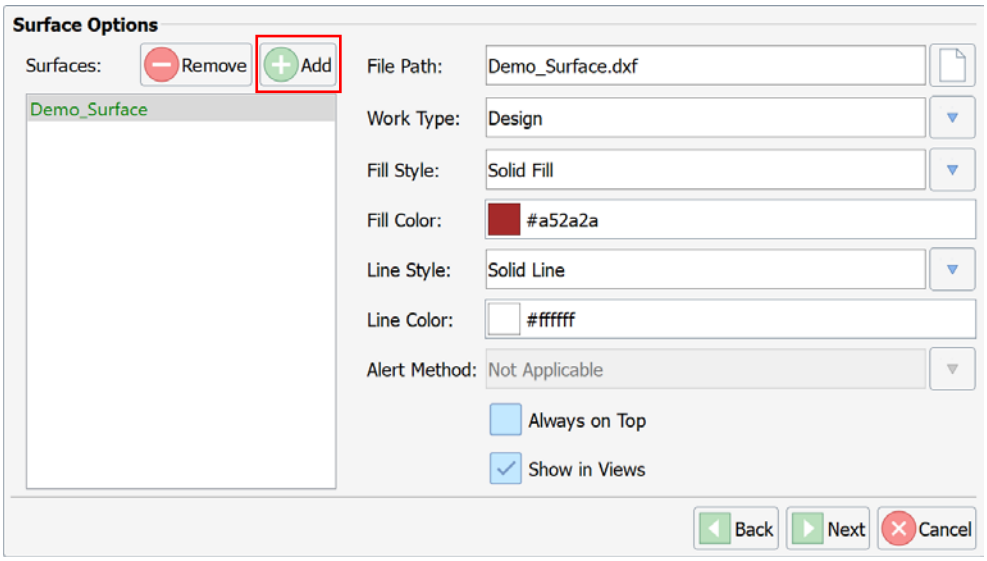
Once information is completed, click **Next** to continue or **Cancel** to cancel new job creation.

Continued on next page

Surface Options

The **Surface Options** window displays. Click **Add** and select the file.

Note: You can add multiple types of surfaces.



Continued on next page

Surface Options, continued

Click the down-arrow to select a **Work Type** option.

- **Design**- This is the most commonly selected option. The Design surface is the surface you are grading to.
- **Existing**- This is for uploading current as-built data, versus generating as-built data from a null grid.
- **Warning** – Select to trigger a warning in the software if your elevation is either above or below the uploaded surface (see **Alert Method**).
- **Watch** – This is similar to Warning. This allows for two levels of alert (i.e., you can choose to upload a 'Watch' surface to set low priority alerts to an operator and set another 'Warning' surface for higher priority alerts to an operator.
- **As-Built** –Select **As-Built** if you have a jobsite topo to upload to the current actual surface.
- **Pass Count** –Select to color the screen based on how many times a machine has passed over a grid cell.

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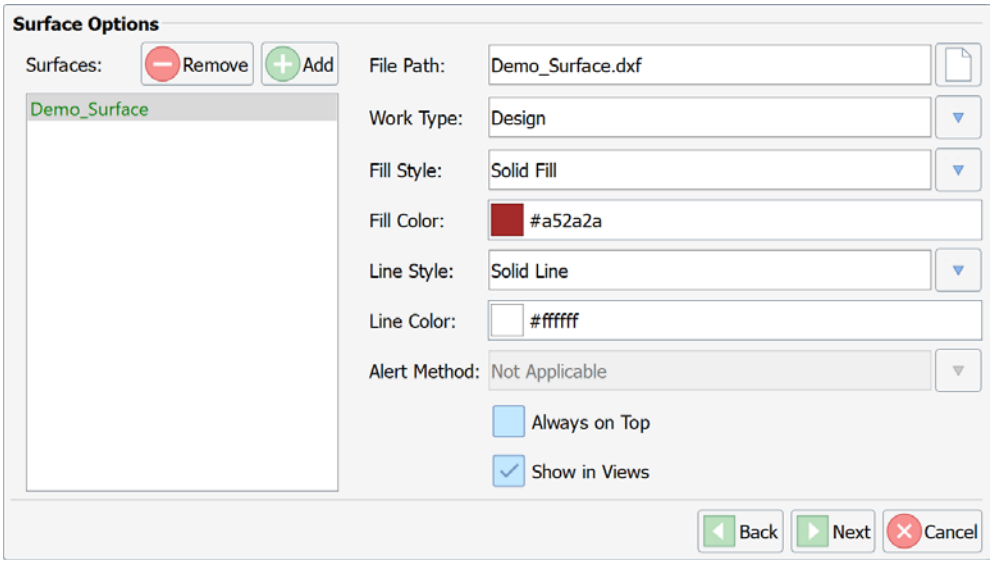
Surface Options, continued

The option you selected displays in the **Work Type:** list.



In addition to **Work Type**, the following options are available:

- Fill Style
- Fill Color
- Line Style
- Line Color
- Alert Method: This option is available when **Work Type** is set to **Warning** or **Watch**. This can be set to **Alert When Below**, **Alert When Above**, or **When Crossing**.
  - **Alert When Below** – issues an alert when the cutting edge of the machine is below the warning or watch surface and can be used to prevent overcutting.
  - **Alert When Above** – an alert is issued when the cutting edge is above the surface. This alert could be used for safety purposes.
  - **When Crossing** – an alert is set if you are on a dangerous surface, such as a gas well.

Continued on next page

Surface Options, continued

There are two checkboxes: **Show in Views** and **Always on Top**. Selecting **Show in Views** will allow the surface to show up in the Plan View section and profile views.

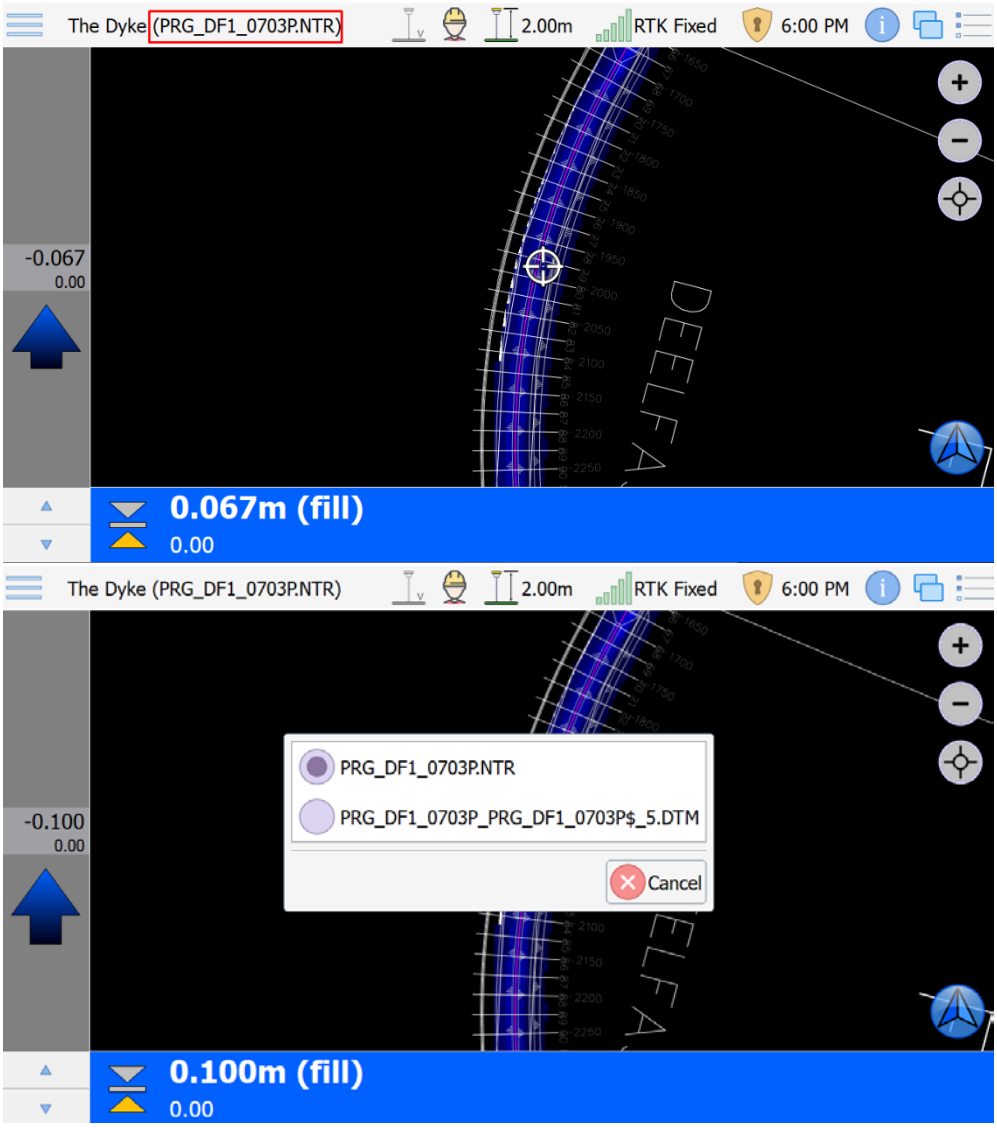
Always on Top will show the surface (if a secondary surface) above the primary surface. For instance, you can load multiple design surfaces. The surface at the top of the list drives the Cut/Fill. The other surfaces can be used visually. For instance, if you are cutting to ore and want to see ore deposits, you can upload a surface, click **Always on Top**, and see the surface.

Once information is completed, click **Next** to continue or **Cancel** to cancel new job creation.

Continued on next page

Surface Options, continued

If multiple design surfaces are loaded, the active design will be shown on the top toolbar of the Plan View. Click on the design file to switch the active design.



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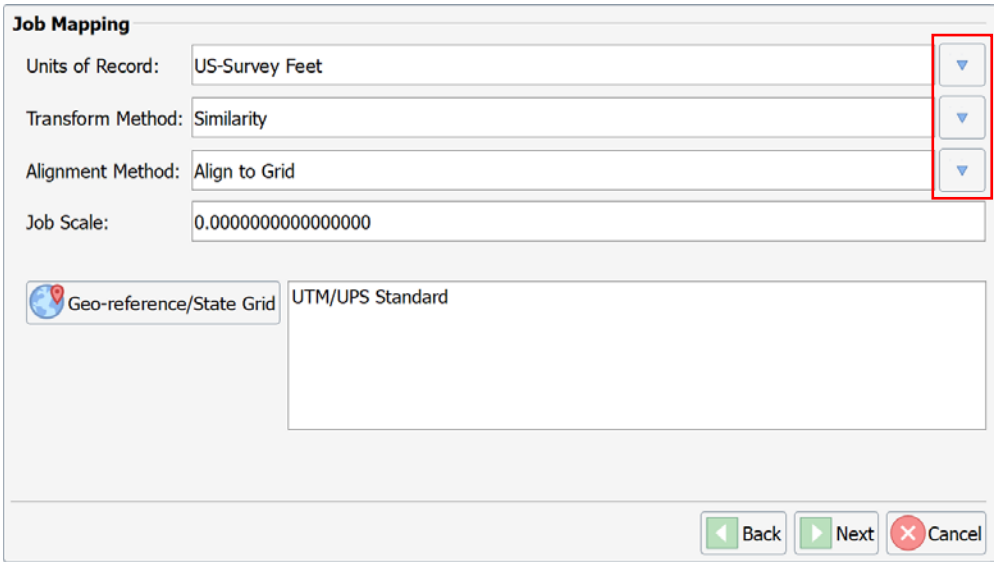
Job Mapping

The **Job Mapping** window displays.

Click the down-arrow to select units for the following fields:

- Units of Record
- Transform Method
- Alignment Method

Press in the text box to enter the **Job Scale**.



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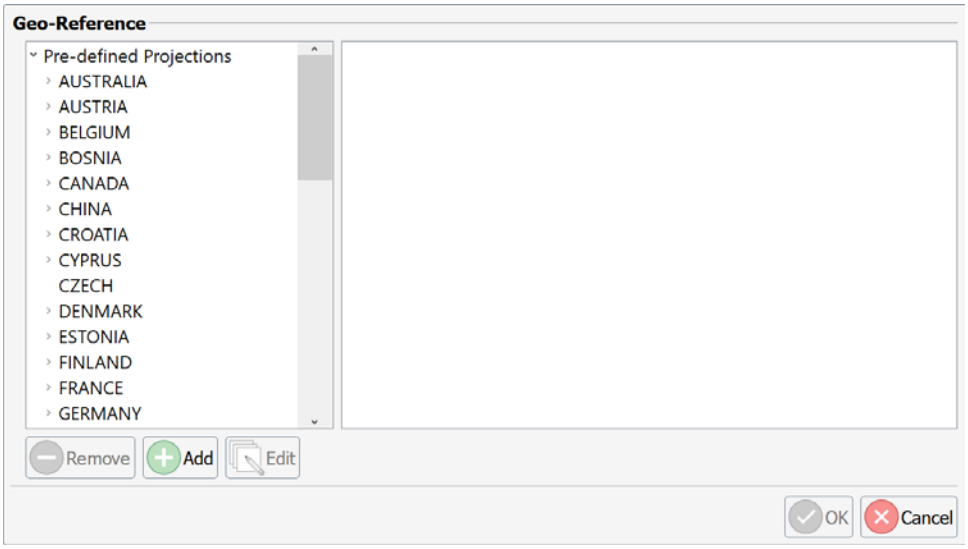
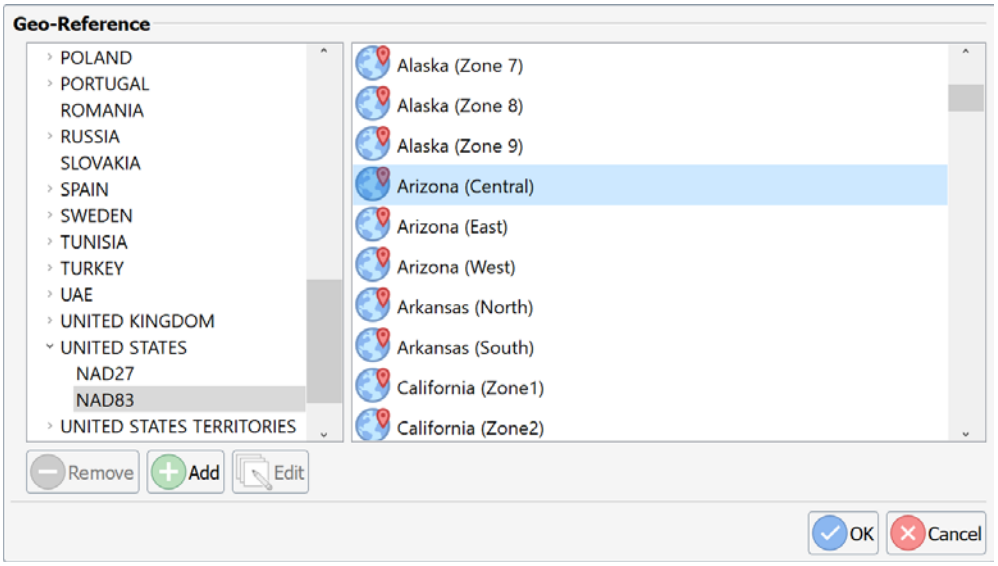
Job Mapping, continued

To set a geographical reference grid, click **Geo-reference/State Grid**. Select from the displayed list on the left side.



Selected desired zone for use on the right side.



Once information is completed, click **Next** to continue or **Cancel** to cancel new job creation.

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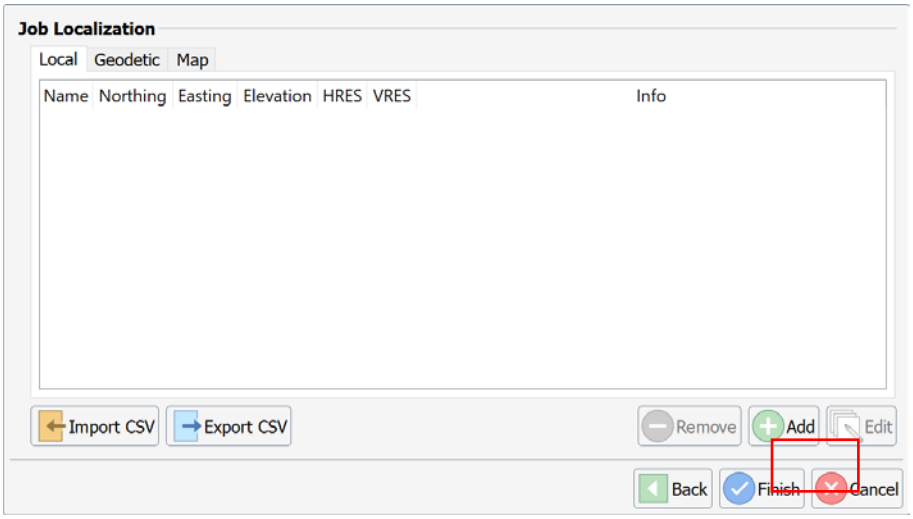
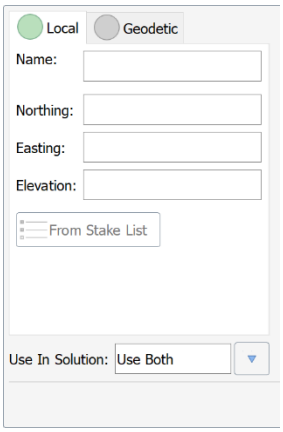
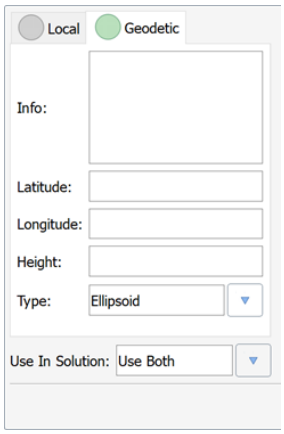
Job Localization

The **Job Localization** screen displays. Click **Add**.







Select the text box to set the localization settings:

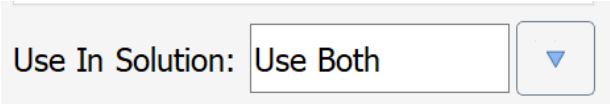
Local	Geodetic
Name	Info
Northing	Latitude
Easting	Longitude
Elevation	Height

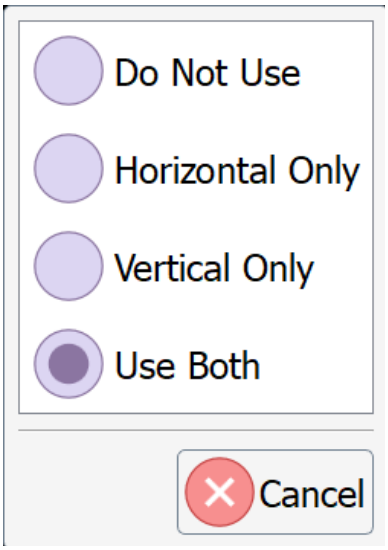
Continued on next page

Job Localization, continued

The **From Stake List** button allows the user to select a control point from the stake list.

Use the drop-down arrow next to **Use In Solution:** to select from the following localization display options:



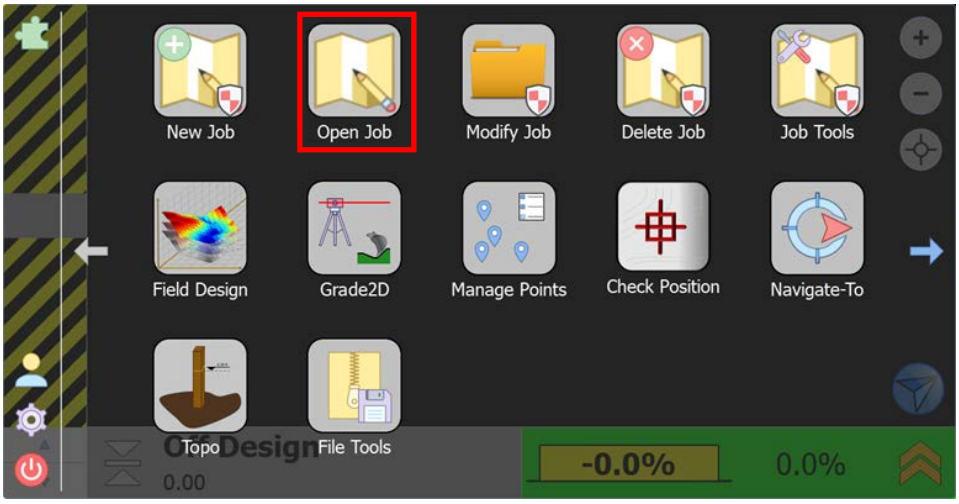


If residuals are high for the point, you may opt to not use the point. Or, if residuals are high for one component (horizontal or vertical), you may opt to turn off that one component. Click **Ok**. Click **Finish**.

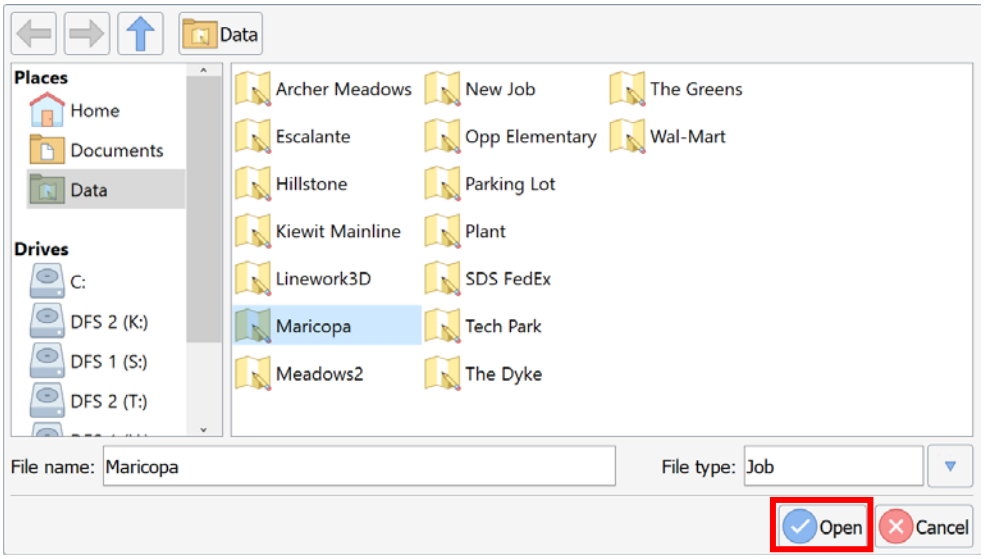
Open Job

Open Job

To open an existing Job in GradeMetrix, on the **Home** screen, click the **Open Job** on the GradeMetrix home screen.



The file explorer displays. Navigate to the desired job and click to highlight the job you want to open. Click **Open**.

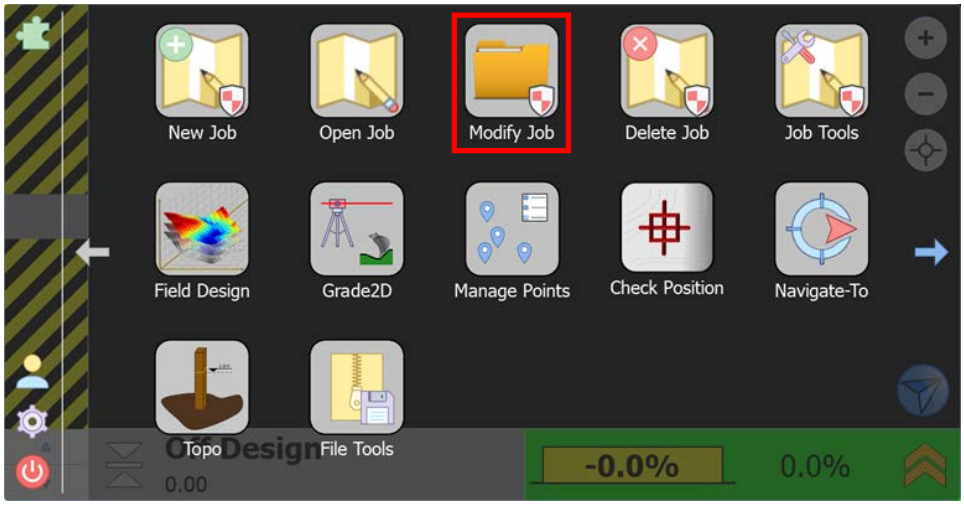


Modify Job

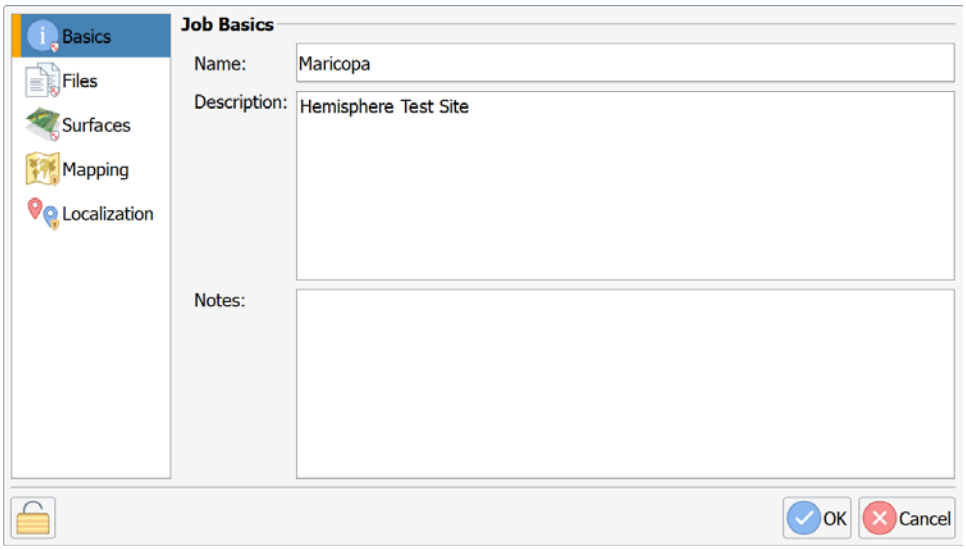
Modify Job

To modify an existing job in GradeMetrix, click the **Modify Job** icon on the GradeMetrix **Main Menu**.

Note: To modify some **Job** files, you must be logged in as an **Administrator**.



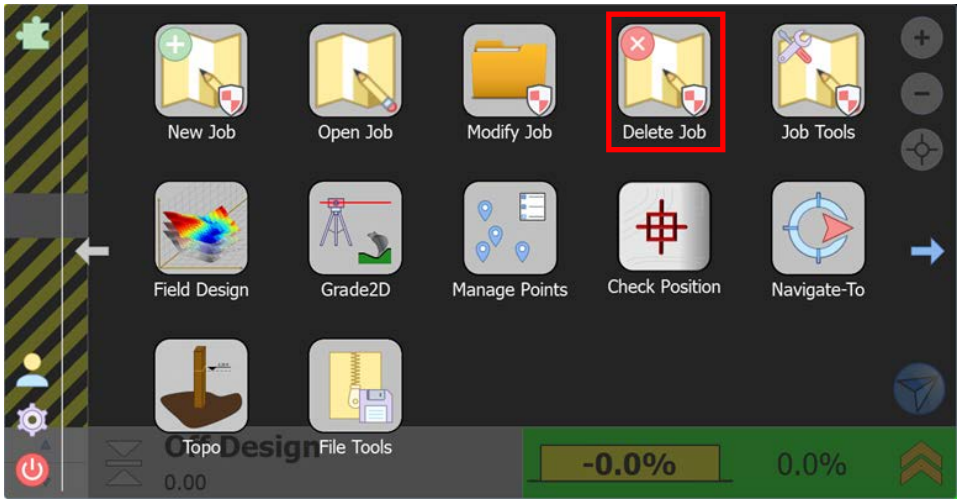
In the **Modify Job** screen, you can change your **Mapping** settings, Job **Files**, and **Localization**. See **Create a Job** for a description of each feature.



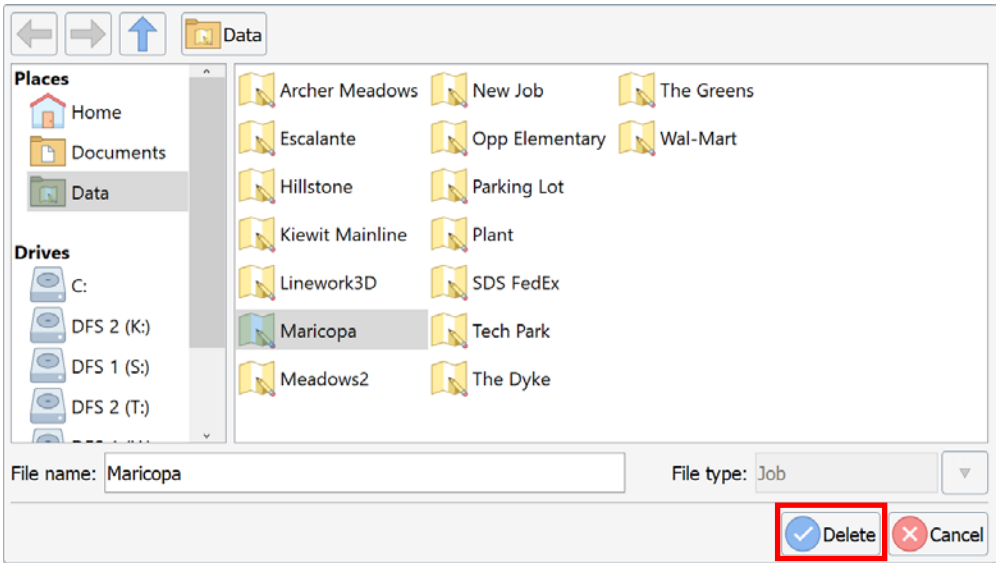
Delete Job

Delete Job

To delete a job created in GradeMetrix, on the **Main Menu**, click the **Delete Job** icon.



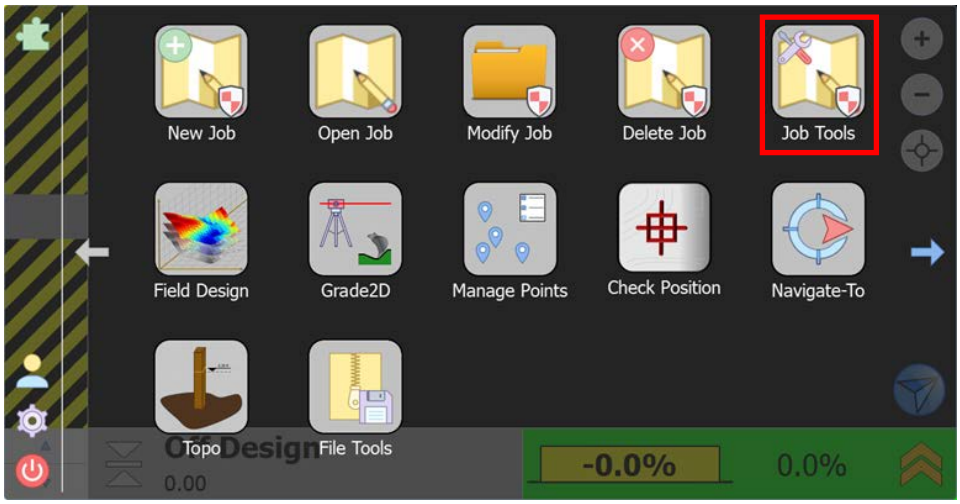
Click to highlight the name of the job you wish to delete and click **Delete**.



Job Tools

Job Tools

On the GradeMetrix **Main Menu**, click the **Job Tools** icon.



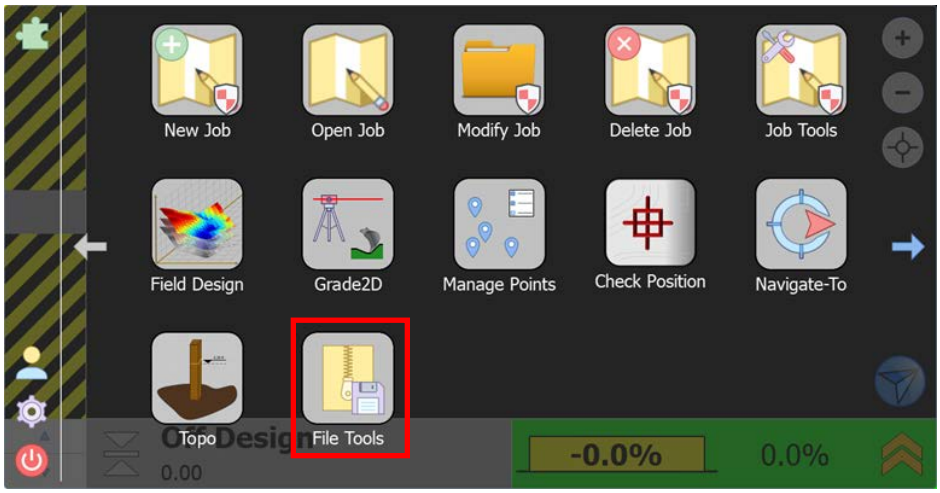
You can select from the following options:

1. **Manage Layers** – Change settings associated with layers.
2. **Export Job** – Save your job to a thumb drive.
3. **Import LandXML** – This routine allows you to import a LandXML file and convert it to a surface.
4. **Copy Job** – Create a clone of your job.
5. **Rename Job** – Change the name under which the job is saved.

File Tools

File Tools

On the GradeMetrix **Main Menu**, click the **File Tools** icon.

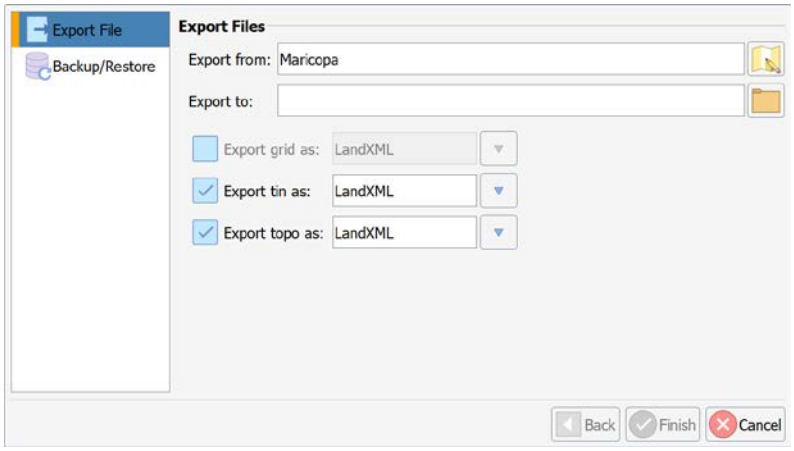


To export files, click **Export File**. Click to select your job in **Export from**. Click on the folder next to **Export to**, to select a location to save from.

To Export grid, click to check **Export grid as**. Select on the dropdown box to the right to select from **LandXML**, **DXF**, or **CSV**.

To Export tin, click to check **Export tin as**. Click on the dropdown box to the right. Select from **LandXML** or **DXF**.

To Export topo, click to check **Export topo as**. Click on the dropdown box to the right. Select from **LandXML** or **CSV**.



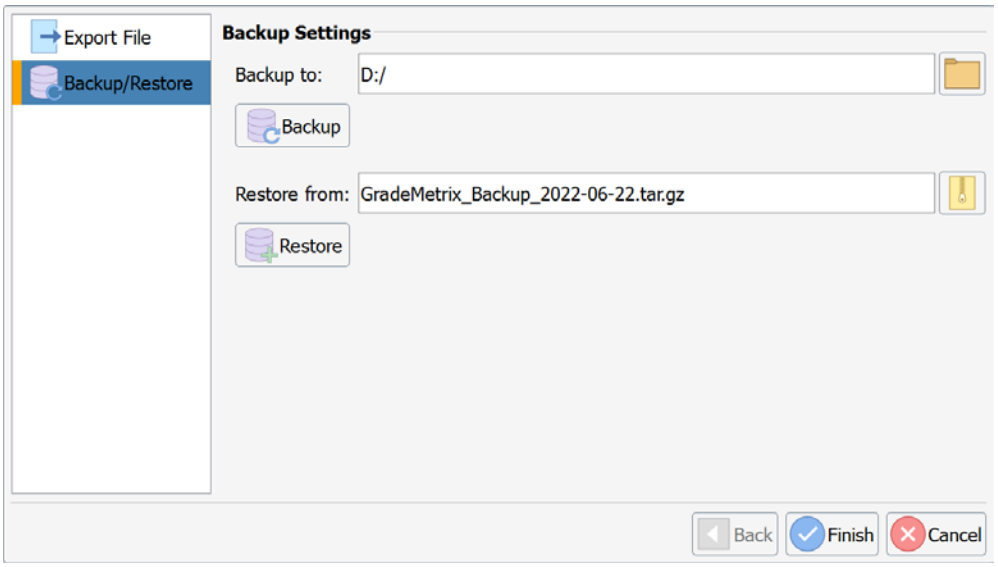
File Tools, Continued

File Tools, continued

The **Backup/Restore** section of **File Tools** is used to create a backup or restore from a backup.

To create a **backup**, select the file folder button, and then select the destination for the backup file to be stored. Once the location is selected, press the **Backup** button to create the backup.

To restore from an existing backup, select the zipped file folder and select the backup file. Once the file is selected, press the **Restore** button.



Once the backup or restoring process is completed, press the **Finish** button to close the menu.

Chapter 4: Machine Configuration

Overview

Introduction

This chapter contains all the information you need to configure your excavator to use GradeMetrix software.

Contents

Menu Icons

Menu Icons

The following icons are used to perform machine configuration functions in GradeMetrix.

Table 4-1: Main Menu Icons-Machine Configuration

Icon Name	Icon	Description
Equipment Setup		Use in administrator mode. Configure the dimensions of your machine, the GNSS hardware you are using, and save/load these settings.
Calibrate Sensors		Wizard to run you through the process of calibrating the sensors.
Quick Calibrate		Use Quick Calibrate to manually calibrate a single sensor.
3D Calibration		This icon is used to calibrate the primary GNSS antenna offsets as well as the heading offset of the receiver.
RTK Source Configuration		Configure NTRIP, Internal Radio, and External Radio settings.
Receiver Configuration		View information associated with the attached antenna and set RTK Timeout time.
Update Firmware		Update the GNSS Firmware.

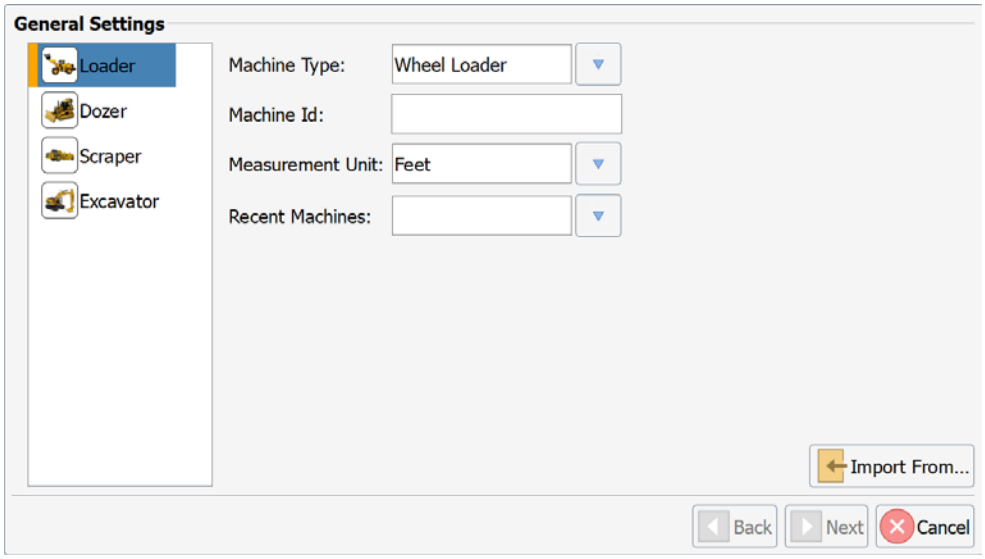
Equipment Setup

Equipment Setup

On the GradeMetrix **Main Menu** (screen 2), use **Equipment Setup** to configure your machine.

Note: This manual contains limited information on how to upload a machine configuration and hang buckets. For full details on Equipment Setup, please see the HGNSS GradeMetrix Installation Guide.

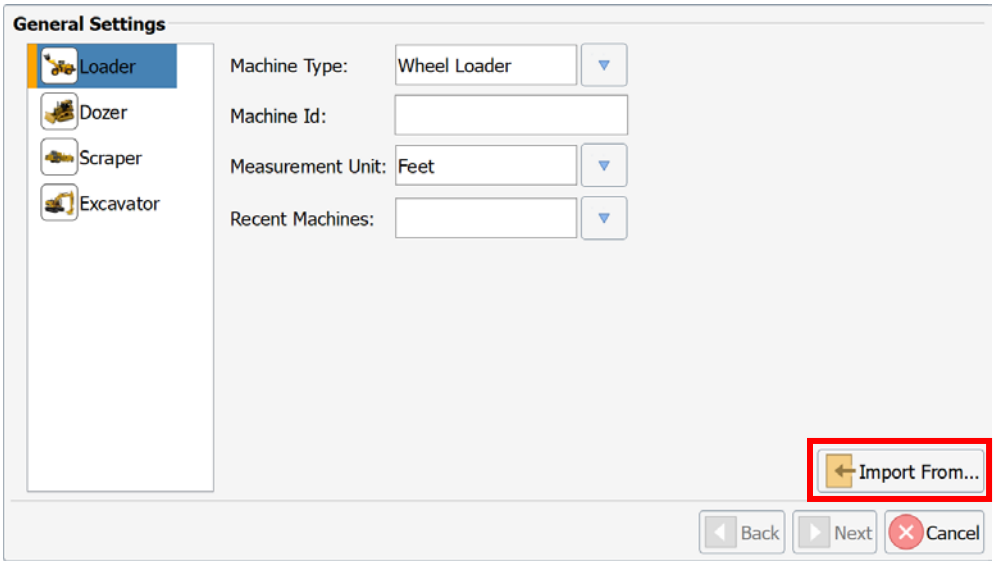
When you open Equipment Setup, the following screen displays:



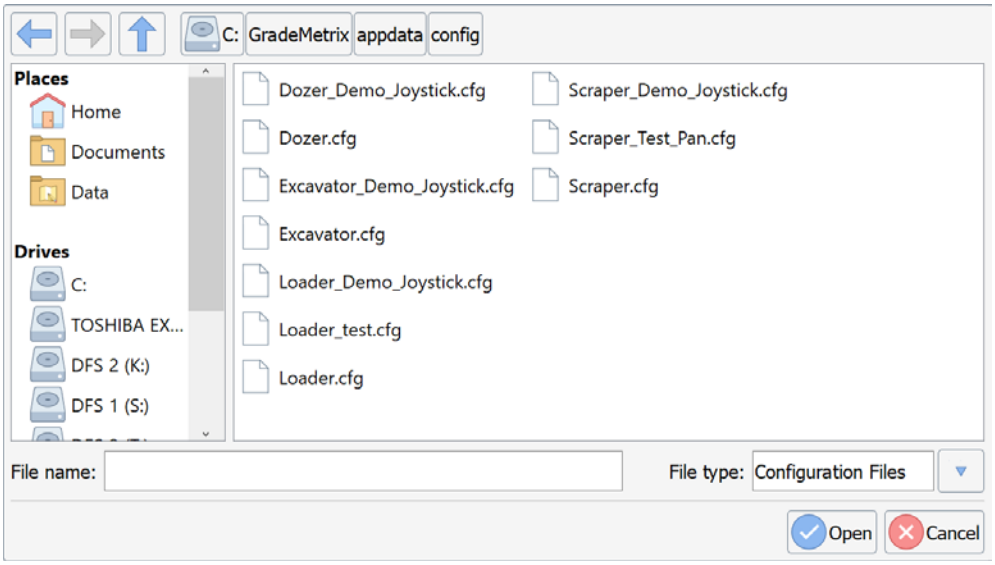
Continued on next page

Equipment Setup, continued

Click **Import From…** to upload an existing machine file.



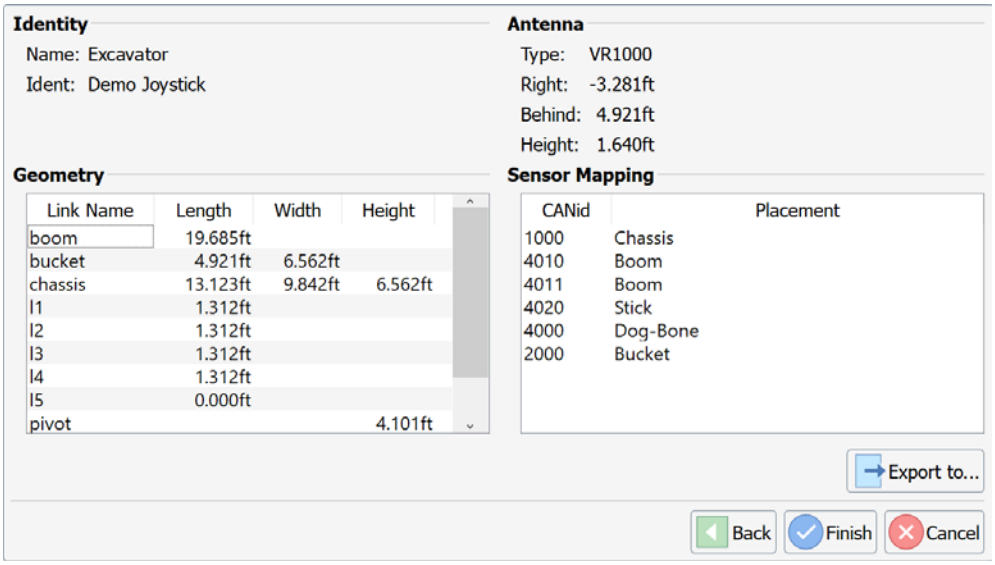
Navigate to the location of the machine file, select the machine file, and click **Open**.



Continued on next page

Equipment Setup, continued

The display updates to show the current dimensions and sensors for the machine you are uploading:



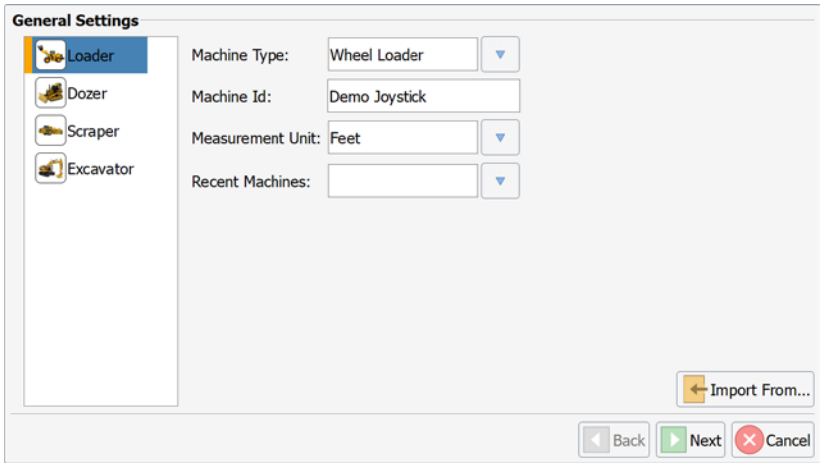
Click **Finish**.

GradeMetrix allows you to move the terminal hardware between various machines. For example, if you have two excavators, you can purchase one complete GradeMetrix Excavator system and an additional wiring kit. You can then move the VR1000/500 and the terminal hardware from one machine to another and then load the proper machine dimensions using the **Import from** steps.

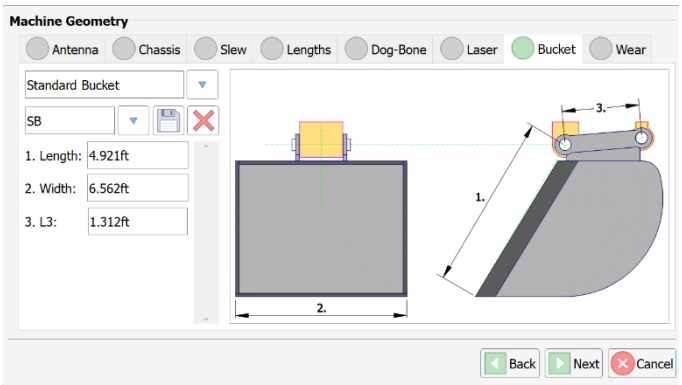
Continued on next page

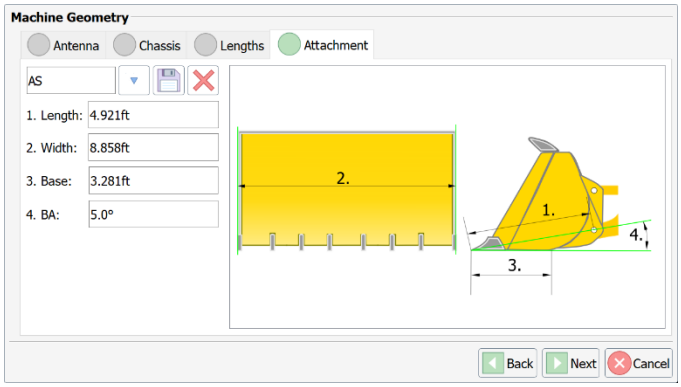
Equipment Setup, continued

On certain machine types, multiple attachments can be added. After your machine is installed, go to **Equipment Setup**, select the machine, and click **Next**.



Click **Bucket/Attachment** (depending on machine type).





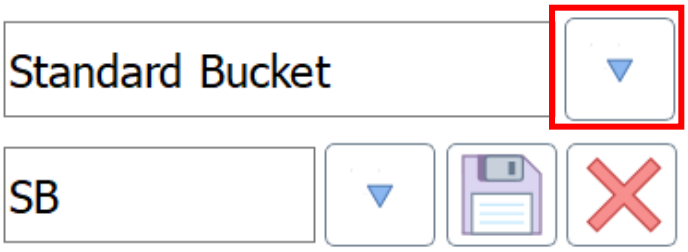
Continued on next page

Equipment Setup, Continued

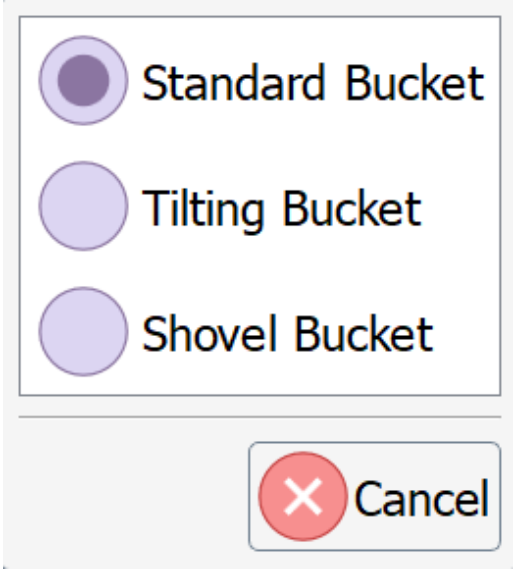
Equipment Setup, continued

The installer may have calibrated several buckets or attachments.

Click on the down arrow next to the bucket type.



A list of supported bucket types displays:

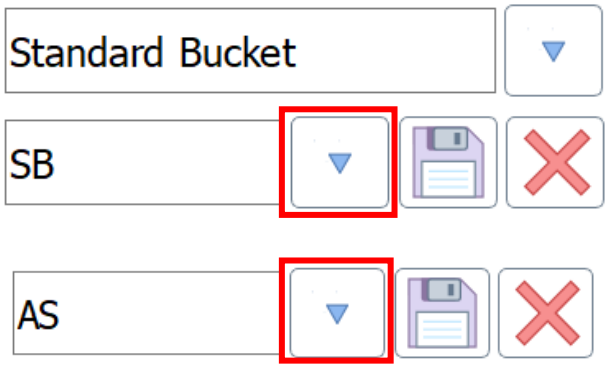


Continued on next page

Equipment Setup, Continued

Equipment Setup, continued

Click on the down arrow next to the name to change the bucket/attachment.



The user can create and save different buckets/attachments. Press inside the name box and a keypad will display. Enter a name for the bucket/attachment. Once all information is correctly entered, the user can select the **Save** icon. To delete a bucket/attachment the user can select the red X icon.

After selecting the correct bucket, click **Next**. You will be navigated to the sensor page. Click **Next** again. You will then be navigated to the summary page. Click **Finish**.

The created buckets can now be selected in the **Grade** screen from the dropdown menu (bucket icon) in the top tool bar.

Calibrate Sensors

Calibrate Sensors	For full details on calibrating sensors, please see the HGNSS GradeMetrix Installation Guide.

Quick Calibrate

Quick Calibrate	For full details to quick calibrate sensors, please see the HGNSS GradeMetrix Installation Guide.

3D Calibration

3D Calibration	For full details on 3D calibration, please see the HGNSS GradeMetrix Installation Guide.

RTK Source Configuration

Overview

RTK Source Configuration contains NTRIP, Internal Radio, and External Radio configuration sections.

On the GradeMetrix **Main Menu**, click the **RTK Source Configuration** icon.

Continued on next page

RTK Source Configuration, Continued

RTK Configuration

The **RTK Configuration** screen contains three sections:

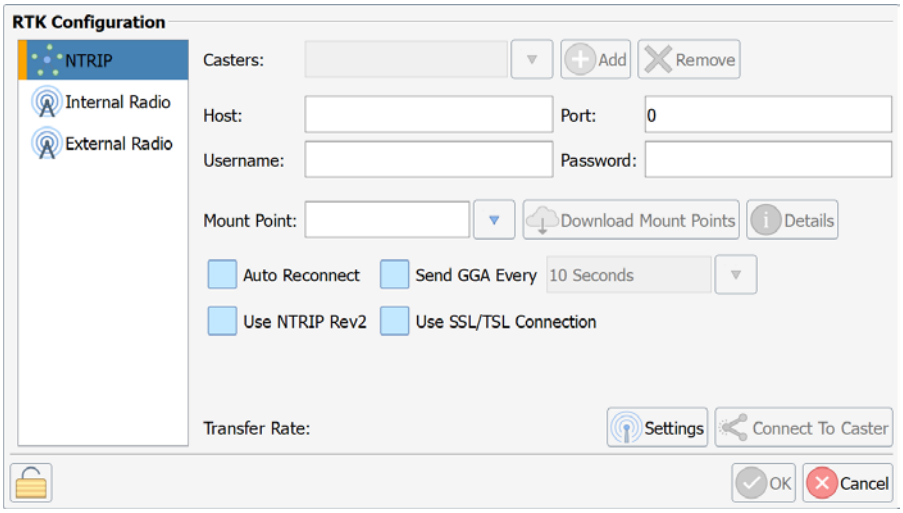
- NTRIP
- Internal Radio
- External Radio

Continued on next page

RTK Source Configuration, Continued

RTK Configuration, continued

If receiving RTK over a network, use the embedded **NTRIP** client to receive RTK corrections from an NTRIP caster.



Follow these steps to populate the **NTRIP Configuration** information.

Step	Action
1	Type in a name for the **Caster**. Type the **IP** (or DNS), Port, **Username**, and **Password**.
2	Some NTRIP casters will require you to send a position to the caster on a set interval (VRS networks and networks with a "nearest" option require this). If your caster requires this, click the checkbox next to **Send Position to Caster Every** and select the interval.
3	Click **Download Source Table**. The source table will download and the list of available mountpoints display. Select the appropriate mount point. **Note:** You must be connected to a network to download the source table.
4	If you click **Add**, this caster will be saved as a list of available casters to select from (see **Casters** at the top of the screen). If you do not click **Add**, you can still use the NTRIP caster, but the default caster will be used, and you cannot save a list.
5	Select the option to auto-connect when the software opens and auto-reconnect to restore a temporarily lost internet connection.
6	Click **Connect To Caster.**

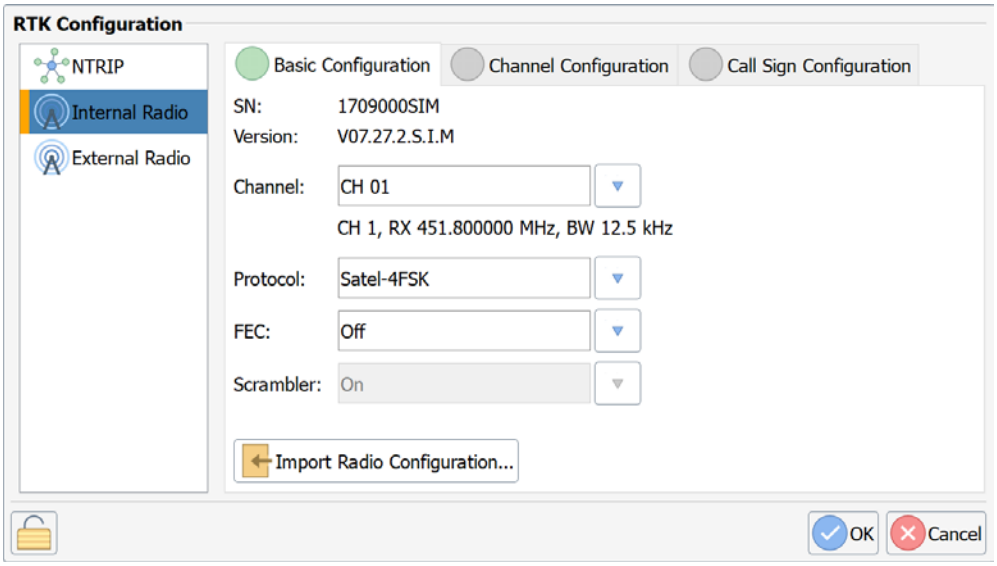
Continued on next page

RTK Source Configuration, Continued

RTK Configuration, continued

The **Internal Radio** screen displays three tabs:

- Basic Configuration
- Channel Configuration
- Call Sign Configuration



Click the **Import Radio Configuration** button to load a channel file. The explorer window displays. Click to locate and select the configuration file you wish to use.

When finished making your changes/selection, click **OK** to save and return the Grade View.

Continued on next page

RTK Source Configuration, Continued

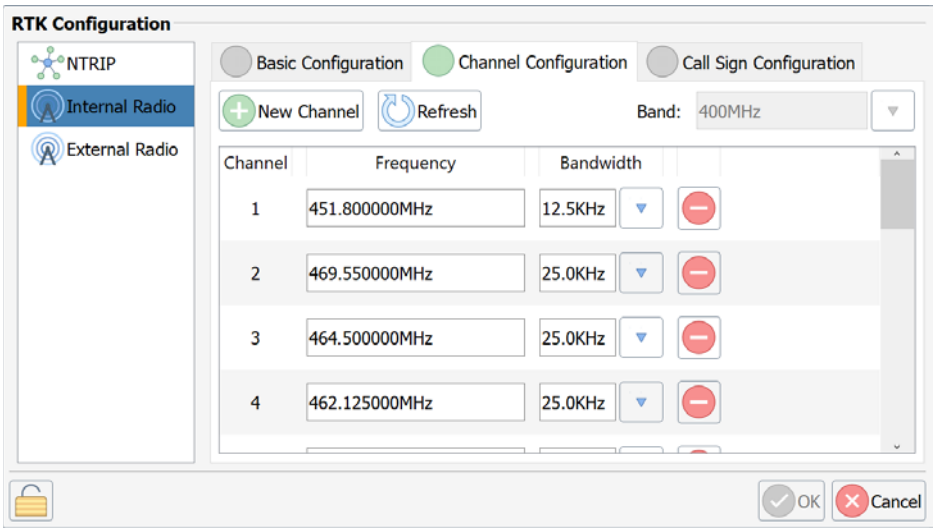
RTK Configuration, continued

On the **Basic Configuration** tab, click the down-arrow to select values for the following fields:

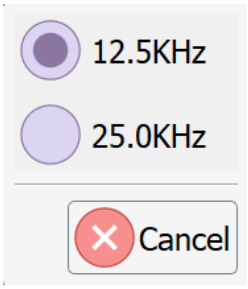
- Channel
- Protocol
- FEC

On the **Channel Configuration** tab, click in the text box to enter values for **Frequency** and click the down arrows to select values for **Channel Width**. The icon will delete the line.

Note: You must be logged in as an **Administrator** to edit the **Channel Configuration**.



Channel Width Selections



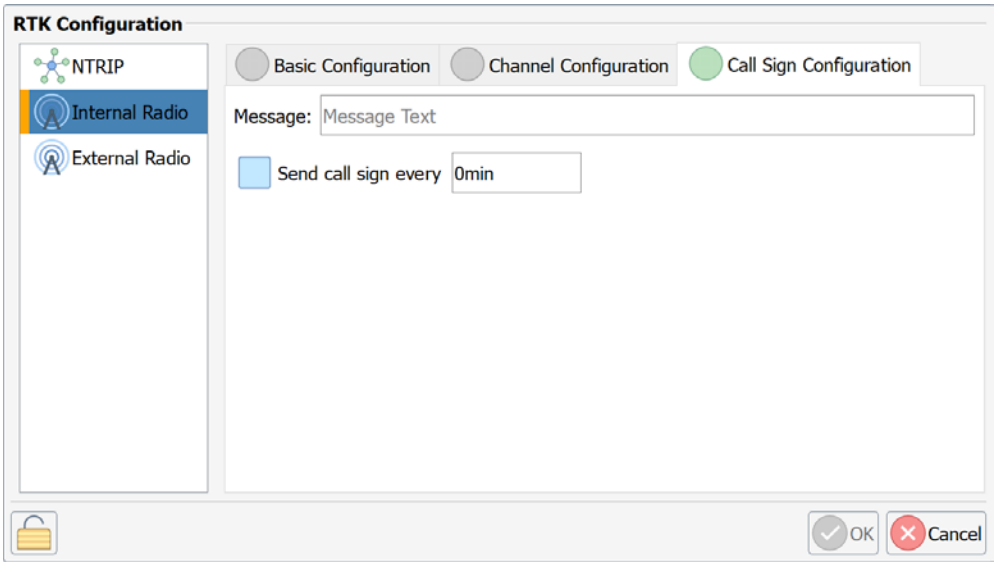
When finished making your changes/selection, click **OK** to save and return the Grade View.

Continued on next page

RTK Source Configuration, Continued

RTK Configuration, continued

On the **Call Sign Configuration** tab, type a call sign message and select the message rate frequency.



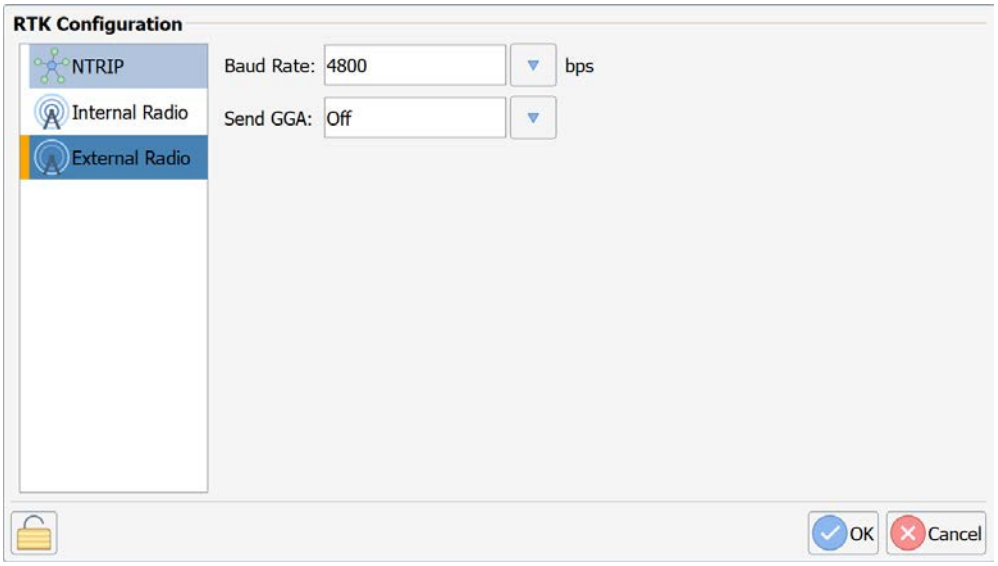
When finished making your changes/selection, click **OK** to save and return the Grade View.

Continued on next page

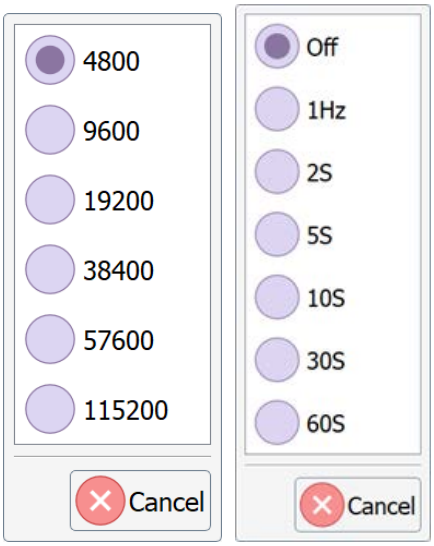
RTK Source Configuration, Continued

RTK Configuration, continued

The **External Radio** section contains the settings for Buad Rate and sending GGA rates for an external radio.



Select the dropdown arrow for either setting and the below screens will display.



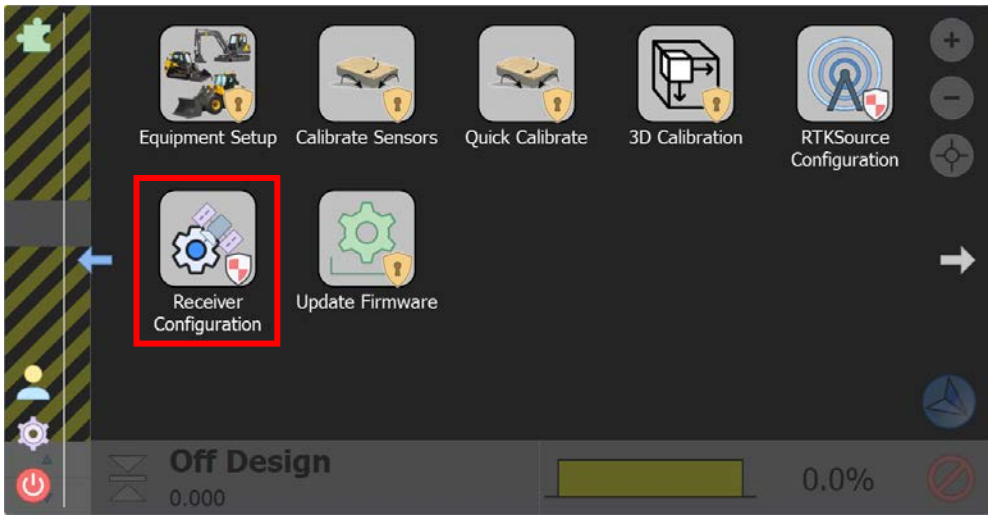
When finished making your changes/selection, click **OK** to save and return the Grade View.

Receiver Configuration

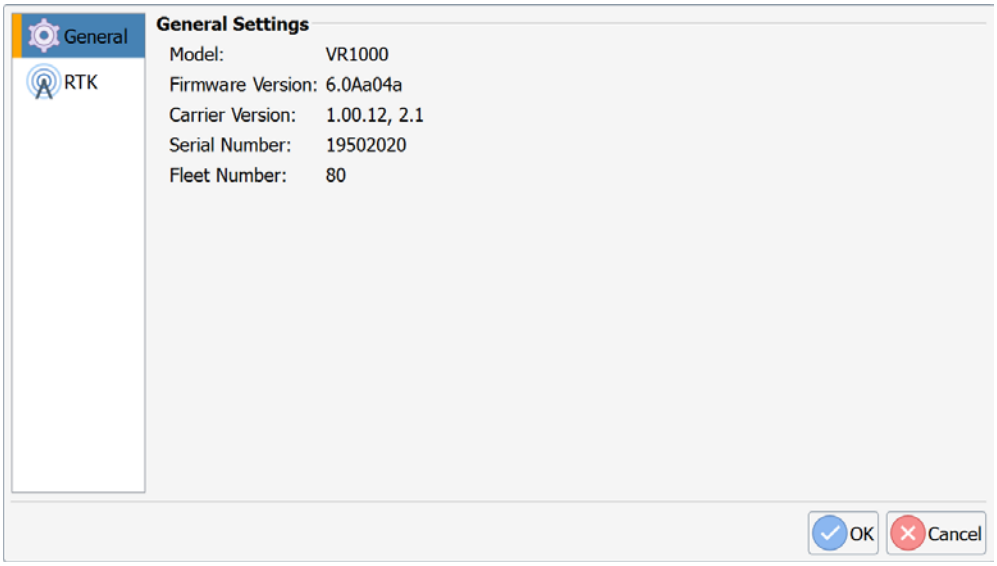
Receiver Configuration

Receiver Configuration has two sections: **General** and **RTK**. The **General** section is used to view the model, firmware version, carrier version, serial number, and fleet number of the attached antenna. The **RTK** section is used to set the RTK Timeout time.

On the GradeMetrix **Main Menu**, click the **Receiver Configuration** icon.



The below image is of the General screen of the **Receiver Configuration**.



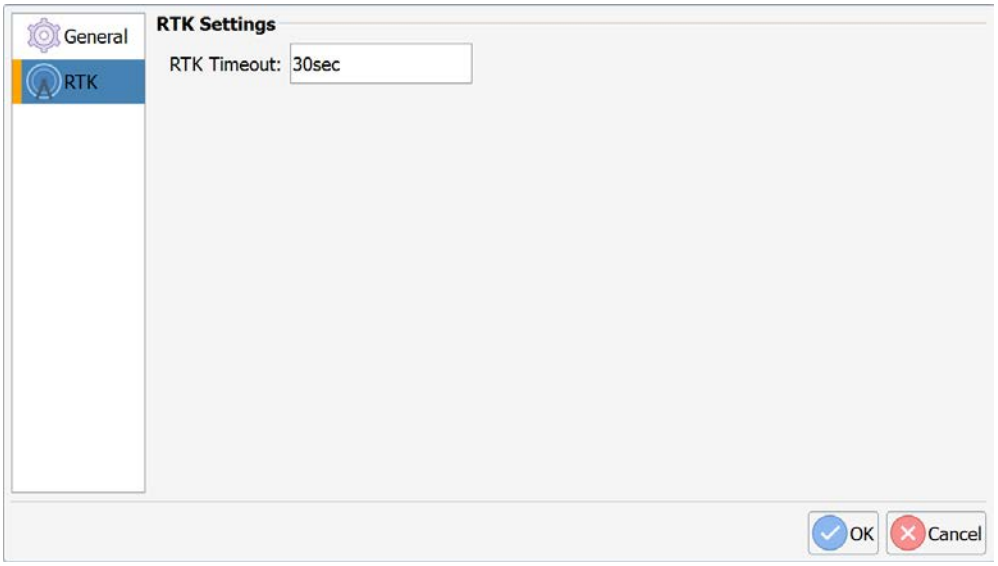
Continued on next page

Receiver Configuration, Continued

Receiver Configuration, continued

The below image is of the **RTK** screen of the **Receiver Configuration**.

The **RTK Timeout** time is the amount of time RTK can be extrapolated for after the RTK source has been lost. To change the time, press inside the text box. The default is set to 30 seconds. The minimum allowed to set is 6 seconds and the maximum allowed is 8100 seconds.



Update Firmware

Update Firmware

Update Firmware is used to update the GNSS Firmware of the receiver.

On the GradeMetrix **Main Menu**, click the **Update Firmware** icon.

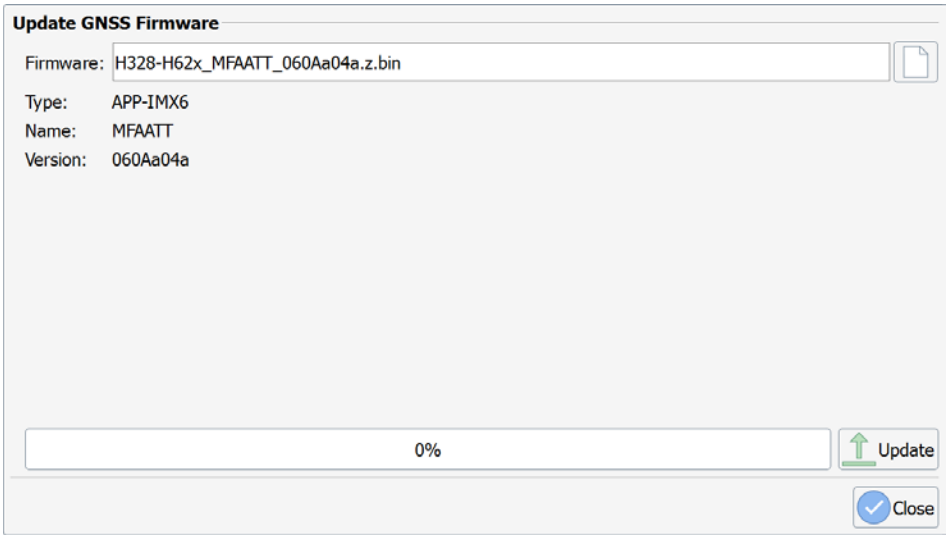
To upload the file for the GNSS Firmware update, the user will need to select the file icon on the right side of the Firmware box.

Continued on next page

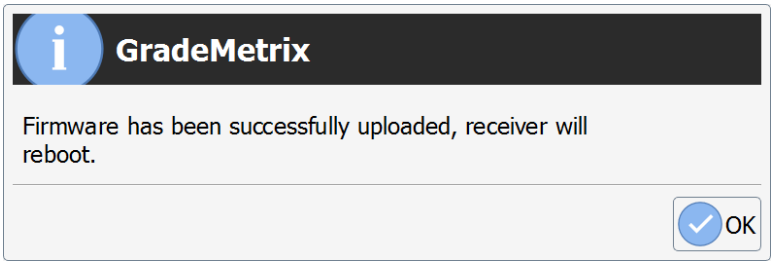
Update Firmware, Continued

Update Firmware, continued

When the file is loaded, the user will need to select the **Update** button, then **Yes** to confirm the firmware update to start the process.



After the update process is completed, the user will need to select **OK** for confirmation of the successful upload, and the receiver will reboot.



After completion of the update process, the user will need to select **Close** at the bottom of the screen to return to the Main Menu.

Chapter 5: Navigation and Field Design

Overview

Introduction

This chapter contains all the information you need to set up navigation and field design using GradeMetrix software.

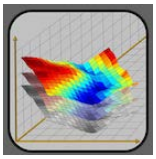
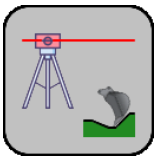
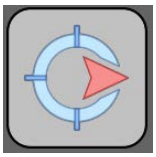
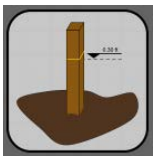
Contents

Menu Icons

Menu Icons

The following icons are used to perform navigation and field design functions in GradeMetrix.

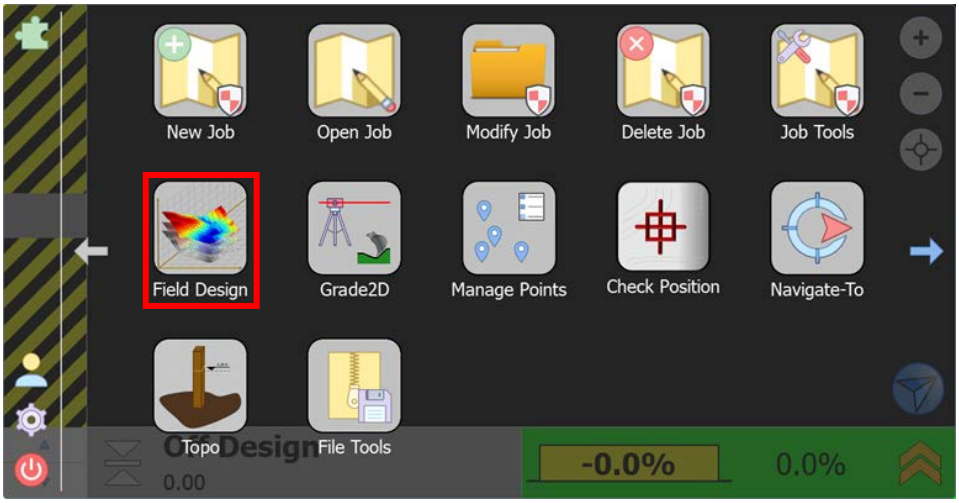
Table 5-1: Main Menu Icons-Navigation and Field Design

Icon Name	Icon	Description
Field Design		Use Field Design to create a surface when a model is not available.
Grade2D		This is for 2D operation. You can bench and dig and use an optional laser for elevation.
Manage Points		Use to add, remove, edit, and import points in the job.
Check Position		Check position and measurements. To check the accuracy of your results, compare the NEZ of the cut/fill location to a known NEZ. If the error displayed is not within specification, refer to Appendix A, Troubleshooting.
Navigate-To		Enter a NEZ or select from a list of control points. Grade Metrix provides distances/directions to that point.
Topo		Use for conducting a topo. The software can be configured to store points manually or automatically in intervals (distance or time).

Field Design

Field Design

To access **Field Design** settings, click the **Field Design** icon in the GradeMetrix **Main Menu**.



There are 5 different sections in **Field Design:**

- Flat Pad
- Slope Pad
- Ramp
- Points Surface
- Clear Design

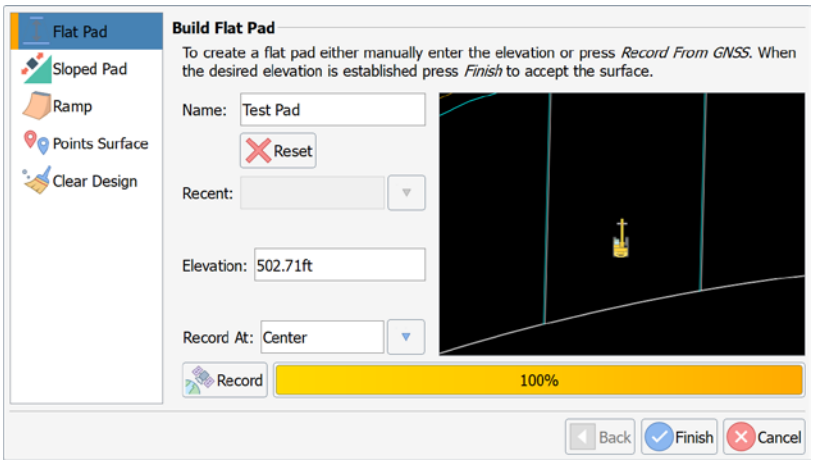
Flat Pad

Use **Flat Pad** to enter a set elevation to grade to (regardless of design file).

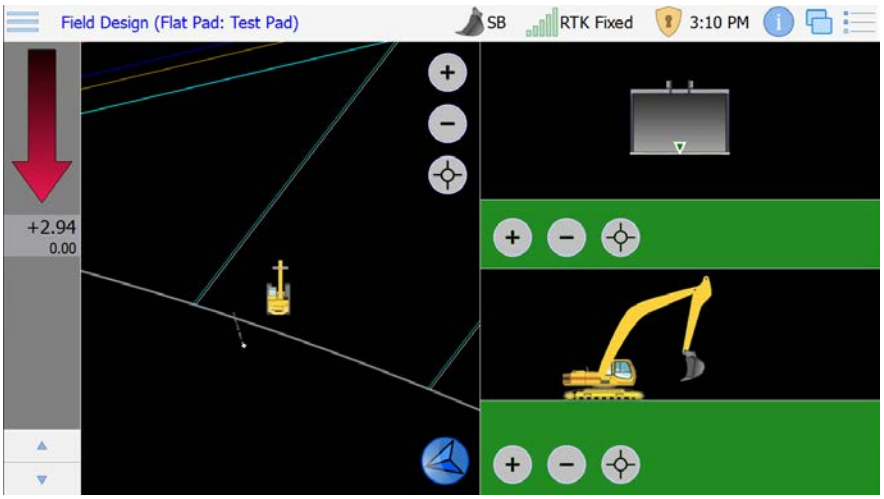
To set up a flat pad:

1. Type a name or select from the dropdown of **Recent**.
2. Validate the **Record At** location (Left, Center, or Right)
3. Select **Record** to record current elevation.
4. If needed, edit the elevation.

Click **Finish**. Design elevation is set to 509.87’ in the following example.



Notice the surface is now green (indicating field design is used instead of DTM) and the **Job Name** at the top-left of the screen is now **Field Design**.



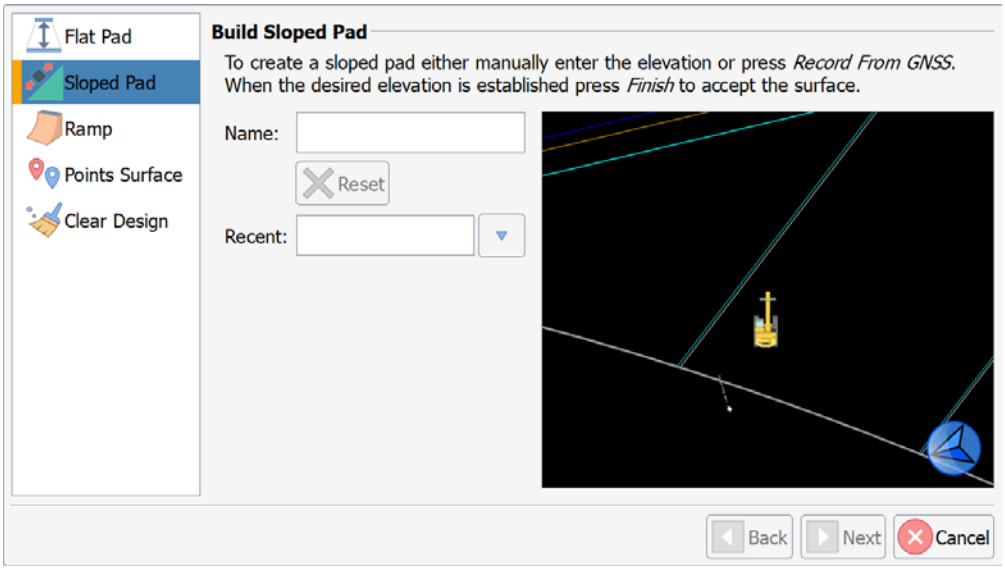
Continued on next page

Slope Pad

Choose **Slope Pad** to build a slope pad.

To create a **Slope Pad** and enter a **Name** by selecting inside the text box or select an existing Slope Pad by using the dropdown arrow by **Recent**.

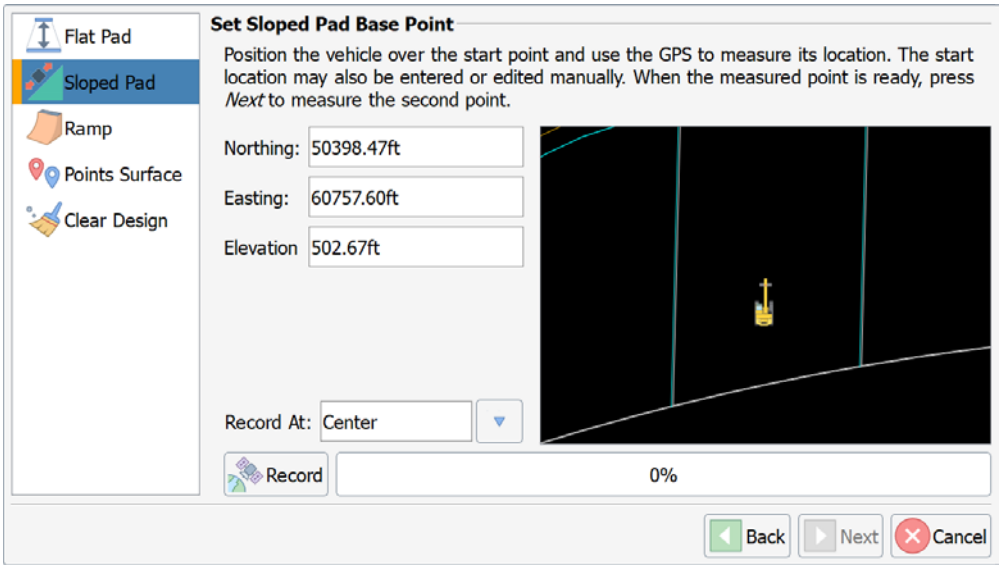
Press **Next**.



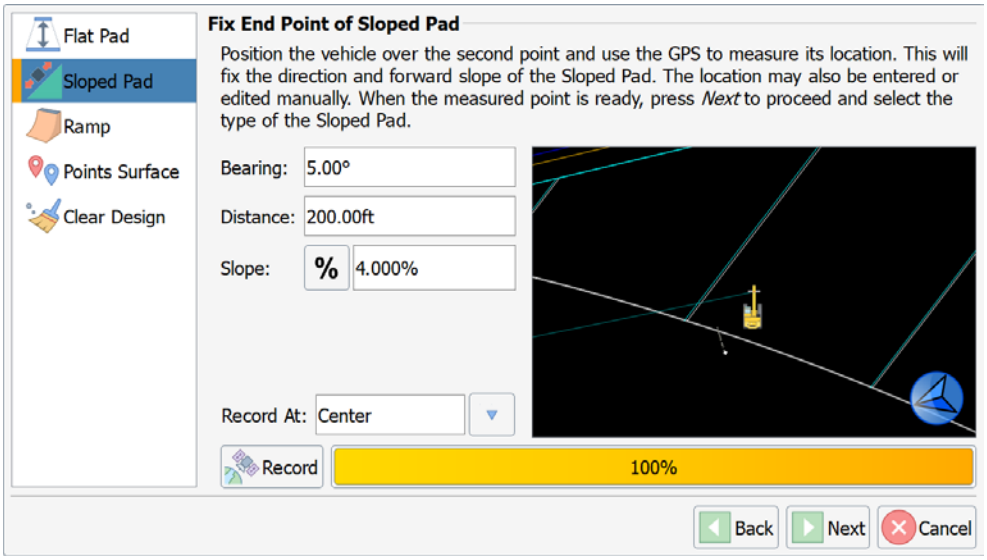
Continued on next page

Slope Pad, continued

Position the vehicle over the start point and use the GPS to measure its location. Once the vehicle is in position, verify the **Record At** location, and then press **Record**. The **NEZ** values can be edited after recording. Once completed, press **Next**.



Drive to the second point (calculates heading), verify **Record At** location, and click **Record**. The **Bearing, Distance,** and **Slope** can be edited after recording.



Continued on next page

Slope Pad, continued

The **Slope** measurement type can be changed by pressing the icon.

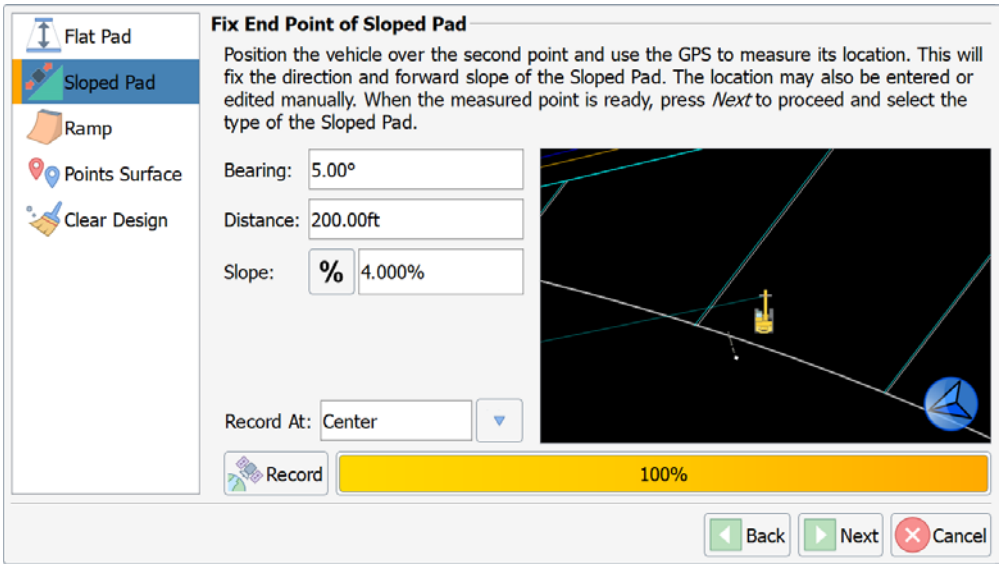


Table 5-2: Slope Icon Options

Icon	Description
%	Percentage
r/r	Run/Rise (reversible)
Δ	Delta elevation

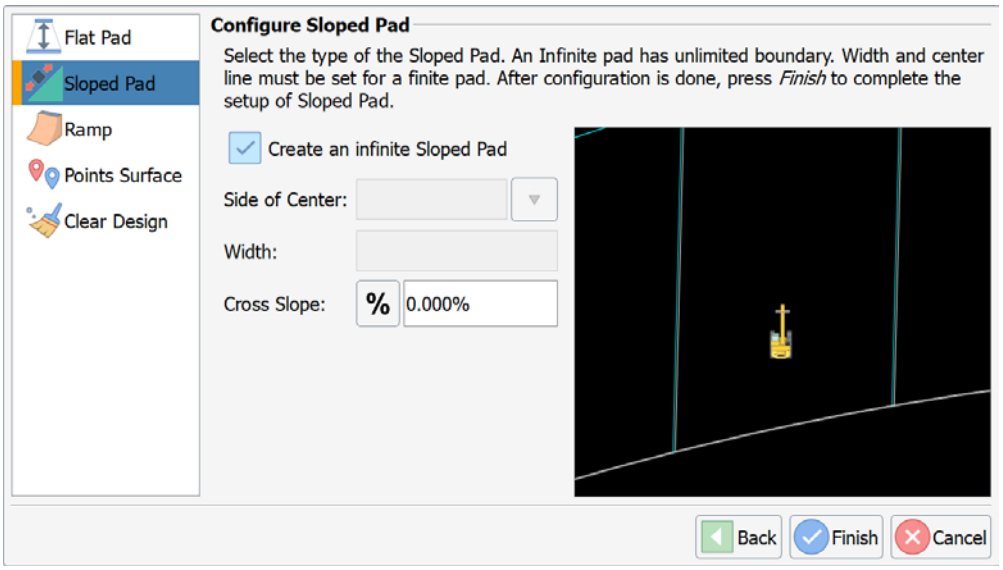
After settings are set, press **Next** to continue setup.

Continued on next page

Slope Pad, continued

In the last step of configuring a sloped pad, the user will need to select the type of sloped pad. An **Infinite** pad has an unlimited boundary, which is the default selection. If the user wants to use a finite pad, select the checkbox to unselect the Infinite pad. The user will need to select the **Side of Center**, **Width**, and **Cross Slope**. The **Cross Slope** measurement type can be changed by pressing on the icon, see **Table 5-2: Slope Icon Options** for more information.

After the information is entered, select **Finish** to complete **Slope Pad** creation.



Continued on next page

Ramp

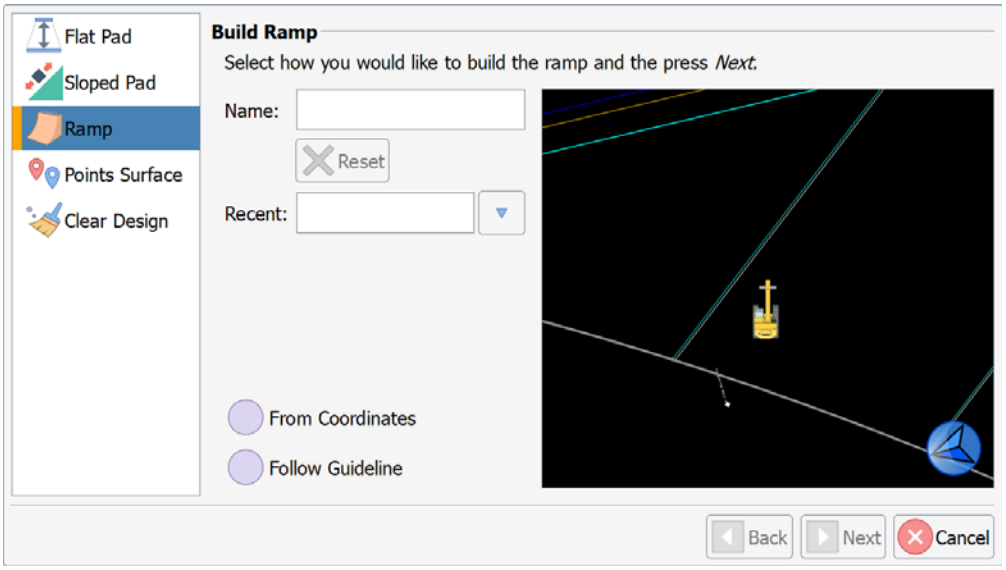
Choose **Ramp** to build the ramp by using coordinates or following a set guideline.

Note: If you do not have a guideline selected, you must create this ramp based on coordinates.

Enter a **Name** for the ramp by pressing inside the text box or the user can select an existing Ramp by using the dropdown arrow by **Recent**.

The user is required to select either **From Coordinates** or **Follow Guideline**. Guidelines can be selected from ones contained inside of the linework or from lines that are created through the Topo routine.

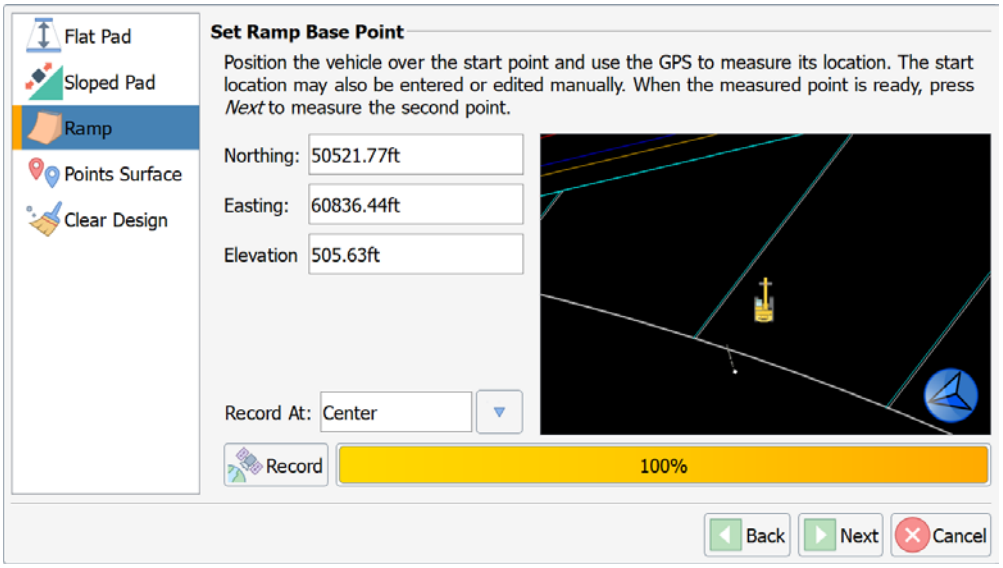
Press **Next**.



Continued on next page

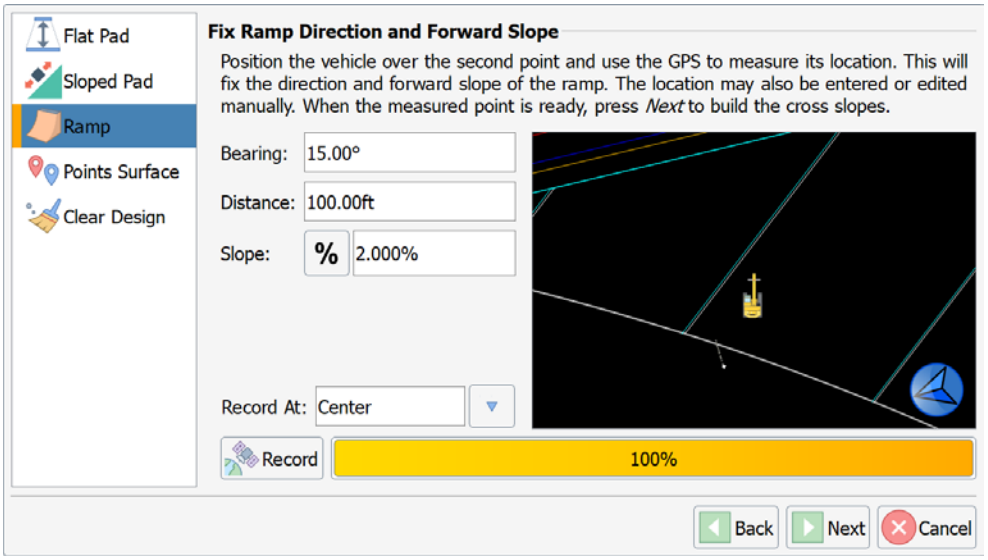
Ramp, continued

Drive to the starting point, verify **Record At** location, and select **Record**. The **NEZ** values can be edited after recording. Once completed select **Next**.



Drive to the second point (calculates heading), verify **Record At** location, and select **Record**. The **Bearing**, **Distance**, and **Slope** can be adjusted after recording.

Note: The Slope measurement type can be changed. See **Table 5-2** for more information.



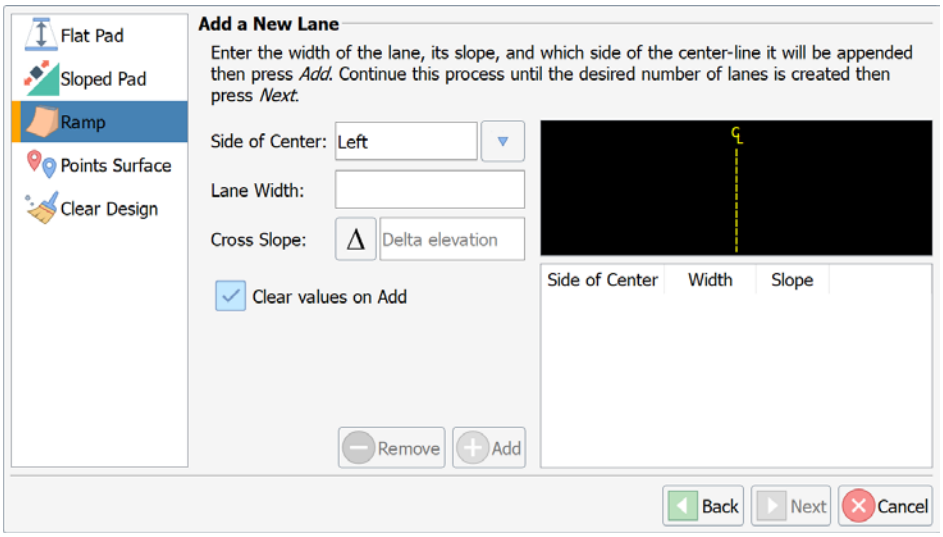
Continued on next page

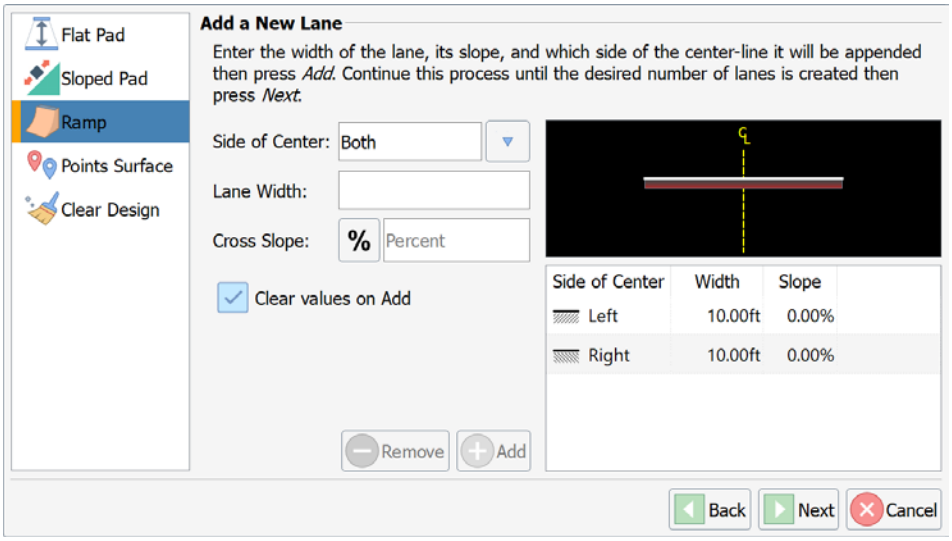
Ramp, continued

Select the **Side of Center** the lane will input on (left, right, or both). Enter the **Lane Width**. Enter **Cross Slope** for the lane. If there is not a cross slope, enter 0 (zero). Press **Add**.

Clear values on Add will clear the **Lane Width** and **Cross Slope** each time the **Add** button is pressed.

The user can add lanes to the design. They will be added, in the order they are entered, from the center line out.

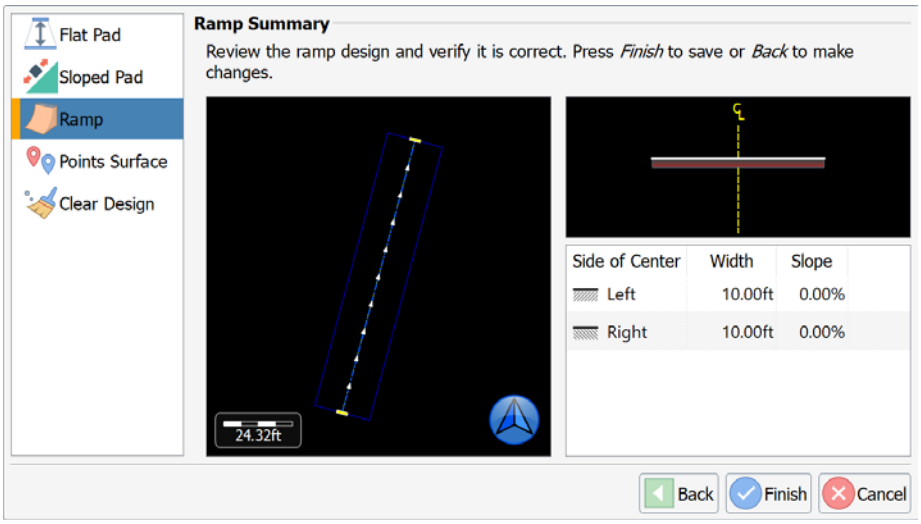




Continued on next page

Ramp, continued

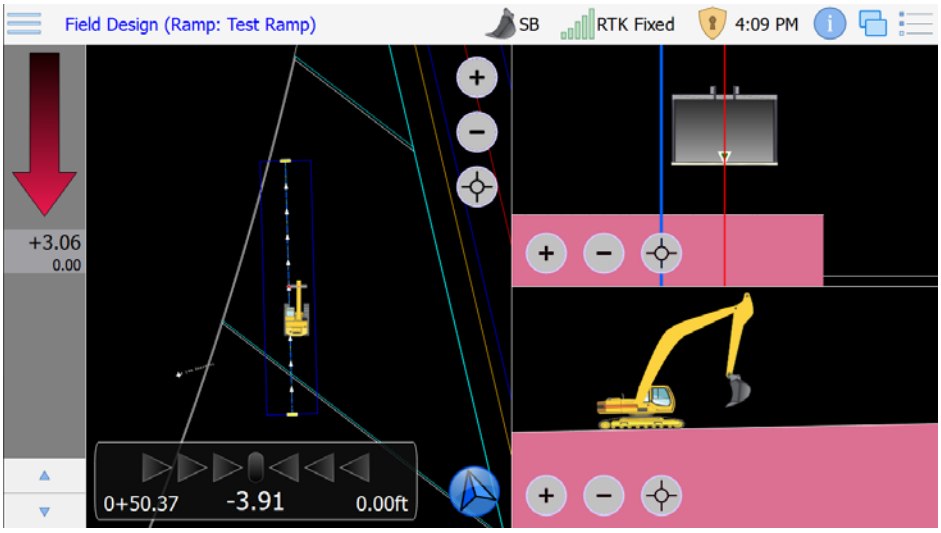
Review the ramp and press **Finish**.



The example below shows the newly created ramp (in blue).

Important: This ramp becomes the job design. If the machine is not on the ramp, the machine is off the job design.

The job on the top-left is shown as **Field Design** – indicating that you are not grading to your DTM but instead grading to the **Field Design**.



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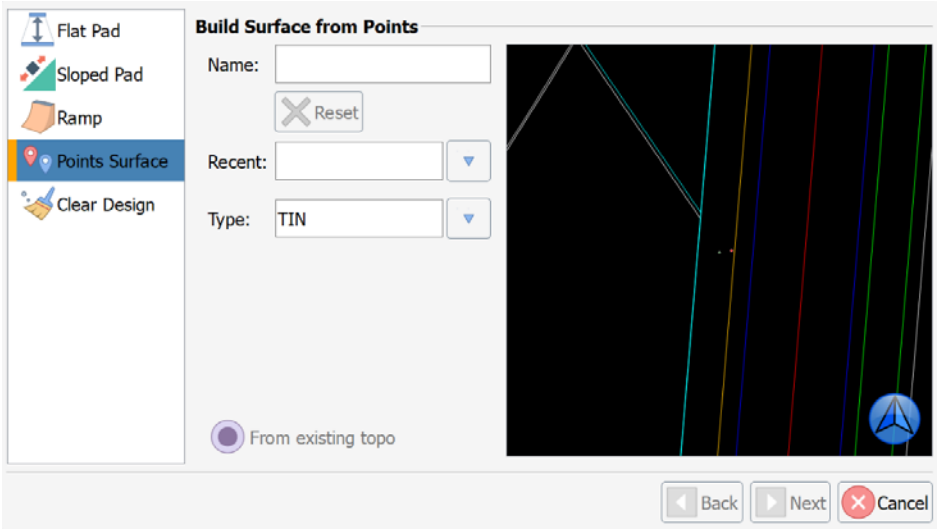
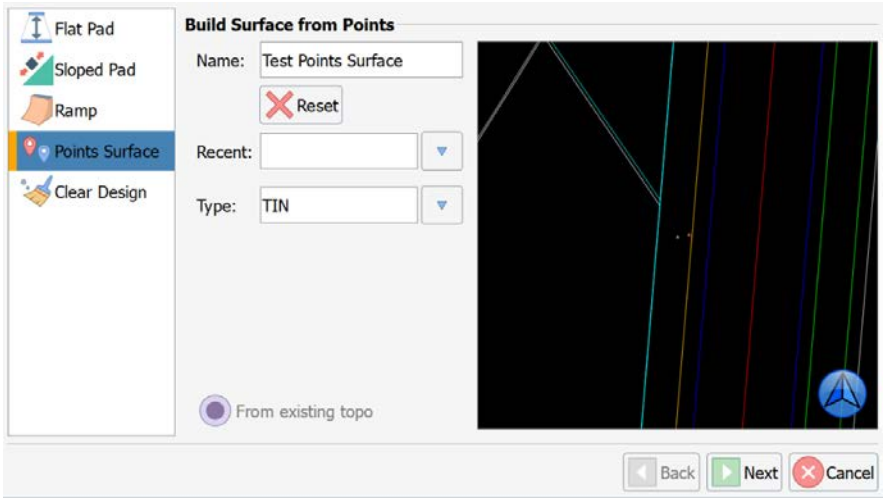
Points Surface

Choose **Points Surface** to build the surface by using points collected in an existing topo.



Enter a **Name** for the ramp by pressing inside the text box or the user can select an existing Points Surface by using the dropdown arrow by **Recent**. Select between **TIN** and **Best Fit Plane** for **Type.** If you select TIN, a surface is generated from points. TIN surfaces will capture the hills and valleys of your surface (accuracy varies based on resolution of the topo). **Best Fit Plane** will create a single best fit plane.

Press **Next**.



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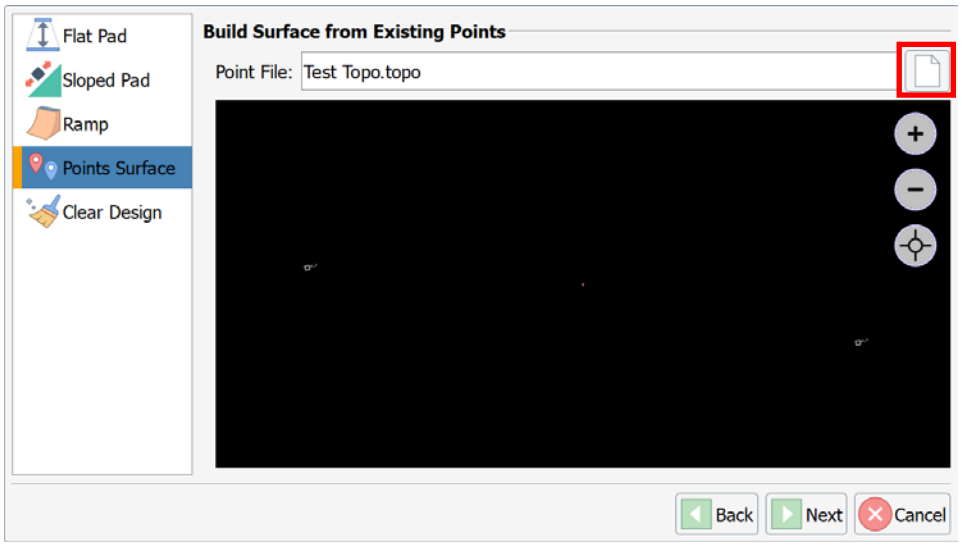
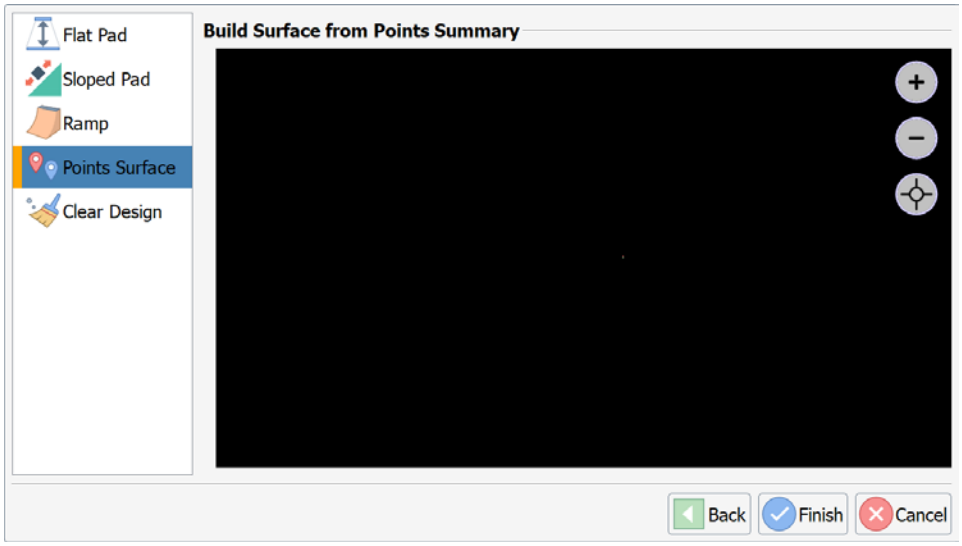
Points Surface, continued

Select the topo file that contains the points to use in surface creation. The last opened topo file will be automatically loaded. To change the **Point File** used, select the file icon to the right.

> **Note**: For information on creating and working with a topo file, see **Chapter 5: Topo**.



Press **Next**.



Press **Finish**.

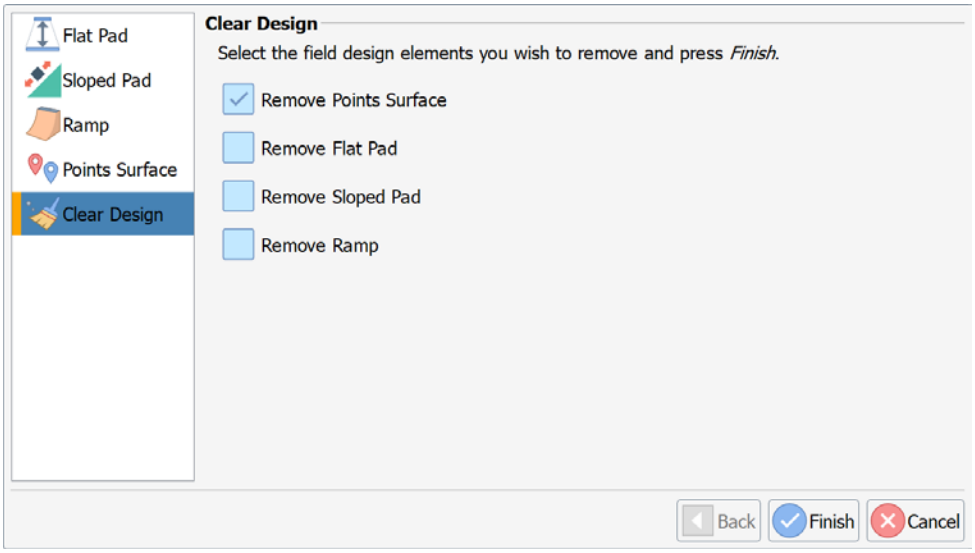
Continued on next page

Field Design, Continued

Clear Design

If you wish to remove a field design element (or multiple), click to select option(s) in the **Clear Design** list.

For example, to remove the flat pad option, click to select **Remove Points Surface**, and click **Finish**.

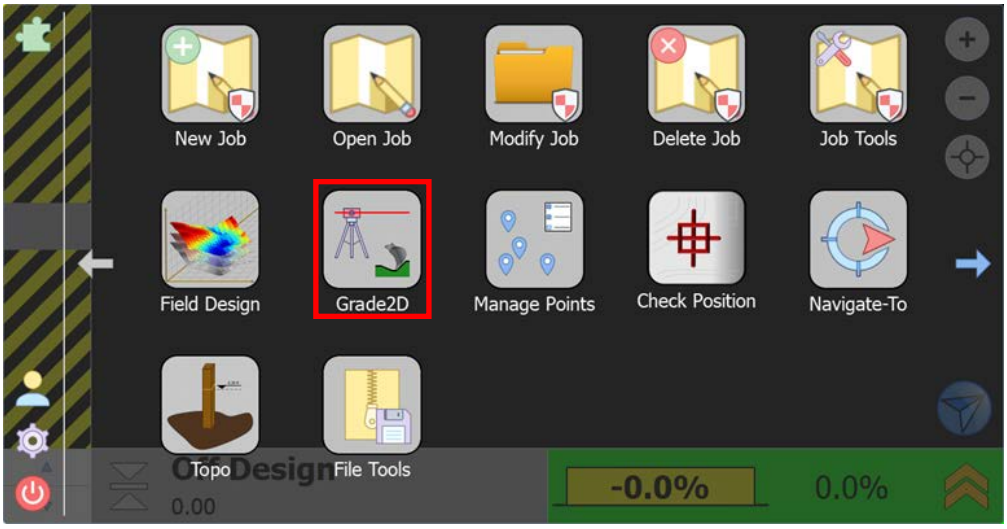


Your design elevation returns to the previously loaded Digital Terrain Model (DTM) file.

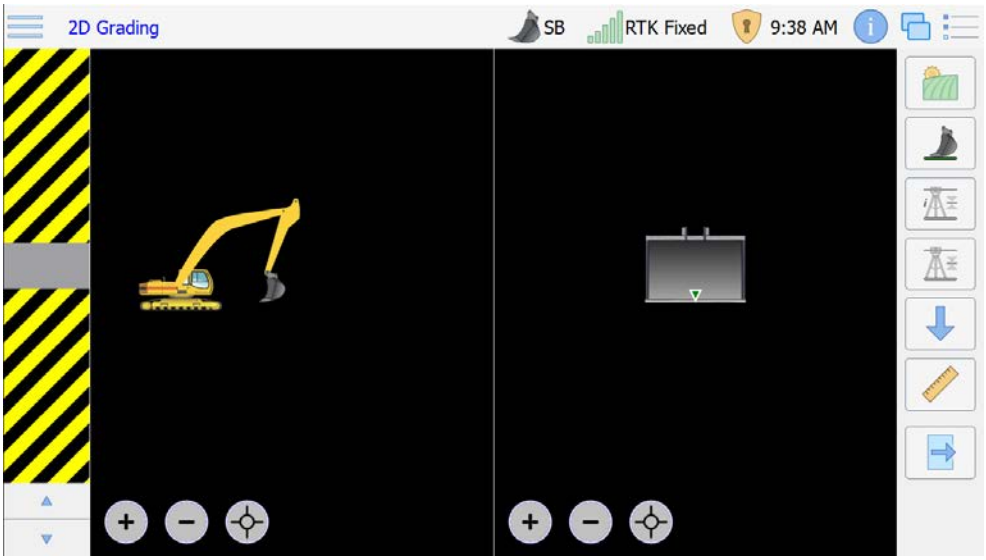
Grade 2D

Grade2D

GradeMetrix Excavator has a **2D** option. You can use an optional laser receiver on the excavator or bench each time you move the machine.



Once you are in **Grade2D,** your DTM/linework will disappear.



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Grade2D, continued

There are icons on the right of the screen. The following table lists the icons and definitions used in **Grade2D**.

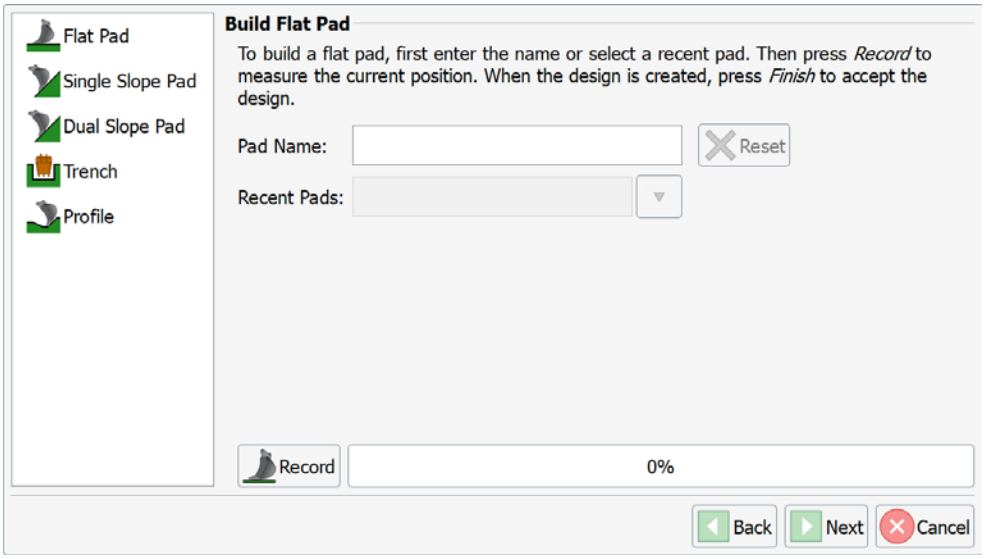
Table 5-2: Grade2D Icons and Definitions

Icon	Definition
	Create the main design work (flat pad, trench, profile, single slope pad, dual slope pad)
	Set reference elevation
	Capture initial laser reference
	Reference to laser level
	Cache current elevation for when traversing
	Measure a slope with the bucket
	Exit Grade2D

Continued on next page

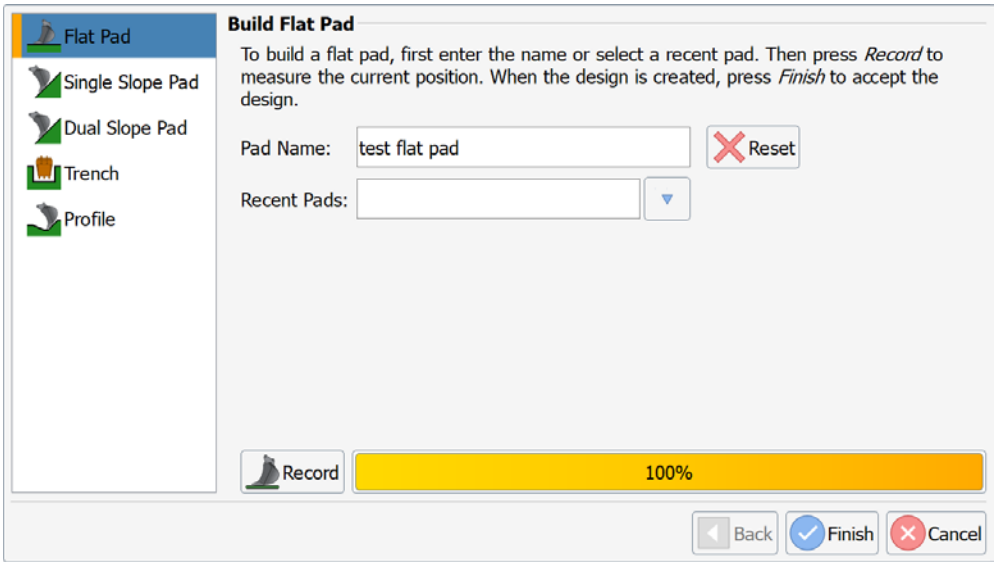
Grade2D, continued

When you enter **Grade2D**, the first step is to create a surface ( ).



Use **Flat Pad** to create a surface at a set elevation:

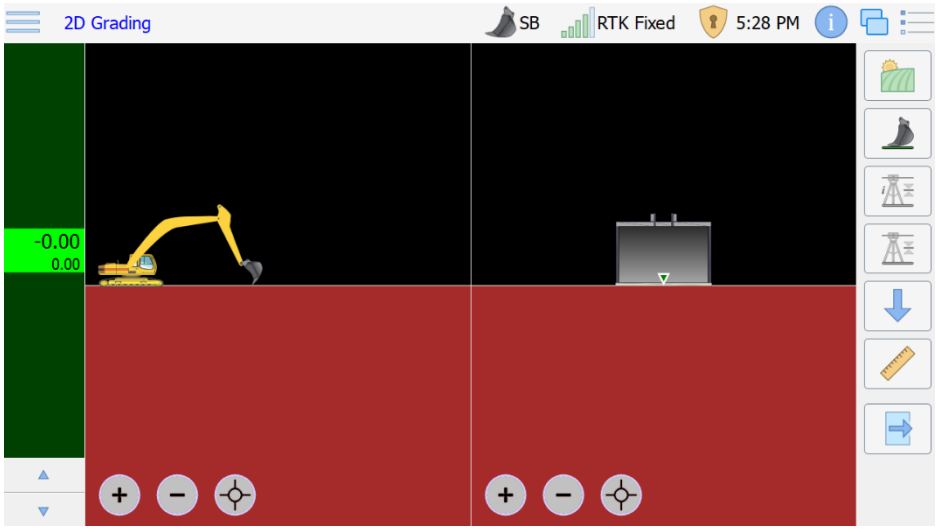
1. Type a **Pad Name** (or select a **Recent Pad**).
2. Set the **cutting edge** on a benchmark.
3. Press **Record** to measure the current position.
4. Press **Finish** to accept the design.



Continued on next page

Grade2D, continued

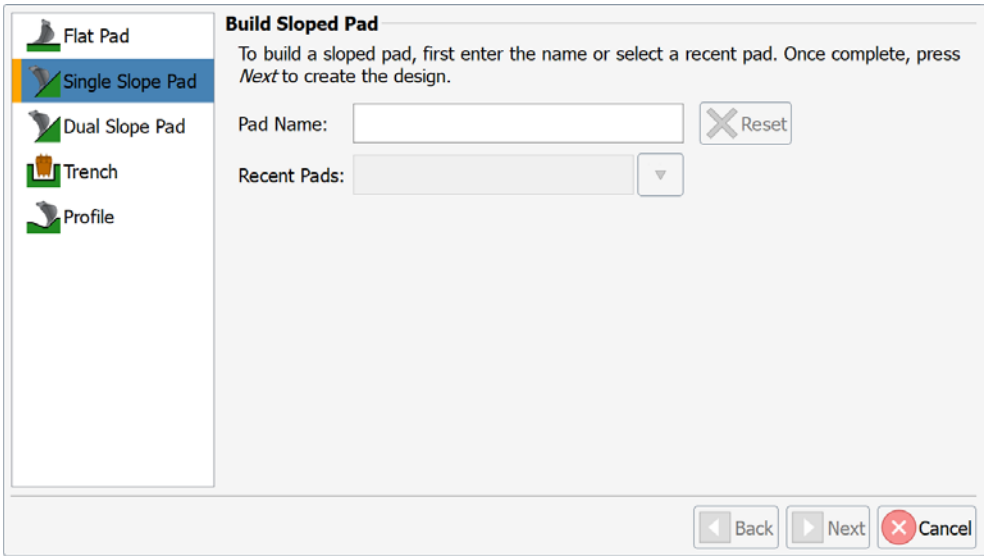
Below is the Grade2D screen with **Flat Pad** created.



Continued on next page

Grade2D, continued

To create a **Single Slope Pad**, first select the  icon.

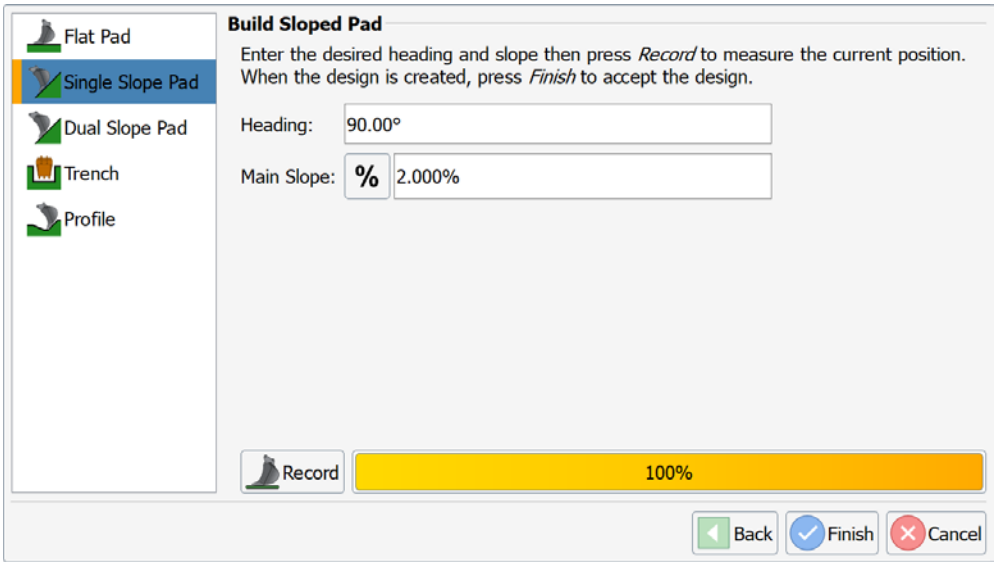


To build a Sloped Pad:

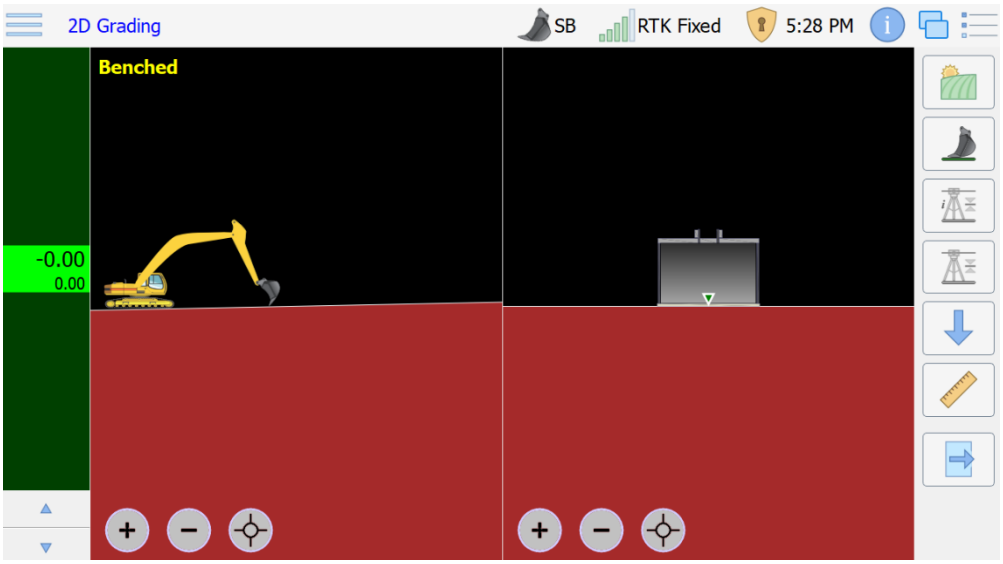
1. Enter the name of the pad or select a recent pad.
2. Press **Next**.
3. Press **Record** to measure the current position.
4. Enter the desired **Heading** and **Main Slope** value.
   a. The **Main Slope** measurement can be entered as 4 different options. See **Table 5-2: Slope Icon Options** for more information.
5. Press **Finish** to accept the design.

Continued on next page

Grade2D, continued



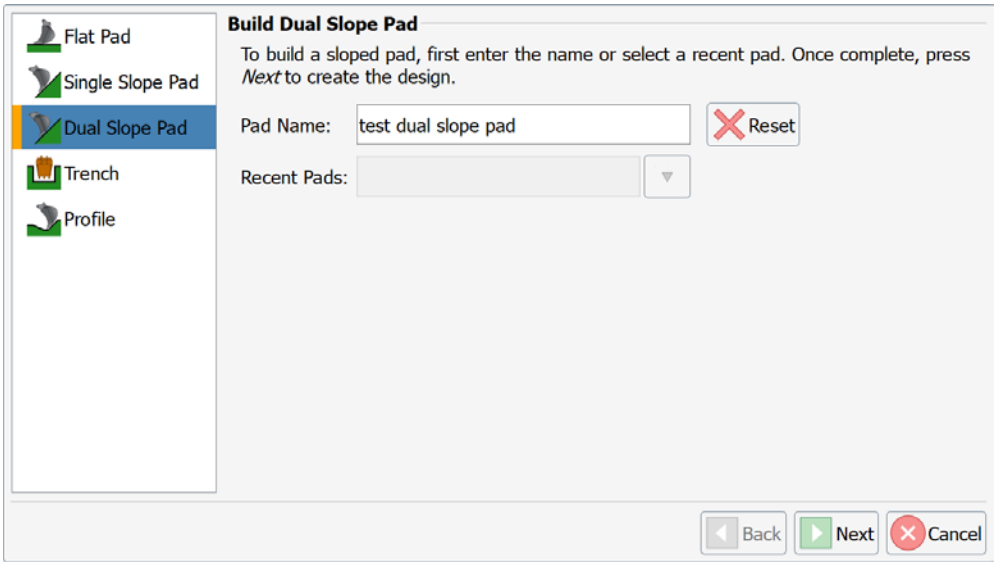
Below is the Grade2D screen with **Single Slope Pad** created.



Continued on next page

Grade2D, continued

To create a **Dual Slope Pad**, first select the  icon.

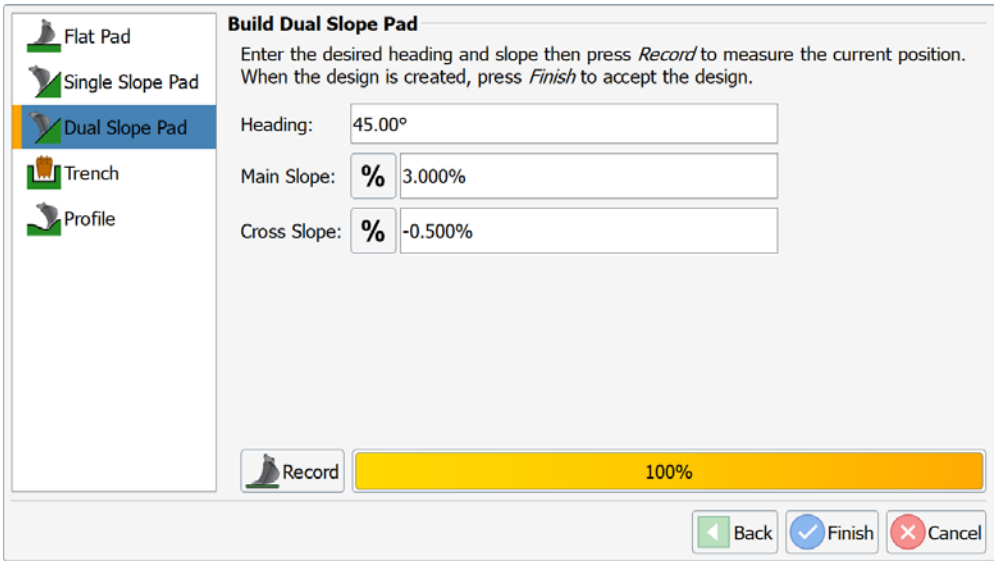


To set a **Dual Slope Pad**:

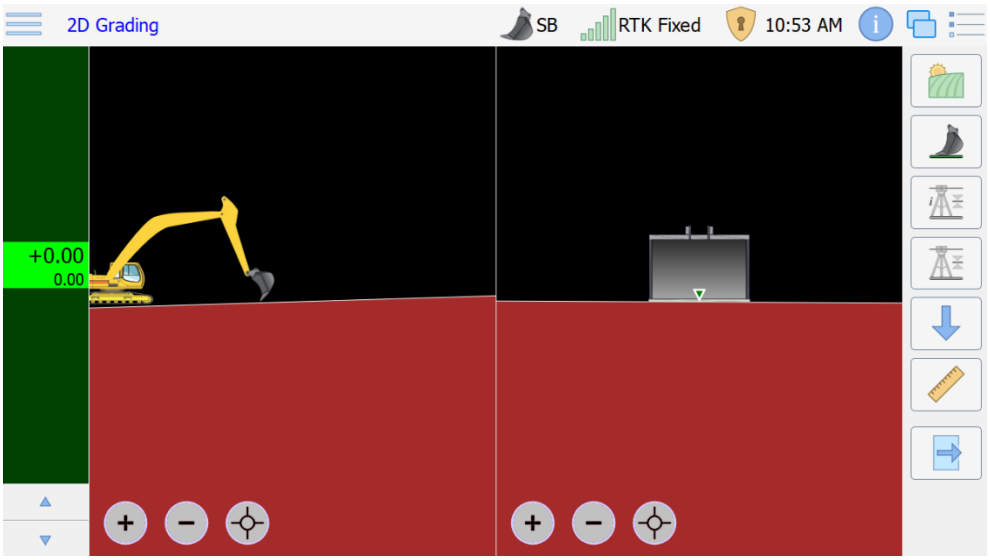
1. Enter the name for the pad or select a recent pad.
2. Press **Next**.
3. Press **Record** to measure the current position.
4. Enter the desired **Heading**, **Main Slope**, and **Cross Slope** measurement.
   a. The **Main Slope** and **Cross Slope** measurements can be entered as 4 different options. See **Table 5-2: Slope Icon Options** for more information.
5. Press **Finish** to accept the design.

Continued on next page

Grade2D, continued



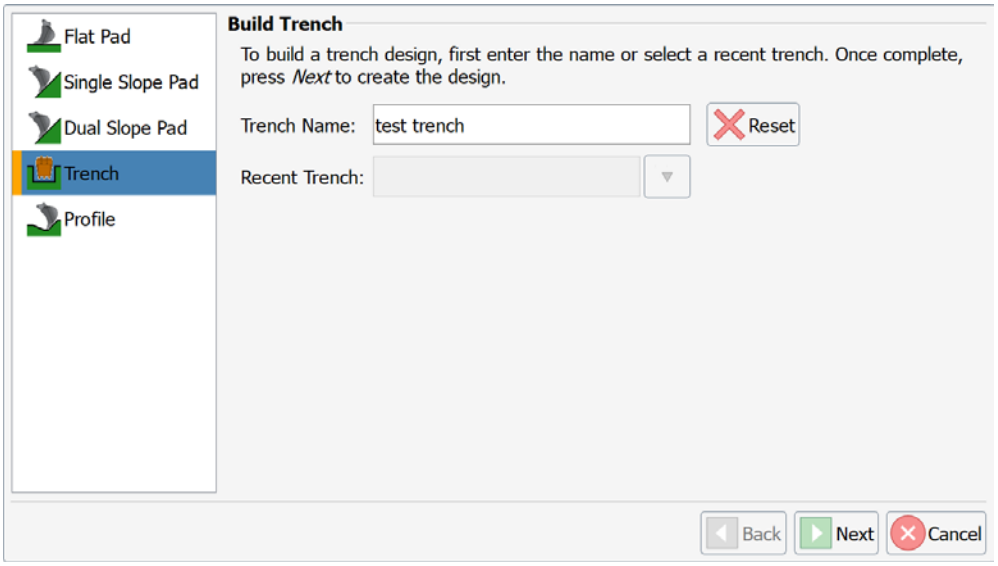
Below is the Grade2D screen with **Dual Slope Pad** created.



Continued on next page

Grade2D, continued

To create a **Trench**, first select the  icon.

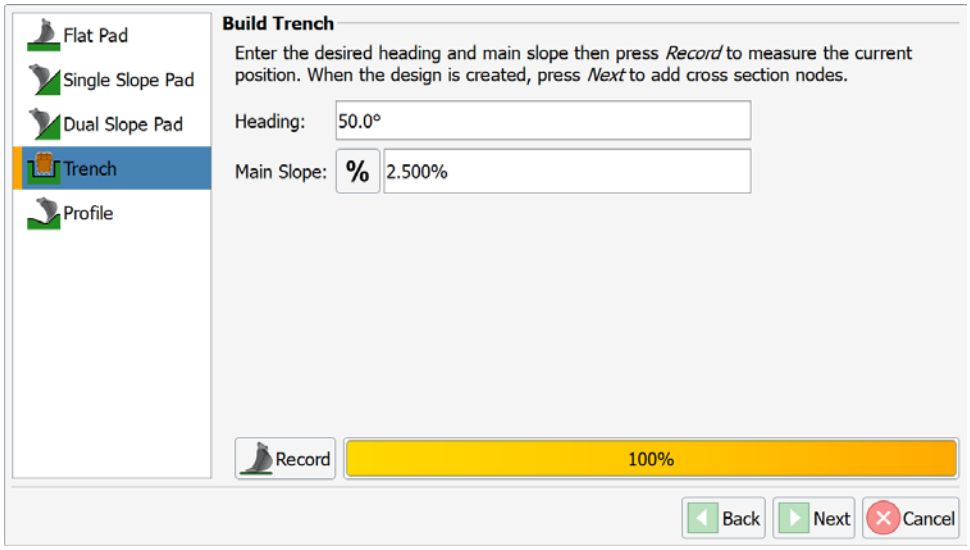


To set a **Trench**:

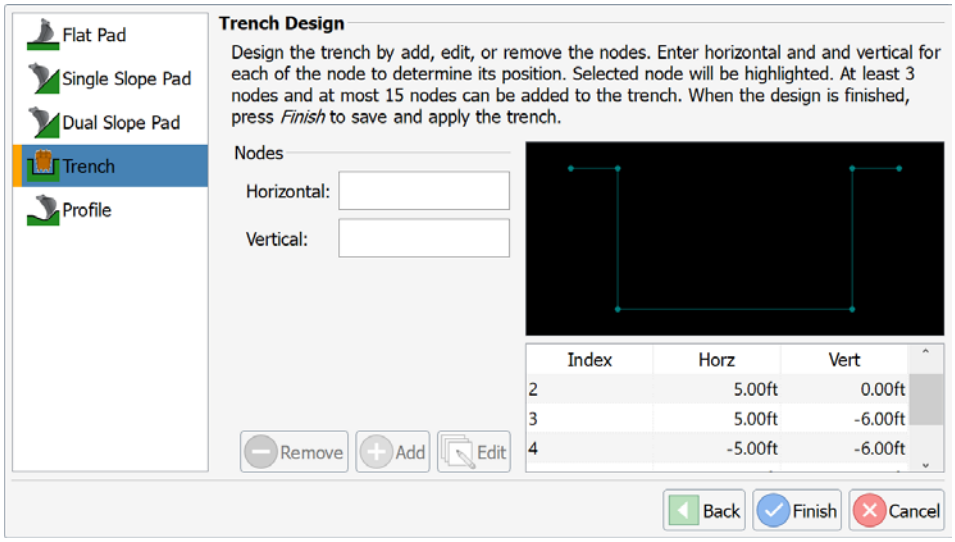
1. Enter the name for the trench or select a recent trench.
2. Press **Next**.
3. Press **Record** to measure the current position.
4. Enter the desired **Heading** and **Main Slope** measurement.
   a. The **Main Slope** measurement can be entered as 4 different options. See **Table 5-2: Slope Icon Options** for more information.
5. Press **Next**.

Continued on next page

Grade2D, continued



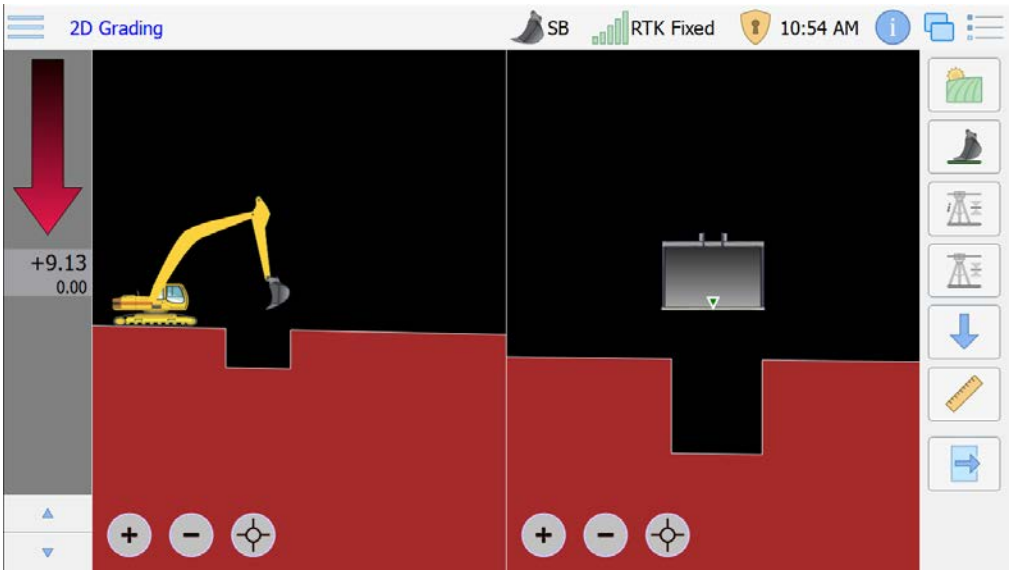
6. Design the **Trench** by entering nodes.
   a. Enter horizontal and vertical for each of the nodes to determine its position.
   b. The selected node will be highlighted.
   c. At least 3 nodes and at most 15 nodes can be added to the trench.
7. Nodes can be selected from the list and can be edited or removed from the design.
8. Press **Finish** to accept the design.



Continued on next page

Grade2D, continued

Below is the Grade2D screen with a **Trench** created.

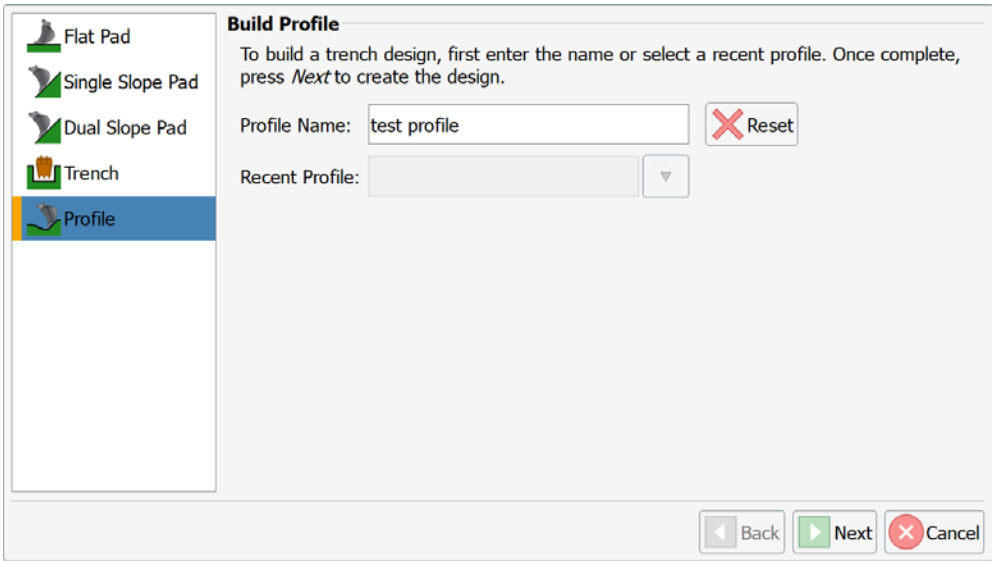


If you traverse the machine, you will need to re-bench. Set the bucket (point of interest) on a benchmark and click the **Set Reference Elevation** icon ( ).

Continued on next page

Grade2D, continued

To create a **Profile**, first select the  icon.

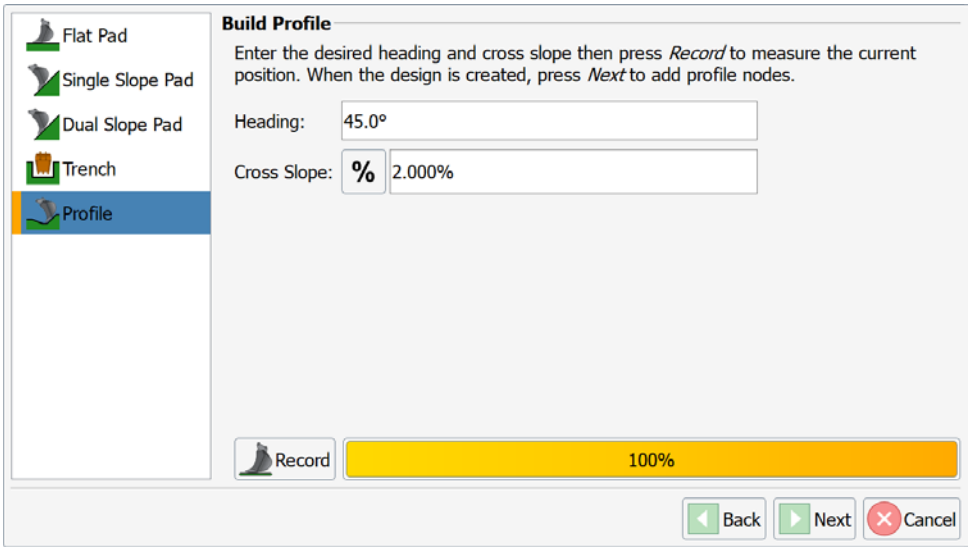


To set a **Profile**:

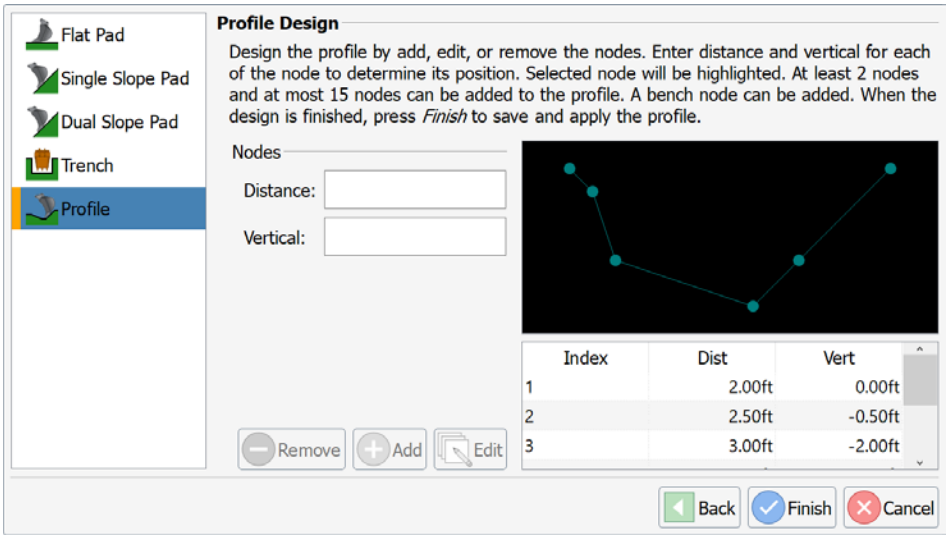
1. Enter the name for the trench or select a recent trench.
2. Press **Next**.
3. Press **Record** to measure the current position.
4. Enter the desired **Heading** and **Cross Slope** measurement.
    a. The **Cross Slope** measurement can be entered as 4 different options. See **Table 5-2: Slope Icon Options** for more information.
5. Press **Next**.

Continued on next page

Grade2D, continued



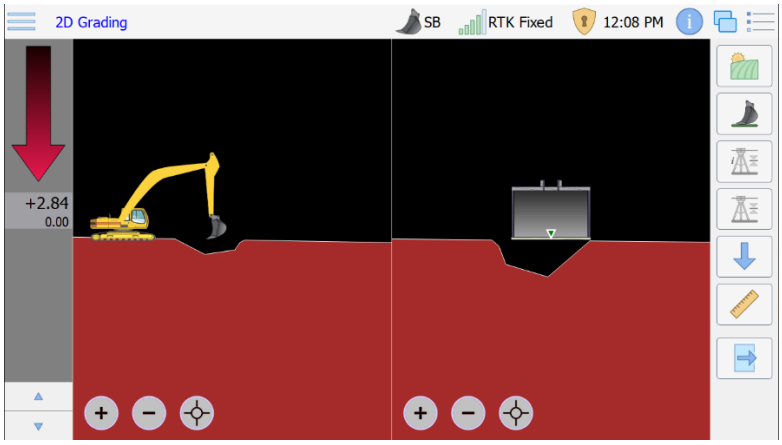
6. Design the **Profile** by entering nodes.
   a. Enter the distance and vertical for each of the nodes to determine its position.
   b. The selected node will be highlighted.
   c. At least 3 nodes and at most 15 nodes can be added to the profile.
7. Nodes can be selected from the list and can be edited or removed from the design.
8. Press **Finish** to accept the design.



Continued on next page

Grade2D, continued

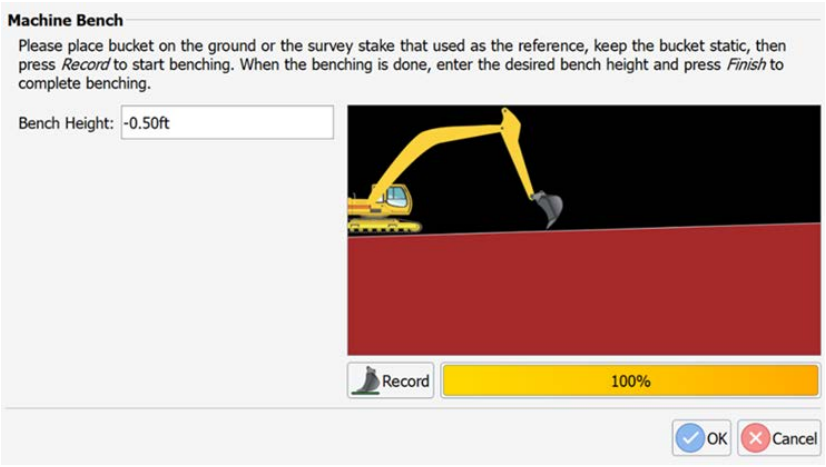
Below is the Grade2D screen with a **Profile** created.



If you traverse the machine, you will need to re-bench. Set the bucket (point of interest) on a benchmark and click the **Set Reference Elevation** icon ( ).

To **Bench** the machine, first select the icon.

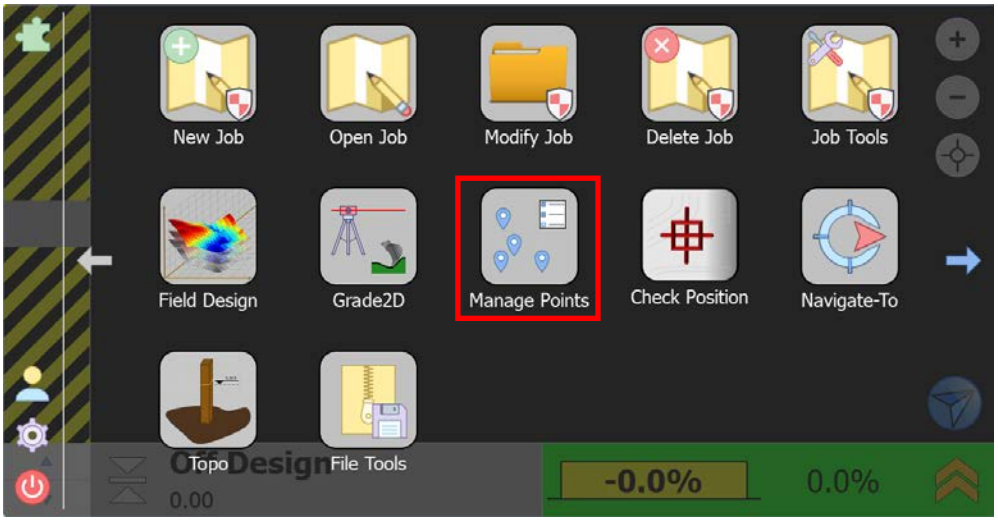
Place the bucket/blade on the ground or the survey stake that is used as the reference, keep the bucket/blade static, then press the **Record** button to start benching. When the benching is done, enter the desired bench height a press **Finish** to complete benching.



Manage Points

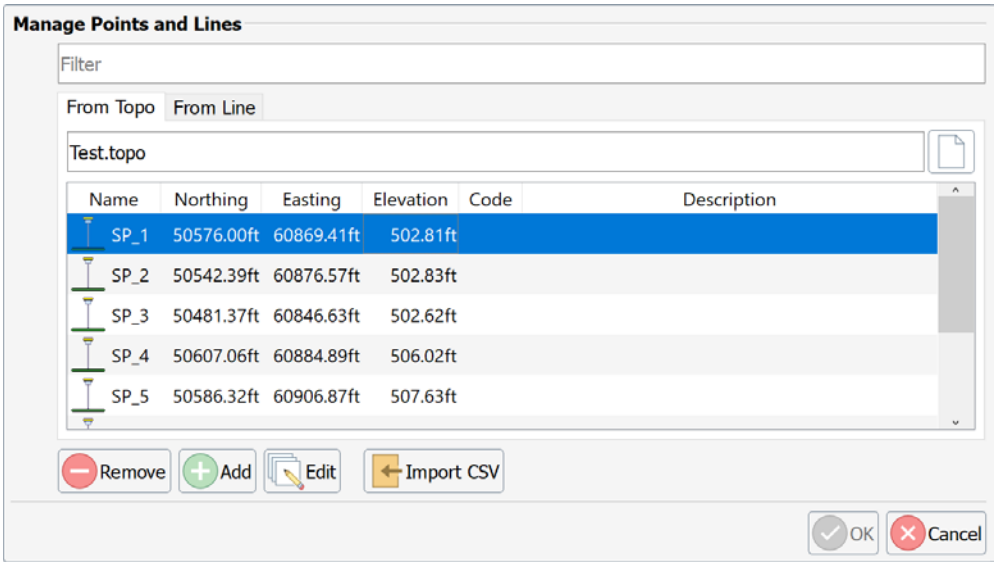
Manage Points

The **Mange Points** section is a shortcut to all points associated with the job and correlating files.



The file can be changed with the  icon on the right.

Points can be added, removed, or edited. .CSV files can be imported.



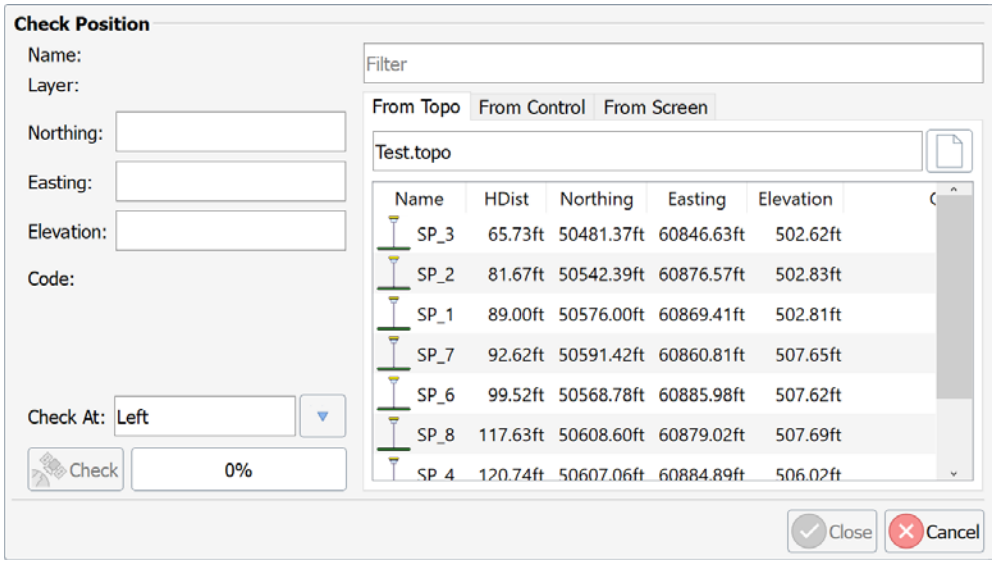
Check Position

Check Position

On the GradeMetrix **Main Menu**, click the **Check Position** icon.

Points can be selected from Topo, Control, or Screen.

The Topo file can be changed with the  icon on the right.



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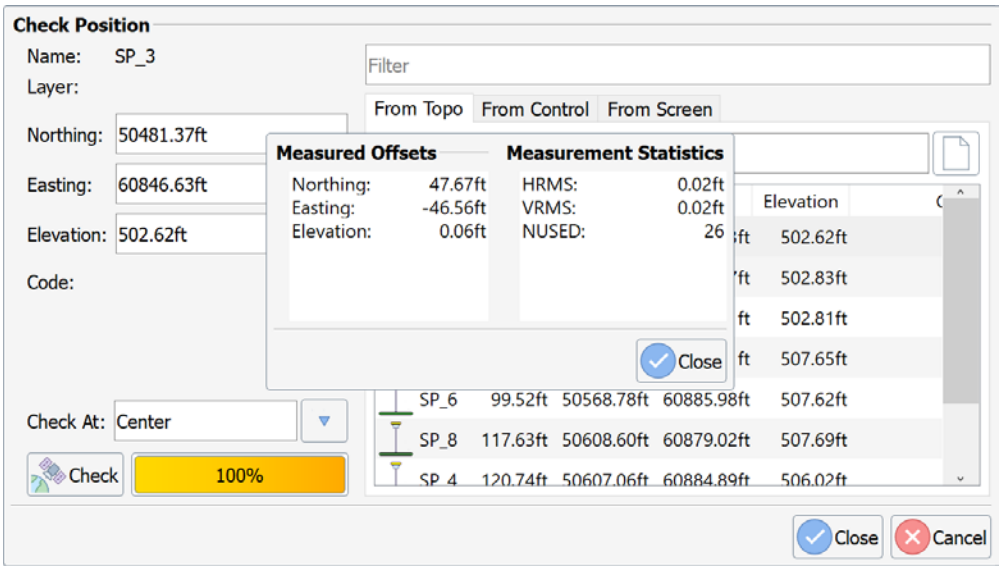
Check Position, Continued

Check Position, continued

Click to highlight the point name from the list or select a point on the **Screen**. When a point is selected, the information will be displayed on the left side of the screen. Select the location for the **Check At**. Press the **Check** button to record the current position. When completed, a window will display **Measured Offsets** and **Measurement Statistics** (see image below).

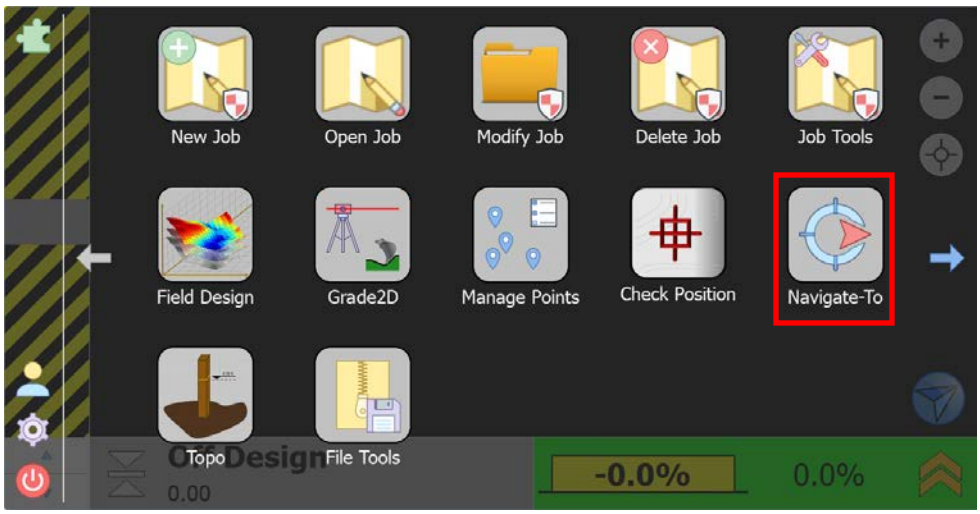


Navigation

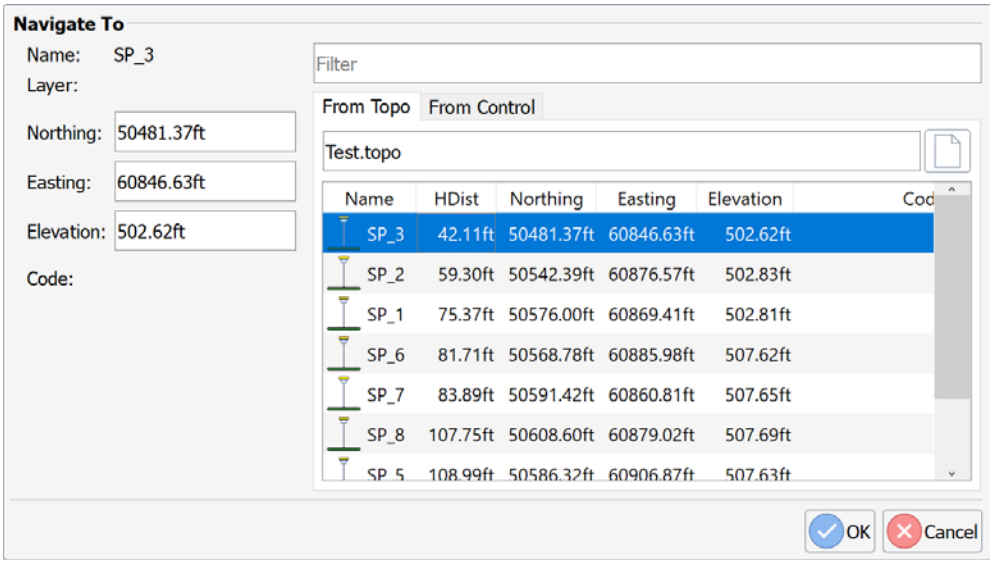
Navigate-To

The **Navigate-To** option provides real-time guidance (distance and direction).

On the GradeMetrix **Main Menu**, click the **Navigate-To** icon.



First, choose a point to navigate to. Press **OK**.



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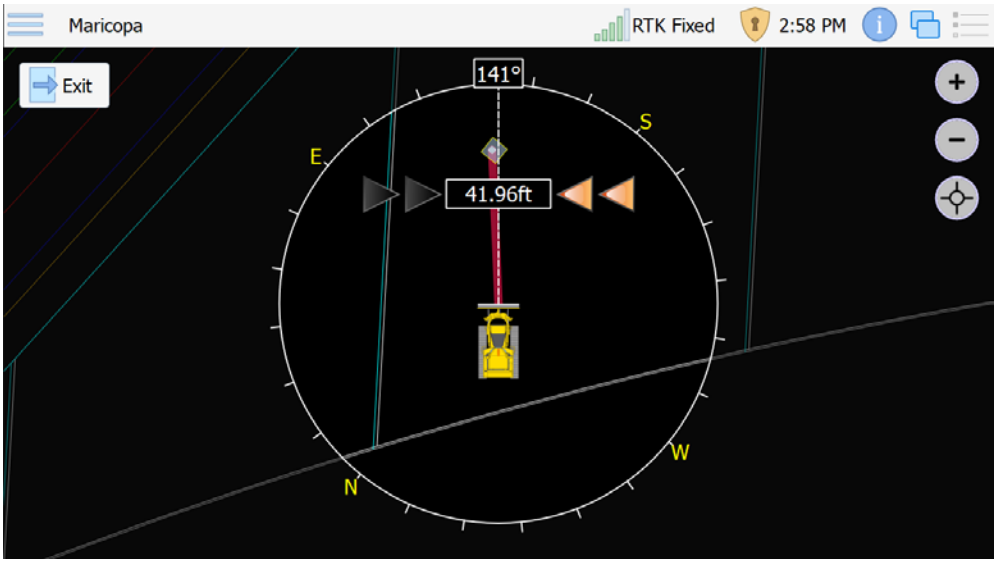
Navigation

A navigation screen displays showing the red line indicating the direction the machine should travel.

The dotted line shows the direction of the machine. The heading is shown in degrees. The arrows illuminate on the right or the left side, depending upon which direction the machine needs to move.

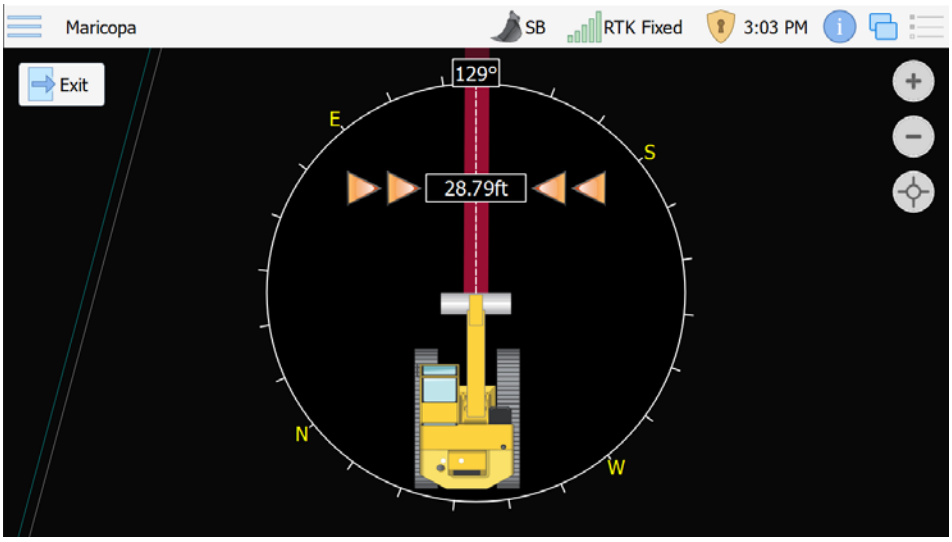
Distance shows how far the machine is from the point.ws



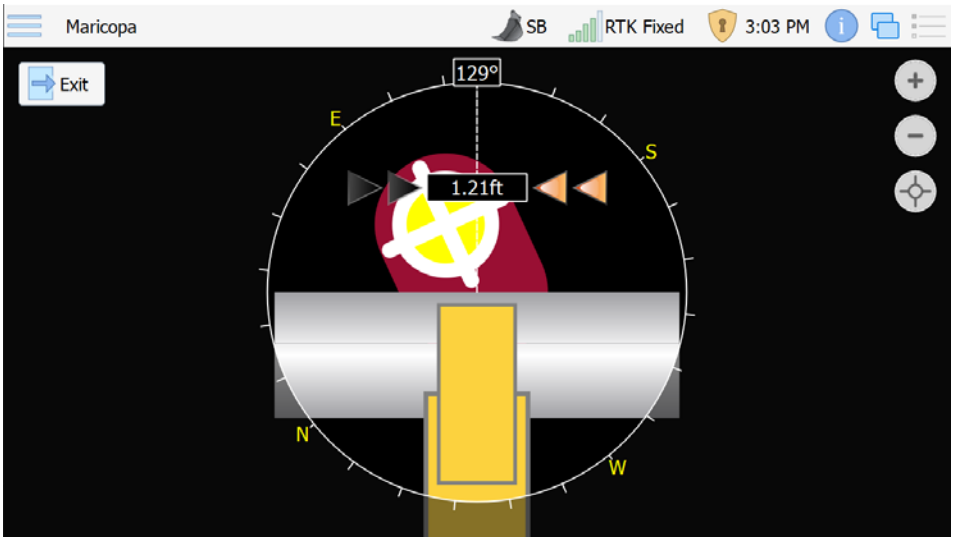
Continued on next page

Navigation, continued

Two illuminated arrows indicate how far the machine is off the line. As the position is corrected, the arrows indicate you are getting closer to the red line (correct position).



As the machine is driven closer, the screen begins to zoom in automatically.

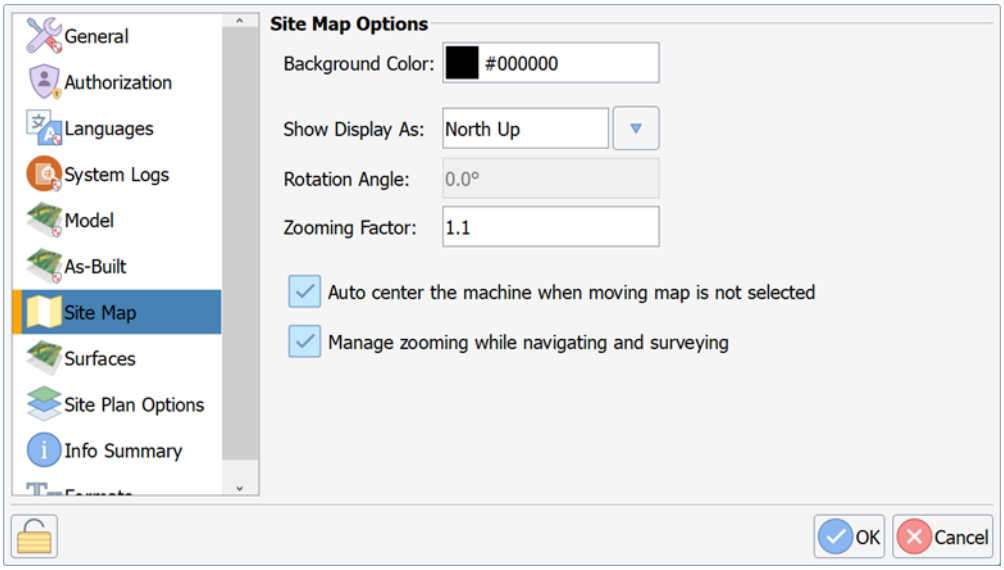


Continued on next page

Navigation, Continued

Navigation, continued

Note: To disable auto-zoom, go to **Settings -> Site Map -> Manage zooming while navigating and surveying**.

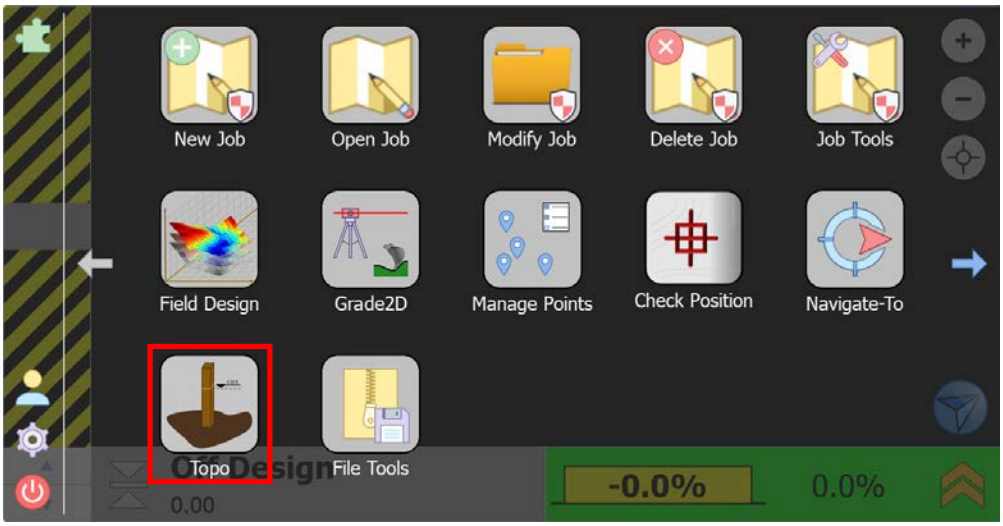


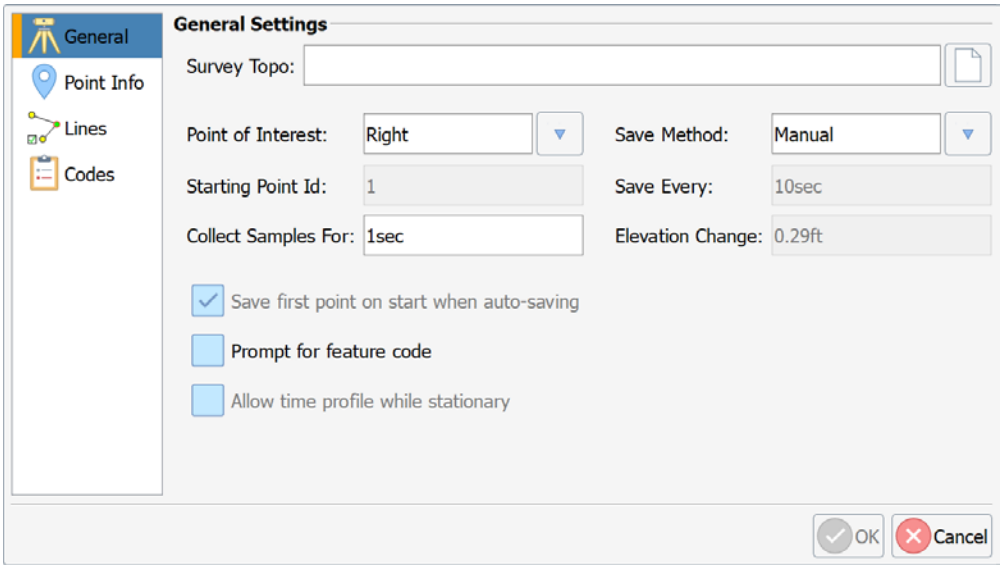
To exit **Navigation**, click the **Exit** button.

Topo

Topo

Use **Topo** to create a topo point file by either manually storing points, or auto-storing points by time or distance intervals.





Continued on next page

Topo, Continued

General Settings

The **General Settings** window displays the selections shown in the following table.

Table 5-3: General Topo Settings

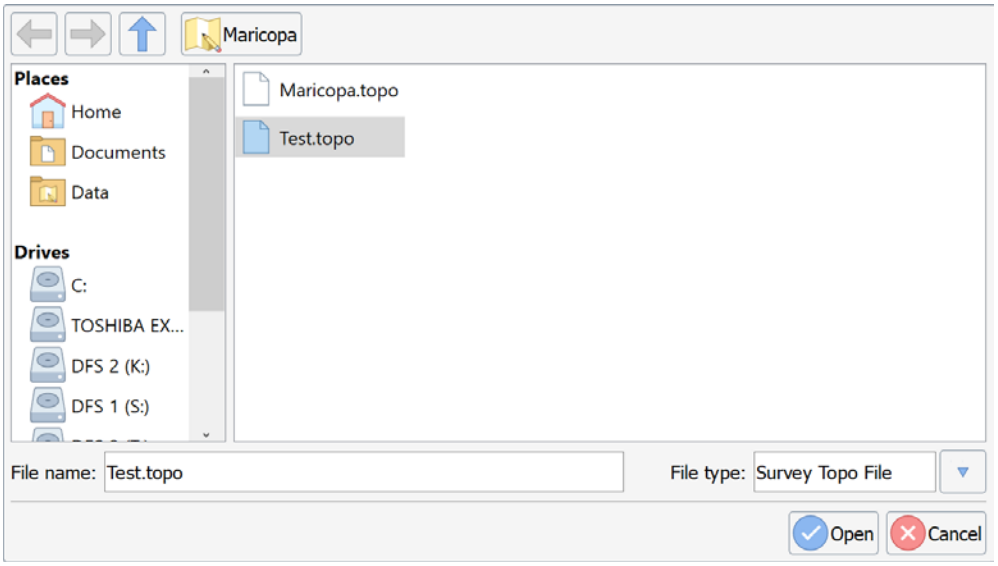
Setting	Description
Survey Topo	Name of the Topo file.
Point of Interest	Select the point of the machine that the NEZ will be taken from when storing points.
Starting Point Id	Each time a point is stored, a corresponding point ID is created. (For reference only)
Collect Samples For	When storing a manual point (not when auto-saving), the point will be averaged for this many seconds before saving.
Save Method	Click the down-arrow to select from the following options: – **Time**-the number input into **Save Every** must be in seconds. – **Distance**-store the point by distance interval. Type a distance value in the **Save Every** field. – **Manual**-store points only when **Single Shot** is pressed.
Elevation Change	If doing an auto-topo, a point will be stored if elevation changes by this value – even if the saving interval has not been met.
Save first point on start when auto-saving	Click the checkbox to select. This option may only be selected if the **Save Method** is **not** manual.
Prompt for feature code	The software prompts the user to select from one of the available feature codes.
Allow time profile while stationary	Click the checkbox to select. This option may only be selected if the **Save Method** is **Time**.

Continued on next page

Topo, Continued

Creating/ Selecting Topo File

On the **General** tab, click the document icon to the right of the **Survey Topo** field to select or create a new file.



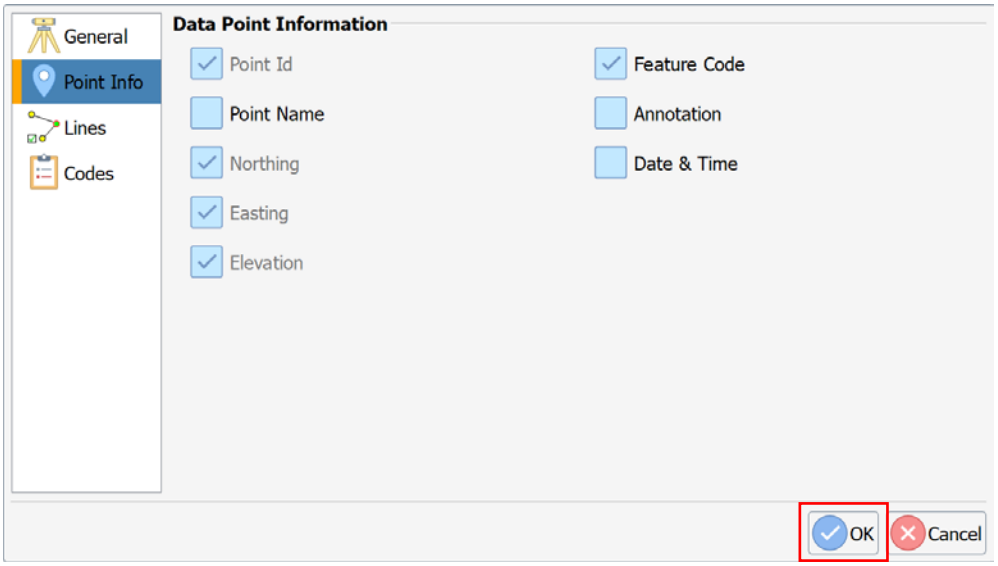
If creating a new Topo, type the name into the **File name** box. If selecting an existing Topo, press to highlight the desired file.

Press **Open.**

Continued on next page

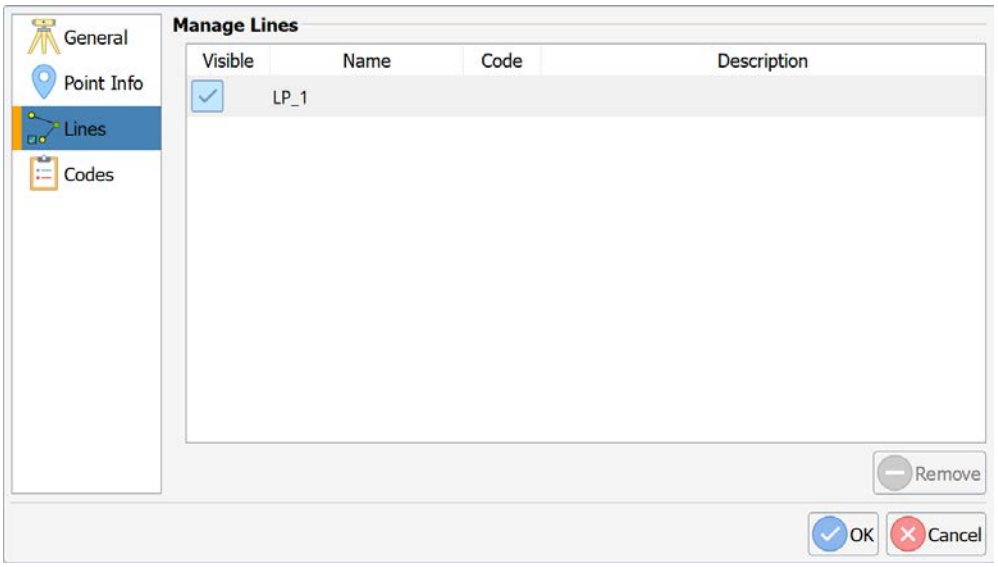
Point Info

Click the box to select the options you wish to save to the topo file. When you are finished making your selections, click **OK**.



Lines

Use the **Lines** section to manage lines associated with the **Topo** file.



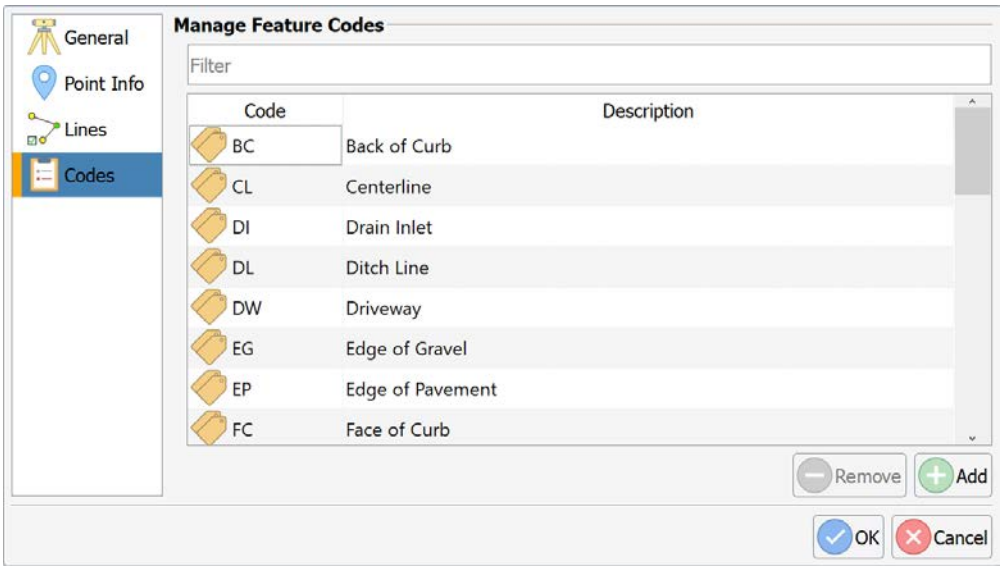
Continued on next page

Codes

You can select to prompt for **Feature Code**. When a point is stored, you will receive a prompt for a code.

The **Manage Feature Codes** screen displays the listing of feature codes. Click to highlight the **Feature Code** you wish to add and click **Add**. Press **OK**.

Note: Do not select this feature if auto storing points.



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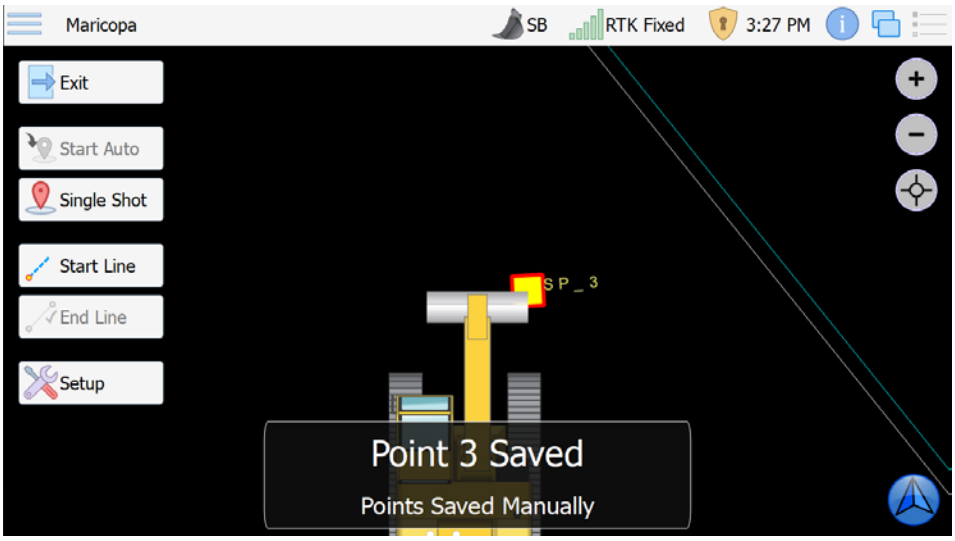
Storing Points and Lines

Note: If storing points manually, **Start Auto** is disabled.

To store a point, click **Single Shot**.



In the example above, locate the orange square on the right side of the cutting edge. This is the point just stored. Note it is on the right, as it was set up in settings (**Point of Interest**), and the message reads "**Point 3 Saved**".

To store a **Line**, use the **Start Line** icon to store the first point of the line. Must have at least 2 stored points for a line. When the last point is recorded, select the **End Line** icon to exit line creation.

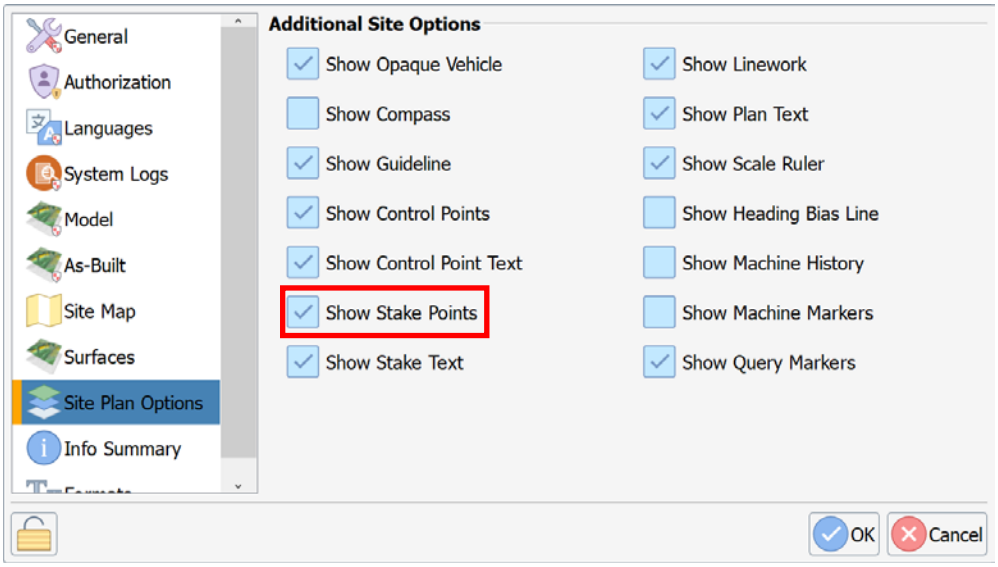
Continued on next page

Storing Points and Lines, continued

To exit, press the **Exit** icon in the top left corner of the screen.

Note: When you return to the **Plan View** you will not see the saved points.

To view stored points, go to **Settings -> Site Plan Options -> Show Stake Points**.



Appendix A: Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for common problems.

Contents

GradeMetrix Troubleshooting

Troubleshooting

Table A-1: Troubleshooting

Symptom	Possible Solution
Incorrect Position	First, check a control point with the machine and the survey rover. If the horizontal or vertical position is off, the first thing you should consider is if it is off by a consistent amount throughout the jobsite, or if the position bust varies throughout the job. If it is consistent, consider the following: • Check your machine measurements/offsets. If any of these are incorrect, your projected position will be off. • Bad localization. Make sure that all of the points in your localization file have low residuals and/or that the correct coordinate system has been chosen. If there is an inconsistent position bust, check: • Sensor mounting was incorrectly chosen and/or sensor was not calibrated. – The above is evident if your position is correct when flat, but not if you are on a slope • If the position at the GPS antenna is correct, but the position bust worsens as you approach the cutting edge, it may be a heading offset error.
No GNSS Position	• First, check to see if the VR500 or VR1000 is powered on. • If the receiver is not powered, disconnect the cable and use a multimeter to verify it is receiving power and ground. • Check the Monitor screen and Sky Plots to see if there is any data from the receiver. If there is no data, but the receiver is powered, there could be a bad serial connection/mismatched baud rate. If using a VR1000, use a multi-meter to measure the voltage from the primary antenna port. The voltage should be 5V. If it is reading 5V from the receiver, check the other end of the cable (that would plug into the antenna). If there is not any voltage, it may be a damaged cable or bulkhead connector.

Continued on next page

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
No RTK	• If using a base station onsite (versus an NTRIP service), first check to verify the base station is turned on. • If the base station is turned on and sending RTK out over UHF, check to see if the Tx (or TD on some radios) light is flashing once per second. • Verify that the other rovers on the job site are receiving RTK corrections, if available. • If it is flashing once per second, check to verify the settings (frequency, bandwidth, forward error corrections, modulation, and protocol) at the base match that of the rover. • Check to see if the UHF light at the rover is blinking once per second. • The receiver may be out of the UHF range. Consider installing the external UHF antenna (if using a VR500). You may need to install repeaters. See if the RTK corrections work when the machine is closer to the base station. • If using NTRIP, check cellular connectivity. One option is to exit GradeMetrix and verify you can go to a website via the browser.

Continued on next page

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
Terminal will not power on	• Check to verify the power cable is connected to machine power. The positive should go to a reliable, clean power source and ground to the chassis of the machine. • Disconnect the cable and refer to the pinout to see if 12V or 24V (depending on the machine) is going into the terminal by using a multi-meter. If the multimeter reads 12V or 24V, then power is confirmed, and the terminal may need to be serviced. If you do not have any power, then check your power source, ground, and all fuses.
No Heading	• If using a VR1000, you need two external antennas. Use a multi-meter to check the voltage coming out of the N-type connectors Is 5V. If 5V is coming from the receiver, check the other end of the cable (that would plug into the antenna). If there is no voltage, then it is a damaged cable or bulkhead connector. • If using a VR1000, check your MSEP antenna separation measurement. It is the distance, in meters, between the two antennas, and must be accurate to within 2 cm.
No Cut/Fill	• Check to see if your GNSS receiver is RTK Fixed. If **Settings -> Model -> Enabling Cut/Fill** is set to “When RTK Fixed” (the default, and suggested, setting), cut/fill will be disabled if the GNSS receiver is not RTK Fixed • Check your RMS tolerances. If HRMS or VRMS is higher than configurable values in Settings -> Model, cut/fill will be disabled. • Check to make sure the receiver has a valid GNSS heading.

Appendix B: Supported Hardware

Overview

Introduction

Appendix B contains the pin-out and data specifications of GradeMetrix supported hardware.

Contents

VR500 pin-out

Figure B-1 shows the power/data cable pin-out assignments for the VR500 Smart Antenna.

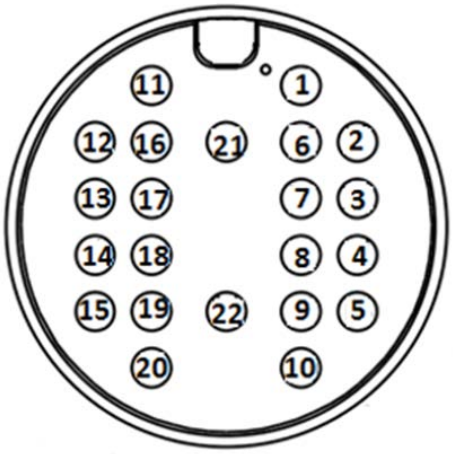


Figure B-1: VR500 pin-out assignments

Continued on next page

VR500 pin-out, continued

Table B-1 shows the cable pin-out specifications.

Table B-1: VR500 pin-out specifications

Pin	Function	Color
1	Power +	Red
2	CAN1 High	Orange-Black stripe
3	CAN1 Low	Yellow-Black stripe
4	Port B RS-232 RX/RS-422 A	Orange
5	Port B RS-232 TX/RS-422 Z	Yellow
6	CAN2 High	Green
7	CAN2 Low	Blue
8	Port B RS-422 B	Purple
9	Port B RS-422 Y	Grey
10	PPS Output	White
11	Port A RS-232 RX	Pink
12	Port A RS-232 TX	Turquoise
13	Signal Ground	Black-White stripe
14	Ethernet TD+	Brown-White stripe
15	Ethernet TD-	Red-White stripe
16	Heading Warning	Orange-White stripe
17	Speed Output	Green-White stripe
18	Ethernet RD+	Blue-White stripe
19	Ethernet RD-	Purple-White stripe
20	Manual Mark Input	Red-Black stripe
21	Power +	Brown
22	Power -	Black

Continued on next page

VR500 Data Specifications

The following lists the data specifications for the VR500 Smart Antenna.

Table B-2: VR500 Sensor

Item	Specification
Receiver type	GNSS Position & Heading RTK Receiver
Channels	1059
Sensitivity	-130 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, and 20 Hz optional
Horizontal accuracy	<table><tr><th></th><th>RMS (67%)</th><th>2DRMS (95%)</th></tr><tr><td>RTK[1,2]</td><td>8 mm + 1 ppm</td><td>15 mm +2 ppm</td></tr><tr><td>Atlas</td><td>0.04 m</td><td>0.08 m</td></tr><tr><td>SBAS [1]</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA[1]</td><td>1.2 m</td><td>2.4 m</td></tr></table>
Heading accuracy	0.27° RMS
Pitch/roll accuracy	1° RMS
ROT	100°/s maximum
Timing (PPS) accuracy	20 ns
Cold start time	< 40 s typical (no almanac or RTC)
Warm start time	< 20 s typical (almanac and RTC)
Hot start time	< 5 s (almanac, RTC, and position)
Maximum speed	1,850 km/h (999 kts)
Maximum altitude	18,000 (59.055 ft)
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3, L-band (Atlas)
Antenna LNA gain input	10 to 40 dB

Continued on next page

VR500 Communication Specifications

Table B-3: VR500 Communication

Item	Specification
Ports	2 full-duplex: 1x RS-232, 1x RS-232/RS-422, CAN
Baud rates	4800 - 230400
Data I/O protocol	Output: NMEA 0183, NMEA 2000, Hemisphere GNSS Proprietary ASCII and Binary Messages Input: Hemisphere GNSS Proprietary ASCII and CAN commands (for configuration)
Correction I/O protocol	Hemisphere GNSS ROX, CMR, CMR+, RTCM v2.3 (DGPS), RTCM v3x incl MSM
Timing output	PPS, CMOS, active low, programmable falling or rising edge sync, 10kΩ, 10 pF load
Ethernet	1x

VR500 Power Specifications

Table B-4: VR500 Power

Item	Specification
Input voltage	9-32 VDC
Power consumption	10.8W Maximum (All signals and L-band)
Current consumption	1.2A Maximum

Continued on next page

VR500 Environmental Specifications

Table B-5: VR500 Environmental

Item	Specification
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration	Shock: 50Gs, 11ms half sine pulse (MIL-STD-810G w/Change 1 Method 516.7 Procedure 1) Vibration: 7.7Grms (MIL-STD-810G w/Change 1 Method 514.7 Category 24)
EMC[4]	CE (ISO 14982/EN 13309/ISO 13766/IEC 60945) Radio Equipment Directive 2014/53/EU, E-Mark, RCM
Enclosure	IP69

VR500 Mechanical Specifications

Table B-6: VR500 Mechanical

Item	Specification
Dimensions	68.6 L x 22 W x 12.3 H cm
Weight	3.9 kg
Status indication	Power, GNSS, Heading, Radio
Power/Data connector	22-Pin environmentally sealed

Continued on next page

VR500 L-band Sensor Specifications

Table B-7: VR500 L-band Sensor

Item	Specification
Receiver type	Single Channel
Channels	1530 to 1560 MHz
Sensitivity	-130 dBm
Channel spacing	5.0 kHz
Satellite selection	Manual and Automatic
Reacquisition time	15 seconds (typical)

VR500 Aiding Device Specifications

Table B-8: VR500 Aiding Device

Device	Description
Gyro	Provides smooth heading, fast heading reacquisition, and reliable < 0.5° per minute heading for periods up to 3 minutes when loss of GNSS has occurred.[4]
Tilt sensor	Provide pitch and roll data and assist in fast startup and reacquisition of heading solution.

[1.] Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity
[2.] Depends on multipath environment, number of satellites in view, WAAS coverage, and satellite geometry
[3]. Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for differential services), and ionospheric activity
[4.] Based on a 40 second time constant
[5.] Hemisphere GNSS proprietary

VR1000 pin-out

Figure B-2: VR1000 pin-out assignments

1. Primary antenna
   GNSS_RF1+5V
2. Secondary antenna
   GNSS_RF2+5V
3. Radio antenna
   Radio RF
4. BT/Wi-Fi antenna
   BT/Wi-Fi RF

Continued on next page

VR1000 pin-out, continued

Table B-9 lists the VR1000 connector pin-out.

Table B-9: VR1000 Connector Pin-out

Pin	Description	Note
1	CAN2_L	CAN2 Low
2	CAN1_H	CAN1 High
3	RD-	Ethernet RX-
4	TD-	Ethernet TX-
5	PA_RX	RS232 Port A Rx
6	PPS	1PPS OUT
7	RS422 TX+/SPEED OUT	Port B RS422 TX+/SPEED OUT
8/15	POW-	Power Ground
9	CAN2_H	CAN2 High
10	CAN1_L	CAN1 Low
11	RD+	Ethernet RX+
12	TD+	Ethernet TX+
13	PA_TX	RS232 Port A Tx
14	RS422 RX-/EVENT MARK	Port B RS422 RX-/EVENT MARK
16	CAN2_Shield	CAN2 Shield
17	CAN1_Shield	CAN1 Shield
18/19	GND	Signal Ground
20	RS232_TX PB RS422_TX-	Port B RS232 TX/RS422 TX-
21	RS232_RX PB RS422_RX+	Port B RS232 RX/RS422 RX+
22/23	POW+	Power Positive

Continued on next page

VR1000 Data Specifications

Table B-10: VR1000 Receiver

Item	Specification
Receiver Type	GNSS Position & Heading RTK Receiver
Signals Received	GPS, GLONASS, BeiDou, Galileo, QZSS, NavIC (IRNSS) and Atlas
Channels	1059
GPS Sensitivity	-142 dBm
SBAS Tracking	3-channel, parallel tracking
Update Rate	10 Hz standard, 20 Hz optional
Timing (PPS) Accuracy	20 ns
Rate of Turn	100°/s maximum
Cold Start	40 s (no almanac or RTC)
Warm Start	20 s typical (almanac and RTC)
Hot Start	5 s typical (almanac, RTC and position)
Heading Fix	10 s typical (Hot Start)
Antenna Input Impedance	50 Ω
Maximum Speed	1,850 mph (999 kts)
Maximum Altitude	18,288 m (60,000 ft)
Differential Options	SBAS, Atlas (L-band), RTK

Continued on next page

VR1000 Accuracy Specifications

Table B-11: VR1000 Accuracy

<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>Positioning</td><td>
<table>
<tr><th></th><th>Horizontal (95%)</th><th>Vertical (95%)</th></tr>
<tr><td>Autonomous, no SA[2]</td><td>1.2 m</td><td>2.5 m</td></tr>
<tr><td>SBAS (WAAS)[2]</td><td>0.25 m</td><td>0.5 m</td></tr>
<tr><td>Atlas (L-band) [2,3]</td><td>0.04 m</td><td>0.08 m</td></tr>
<tr><td>RTK[1]</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr>
</table>
</td></tr>
<tr><td>Heading (RMS)</td><td>< 0.2° @ 0.5 m antenna separation
< 0.1° @ 1.0 m antenna separation
< 0.05° @ 2.0 m antenna separation
< 0.02° @ 5.0 m antenna separation
< 0.01° @ 10.0 m antenna separation</td></tr>
<tr><td>Pitch/Roll (RMS)</td><td>1°</td></tr>
<tr><td>Heave (RMS)</td><td>30 cm (DGPS) [3],10 cm (RTK) [3]</td></tr>
</table>

Continued on next page

VR1000 Communication Specifications

Table B-12: VR1000 Communication

Item	Specification
Ports	2 full-duplex, RS-232, CAN
Baud Rates	4800 - 230400
Correction I/O Protocol	Hemisphere GNSS ROX, CMR, CMR+, RTCM v2.3 (DGPS), RTCM v3x incl MSM
Data I/O Protocol	Output: NMEA 0183, NMEA 2000, Hemisphere GNSS Proprietary ASCII and Binary Messages Input: Hemisphere GNSS Proprietary ASCII and CAN commands (for configuration)
Timing Output	PPS, CMOS, active low, programmable falling or rising edge sync, 10kΩ, 10 pF load

VR1000 Power Specifications

Table B-13: VR1000 Power

Item	Specification
Input Voltage	9-36 VDC
Power Consumption	10.8W Maximum (All signals and L-band)
Current Consumption	1.2A Maximum
Maximum Power Isolation	No
Reverse Polarity Protection	Yes

Continued on next page

VR1000 Environmental Specifications

Table B-14: VR1000 Environmental

Item	Specification
Operating Temperature	-40°C to +70°C (-40°F to +158°F)
Storage Temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing
Mechanical Shock	50G, 11ms half sine pulse (MIL-STD-810G w/ Change 1 Method 516.7 Procedure 1)
Vibration	7.7 Grms (MIL-STD-810G w/Change 1 Method 514.7 Category 24)
EMC	CE ISO14982/EN13309/ISO13766/IEC60945), Radio Equipment Directive 2014/53/EU, E-Mark, RCM
Enclosure	IP69K

VR1000 Mechanical Specifications

Table B-15: VR1000 Mechanical

Item	Specification
Dimensions	No mounting Plate 23.2 L x 16.5 W x 7.9 H (cm) 9.1 L x 6.5 W x 3.1 H (in) With Mounting Plate 23.2 L x 21.4 W x 8.3 H (cm)
Status Indications (LED)	Power, Primary Antenna, Secondary Antenna, Heading, Quality, Atlas, Bluetooth, Wi-Fi, CAN1, CAN2, Ethernet, Radio
Power/Data Connector	23-pin multi-purpose

Continued on next page

VR1000 L-band Sensor Specifications

Table B-16: VR1000 L-band Sensor

Item	Specification
Receiver Type	Single Channel
Channels	1530 to 1560 MHz
Sensitivity	-140 dBm
Channel Spacing	5 kHz
Satellite Selection	Manual or Automatic
Reacquisition Time	15 sec (typical)

VR1000 Aiding Device Specifications

Table B-17: VR1000 Aiding Devices

Item	Specification
Gyro	Provides smooth heading, fast heading reacquisition, and reliable < 0.5° per min heading for periods up to 3 min. when loss of GNSS has occurred [4]
Tilt Sensors	Provide pitch/roll data and assist in fast start-up and reacquisition of heading solution

[1]Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity

[2] Depends on multipath environment, number of satellites in view, WAAS coverage, and satellite geometry

[3] Requires a subscription

[4] Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for differential services), and ionospheric activity

IronOne pin-outs

Figure B-3 shows the display pin-outs for the IronOne OEM Hardware.

Figure B-3: IronOne pin-out assignments

Table B-18: IronOne display pin-outs

Comm 12 pin	Description	
1	CAN H	COM1 in Win10 device manager
2	RS232 TX 1	COM2 in Win10 device manager
3	RS232 RX 1	
4	GPIO	
5	GND	Signal ground
6	RS422 TX 1	COM4 in Win10 device manager RS232/RS422/RS485 can Switch on BIOS setup: BIOS setup->Advanced->F81216SEC Super Io Configuration->Serial Port 4 Configuration
7	RS422 TX 2	
8	RS422 RX 1	
9	RS422 RX 2	
10	GND	Power ground
11	V12+ OUT	Power out for serial device
12	CAN L	COM1 in Win10 device manager

Continued on next page

IronOne pin-outs, continued

Table B-19: IronOne video pin-outs

Video 12 pin	Description
1	V12+ OUT1
2	GND
3	CAN2 L _IN
4	CAN2 H _IN
5	NET 1TX+_IN
6	NET1 TX-_IN
7	NET 1RX-I_N
8	NET1 RX+_IN
9	GPIO2_IN
10	GND
11	VIDEO2_IN
12	VIDEO1_IN

Table B-20: IronOne communications

Comm DT15-12PA
CAN x 1
UART（RS-232 x 1）
RS-422/RS-485/RS-232 x 1 Software switch）
GPIO x 1（Default input pullup 5V）
12V/0.75A Power output

Table B-21: IronOne power connector

Power	Description
1	PWR+
2	PWR-
3	ACC
4	NC
5	PWR-
6	PWR+

Continued on next page

IronOne pin-outs, continued

Table B-22: IronOne video communication

Video DT15-12PB
CAN x 1
CVBS video input x 2
10M/100M LAN x 1
GPIO x 1（Default input pullup 5V）
12V/0.75A Power output

The following lists the data specifications for the IronOne OEM Hardware.

Table B-23: IronOne Mechanical

Specification	Description
Dimensions	22.9 L x 16.9 W x 5.2 H (cm) 9.0 L x 6.6 W x 2.0 H (in)
Weight	1.38 kg (3.04 lbs.)
Mount	Adjustable 1.5” RAM ball mount

Table B-24: Environmental

Specification	Description
Operating Temperature	-20°C to +70°C (-4°F to 158°F)
Storage Temperature	-40°C to +85°C (-40°F to 185°F)
Operating Humidity	30% ~ 95% (Relative Humidity)
Storage Humidity	45% ~ 80% (Relative Humidity)
Enclosure	IP67
Vibration	EP455 5.15

Continued on next page

IronOne pin-outs, continued

Table B-25: Power

Specification	Description
Input Voltage	7 - 36 VDC
Power Consumption	36 W
Current Consumption	3.0 A @ 12 VDC

Table B-26: Sensor and Multimedia

Specification
1x 2W Buzzer
1x Headphone Jack

IronTwo pin-outs

Figure B-4 shows the display pin-outs for the IronTwo OEM Hardware.

Figure B-4: IronTwo pin-out assignments

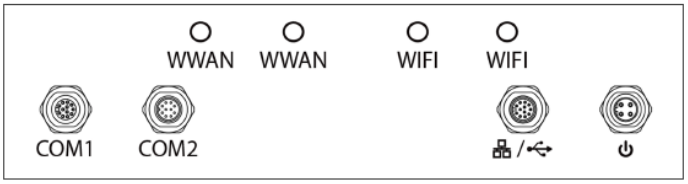
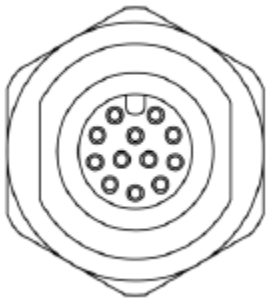


Figure B-5: IronTwo pin-out label

Table B-27: IronTwo display pin-outs

COM1	Description
1	CANH_2
2	CANL_2
3	RXB
4	TXB
5	RTSB
6	CTSB
7	GND
8	DI_2
9	+5V_OUT
10	VOUT+
11	DEV_EN
12	VOUT-



Continued on next page

IronTwo pin-outs, continued

Table B-28: IronTwo COM2 pin-out

COM2	Description
1	CANH_1
2	CANL_1
3	RXA
4	TXA
5	RTSA
6	CTSA
7	GND
8	DI_0
9	DI_1
10	+5V_OUT

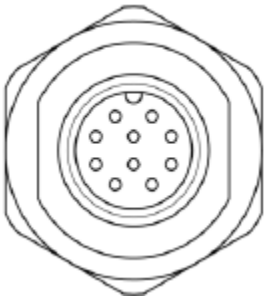


Table B-29: IronTwo Communication/USB pin-out

	Description
1	USB_DP1
2	VUSB_VBUS2
3	LAN1_MDI0-
4	LAN1_MDI1-
5	LAN1_MDI1+
6	LAN2_MDI0+
7	LAN2_MDI0-
8	LAN2_MDI1+
9	USB_DM1
10	GND
11	LAN1_MDI0+
12	LAN2_MDI1-

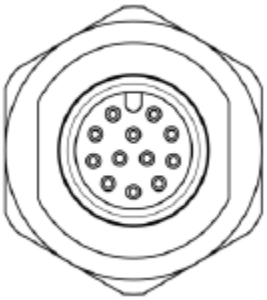
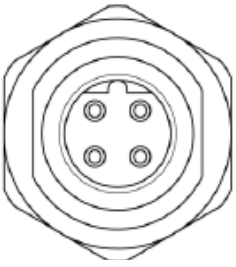


Table B-30: IronTwo power connector

Power	Description
1	VIN+
2	VIN-
3	VIN-
4	IGN_IN



Continued on next page

IronTwo Hardware

The following lists the data specifications for the IronTwo OEM Hardware.

Table B-31: IronTwo Mechanical

Specification	Description
Dimensions	26.3 L x 17.1 W x 3.5 H (cm) 10.4 L x 6.7 W x 1.4 H (in)
Weight	1.4Kg
Mount	Adjustable 1.5” RAM ball mount

Table B-32: IronTwo Environmental

Specification	Description
Operating Temperature	-20°C to +60°C (-4°F to 140°F)
Storage Temperature	-30°C to 60°C
Operating Humidity	30% ~ 90% (Relative Humidity)
Storage Humidity	10% to 95% RH
Enclosure	IP65
Vibration	1.48/1.90/2.24 g rms for XYZ/ 5-500Hz

Table B-33: IronTwo Power

Specification	Description
Input Voltage	9 - 36 VDC

Table B-34: IronTwo Sensor and Multimedia

Specification
1x 1W Speaker

End User License Agreement

End User License Agreement

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End User License Agreement, continued

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Warranty Notice

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Warranty Notice, continued

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