Hemisphere®

875-0391-0

User Guide

Revision: **A2**

April 23, 2019

GradeMetrix™

OEM Machine Control & Guidance Management Software

Table of Contents

Device Compliance, License and Patents 4
Terms and Definitions 6
Chapter 1: Introduction 8
Overview 8
Product Overview 8
Key Features 9
Chapter 2: Getting Started with GradeMetrix 10
Overview 10
Software Installation 11
Operator Interface 14
GradeMetrix Main Menu 36
Chapter 3: Working with GradeMetrix Jobs 59
Overview 59
Create a Job 60
Open a Job 78
Modify a Job 79
Delete a Job 84
Job Tools 85
Equipment Setup 86
Sensor Network 98
Calibrate Sensors 102
Quick Calibrate 103
Heading Calibration 106
Radio Settings 107
NTRIP Configuration 112
Control 114
Navigation 117
Design a Job 122
Topo 130
Firmware Update 137

Appendix A - Troubleshooting 138
Overview 138
GradeMetrix Troubleshooting 139
Appendix B: Supported Hardware 143
Overview 143
VR500 Vector Smart Antenna 143
VR1000 GNSS Receiver 150
IronOne OEM Hardware 157
Index 160
End User License Agreement 161
Warranty Notice 165

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:

1. This device may not cause harmful interference, and
2. 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.

Copyright Notice

Copyright Hemisphere GNSS, Inc. (2019). All rights reserved.
No part of this manual may be reproduced, transmitted, transcribed, stored in a retrieval system or translated into any language or computer language, in any form or by any means, electronic, mechanical, magnetic, optical, chemical, manual or otherwise, without the prior written permission of Hemisphere GNSS.

Trademarks

Hemisphere GNSS®, the Hemisphere GNSS logo, TRACER™, Crescent®, Eclipse™, e-Dif®, L-Dif™, PocketMax4™, S320™, SBX-4™, Vector™, XF1™, and XF2™ are proprietary trademarks of Hemisphere GNSS, Inc. Other trademarks are the properties of their respective owners.

Patents

Hemisphere GNSS products may be covered by one or more of the following patents:

Patents			
6111549	6876920	7400956	8000381
6397147	7142956	7429952	8018376
6469663	7162348	7437230	8085196
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	

Continued on next page

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
Fax: (480) 270-5070
PRECISION@HGNSS.COM
WWW.HGNSS.COM

Technical Support

If you need to contact Hemisphere GNSS Technical Support:

Hemisphere GNSS, Inc.
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
Phone: (480) 348-6380
Fax: (480) 270-5070
HTTPS://HEMISPHERE.ATLASSIAN.NET/SERVICEDESK/CUSTOMER/PORTAL/2

Documentation Feedback

Hemisphere GNSS is committed to the quality and continuous improvement of our products and services. We urge you to provide Hemisphere GNSS with any feedback regarding this guide by opening a support case at the following website: HTTPS://HEMISPHEREGNSS.COM/RESOURCES-SUPPORT/TECHNICAL-DOCUMENTATION

Terms and Definitions

Introduction

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

GradeMetrix 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 Chinese satellite-based navigation system.
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
GPS	Global Position System
Heading	The vector created from the primary to 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).

Continued on next page

Terms and Definitions, Continued

GradeMetrix 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 (same as +180 degrees and -180 degrees). Positive degrees are east of 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 User Guide provides information to help you quickly set up your GradeMetrix™ OEM application software. You can download this manual from the Hemisphere GNSS website at WWW.HGNSS.COM.

Contents

Topic	See Page
Product Overview	8
Key Features	9

Product Overview

Product overview

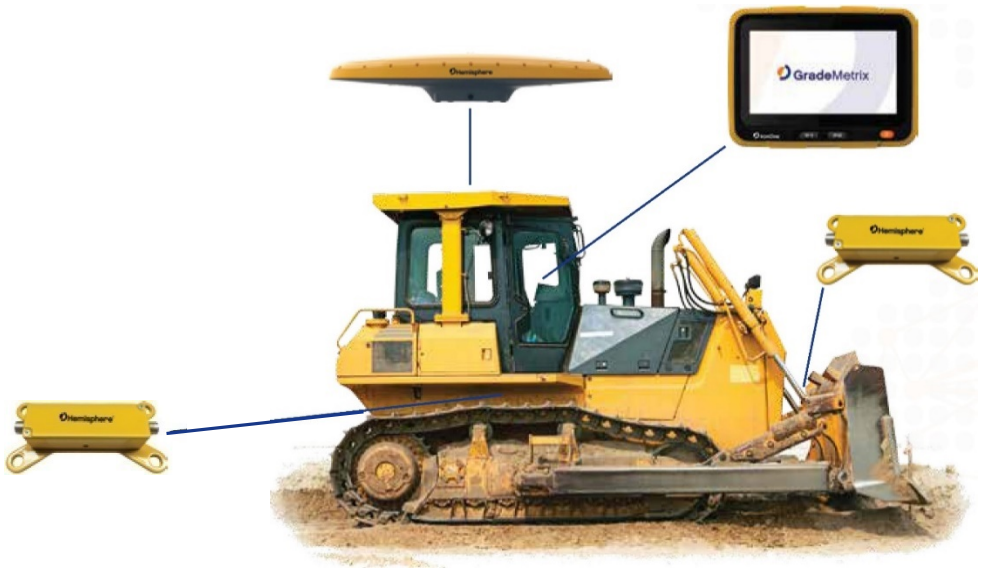
GradeMetrix™ OEM application software platform provides the ultimate tool to manage your machines for any control or guidance application. Whether conducting grading, mining, excavating, drilling, piling, or landfilling, you can rebrand the GradeMetrix software according to your needs.

Key Features

GradeMetrix key features

GradeMetrix OEM software features:

- Easy-to-use/create job localizations
- Import/export multiple file types
- In-the-field volume calculations
- Enhanced graphics for data collection
- Graphical stakeout
- Real-time cut and fill information
- External radio support
- CAD layer management



Chapter 2: Getting Started with GradeMetrix

Overview

Introduction

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

Contents

Topic	See Page
Software Installation	11
Operator Interface	14
GradeMetrix Main Menu	36

Software Installation

Operating system requirements

GradeMetrix can be installed to a ruggedized field computer or an office PC.

GradeMetrix is designed to run on Windows 7, Windows 8, and Windows 10.

Files and formats used in GradeMetrix

Various files are loaded into GradeMetrix on specific, recommended directories on the Control Panel. Files are loaded into these directories using a couple of different methods: manually selecting files in GradeMetrix from memory sticks (USB drives, thumb drives, etc.) or using Windows Explorer to copy files.

GradeMetrix can support the following files and file formats:

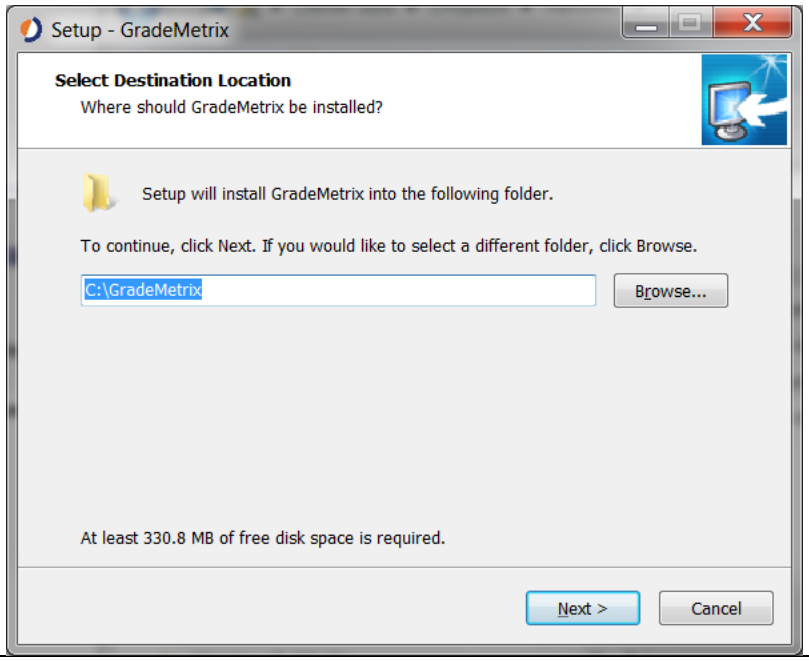
- Site Plan File: DWG, DXF
- LandXML
- Surface Model File: MESH, GRID, TIN, GRD, DWG, DXF, NTD, DTM, FLT, XYZ
- Site Reference File: WKT, DC
- Survey Topo File: TOPO
- Backdrop File: PNG, JPG, BMP
- Tin File: MESH, TIN, NTR, DXF, DWG, FLT
- Grid File: GRID, GRD, DTM, XYZ
- Localization File: LOCAL, LOC

Continued on next page

Software Installation, Continued

Install GradeMetrix software

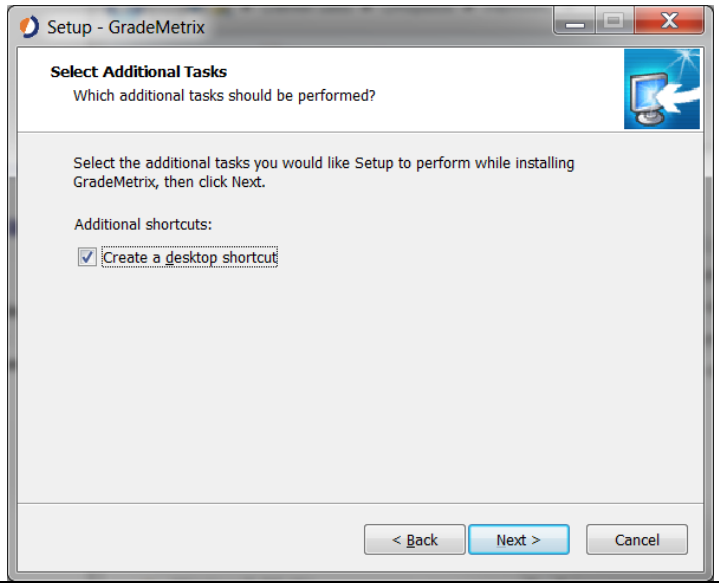
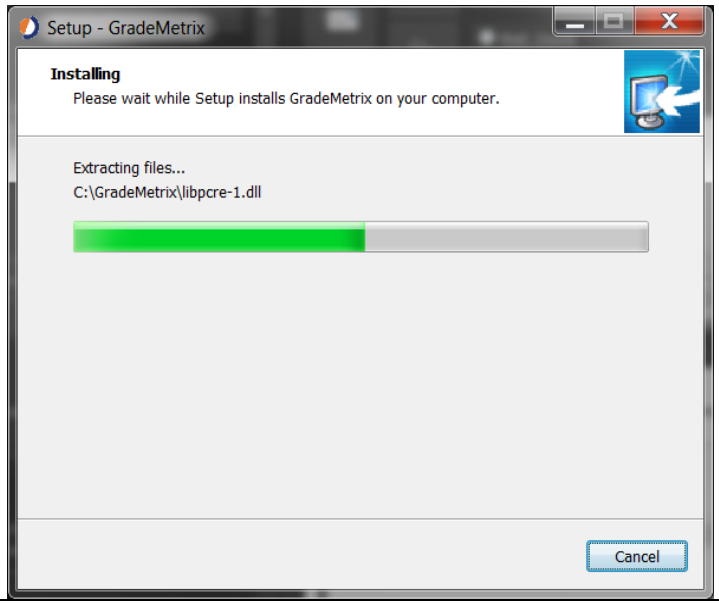
To install your GradeMetrix software, complete the following steps:

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

Continued on next page

Software Installation, Continued

Install GradeMetrix software, continued

Step	Action
3	The **Select Additional Tasks** screen displays. Notice the option to **Create a desktop shortcut** is selected, and click **Next**. 
4	The GradeMetrix software begins installing on your computer. 

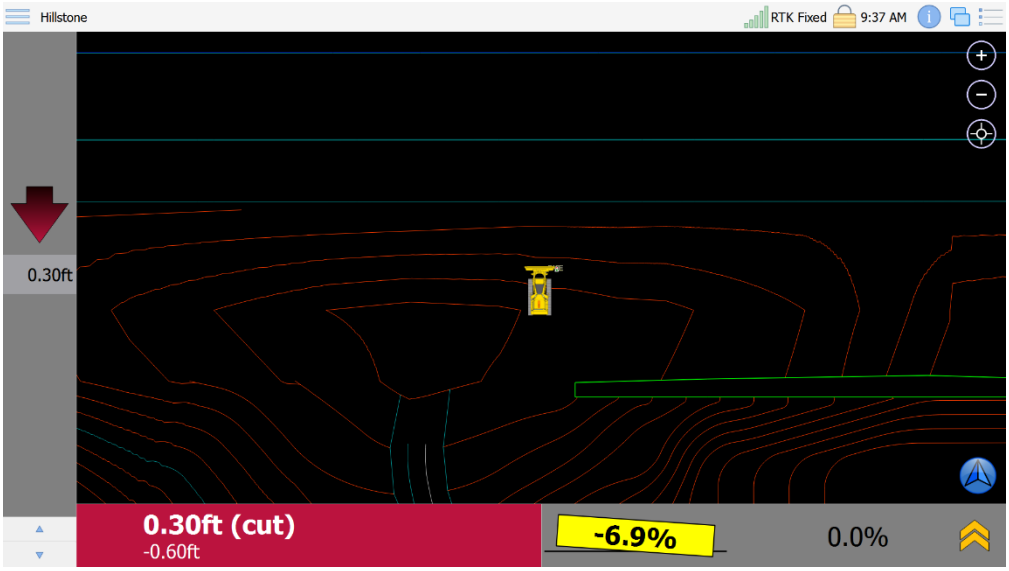
Continued on next page

Operator Interface

Operator interface

Open the GradeMetrix software, and the following screen displays:

Note: The linework and cut/fill is visible on this screen.



Top panel icons

The top panel icons include:

- View Menu
- Information Screens
- Quick Info
- Time
- User/Admin Mode
- Position Quality

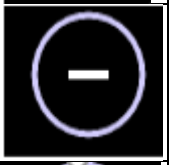
Note: If you are logged in as an Administrator, the shield icon appears.

Continued on next page

Operator Interface, Continued

Adjust views

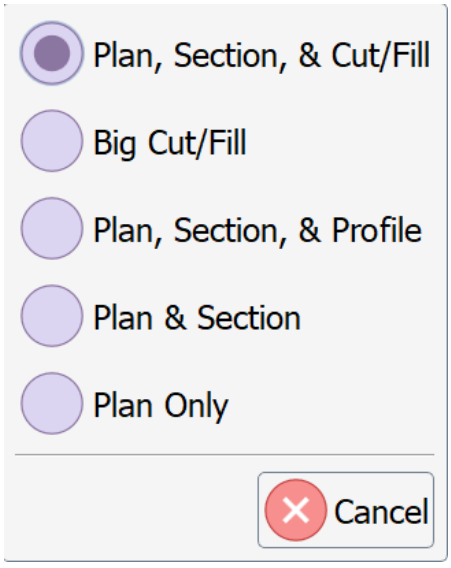
To modify the zoom level on this screen, click the following icons:

Icon	Function
	Zoom In
	Zoom Out
	Fit to Window

Select View

To select a different view, click the  icon (the upper right corner of screen).

The pop-up window displays a list of views/plans:

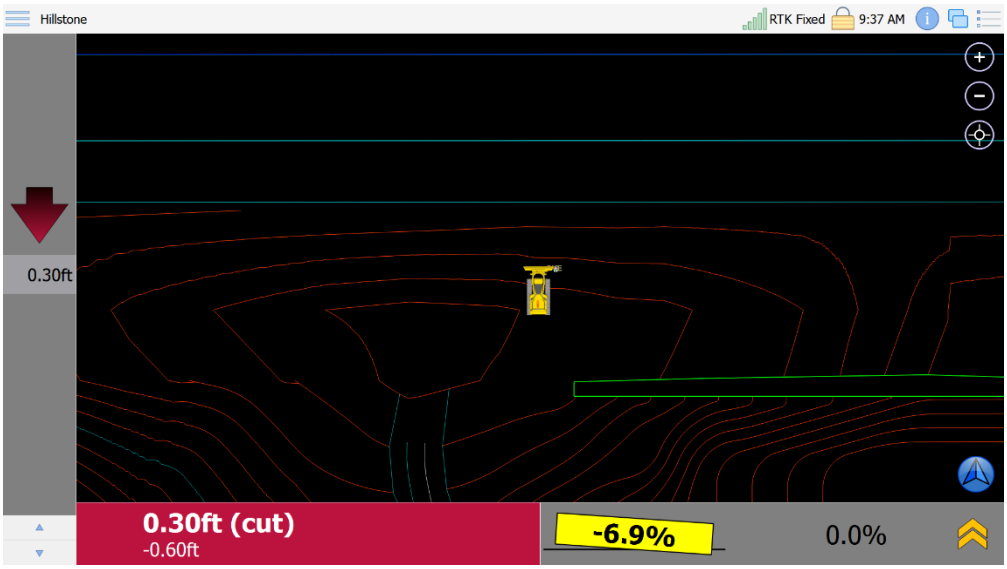


Continued on next page

Operator Interface, Continued

Select View, continued

Click next to select a plan name to select that site or plan view.



The bar on the left of your screen displays the amount of area needed to cut or fill according to the selected plan. The arrows are color-coded to indicate the section status:

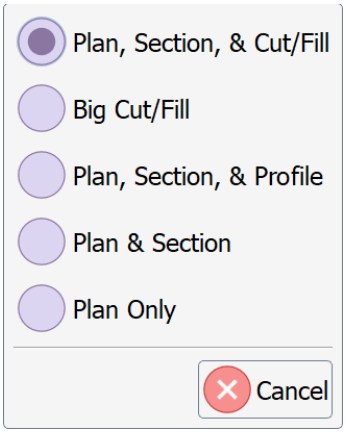
- Red arrow=cut
- Blue arrow=fill
- Green arrow=on grade

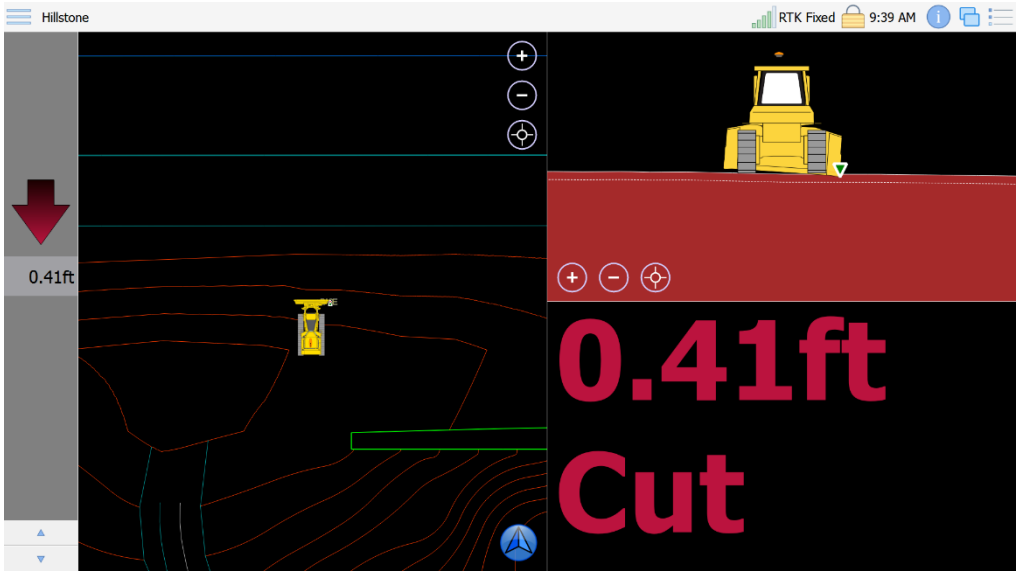
Continued on next page

Operator Interface, Continued

Plan, Section, Cut/Fill view

Select **Plan, Section, & Cut/Fill** to view this information for the selected job.



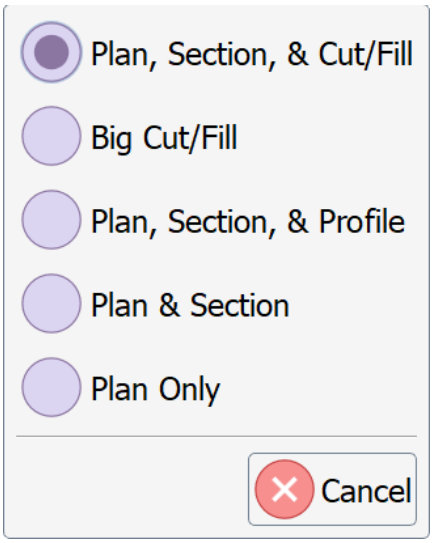


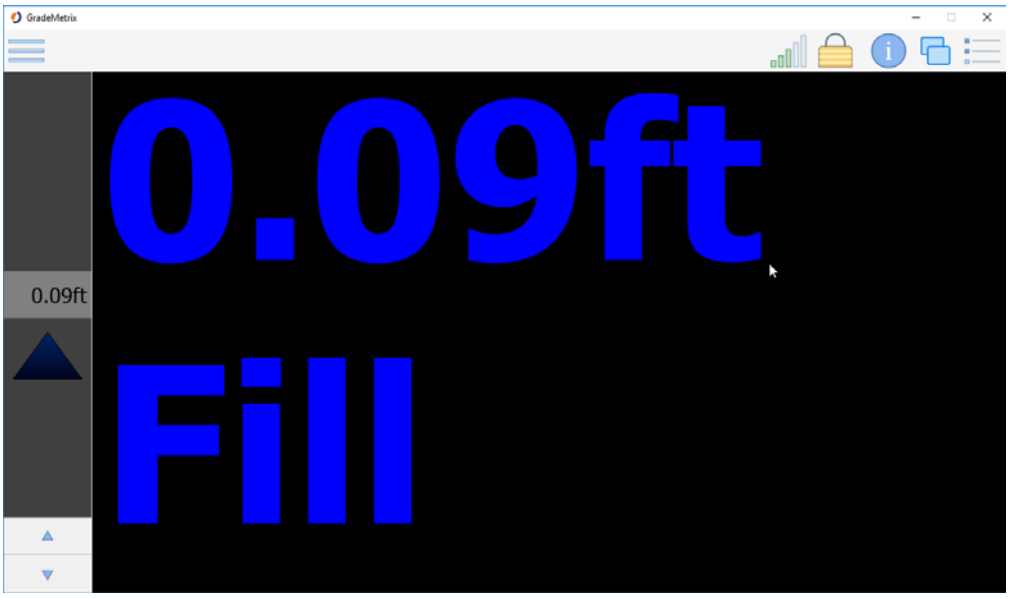
Continued on next page

Operator Interface, Continued

Big Cut/Fill view

The **Big Cut/Fill** view displays only the cut/fill information for the selected job. A red arrow indicates cut is required, a blue arrow indicates fill is required for the plan.



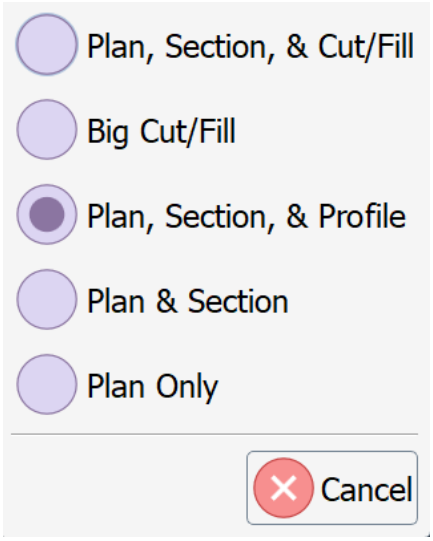


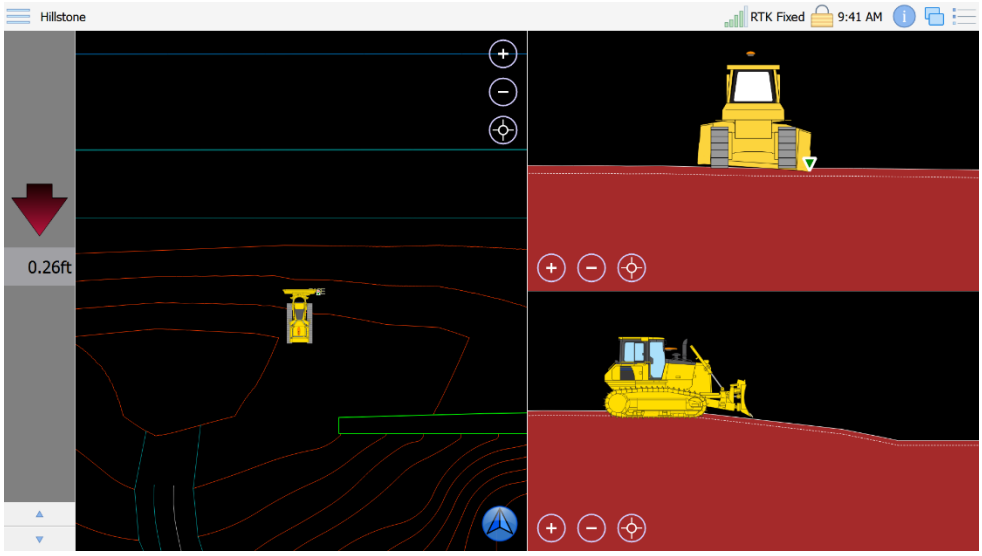
Continued on next page

Operator Interface, Continued

Plan, Section, & Profile view

You can select to view the information for the plan, section, and machine profile information simultaneously on your screen.

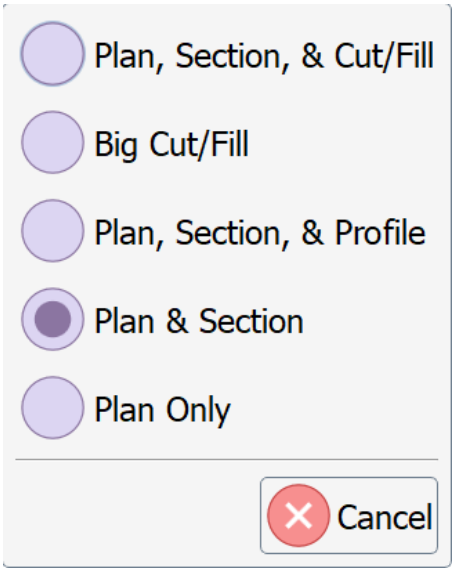


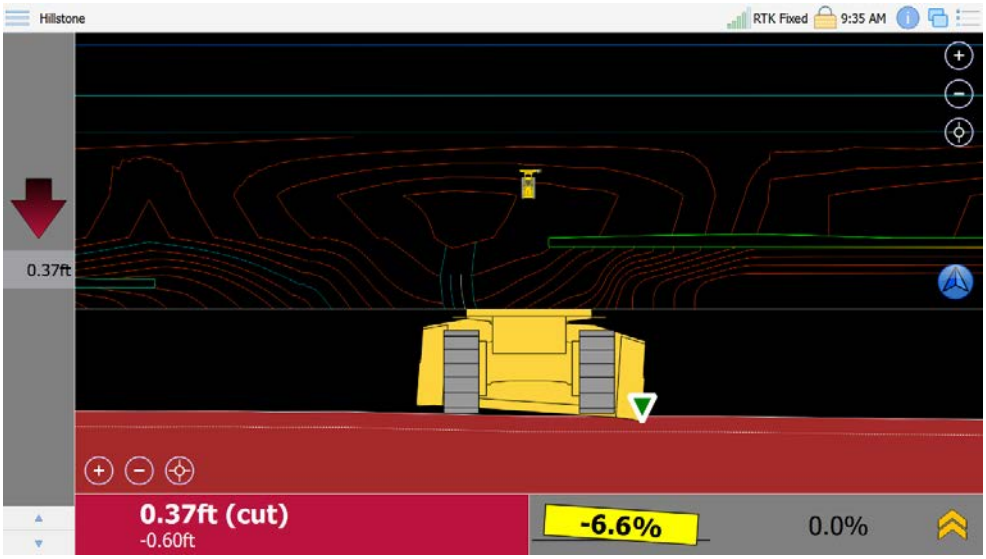


Operator Interface, Continued

Plan & Section view

The upper portion of the screen displays the jobsite plan. The lower screen shows the section view, elevation, and slope tabs.



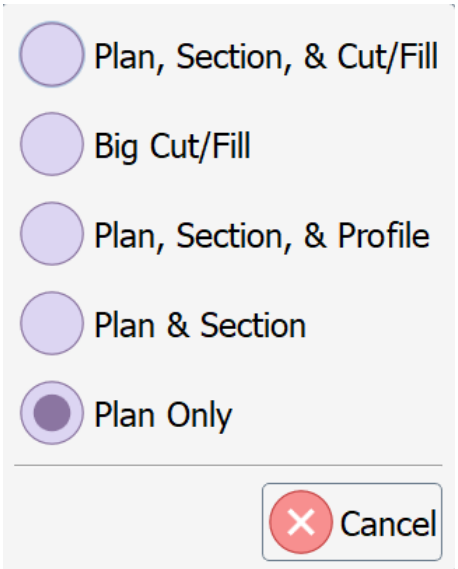


Continued on next page

Operator Interface, Continued

Plan only view

You can select to display only the plan on your screen.



On the left side, the **Cut/Fill Bar** indicates how much to cut or fill according to the selected plan.

A blue arrow indicates how much fill is needed for the plan.
The red arrow indicates more material must be removed to achieve the specified design.

At the bottom left of the screen, the two arrow buttons add a grading offset to the design elevation.

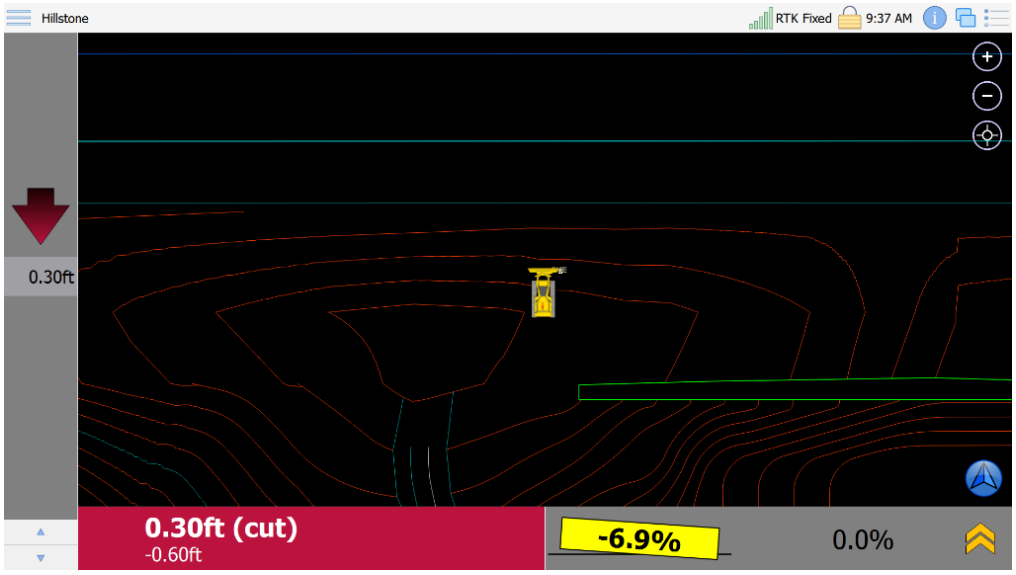
Continued on next page

Operator Interface, Continued

Plan only view, continued

Click the up arrow to increase the offset value, and click the down arrow to reduce the offset value.

The offset can be adjusted by 'pressing and holding' on the Cut/Fill Bar, then entering the desired value.

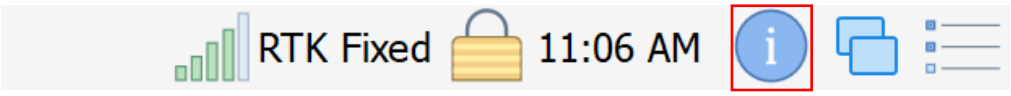


Continued on next page

Operator Interface, Continued

Quick Info

On the top menu bar, click the **Information** icon to display the information menu.



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

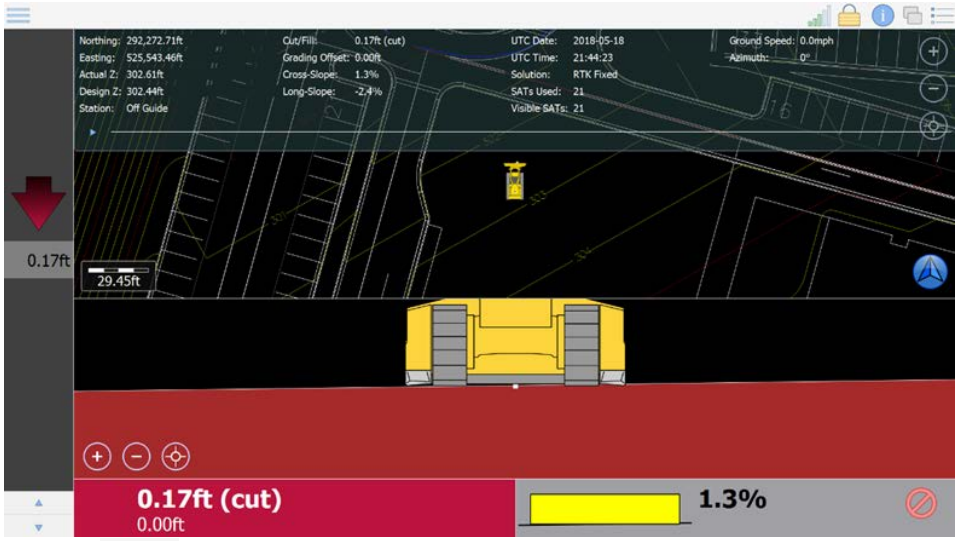
Term	Definition
Northing	Northward-measured distance from the origin, or the "Y"-axis.
Easting	Eastward-measured distance from the origin, or the "X"-axis.
Actual Z	Local height above the origin of the local coordinate system. Actual Z is the elevation, or the "Z" axis.
Design Z	Design elevation (Actual Elevation – Design Elevation = Cut Value (if negative-Fill Value).
Station	If using a guide line, indicates the current station on the guideline.
Cut/Fill	The difference between design and actual elevation.
Grading Offset	A small offset (positive or negative) that affects cut/fill in the design elevation.
Cross slope	The angle made between the left and right side 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, "Real-time Kinematic".
Visible SATs	The quantity of SATS visible in the sky.
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 "true north".

Continued on next page

Operator Interface, Continued

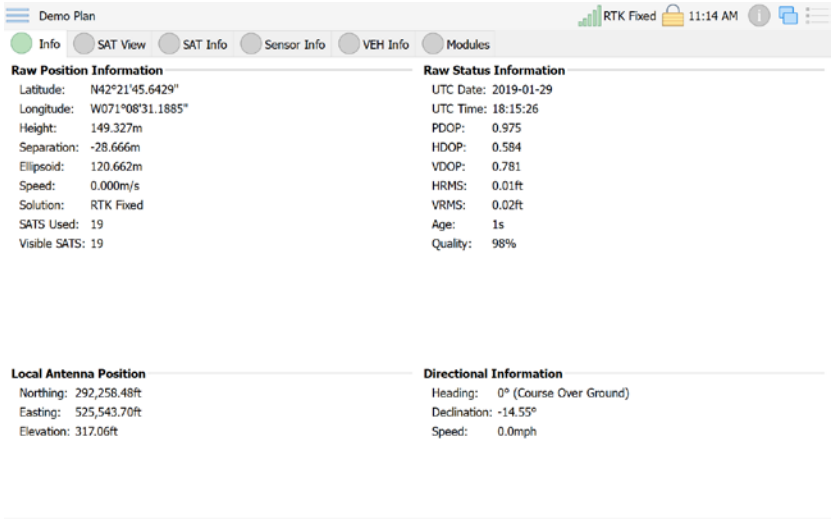
Quick Info, continued

Note: Select/de-select which information fields you want to display by clicking the **Settings** icon, and **Info Summary**.



Click the icon in the upper right corner to view the Information screen.

This icon is disabled when the Quick Info menu is displayed.
Turn off the Quick Info menu to enable the icon.



Continued on next page

Operator Interface, Continued

Antenna Info

The **Antenna Info** tab provides the following information:

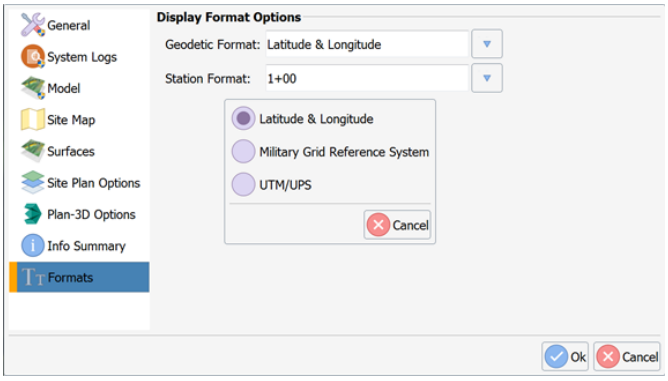
- **Raw Position Information** –raw position and GNSS quality information from the GNSS receiver
- **Raw Status Information** –additional GNSS status information (i.e., dilution of precision, RMS values, RTK latency, and UTC time) from receiver
- **Local Antenna Position** –the NEZ in local project coordinates
- **Directional Information** – the GNSS heading as well as an indicator (if GNSS), or derived heading. It also gives the declination and speed.

Note: The Antenna Info tab automatically displays the Information type specific to the connected antenna.

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



Continued on next page

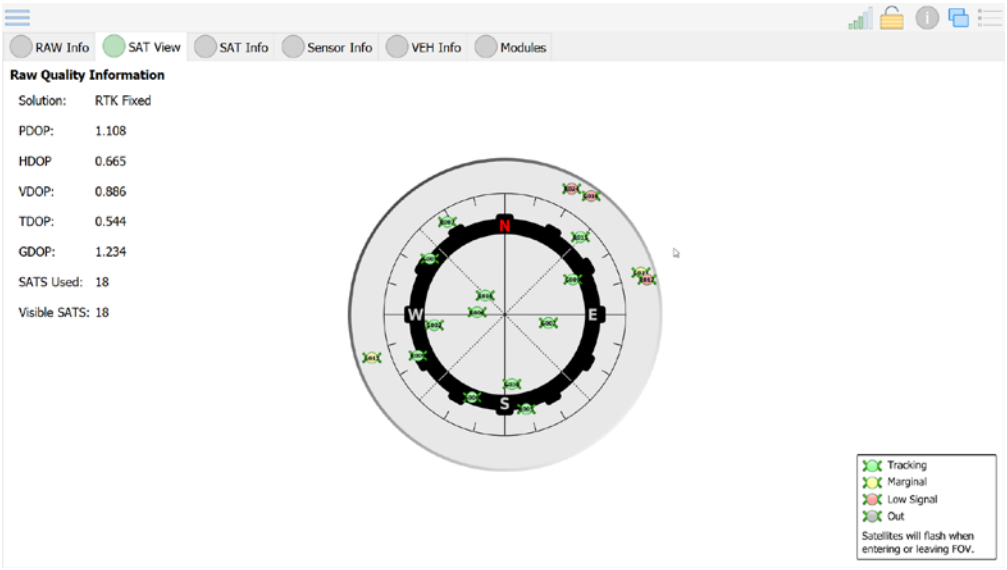
Operator Interface, Continued

SAT View

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

Table 2-1: Satellite Signals

Signal	Color	Description
Tracking	Green	strong signal -used in the solution
Marginal	Yellow	weaker signal- only a partial use in the solution
Low Signal	Red	not tracked in the solution
Out	Grey	No signal



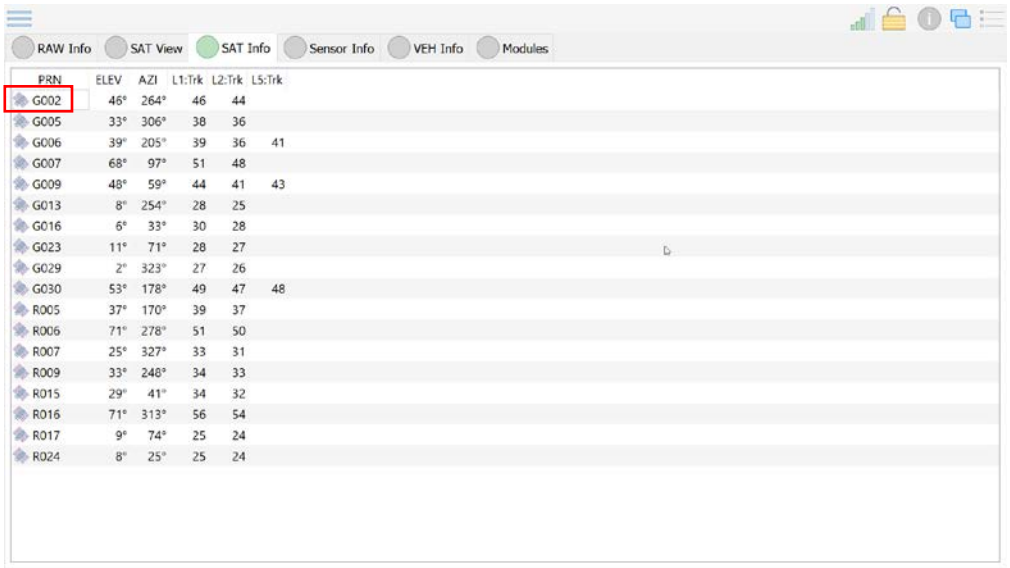
Continued on next page

Operator Interface, Continued

SAT Info

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

To view a sensor property, click the Sensor ID.



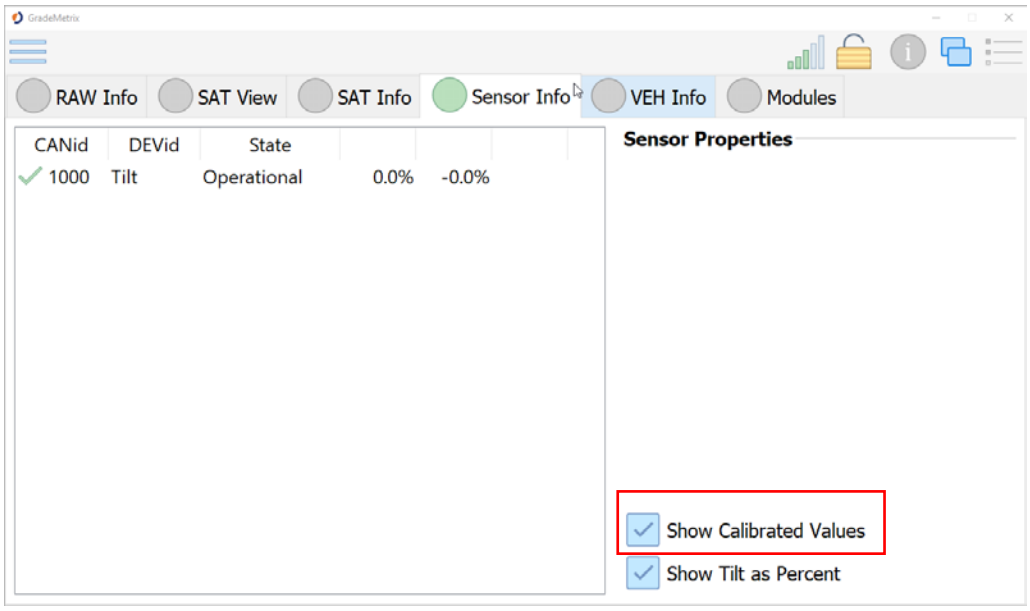
Continued on next page

Operator Interface, Continued

Sensor Info

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

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



Continued on next page

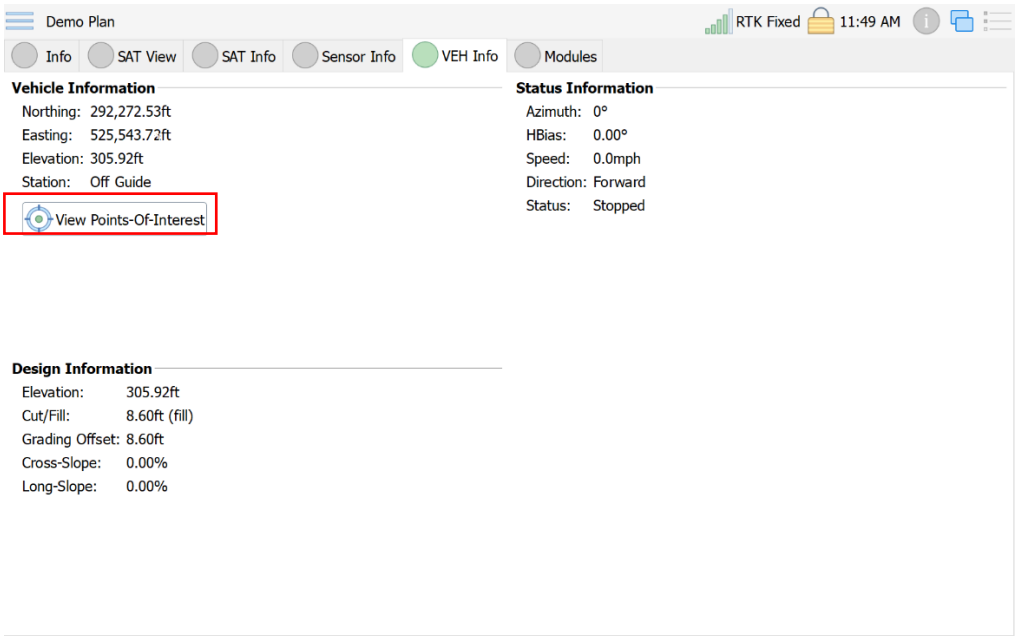
Operator Interface, Continued

VEH Info

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

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

Click **View Points-Of-Interest** to display N-E-Z values at different points on the machine.

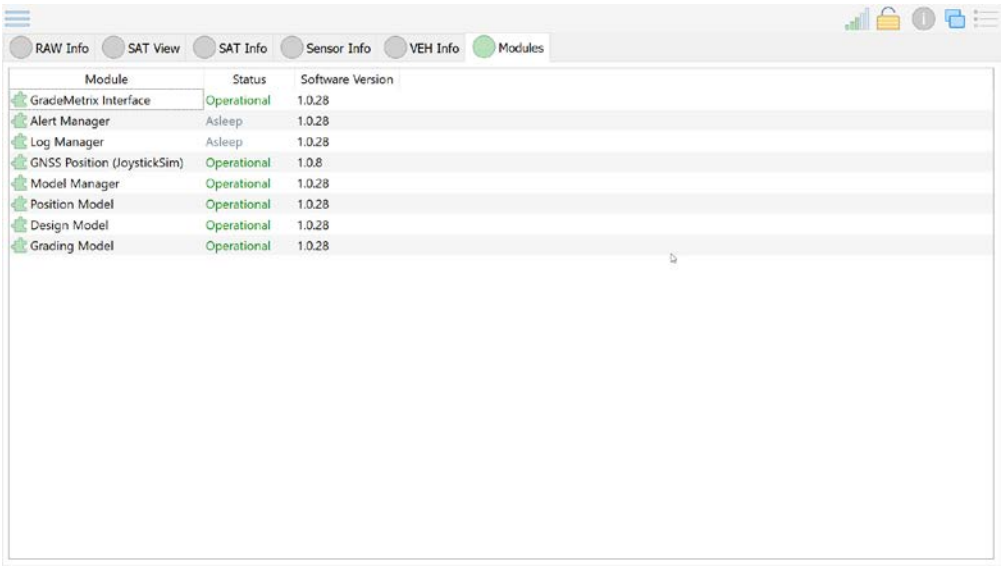


Continued on next page

Operator Interface, Continued

Modules

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



Return to main screen

Click the  icon to de-select and return to the GradeMetrix main screen.

Continued on next page

Operator Interface, Continued

GradeMetrix file requirements

GradeMetrix requires a Plan View file, Design Surface, and Localization file. These files are combined into a Job File. Other file types, such as a Topo File and Guideline file may be loaded.

To create a new job with these files, go to the Main Menu, log into Admin Mode, and click on New Job. Or, click **Open Job** to load an existing job or **Modify Job** to modify an existing job.

Continued on next page

Operator Interface, Continued

GradeMetrix file requirements, continued

When you load an existing job it automatically loads all files associated with the job. A description of some of these file types are below.

Table 2-2:Job File Types

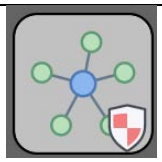
File Type	Description
Job File	A collection of files (plan view, design surface, etc.) along with settings. Loading a job loads all files and settings.
Plan View	The map of a job site that shows distinguishable features (such as buildings, streams, etc.) as well as a general topo map of the site.
Design Surface	The digital terrain model that drives the cut/fill values. An elevation is associated with each northing and easting and this design elevation is compared to the actual elevation of the machine at the current northing/easting.
Guideline File	Provides steering offsets towards a polyline.
Topo File	A file that stores all of the points stored in the Topo routine.

GradeMetrix Main Menu

Main Menu

The GradeMetrix Main Menu displays the following:

Table 2-3:-GradeMetrix Main Menu Icons

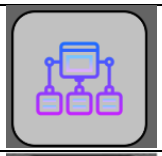
Icon Name	Icon	Description
New Job (*must be accessed by authorized Admin user)*		Create a new job.
Open Job		Open an existing or saved job.
Modify Job		Edit an existing or saved job.
Delete Job		Delete a created job.
Job Tools		Export a job file to external storage or rename a job.
Equipment Setup		Use in administrator mode. Configure the dimensions of your machine, the GNSS hardware you're using, and save/load these settings.
Sensor Network		Log in as administrator to configure sensors. GradeMetrix automatically finds supported sensors on the bus. Set the update rate (i.e., 20Hz, name the device, and define the orientation/mounting of the sensor).

Continued on next page

GradeMetrix Main Menu, Continued

Main Menu, continued

Table 2-3: GradeMetrix Main Menu Icons (continued)

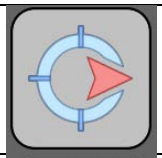
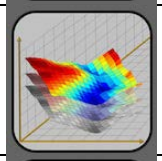
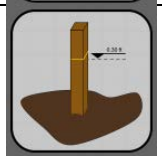
Icon Name	Icon	Description
Calibrate Sensors		Calibrate the sensor to determine a cross slope and long slope offset, based upon the sensor installation. Use this for body sensors.
Quick Calibrate		Use Quick Calibrate to check the cross slope/long slope is on a sensor.
Heading Calibration		Matches the GNSS heading to the actual machine heading.
Radio Settings		Configure the internal UHF radio. Authorized personnel can upload channel tables (frequencies and channel spacing) or configure the channel table from within the software. Any user (such as an operator), can select from pre-defined channels and set the protocol/modulation/FEC (for protocols that allow setting FEC).
NTRIP Configuration		This dialogue is an NTRIP client for configuring RTK over network.
Control		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.

Continued on next page

GradeMetrix Main Menu, Continued

Main Menu, continued

Table 2-3: GradeMetrix Main Menu Icons (continued)

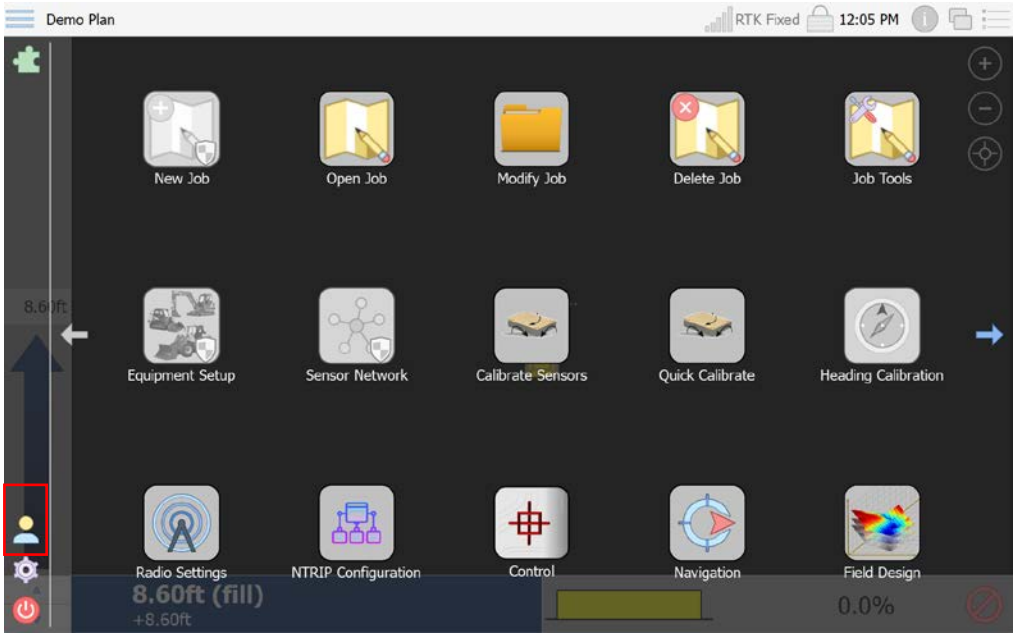
Icon Name	Icon	Description
Navigation		Enter an NEZ, or select from a list of control points. Grade Metrix provides distances/directions to that point.
Field Design		Use Field Design to create a surface when a model is not available.
Topo		Use for conducting a topo. Software can be configured to automatically or manually store points in interval (distance or time).
Firmware Update		Use to update the receiver GNSS firmware.

Continued on next page

GradeMetrix Main Menu, Continued

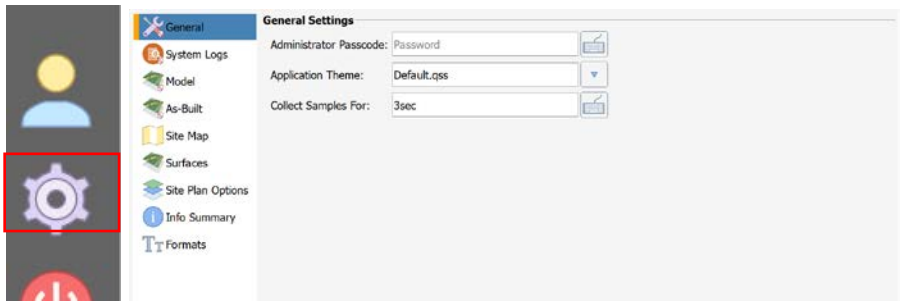
Administrator settings

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.

To set Administrator password, click the **Settings** icon and select the **General** tab. Click the keyboard icon and type your desired password.



After you enable the Administrator permissions, the **New Job** and other settings unlock.

Continued on next page

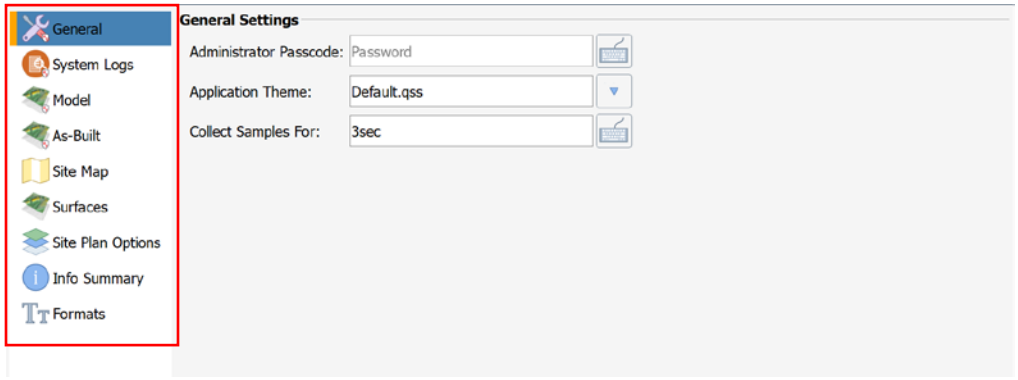
GradeMetrix Main Menu, Continued

Settings

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

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

The **Settings** window displays. The left navigation menu lists the GradeMetrix Settings options:



Continued on next page

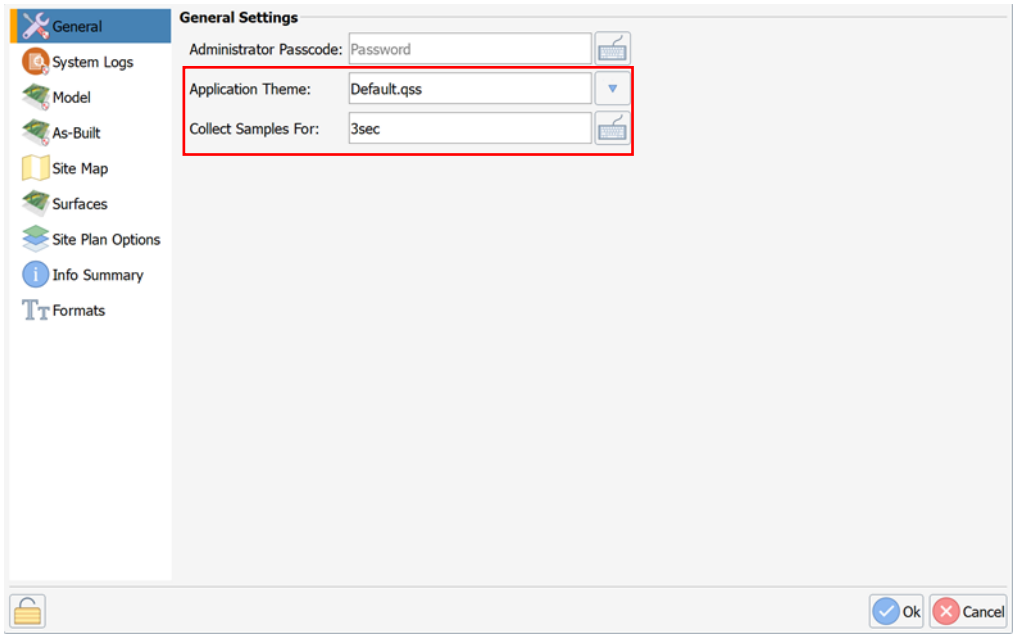
GradeMetrix Main Menu, Continued

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:** keyboard icon and type in the desired value in seconds.

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



Continued on next page

GradeMetrix Main Menu, Continued

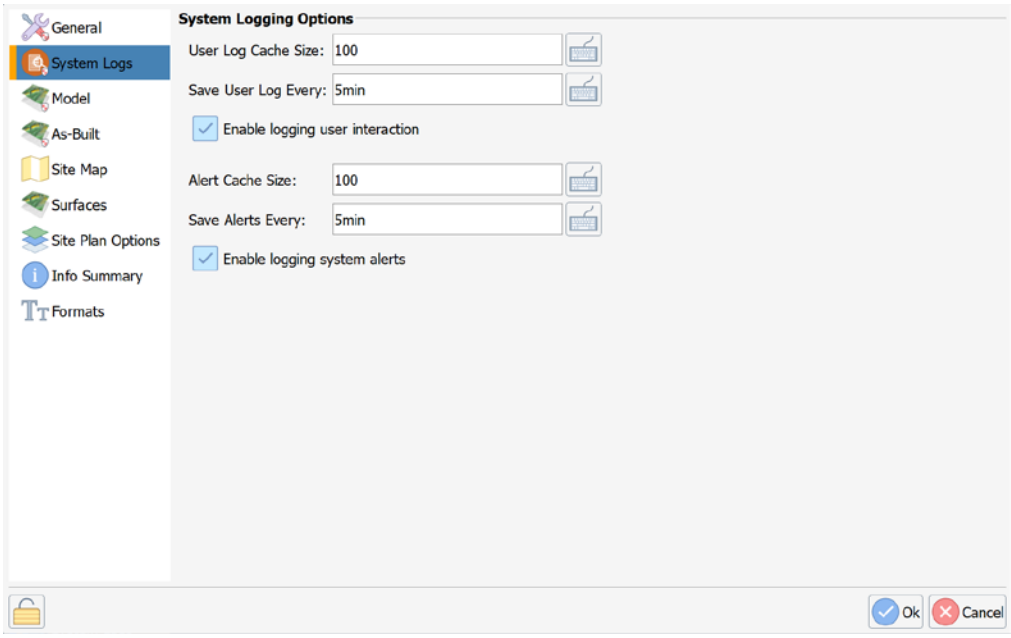
System logs

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

Table 2-4: System Logs

Option	Function
User Log Cache Size:	Determines 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 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 message (GPS errors, sensor errors, etc.).

When you are finished setting the system logging options, click **Ok**. To cancel your changes, click **Cancel**.



Continued on next page

GradeMetrix Main Menu, Continued

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:

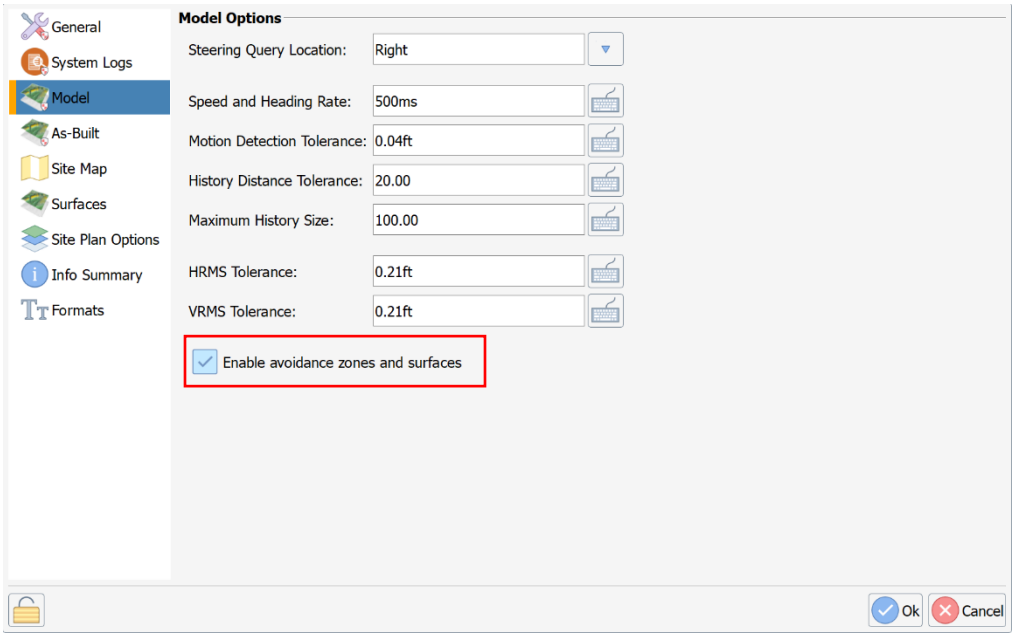
Table 2-5: Model Options

Option	Description
Steering Query Location:	Selects machine POI for steering reference.
Speed and Heading Rate:	The rate at which speed and heading information update.
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 stopped position.
History Distance Tolerance:	Records the cumulative history movement and sets a history marker.
Maximum History Size:	The amount of history markers stored for your previous points.
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

GradeMetrix Main Menu, Continued

Model, continued



Click 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.

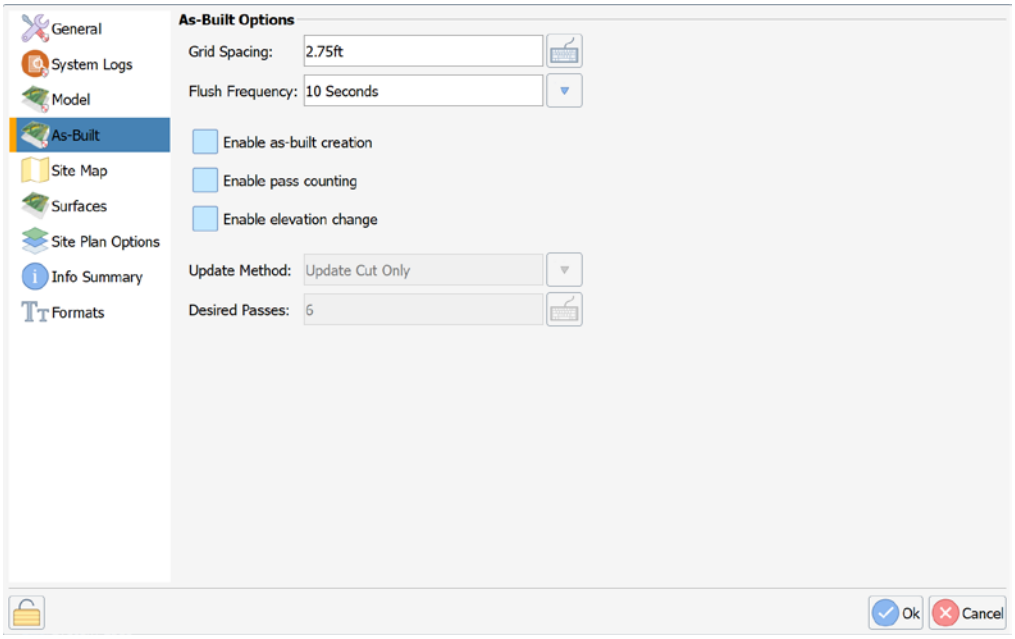
To save your settings, click **Ok**. To cancel your changes, click **Cancel**.

Continued on next page

GradeMetrix Main Menu, Continued

As-Built

The **As-Built** option tracks job progress, and can be configured for pass counts, or cut/fill.



Continued on next page

GradeMetrix Main Menu, Continued

Site map

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

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**-machine always faces the top of the screen as the map rotates
2. **Fixed Rotation**-machine 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.

Click the keyboard icon to the right of the following fields to separate auto center and manage zooming:

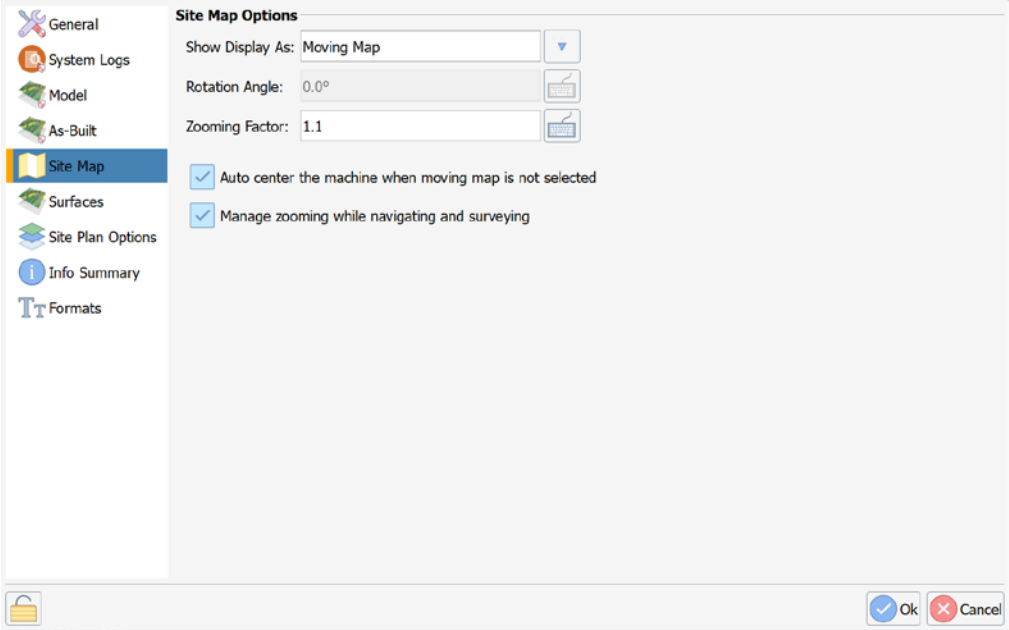
- **Rotation Angle:** if using fixed rotation, enter the degrees to rotate the map clockwise.
- **Zooming Factor:** set the numeric value to zoom on the right side of the plan view (The greater the value set (50 or above), increases the zoom out.)
- **Auto center the machine when the moving map is not selected:** the view adjusts as your machine moves to prevent your machine from driving off screen.

Continued on next page

GradeMetrix Main Menu, Continued

Site map, continued

Manage zooming while navigation and surveying: when staking out a point, the view will zoom in closer to the point.



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

Surfaces

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

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

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.

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

Continued on next page

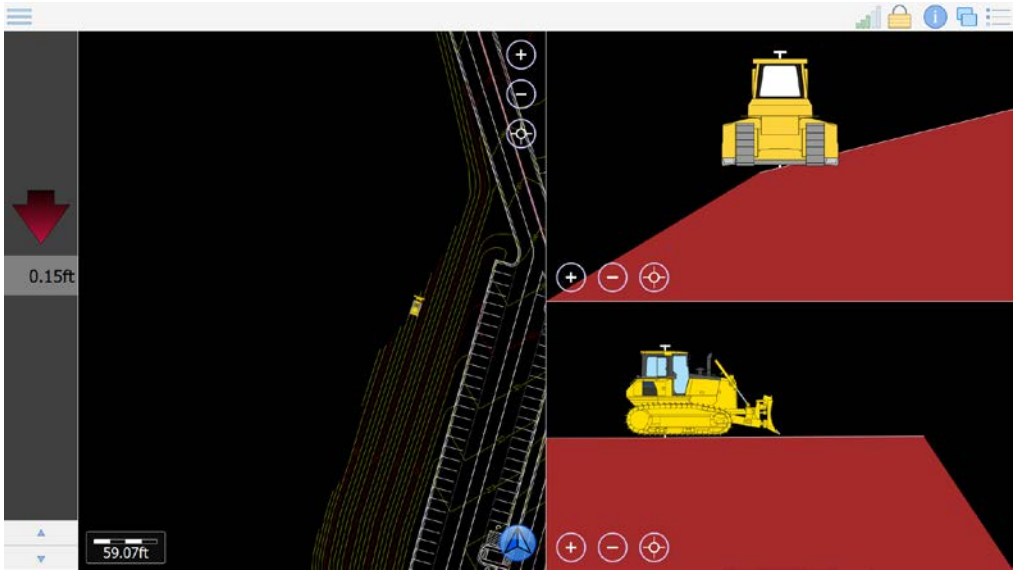
GradeMetrix Main Menu, Continued

Surfaces, continued

Join Method-select to **Join to Bottom Corners** or **Join to Bottom Edge.**

Warning: If you select **Join to Bottom Corners,** your surface may appear to extend past your design.

The below image displays the **Join to Bottom Corners** option. The surface ends at the white line.

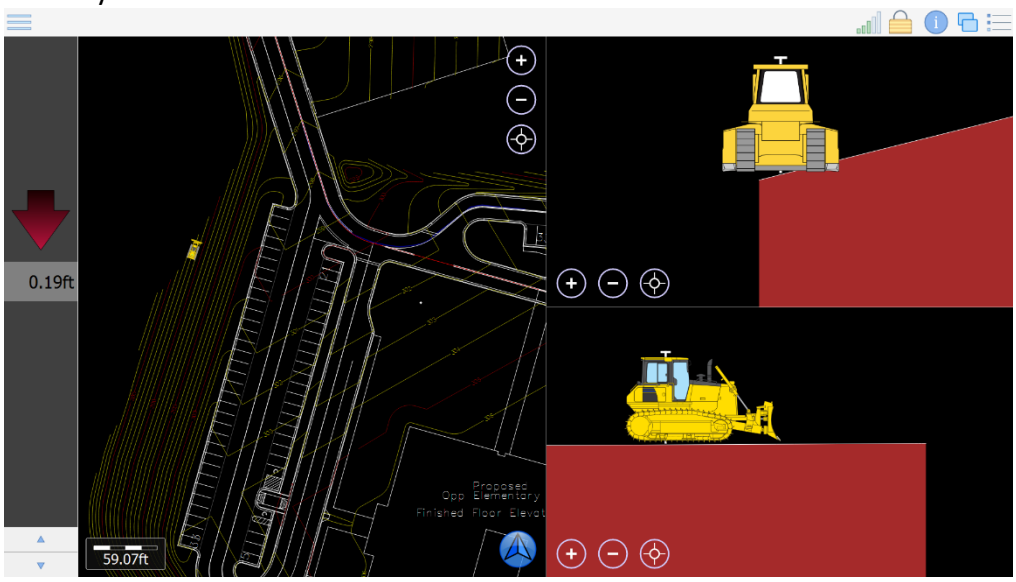


Continued on next page

GradeMetrix Main Menu, Continued

Surfaces, continued

The following image displays the **Join to Bottom Edge option**, which shows where your surface ends.

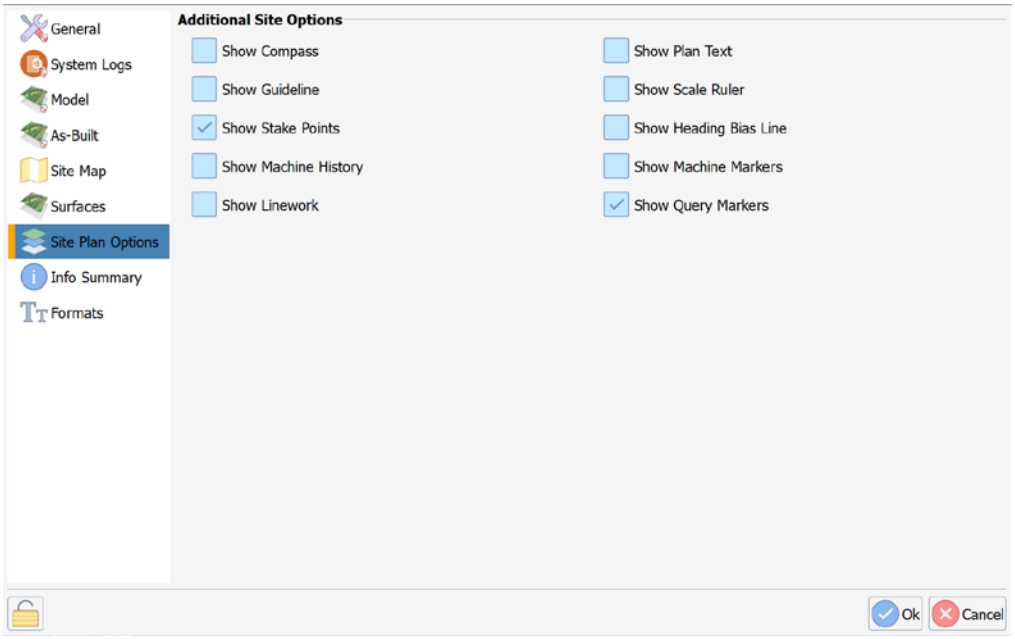


GradeMetrix Main Menu, Continued

Site plan Options

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

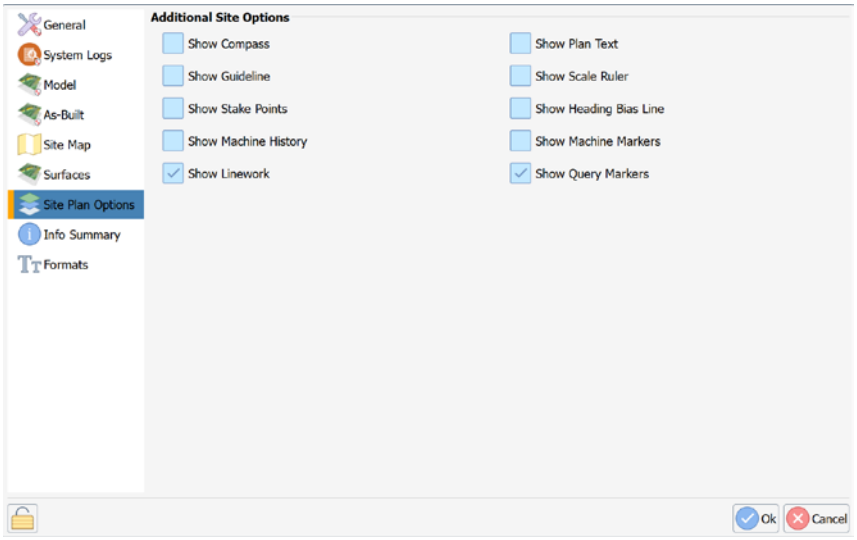
~~**Note:** Show cut/fill cannot be shown simultaneously with show surfaces on the plan view. Show cut/fill only displays if an existing surface is loaded.~~



GradeMetrix Main Menu, Continued

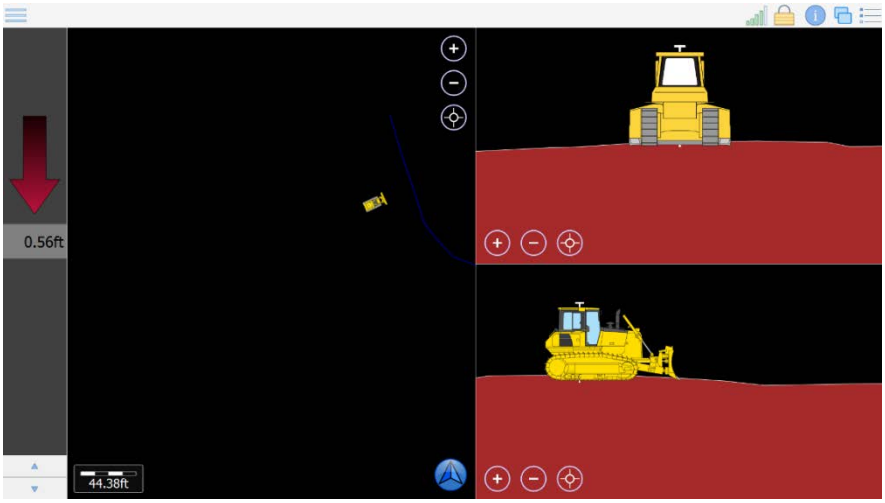
Site plan options, continued

Select **Show Linework**.



Click a second time to de-select **Show Linework**. The following plan view displays:

Note: Guidelines are still displayed.

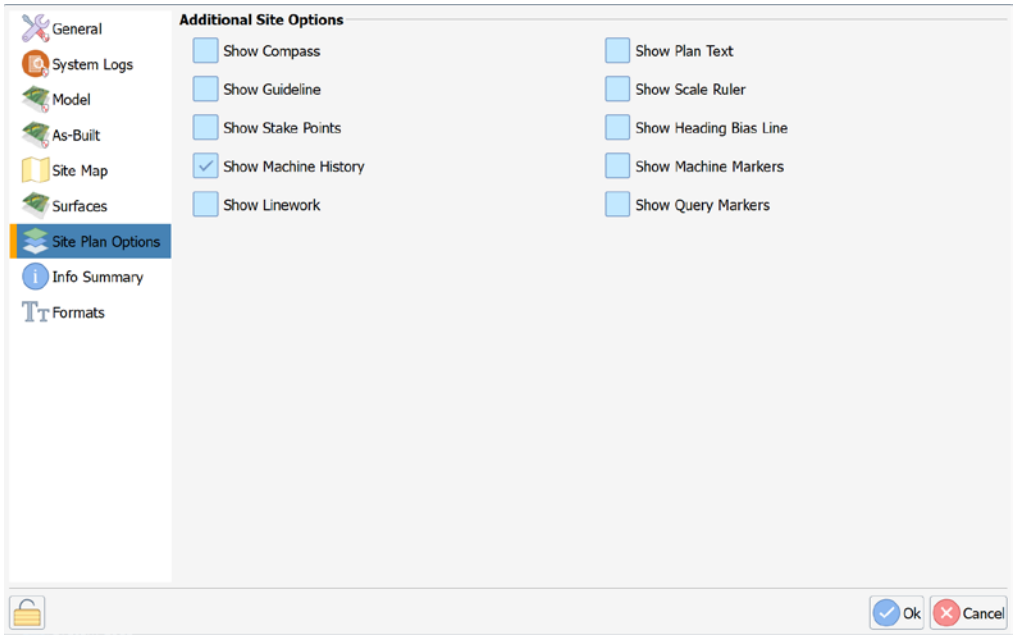


Continued on next page

GradeMetrix Main Menu, Continued

Site plan options, continued

Click to select **Show Machine History**. The plan view displays a mark for each spot the machine has driven, and, if selected, a compass displays.



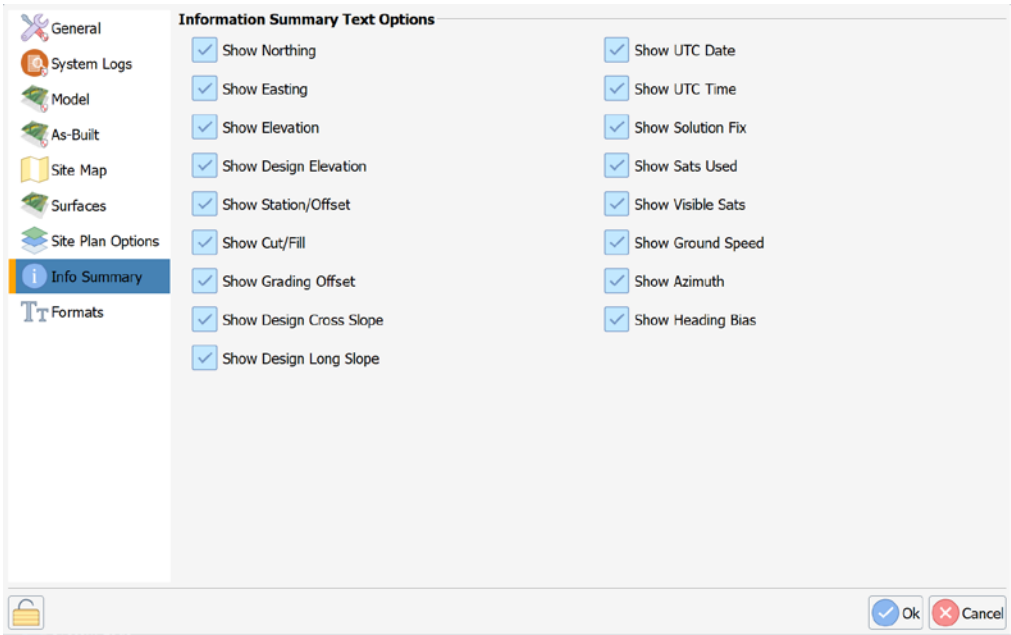
Continued on next page

GradeMetrix Main Menu, Continued

Info Summary tab

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 a second time. After making your selections, click **Ok**.



Continued on next page

GradeMetrix Main Menu, Continued

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.

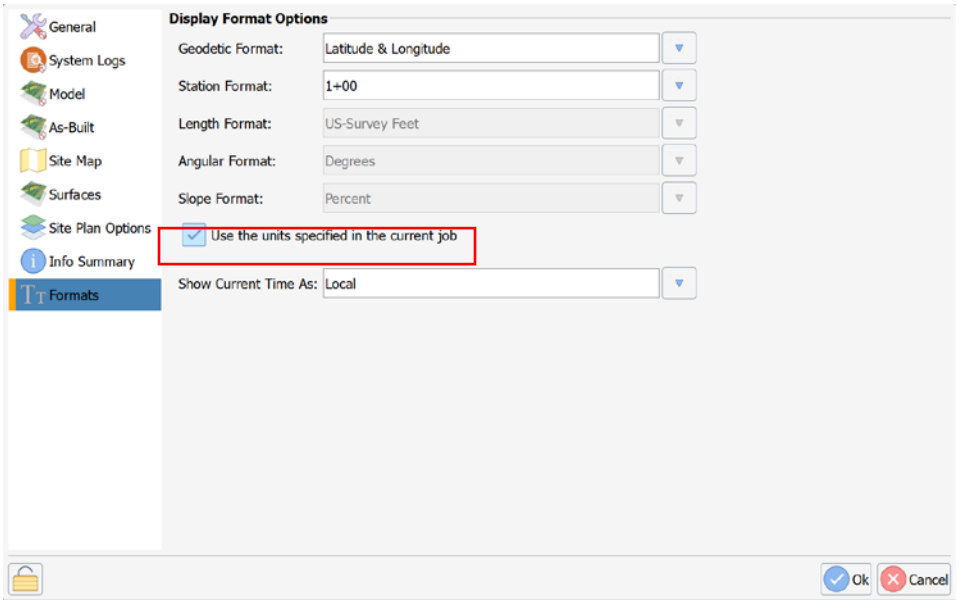
- **Geodetic Format:** displays latitude/longitude, UTM, or military grid
- **Station Format:** shows stations when using a guideline
- **Length Format:** selects the unit of measure for northing and easting
- **Angular Format:** selects between Degrees and Gradians
- **Slope Format:** selects between percent and degrees;:

Note: These fields can only be changed if the check box is unchecked. It is recommended to leave the box check to minimize errors.

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

If desired, click to select the checkbox to select to **use the units specified in the current job.**

Click **Ok** to return to the GradeMetrix Home screen.

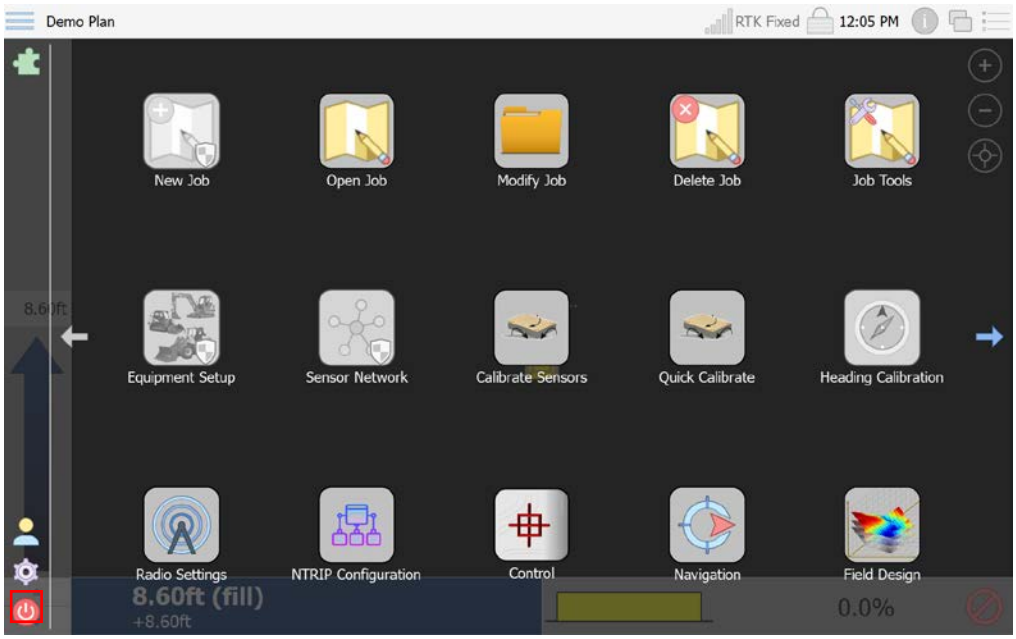


Continued on next page

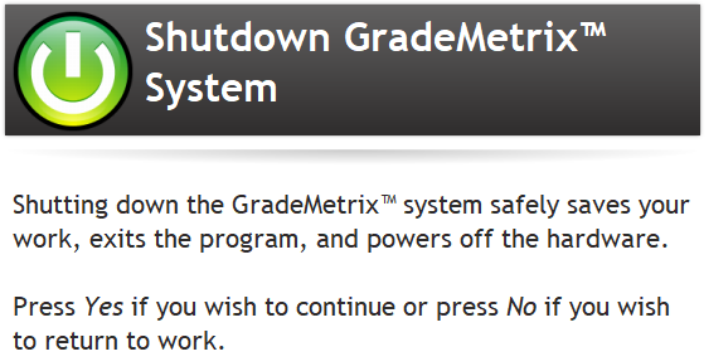
GradeMetrix Main Menu, Continued

Exit GradeMetrix

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



Highlight and click the **Shutdown** option. The confirmation message displays:



Click **Yes.** The GradeMetrix application closes.

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

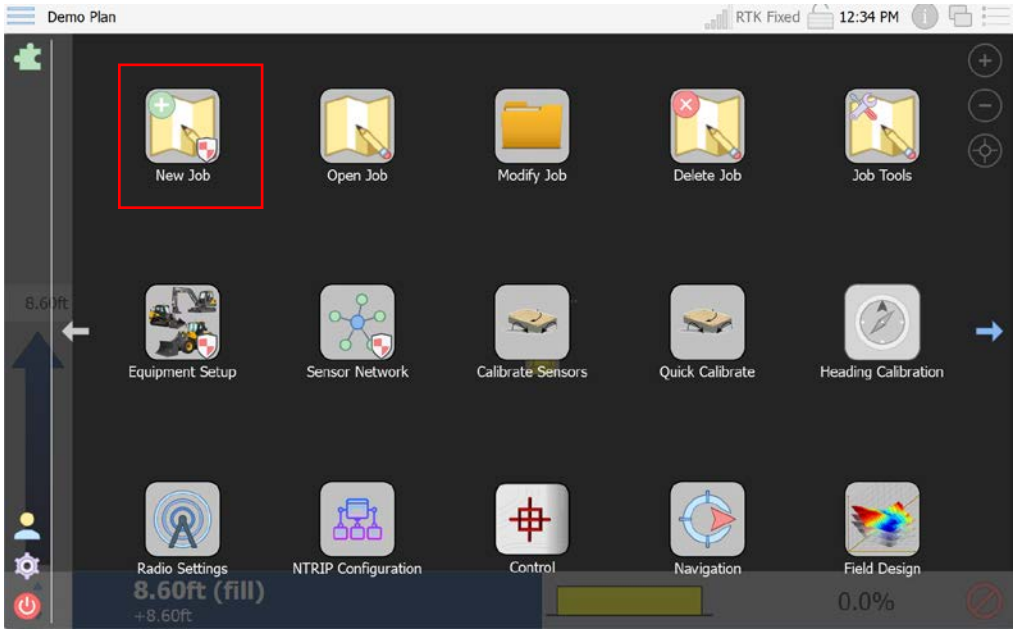
Topic	See Page
Create a Job	60
Open a Job	78
Modify a Job	79
Delete a Job	84
Job Tools	85
Equipment Setup	86
Sensor Network	98
Calibrate Sensors	102
Heading Calibration	106
Radio Settings	107
NTRIP Configuration	112
Control	114
Navigation	117
Design a Job	122
Topo	130
Firmware Update	137

Create a Job

Create a job

To create a job, on the GradeMetrix Home screen, 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 other users.



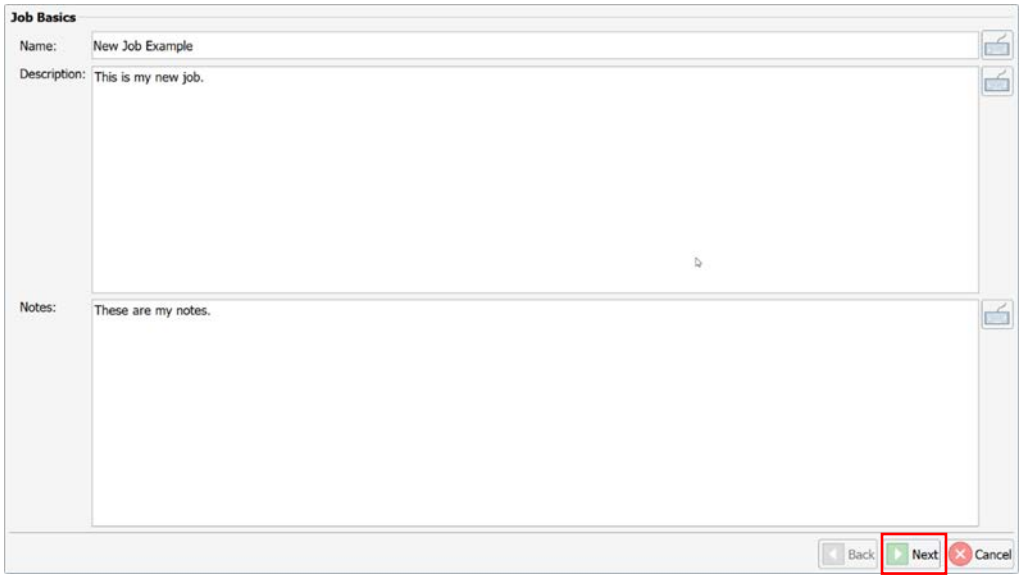
Continued on next page

Create a Job, Continued

Job basics screen

Click the keyboard icon and type the job name, description and job notes.

Click **Next**.



Continued on next page

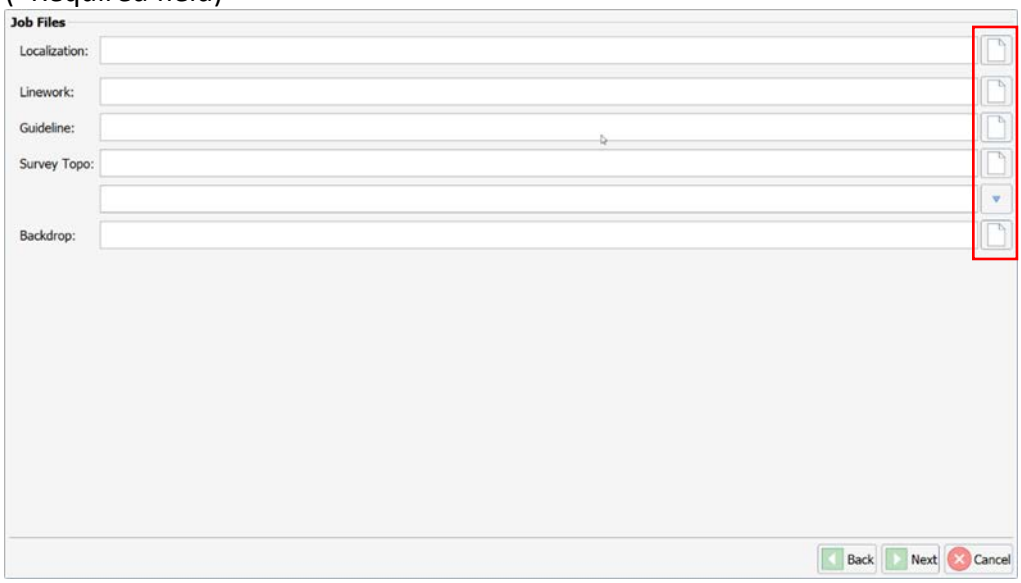
Create a Job, Continued

Job files screen

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

- Localization*
- Linework*
- Guideline
- Survey Topo
- Backdrop

(*Required field)

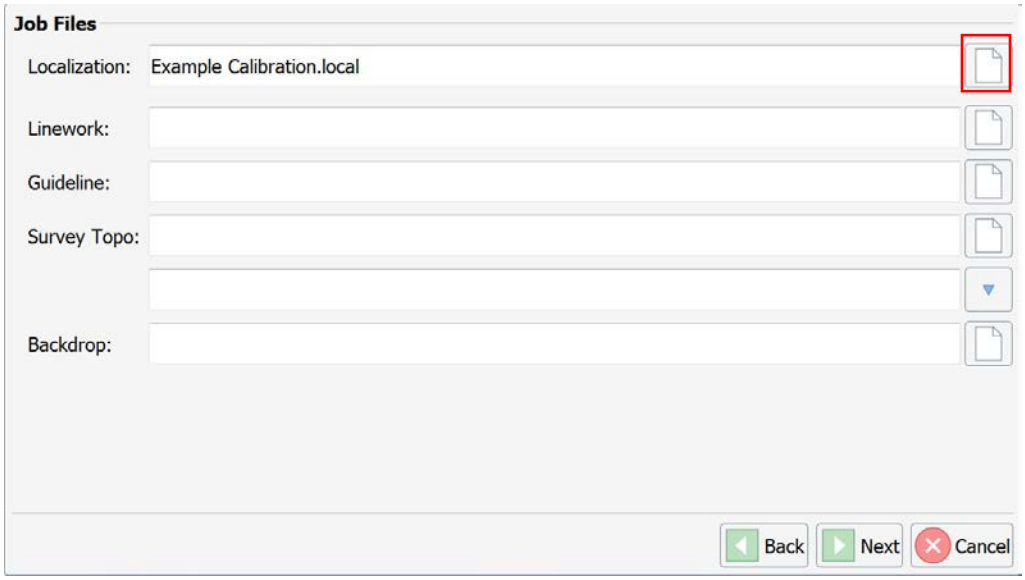


Continued on next page

Create a Job, Continued

Job files screen, continued

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

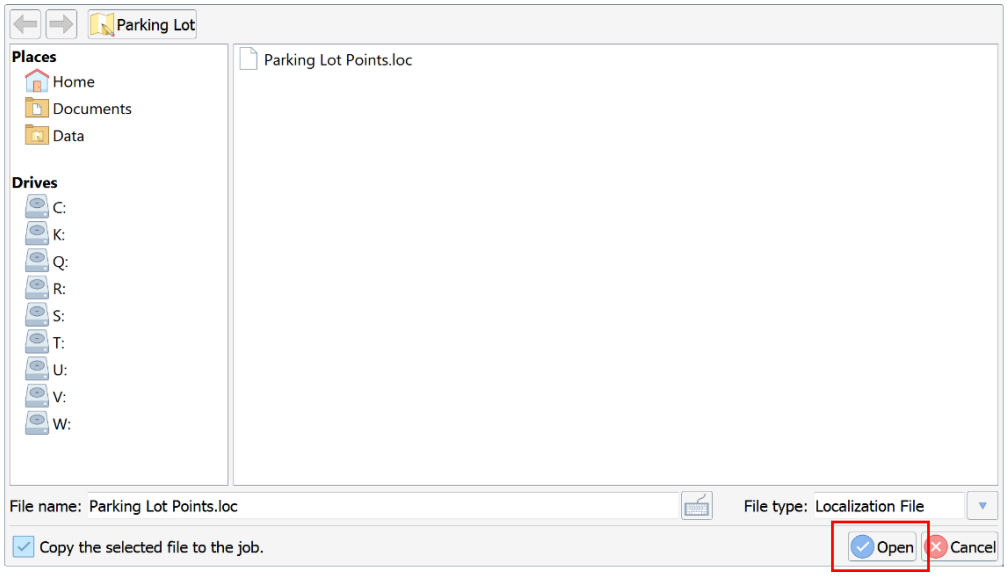


Continued on next page

Create a Job, Continued

Job files screen, continued

The file explorer window opens. Click on the filename you wish to add, and click **Open**.

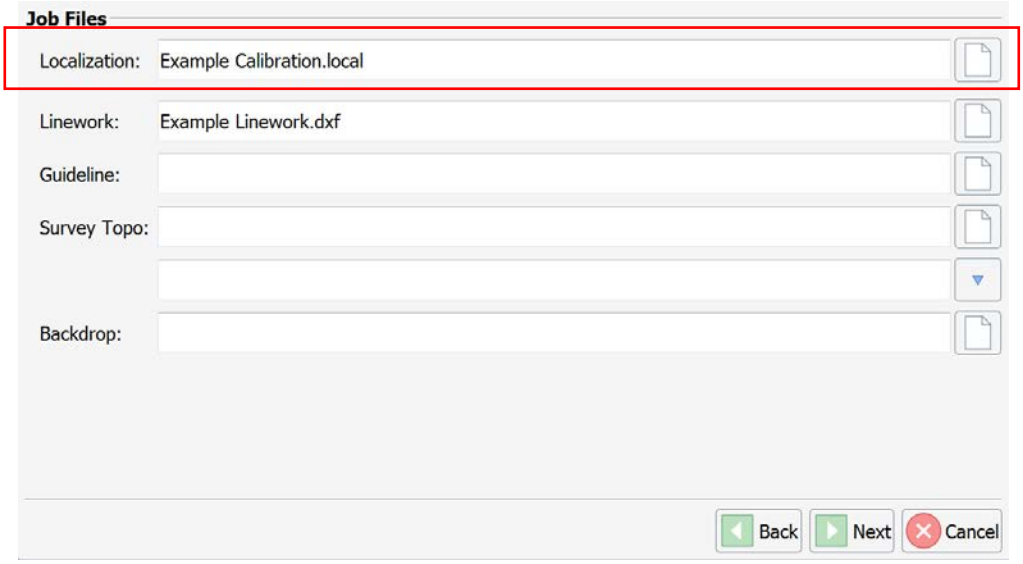


Continued on next page

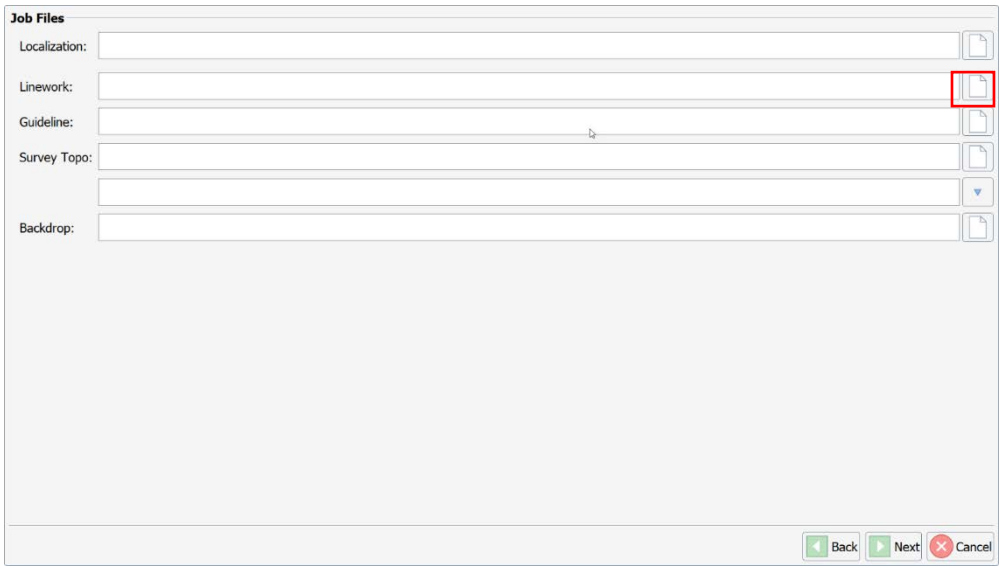
Create a Job, Continued

Job files screen, continued

The selected filename displays in the **Localization** field.



To add the **Linework** file, click the document icon on the right.

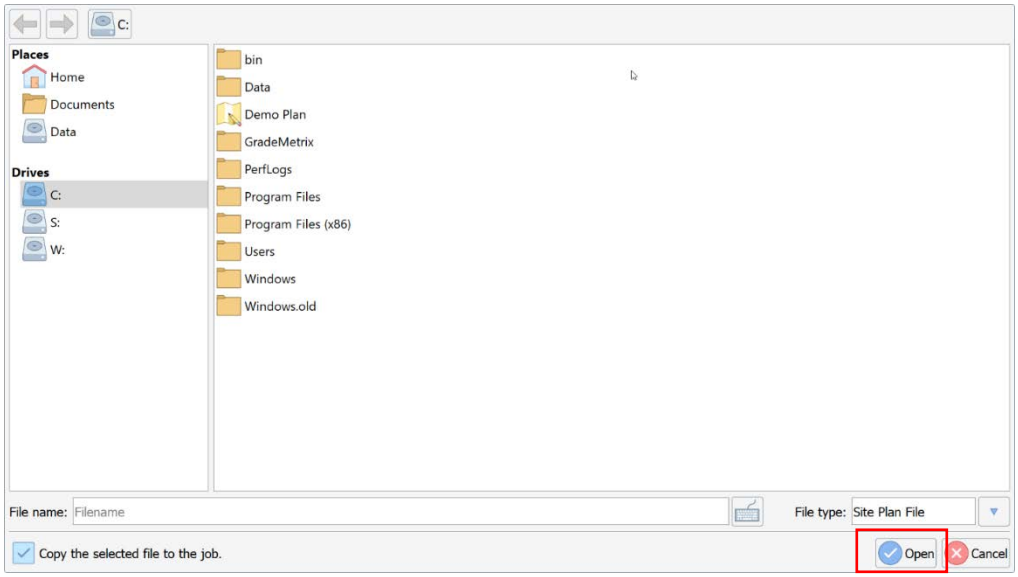


Continued on next page

Create a Job, Continued

Job files screen, continued

A list of available files is displayed. Click on the file you wish to add and click **Open**.



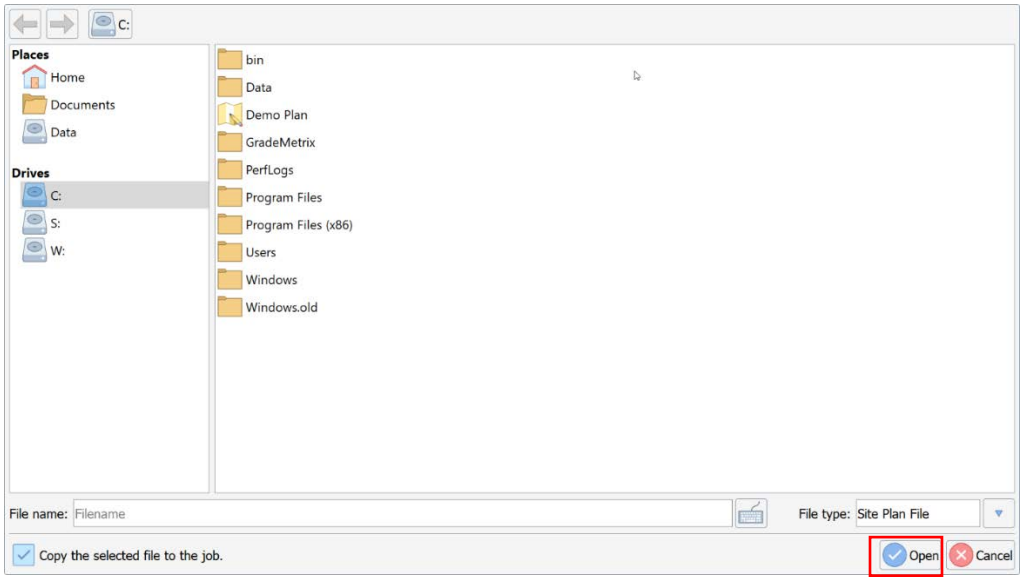
To add the **Guideline** file, click the document icon on the right.

Continued on next page

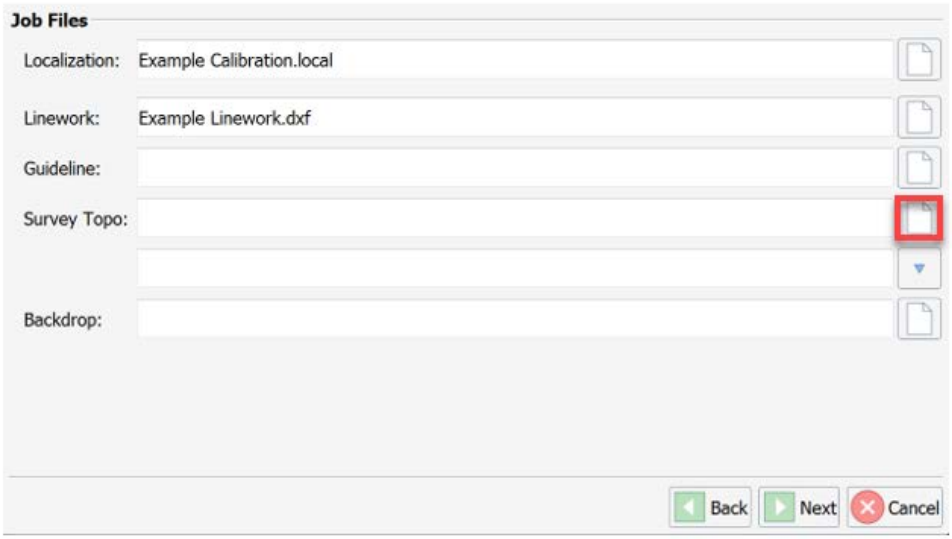
Create a Job, Continued

Job files screen, continued

A list of available files is displayed. Click to select the file you wish to add and click **Open**.



To add the **Survey Topo** file, click the document icon on the right of the field.



Continued on next page

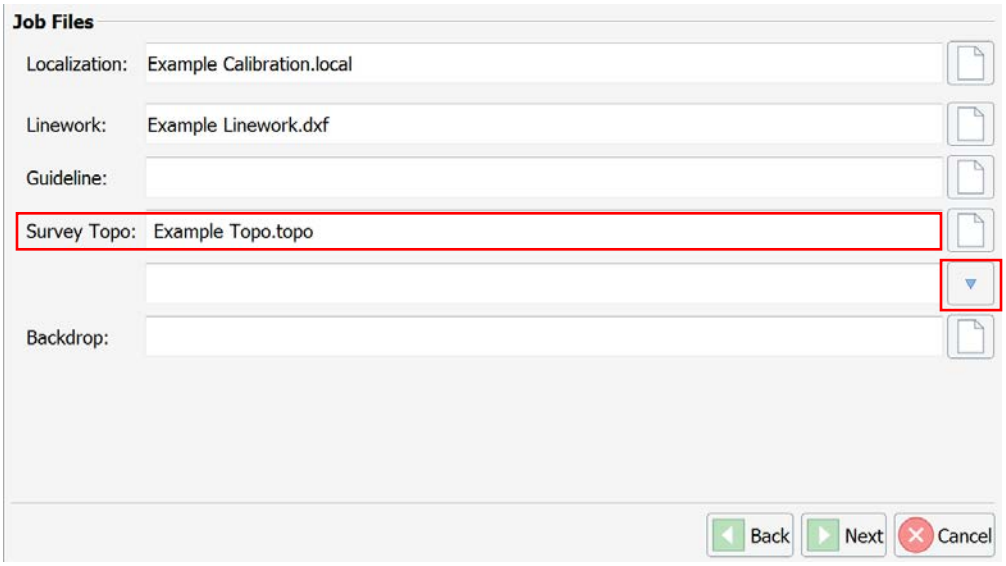
Create a Job, Continued

Job files screen continued

A list of available files is displayed. Click to select the file you wish to add and click **Open**.

The **Survey Topo** filename displays in the field.

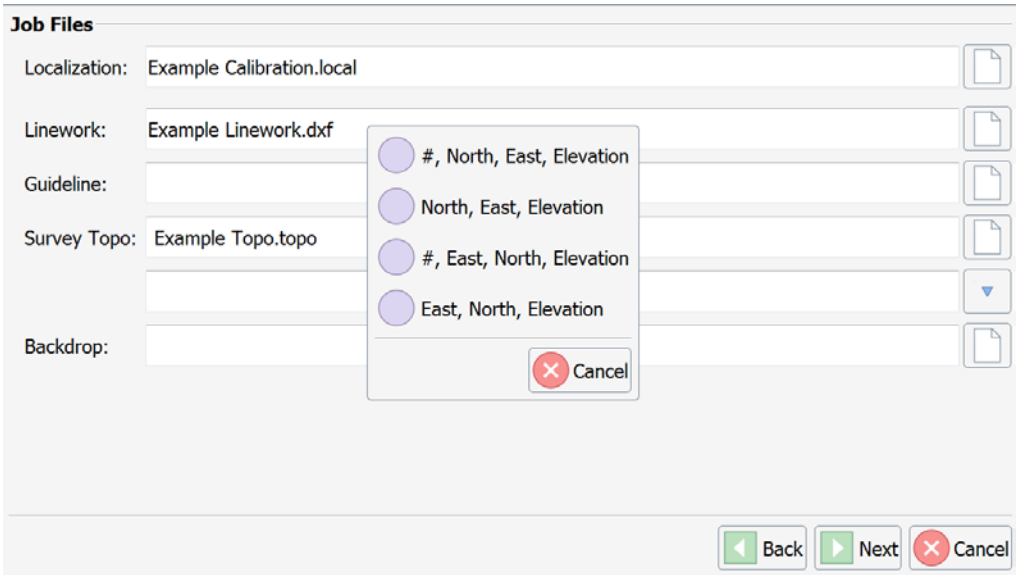
To set the **Survey Topo** elevation, click the down arrow, and click to select the elevation.



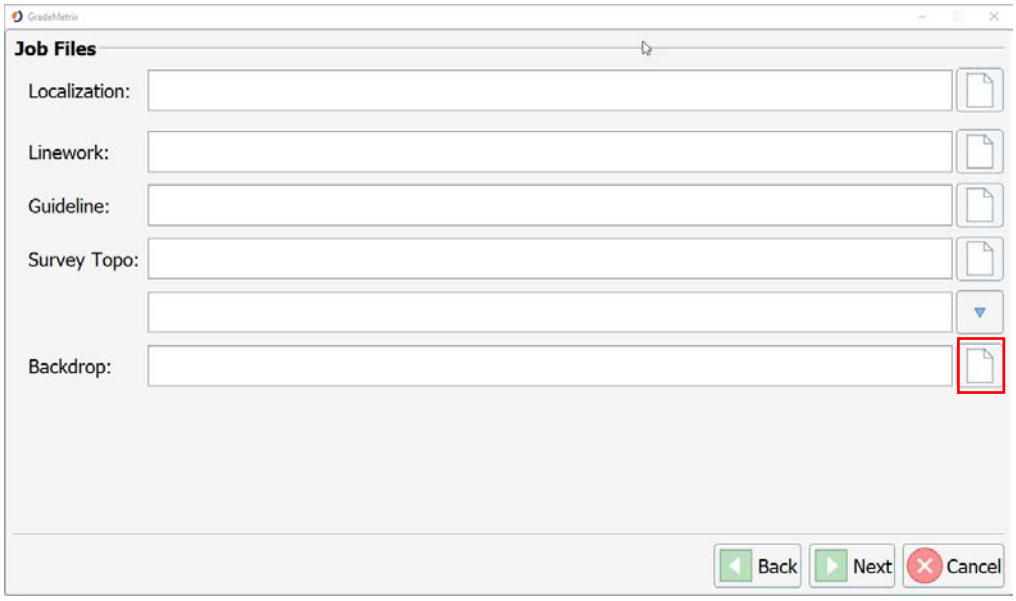
Continued on next page

Create a Job, Continued

Job files screen continued



To set the **Backdrop** (additional linework), click the document icon to the right of the field.

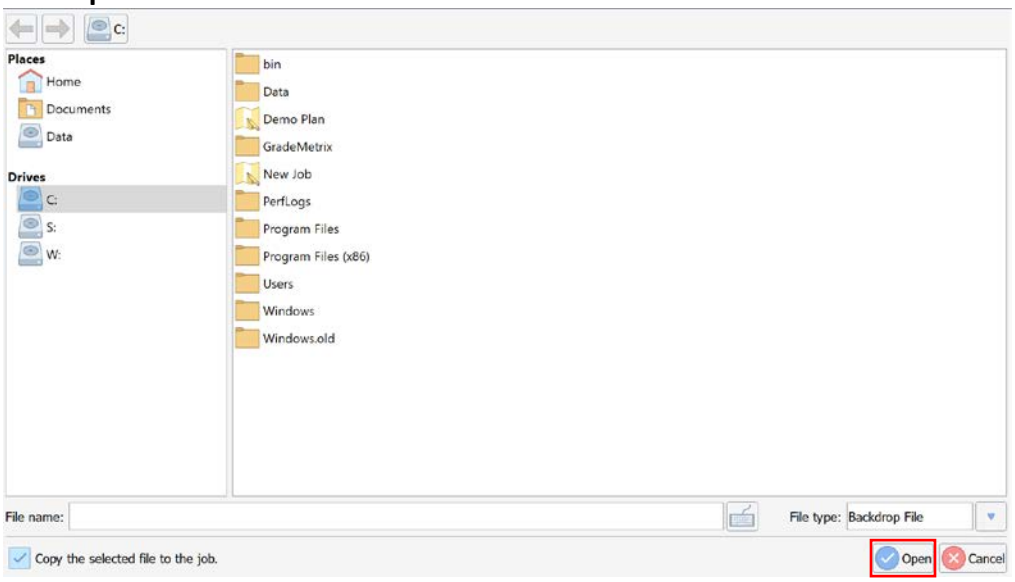


Continued on next page

Create a Job, Continued

Job files screen continued

A list of available files is displayed. Click to select the file you wish to add and click **Open**.



The **Backdrop** filename displays in the field. Click **Next**.

Continued on next page

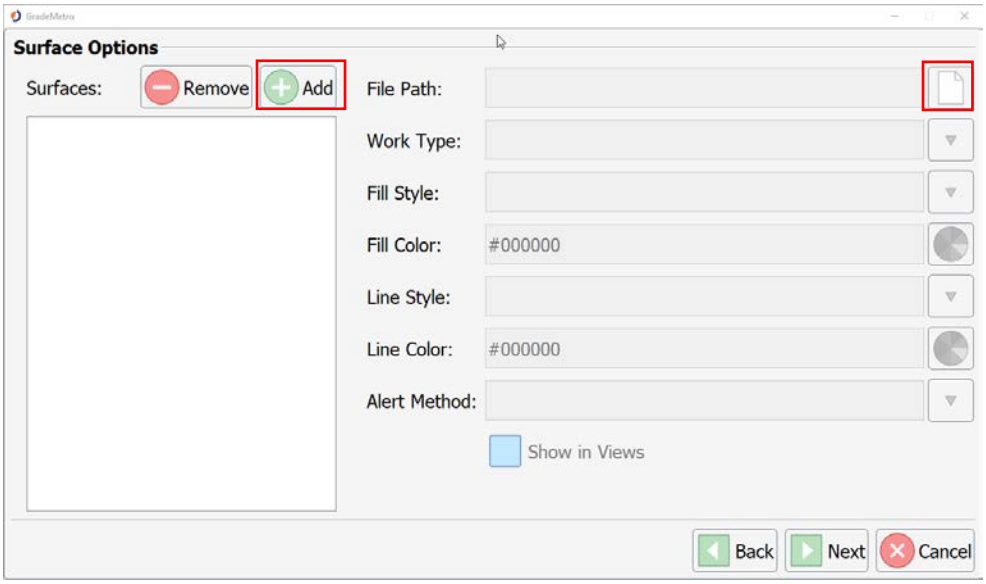
Create a Job, Continued

Surface options window

The **Surface Options** window displays. Click **Add** and type the name of the surface you would like to add.

Note: You can add multiple types of surfaces.

To upload a file, click the document icon to the right of the **File Path:** field and select the desired file.



Continued on next page

Create a Job, Continued

Surface options window, continued

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

- **Design**-the most commonly selected option. The Design surface is the surface you are grading to.
- **Actual** –select **Actual** if you have a jobsite topo to upload to the current actual surface.

Note: The following Work Type options (marked with *) are in development for GradeMetrix Phase 2.

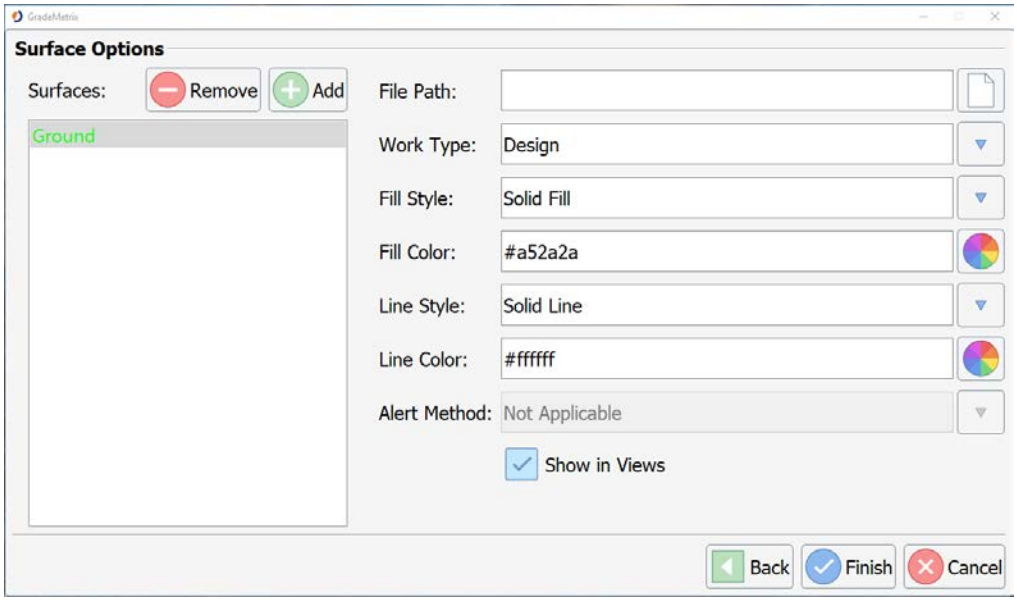
- **Warning** – select to trigger a warning in the software if your elevation is either above or below the uploaded surface (see '**Alert Method**') .
- **Watch** – similar to Warning. This allows for two levels of alert (i.e. you can choose to upload a 'Watch' surface to set low priority alerts to an operator and set another 'Warning' surface for higher priority alerts to an operator.
- **As-Built***
- **Pass Count** –color the screen based on how many times a machine has passed over a grid cell.
- **Density***
- **Counting***
- **Information***
- **Changes Only***
- **Difference***

Continued on next page

Create a Job, Continued

Surface options window, continued

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



For each **Work Type** you must select (set) the following:

- Fill Style
- Fill Color
- Line Style
- Line Color
- Alert Method (**Note: Alert Method** is only applicable if **Work Type** is set to **Warning** or **Watch**. Select from **Alert When Below** or **Alert When Above**.)

Click to select the checkbox: **Show in Views**, and click **Next**.

Note: Show in Views must be selected to display your design in the design surface.

Continued on next page

Create a Job, Continued

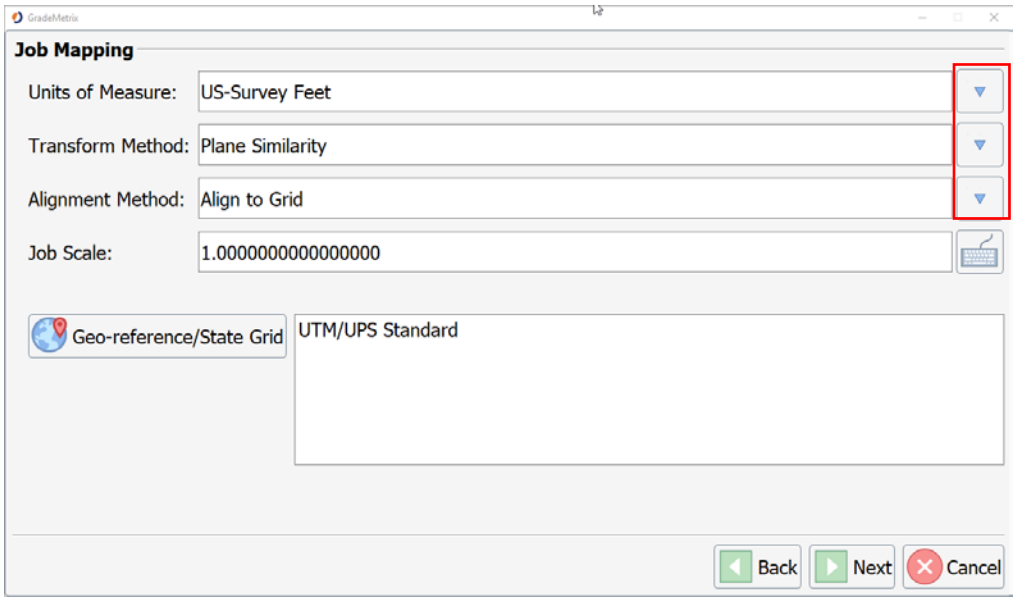
Job Mapping window

The **Job Mapping** window displays.

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

- Units of Measure
- Transform Method
- Alignment Method

Click to use the keyboard icon and type the **Job Scale**.



Continued on next page

Create a Job, Continued

Job Mapping window, continued

To set a geographical reference grid, click **Geo-reference/State Grid**. Click to select from the displayed list.

Click **Next**.

Continued on next page

Create a Job, Continued

Job Localization screen

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

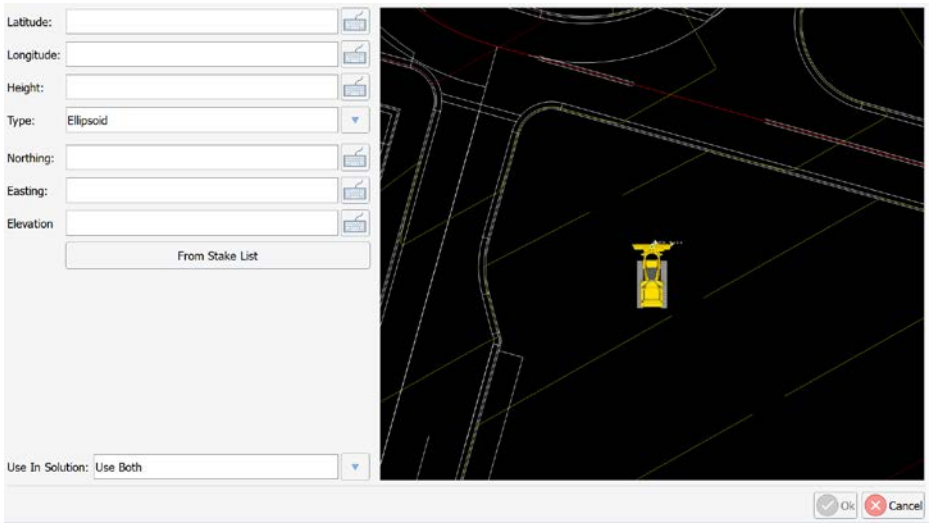
Click the keyboard icon to the right of each field to set the localization settings:

- Latitude
- Longitude
- Height
- Type (drop-down arrow to select **Ellipsoid** or **Geoid**)
- Northing
- Easting
- Elevation

Continued on next page

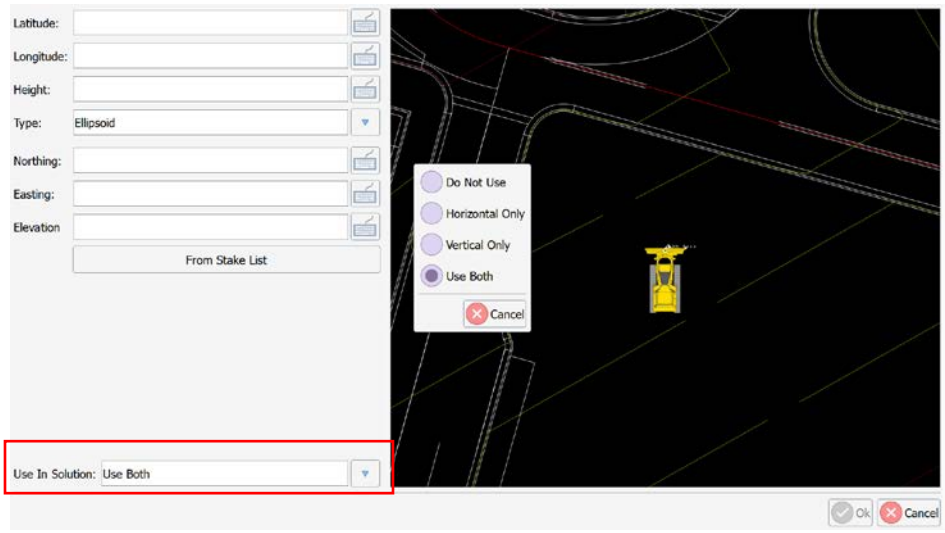
Create a Job, Continued

Job Localization screen, continued



From Stake List button-allows the user to select whether the control point is used in the solution.

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

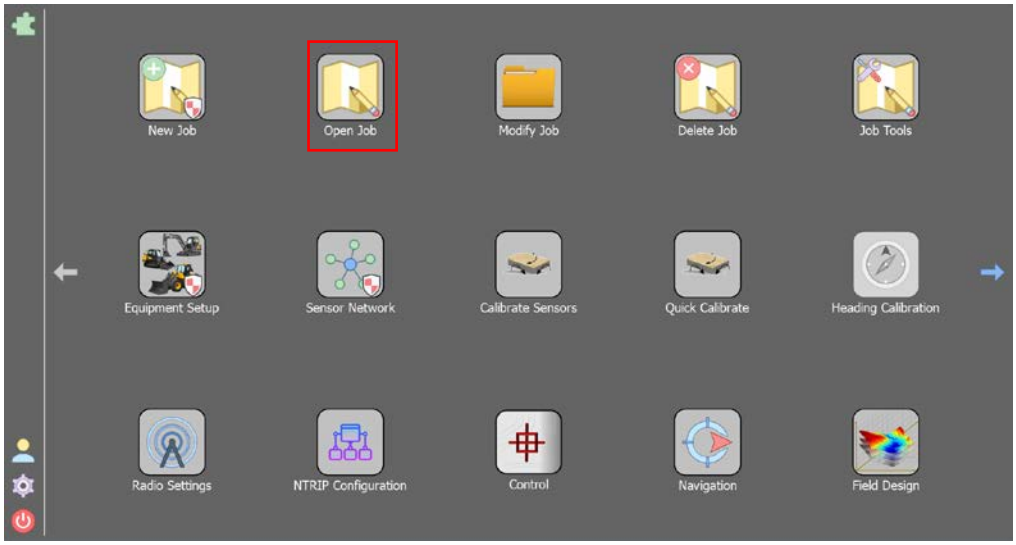


Click **Ok**. Click **Finish**.

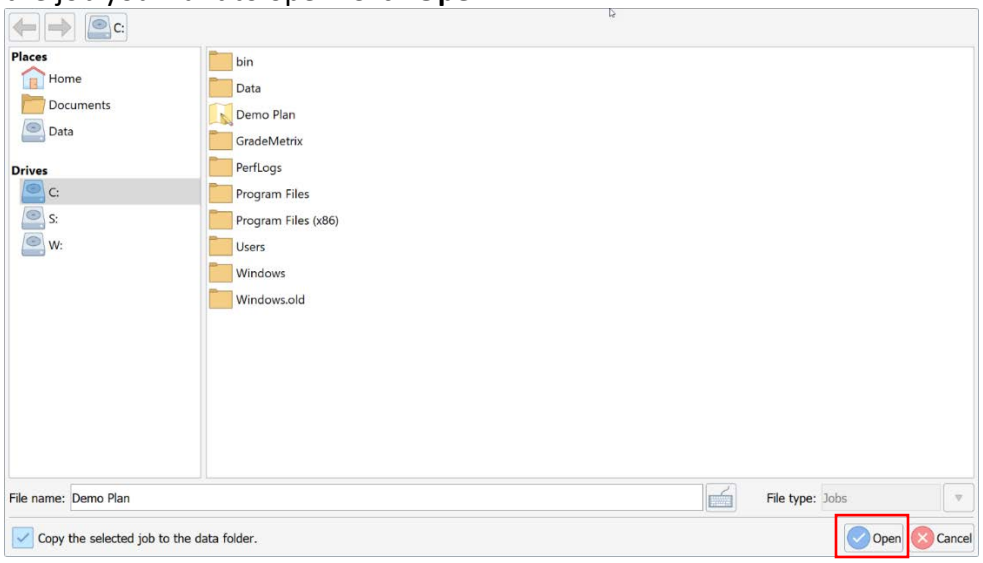
Open a Job

Open a 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**.

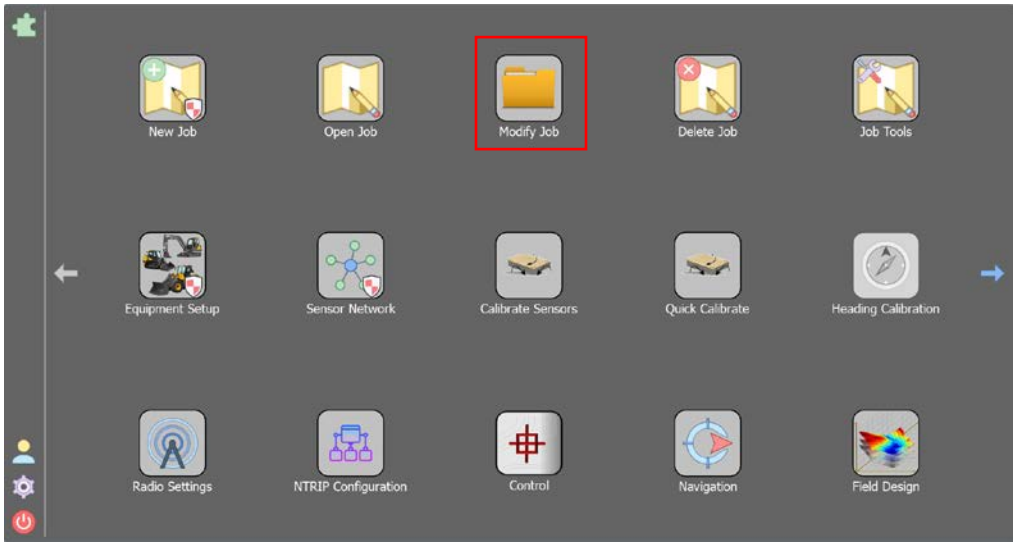


Modify a Job

Modify a 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 Administrator.

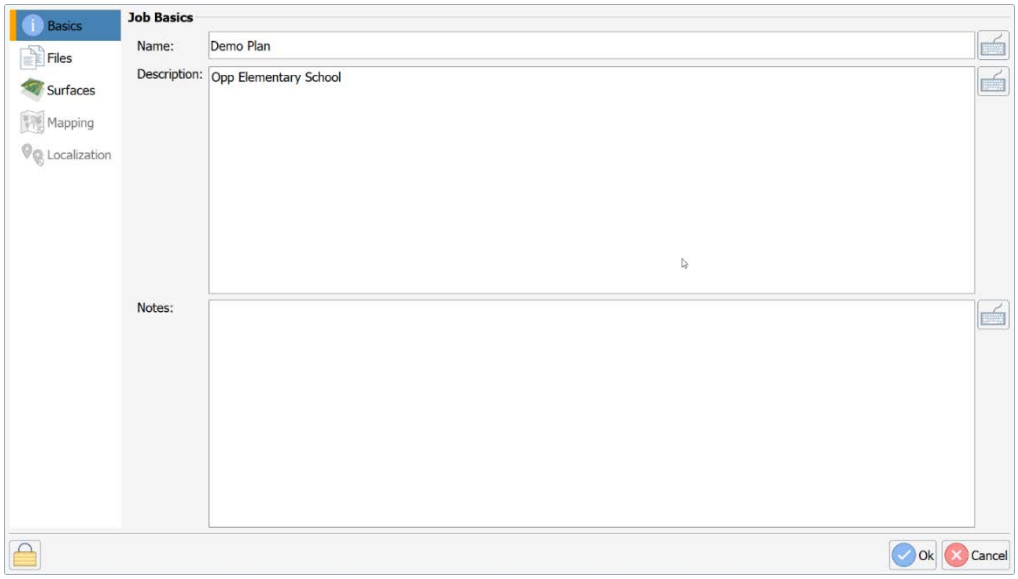


Continued on next page

Modify a Job, Continued

Modify Job basics screen

The **Job Basics** screen displays the **Name**, **Description**, and **Notes** about the job. Click in each field to add the necessary information.



The left navigation menu provides links to the following job information:

- Basics
- Files
- Surfaces
- Mapping
- Localization

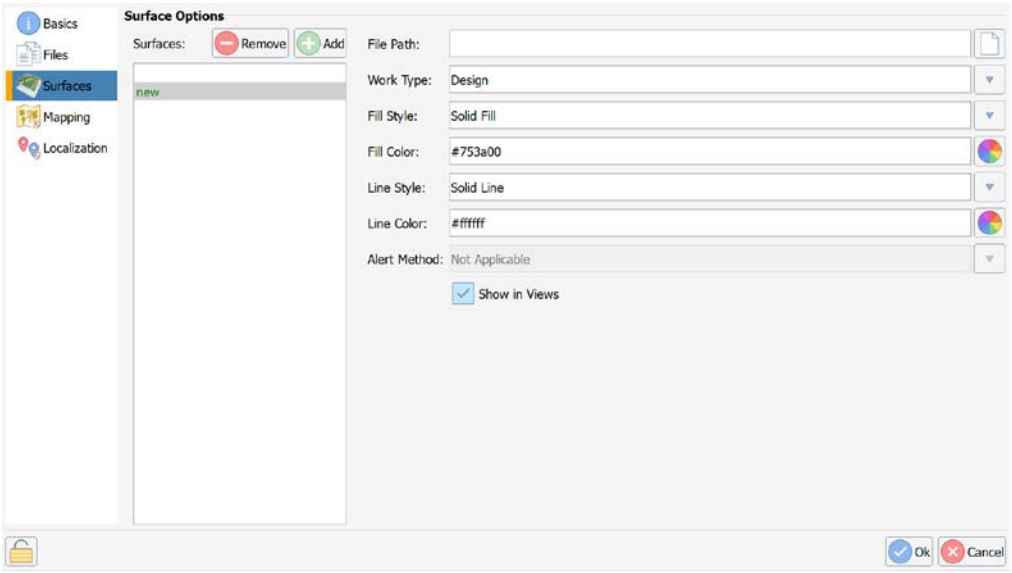
Continued on next page

Modify a Job, Continued

Add job surfaces

From the left navigation menu, click the Surfaces option. The **Surface Options** window displays.

To modify a **Surface**, see **Surface Options** in the **New Job** section of this manual.

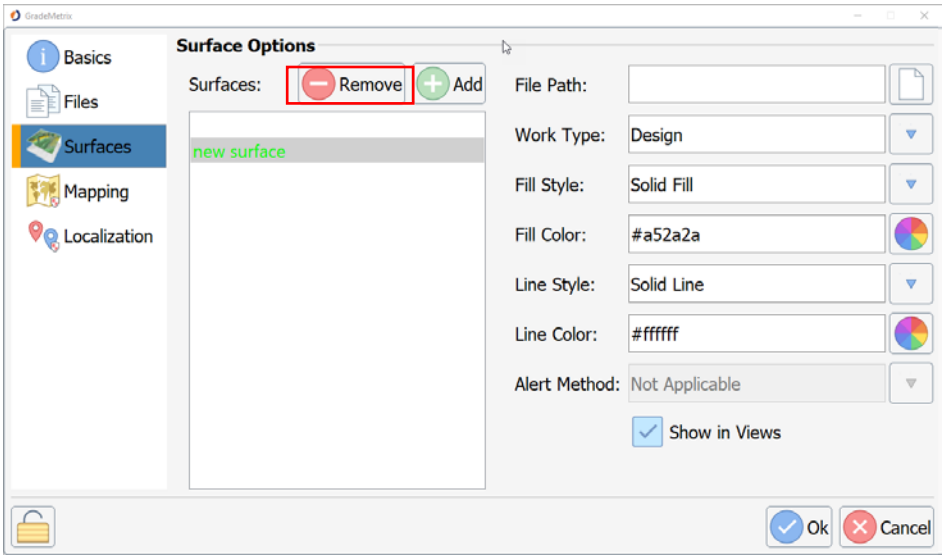


Continued on next page

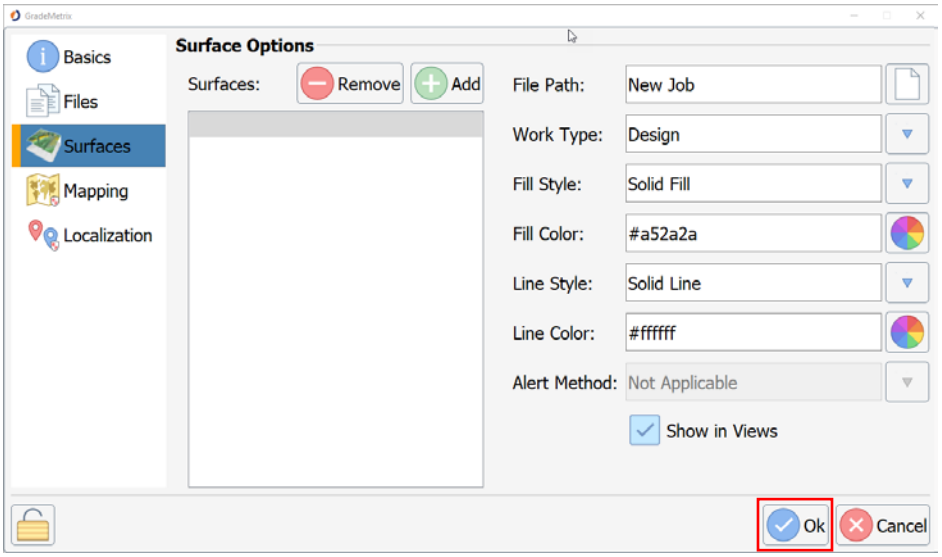
Modify a Job, Continued

Remove a surface option

To remove a **Surface Option**, click to highlight the **Surface Option** name and click **Remove**.



The **Surface Option** is removed from the **Surface Options** field. When you have finished modifying all the necessary **Surface Options**, click **Ok**.

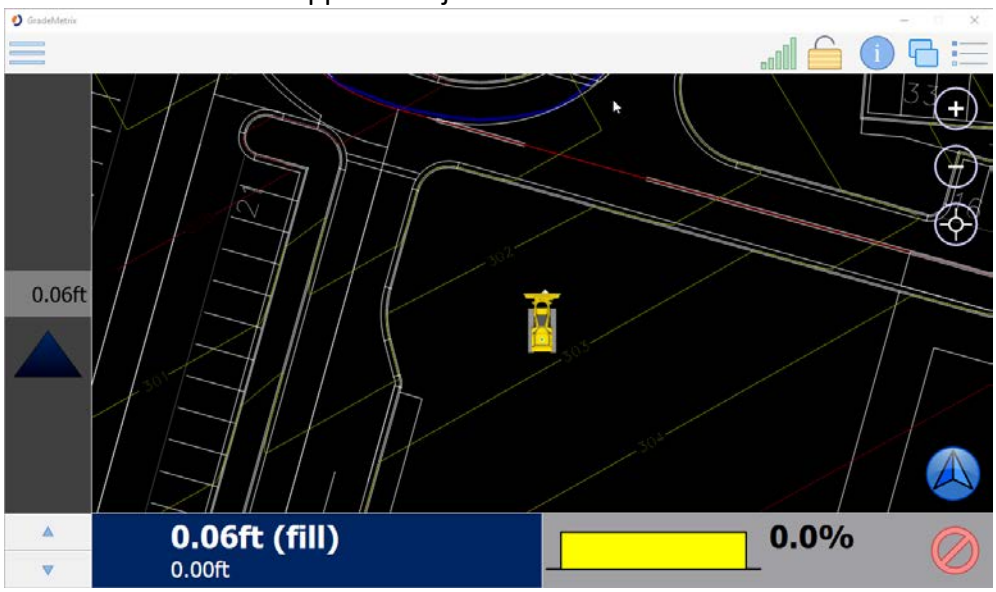


Continued on next page

Modify a Job, Continued

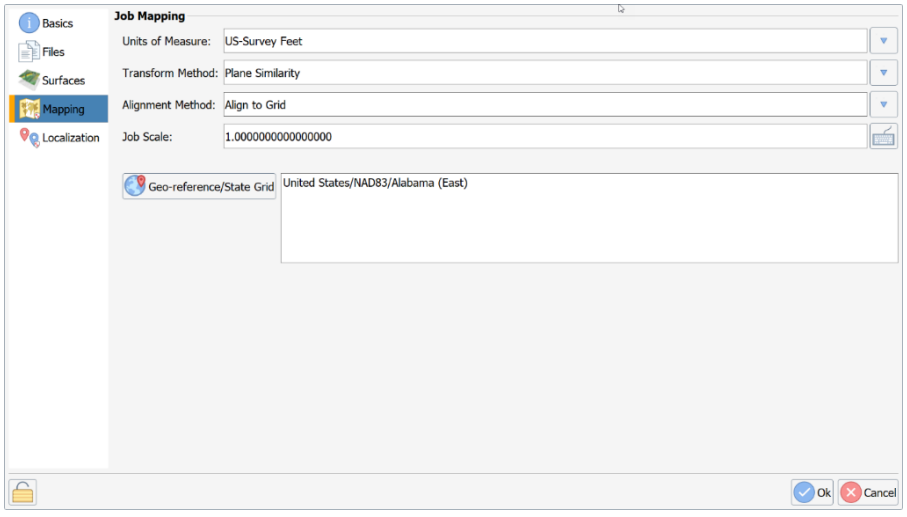
Remove a surface option, continued

The currently opened GradeMetrix Job appears. A slight system delay will occur as GradeMetrix applies the job modifications.



Modify Job mapping screen

From the left navigation menu, click the **Mapping** icon. The **Job Mapping** screen displays. To modify the job mapping, see **Job Mapping** in the **New Job** section of this manual.

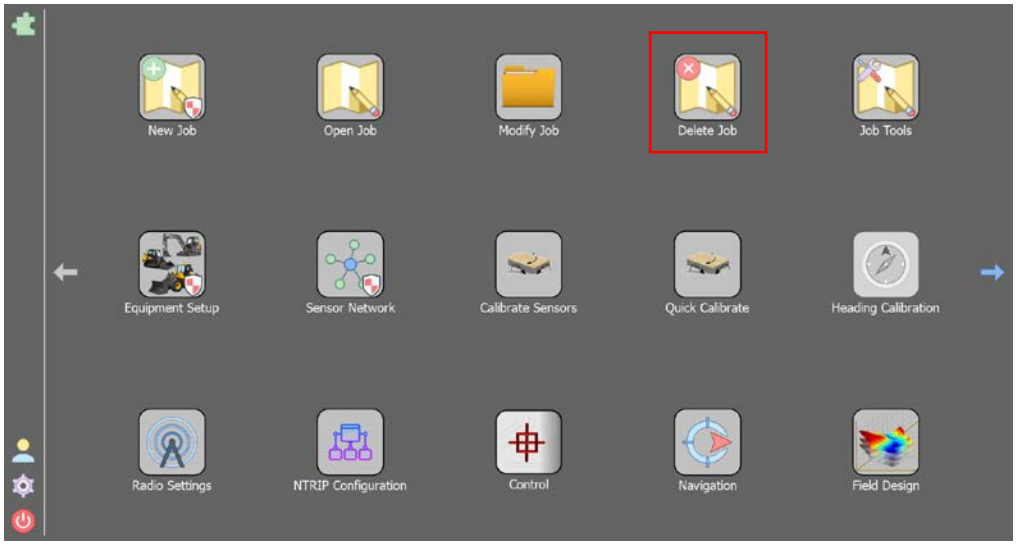


Continued on next page

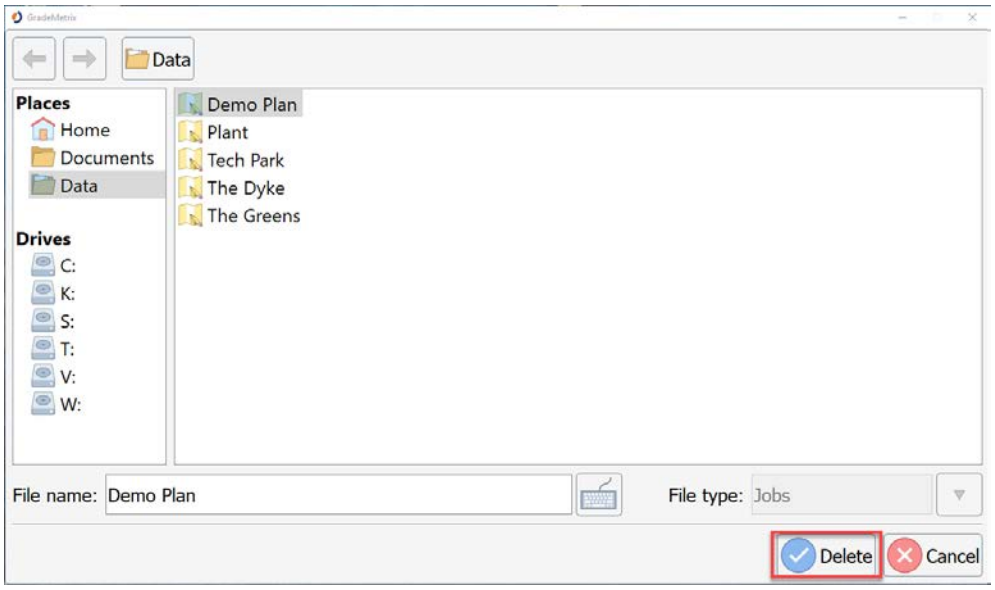
Delete a Job

Delete a job

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



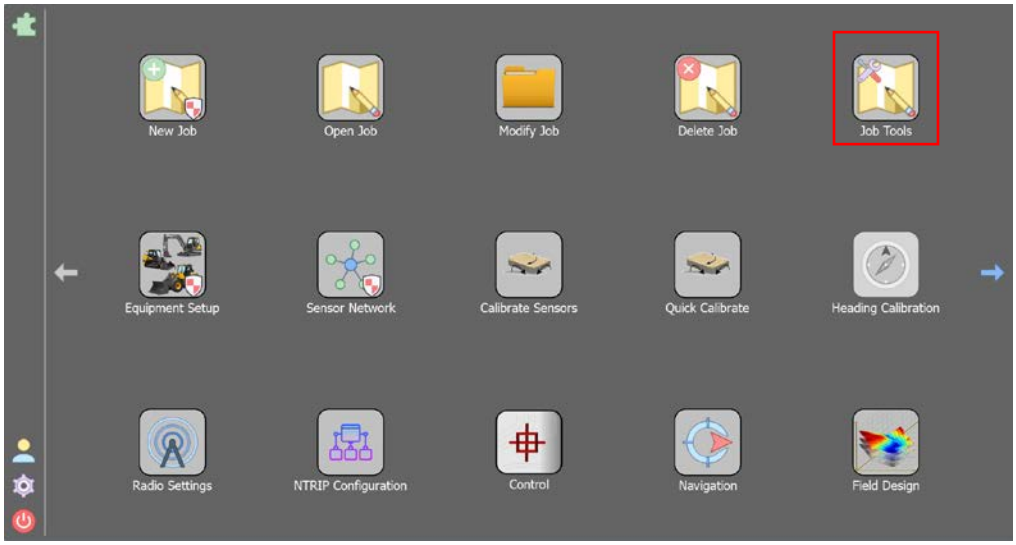
Click to highlight the name of the job you wish to delete and click **Delete**.



Job Tools

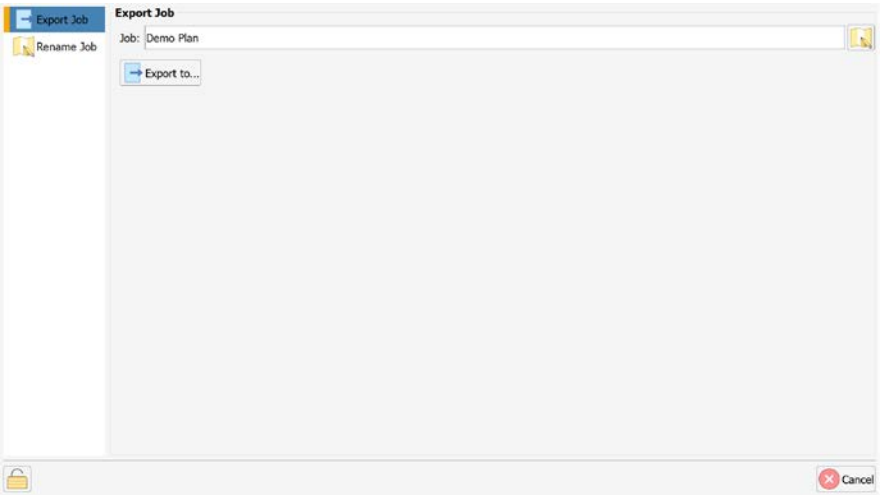
Job Tools

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



You can select from two options:

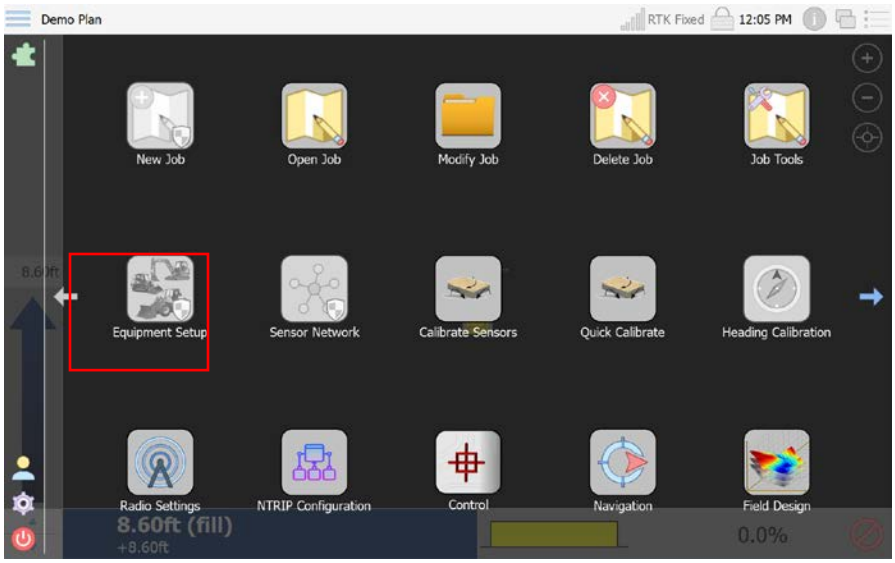
1. Export Job-save your job to a thumb drive
2. Rename Job=change the name under which the job is saved



Equipment Setup

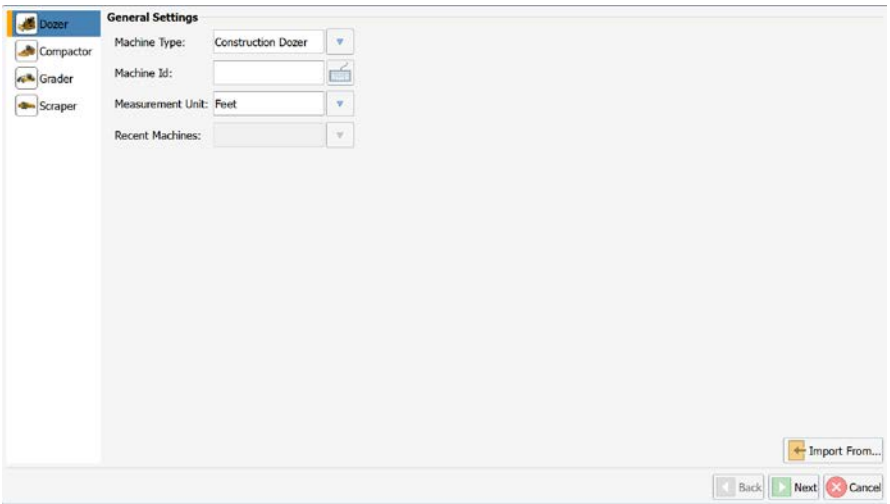
Equipment setup

To set machine and equipment settings, click the **Equipment Setup** icon on the GradeMetrix Main Menu.



In the **General Settings** window, the left navigation window displays the machine types: **Dozer**, **Compactor**, **Grader**, **Scraper**.

Note: Machine types Compactor, Grader, and Scraper are currently under development and will be available in a future release.



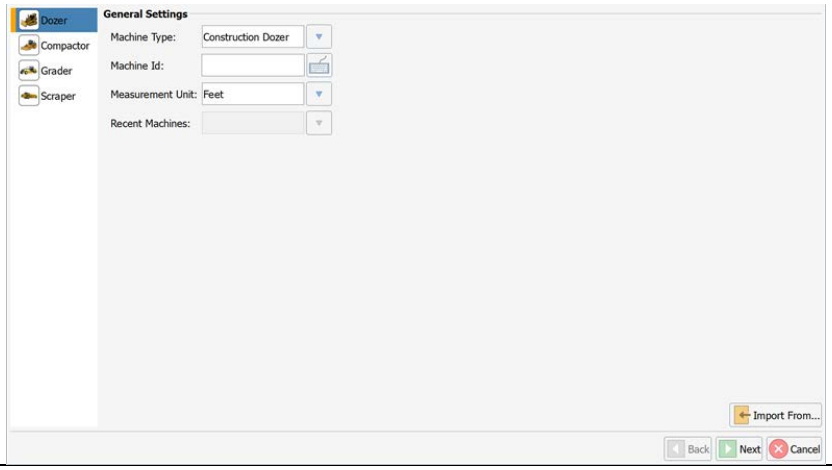
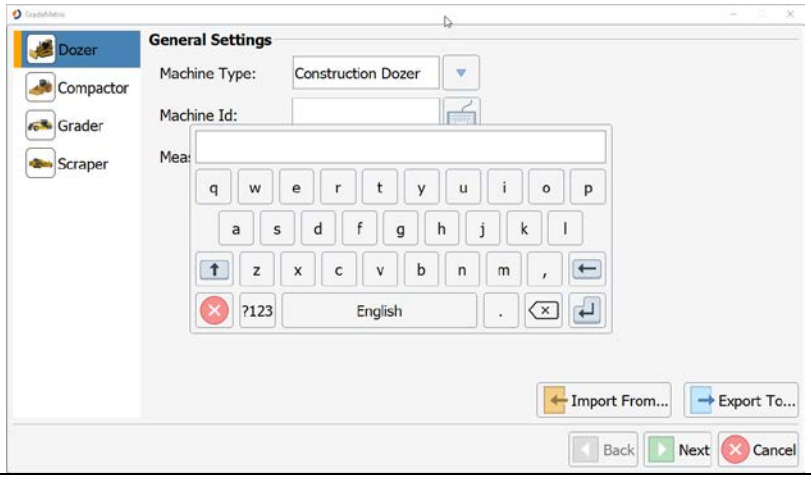
`Continued on next page

Equipment Setup, Continued

Equipment Setup steps

The following steps can be applied to set up any machine.

Table 3-1: Equipment Setup

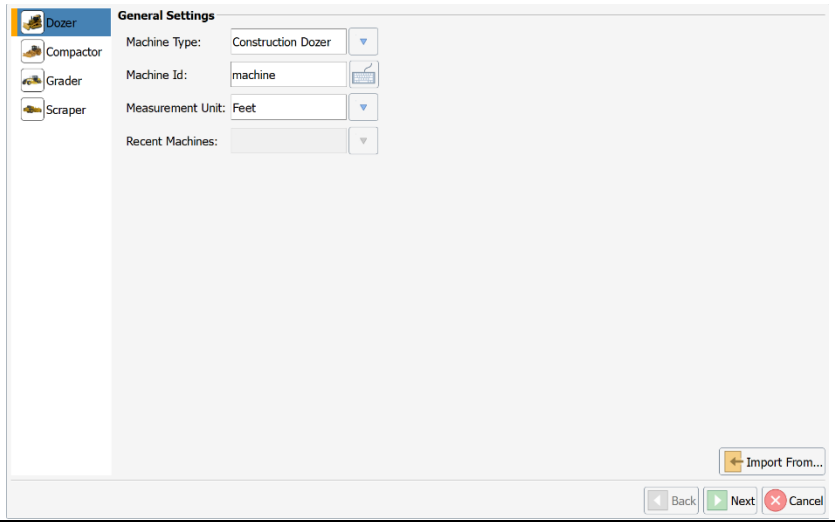
Step	Action
1	At the bottom right of the screen, click **Import From…** to upload a saved machine file. 
2	Use the keyboard to assign a **Machine ID** to this machine. Click **Enter**. 

Continued on next page

Equipment Setup, Continued

Equipment Setup steps, continued

Table 3-1: Equipment Setup (continued)

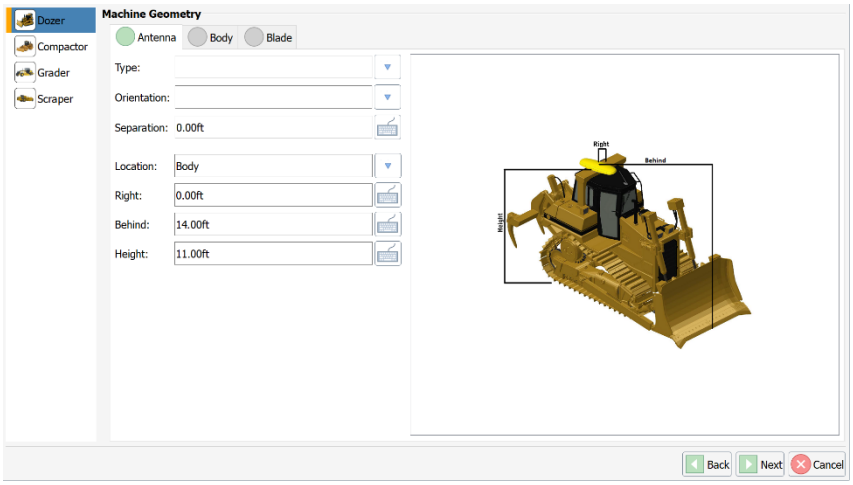
Step	Action
3	Click the down-arrow to select the desired **Measurement Unit**. . **Note:** The **Measurement Unit** only applies to the machine setup. It does not change the display, or job units. Click the down-arrow to select **Recent Machine to select from the last several machines used.** Click **Next.** 

Continued on next page

Equipment Setup, Continued

Equipment Setup steps, continued

Table 3-1: Equipment Setup (continued)

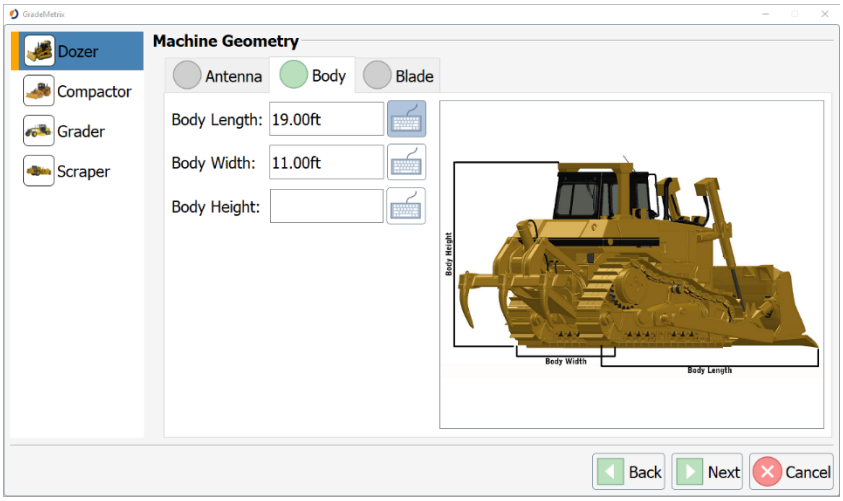
Step	Action
4	The **Machine Geometry** screen displays. On the **Antenna** tab, click to the right of the text box to set the following machine geometry: • Type • Orientation • Separation • Location • Right • Behind • Height **Note:** Machine geometry varies with antenna selection. 

Continued on next page

Equipment Setup, Continued

Equipment Setup steps, continued

Table 3-1: Equipment Setup (continued)

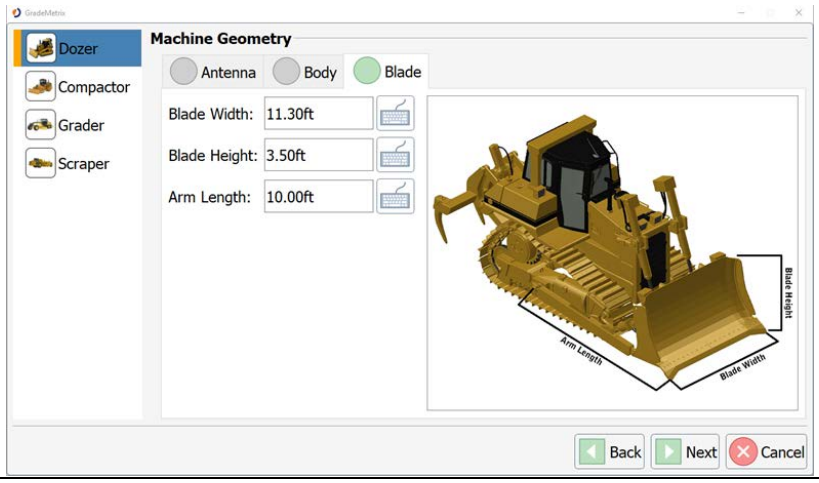
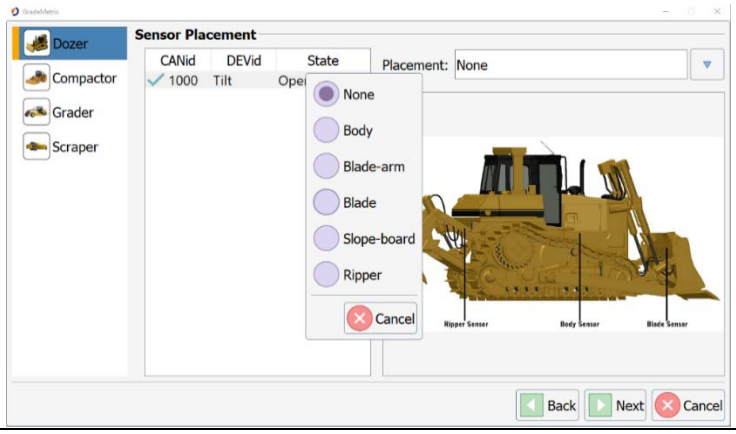
Step	Action
5	Click the **Body** tab. Type the values for the following body measurements: • Body Length • Body Width • Body Height **Note:** The values shown in the screen below are used for graphical purposes only. They do not affect the position accuracy. 

Continued on next page

Equipment Setup, Continued

Equipment Setup steps, continued

Table 3-1: Equipment Setup (continued)

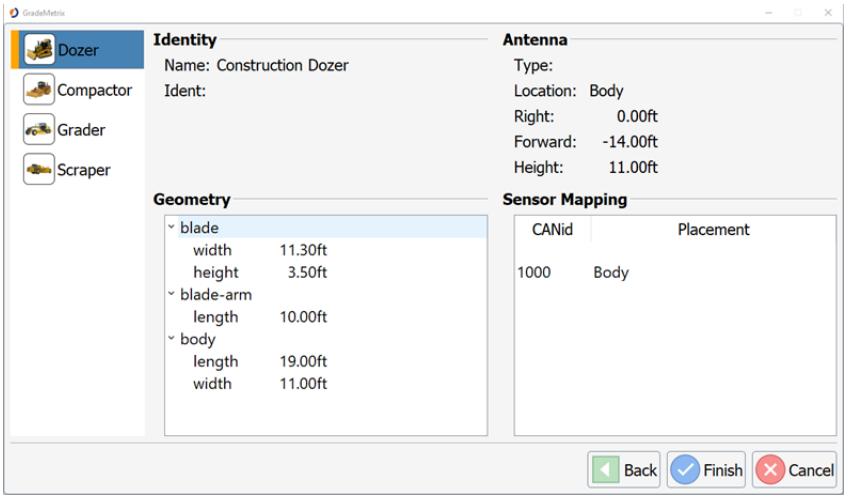
Step	Action
6	Click the **Blade** tab. Type values for the following blade dimensions: • Blade Width • Blade Height • Arm Length Click **Next**. 
7	The **Sensor Placement** window displays. Select each sensor, then click the down arrow to select sensor placement, and click **Next**. 

Continued on next page

Equipment Setup, Continued

Equipment Setup steps, continued

Table 3-1: Equipment Setup (continued)

Step	Action
8	Summary information is displayed. To export and save measurement and spec files, click the **Export To:** button. The list of file locations displays. Locate and click the file to export and click **Save**. Verify all the selections are correct, and click **Finish**. 

Dozer

Click to select **Dozer** on the left navigation menu and click the down-arrow to select **Construction Dozer** or **Mining Dozer** in the **Machine Type** field.

Refer to Table 3.1 Equipment Setup Steps to continue setting up the machine.

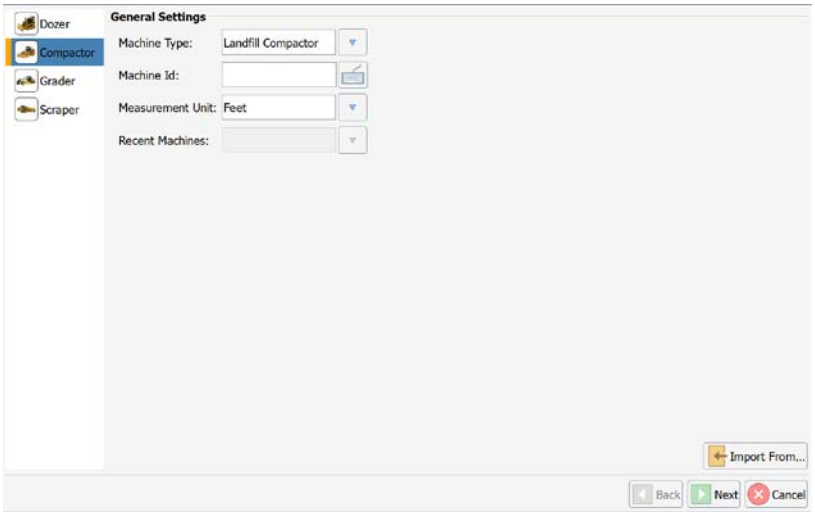
Continued on next page

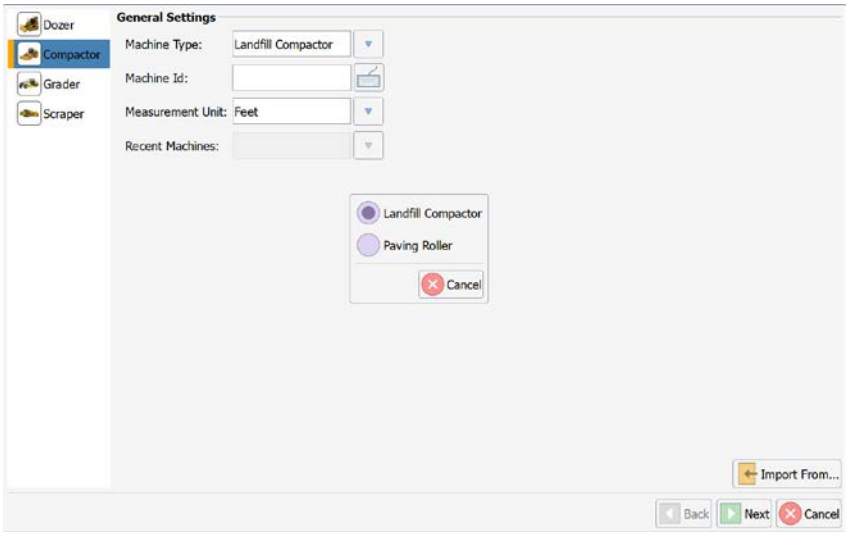
Equipment Setup, Continued

Compactor

Click to select **Compactor** on the left navigation menu and click the down-arrow to select **Landfill Compactor** or **Paving Roller** in the **Machine Type** field.

Refer to Table 3.1 Equipment Setup Steps to continue setting up the machine.





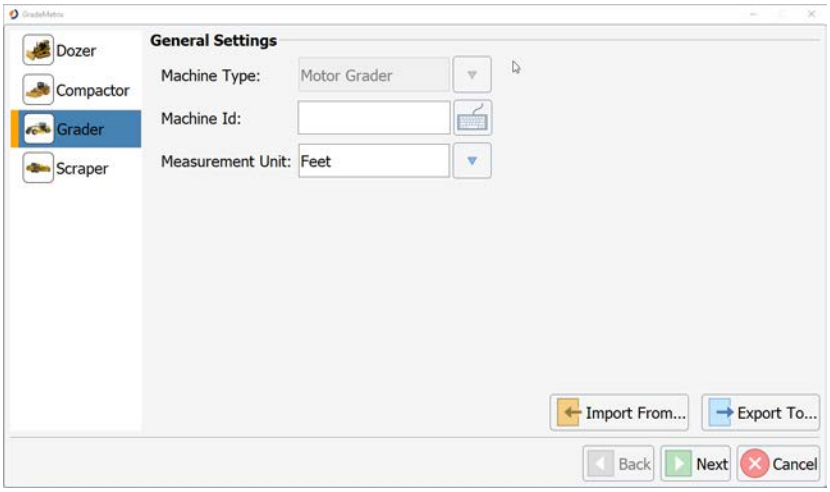
Continued on next page

Equipment Setup, Continued

Grader

Click to select **Grader** on the left navigation menu. **Motor Grader** is the default setting in the **Machine Type** field.

Refer to Table 3.1 Equipment Setup Steps to continue setting up the machine.



Continued on next page

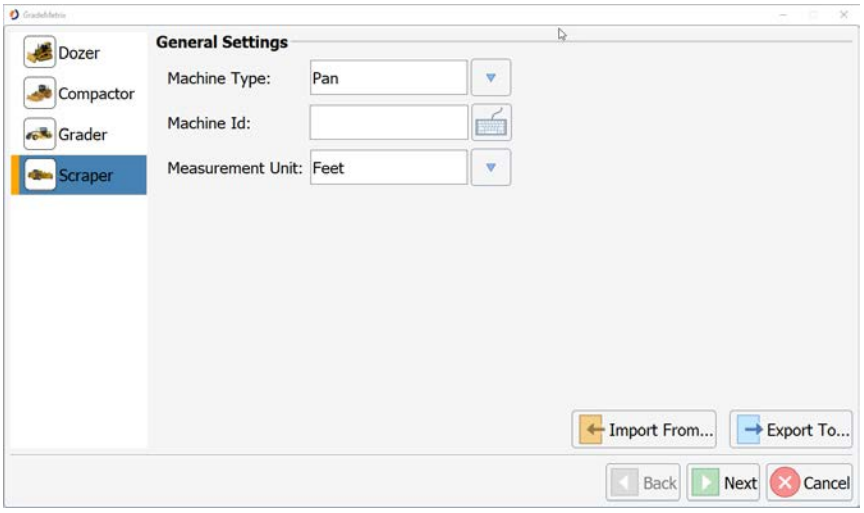
Equipment Setup, Continued

Scraper

Click to select **Scraper*** on the left navigation menu. Use the down-arrow to select **Pan** or **Pull Pan** in the **Machine Type** field.

***The **Scraper** feature is under development and will be available in a future release.

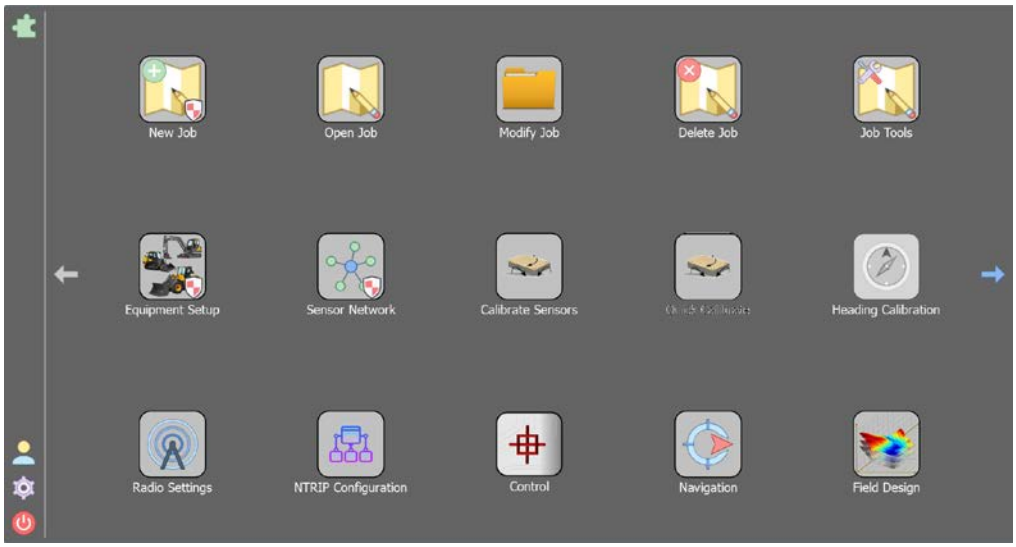
Refer to Table 3.1 Equipment Setup Steps to continue setting up the machine.



Sensor Network

Sensor network

The pitch and roll tilt sensors can be configured through the software (Administrator User only). On the GradeMetrix home Main Menu, click the **Sensor Network** icon.



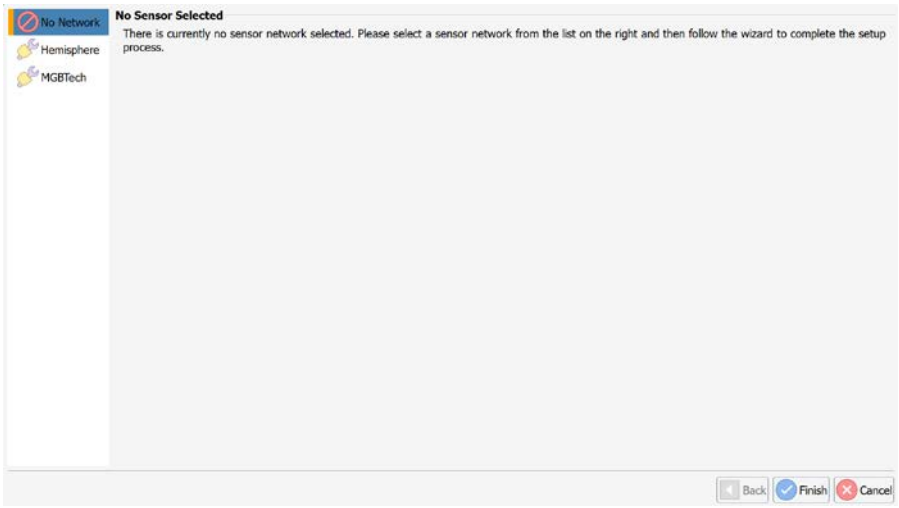
Continued on next page

Sensor Network, Continued

Sensor network, continued

A navigation pane on the left lists the network configurations:

- No Network
- Hemisphere
- MGBTech

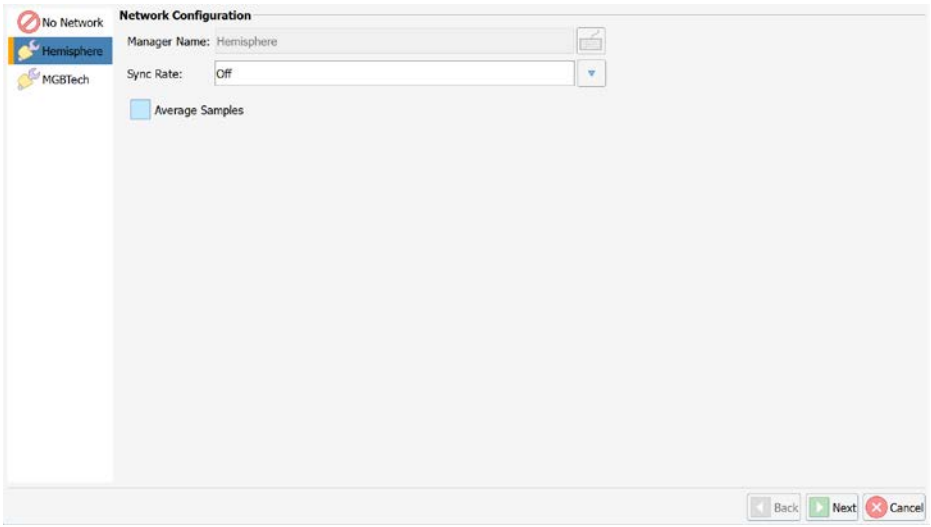


Continued on next page

Sensor Network, Continued

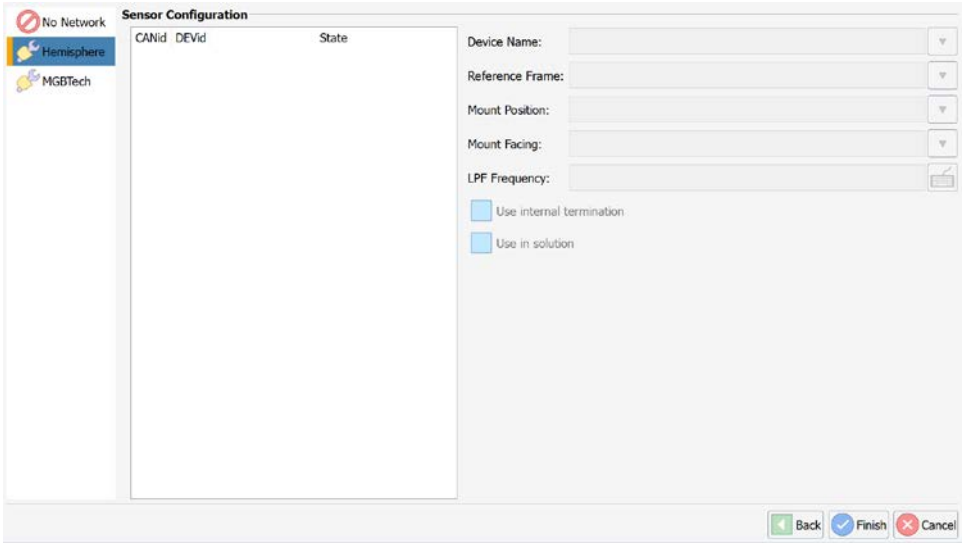
Sensor network, continued

Click **Hemisphere** to set Hemisphere network configuration. Click **Next**.



The **Sensor Configuration** screen displays. Select the desired settings. Click **Finish**.

Note: For position and facing information, refer to the GradeMetrix Installation manuals.

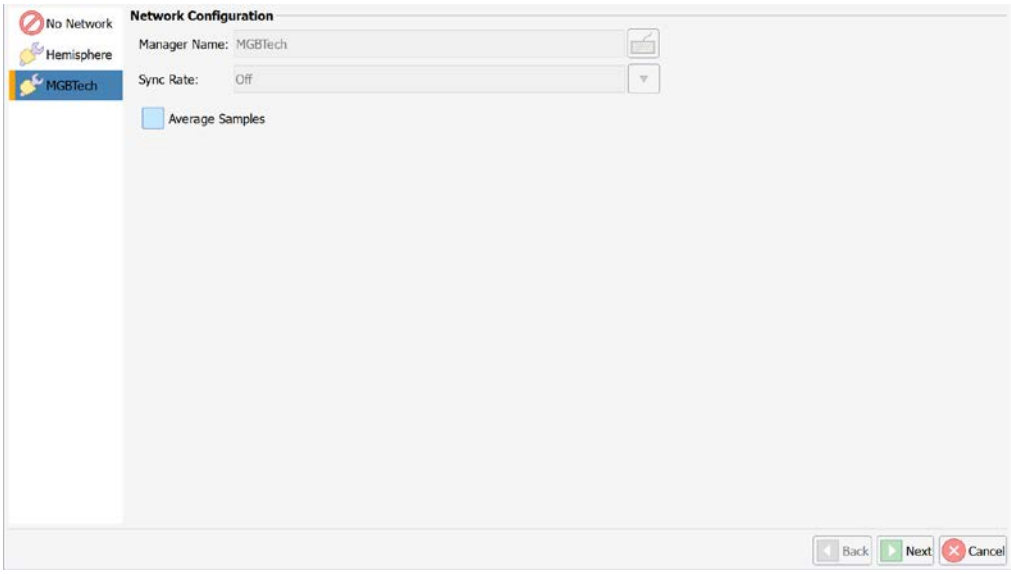


Continued on next page

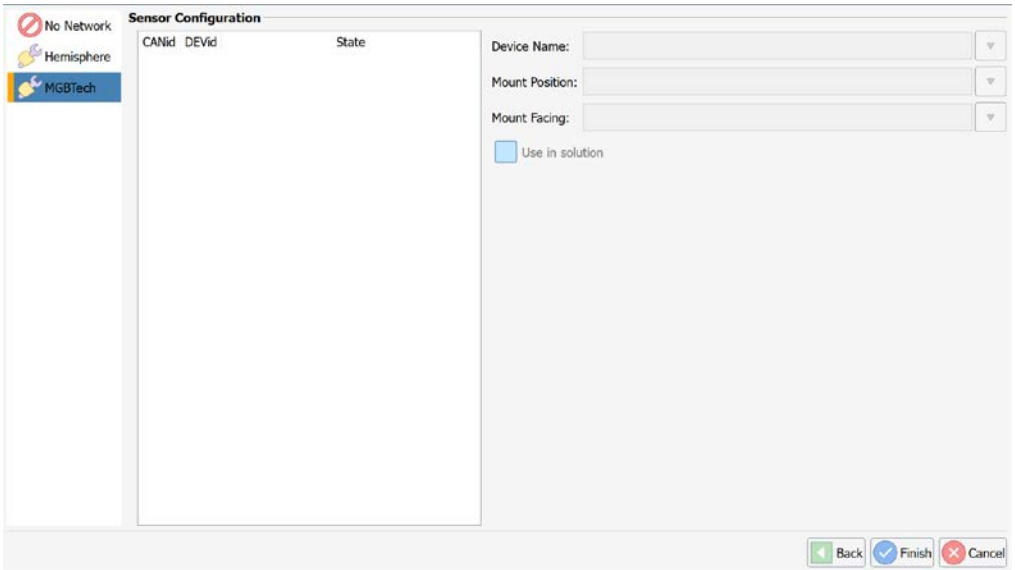
Sensor Network, Continued

Sensor network, continued

Click the **MGBTech** icon to set MGBTech network configuration settings. Click **Next**.



The **Sensor Configuration** screen displays. Select the desired settings. Click **Finish**.

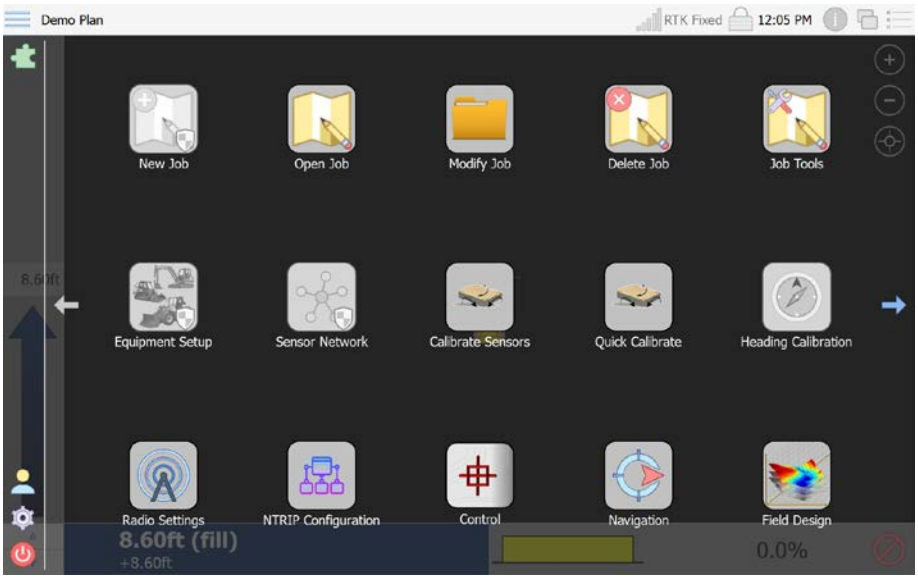


Continued on next page

Calibrate Sensors

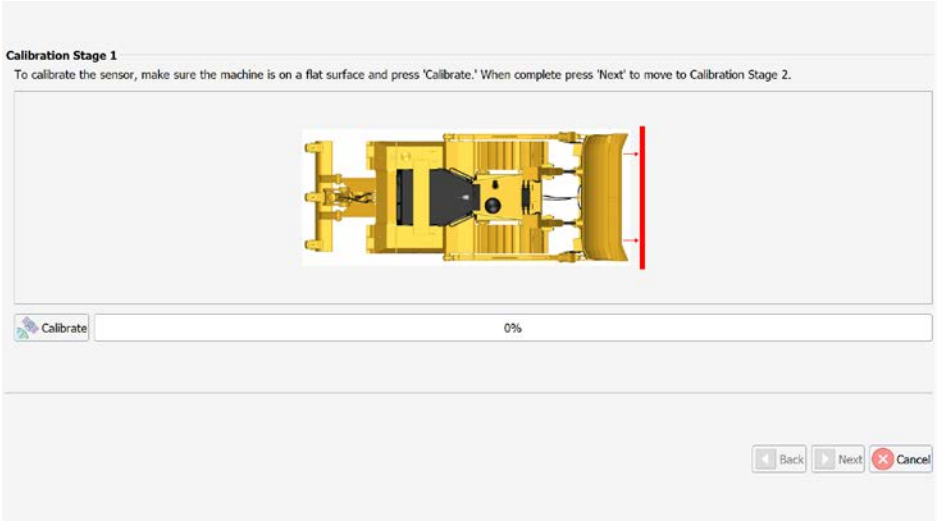
Calibrate sensors

On the GradeMetrix Main Menu, click the **Calibrate Sensors** icon.



The **Calibration Stage 1** screen displays.

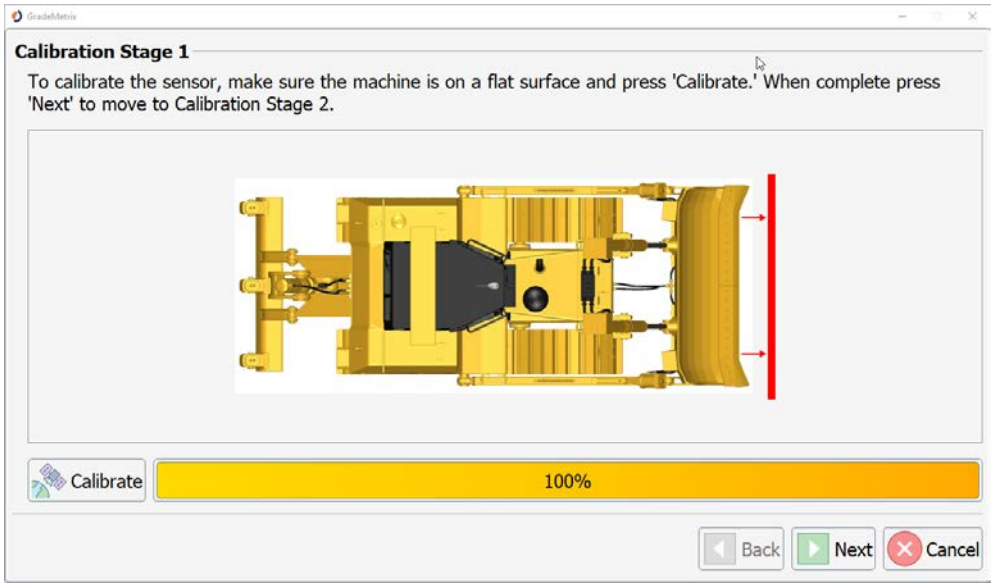
To calibrate the sensors, line up the machine up and click **Calibrate** to average results over a few seconds.



Continued on next page

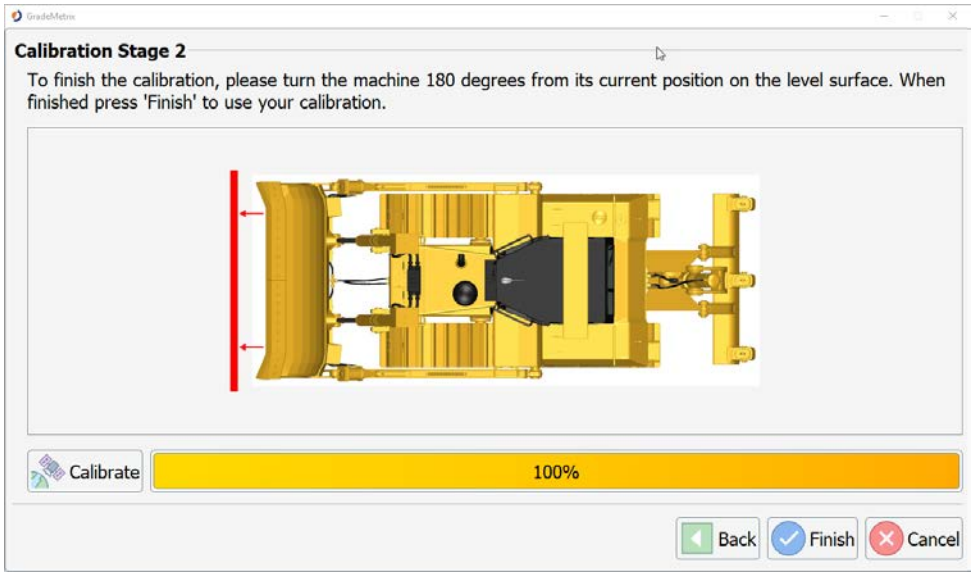
Calibrate Sensors, Continued

Calibrate sensors, continued



Click **Next**. The **Calibration Stage 2** screen displays.

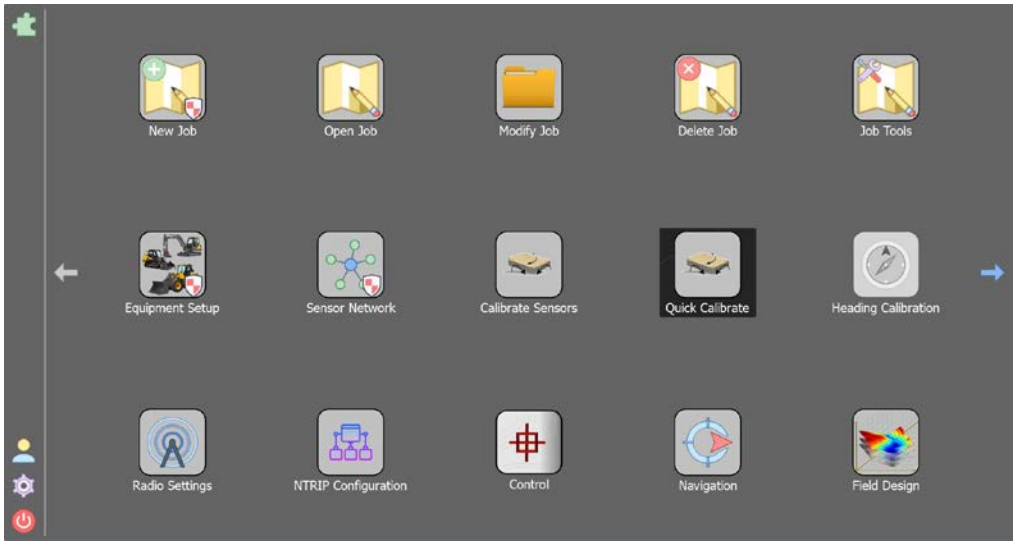
Then turn the machine 180 degrees and place the blade in the same location and click **Calibrate** and click **Finish.**



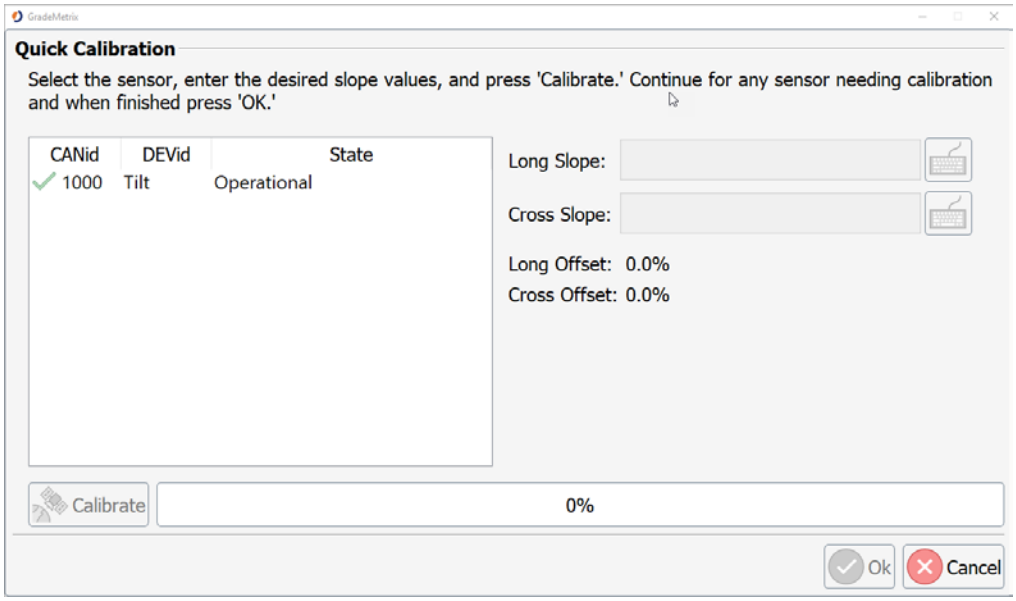
Quick Calibrate

Quick calibrate

The **Quick Calibrate** function allows users to manually enter a slope value. On the GradeMetrix Main Menu, click the **Quick Calibrate** icon.



The **Quick Calibration** window displays. Select the sensor to be calibrated and enter the long and cross slopes.

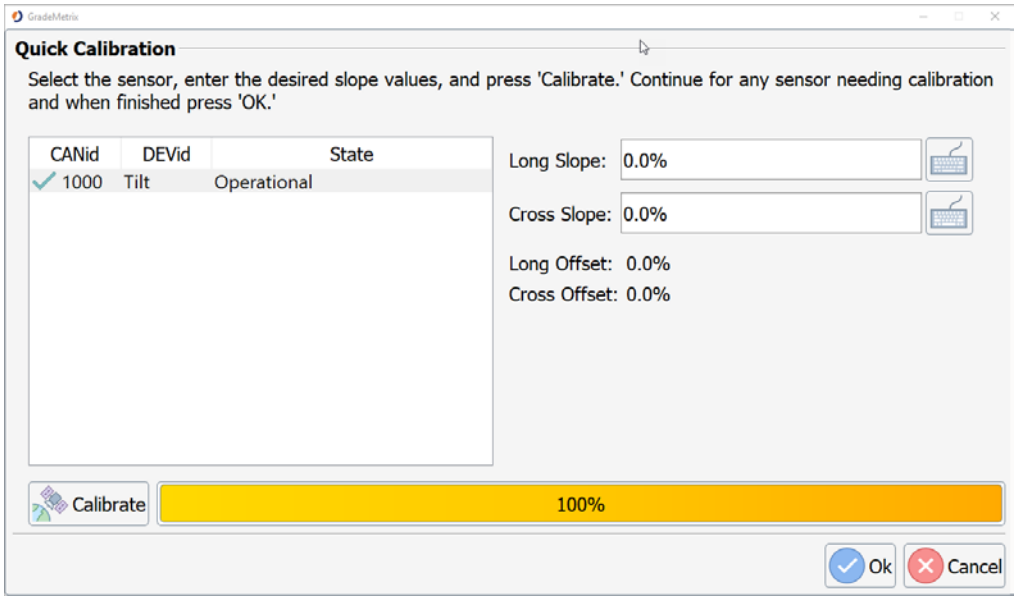


Continued on next page

Quick Calibrate, Continued

Quick calibrate, continued

Click **Calibrate**. Click **Ok**.



Heading Calibration

Heading Calibration

The **Heading Calibration** function is under development.

Radio Settings

Overview

If receiving RTK corrections via the internal UHF radio, you can configure the radio through GradeMetrix.

On the GradeMetrix Main Menu, click the **Radio Settings** icon.

Continued on next page

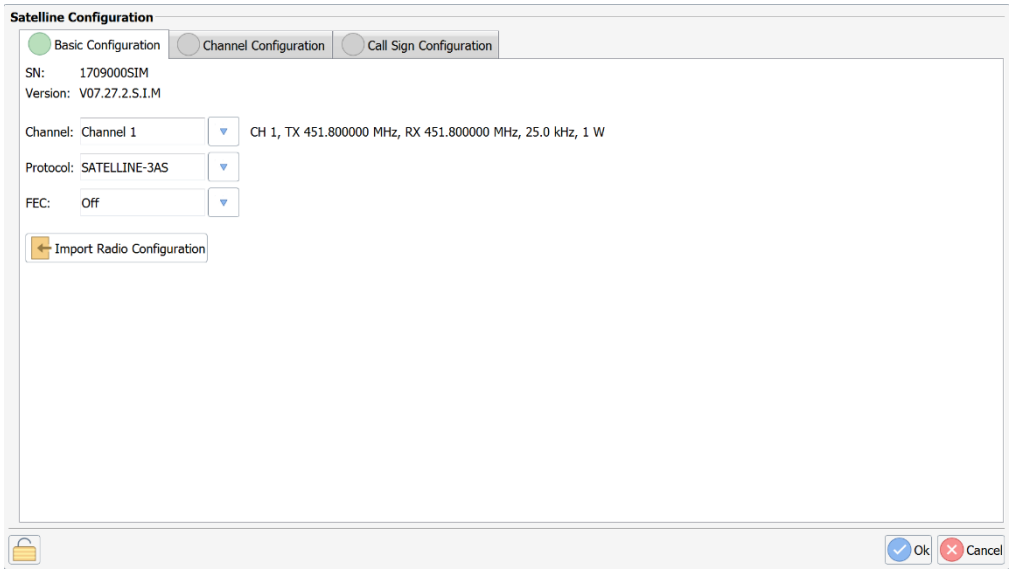
Radio Settings, Continued

Satelline configuration

The Satelline Configuration 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.



Continued on next page

Radio Settings, Continued

Satelline configuration, continued

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

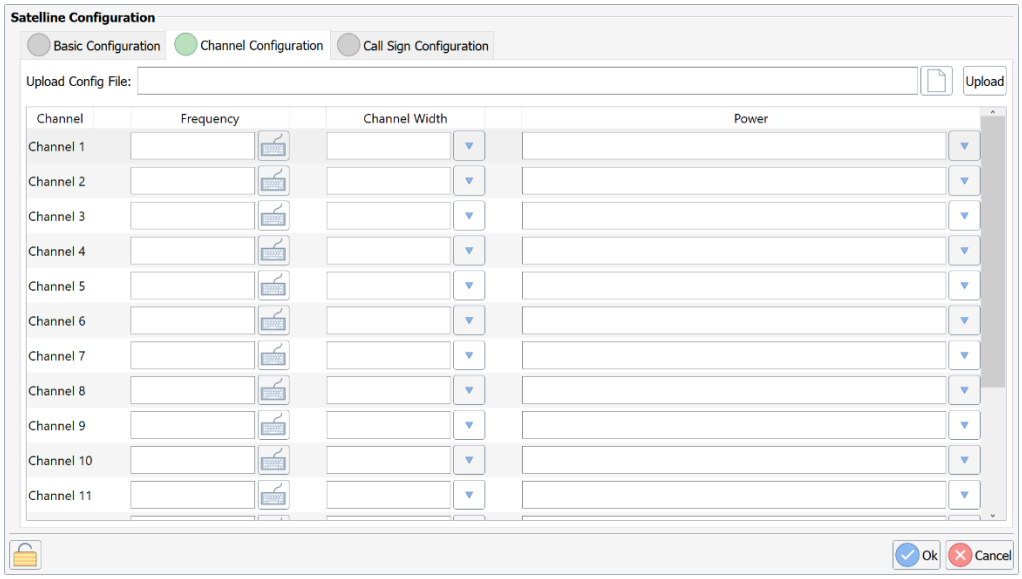
- Channel
- Protocol
- FEC

On the **Channel Configuration** tab, click the down arrows to select values for Frequency, Channel Width, and Power.

Note: You must be logged in as Administrator to set the Channel Configuration.

Select from the channels created here.

Note: Channels available for selection must be set by Administrator users.

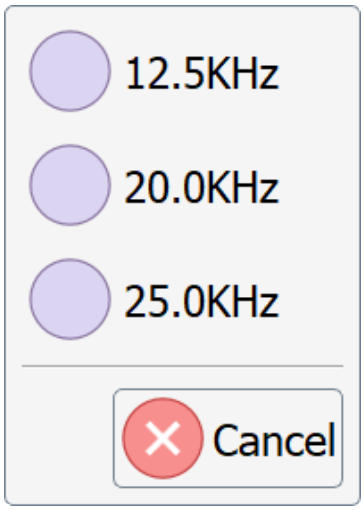


Continued on next page

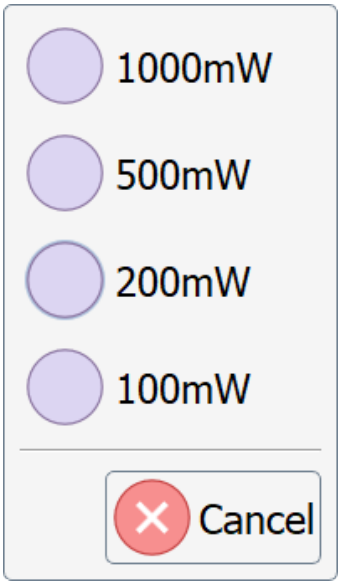
Radio Settings, Continued

Satelline configuration, continued

Channel Width selections



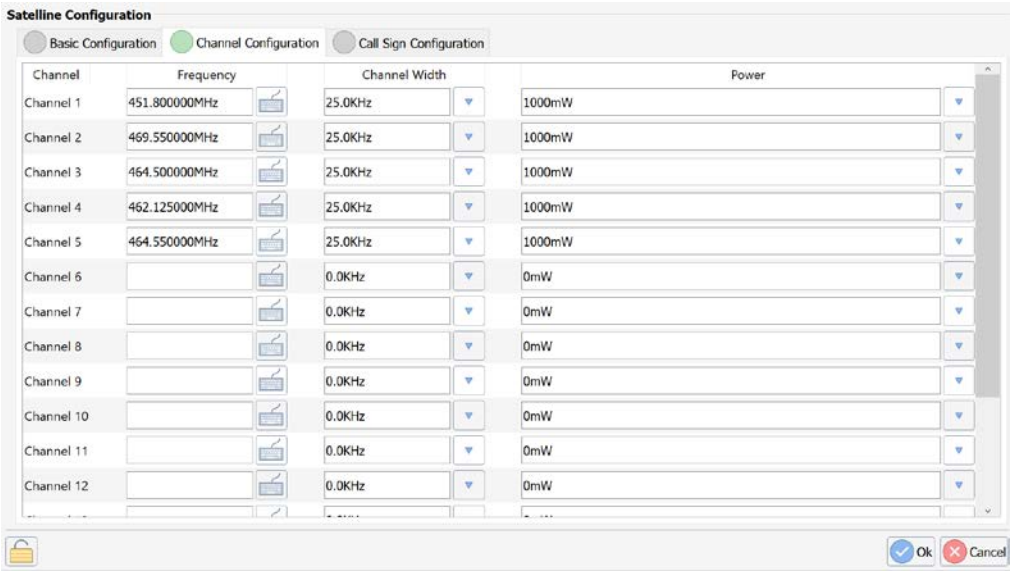
Power selections



Continued on next page

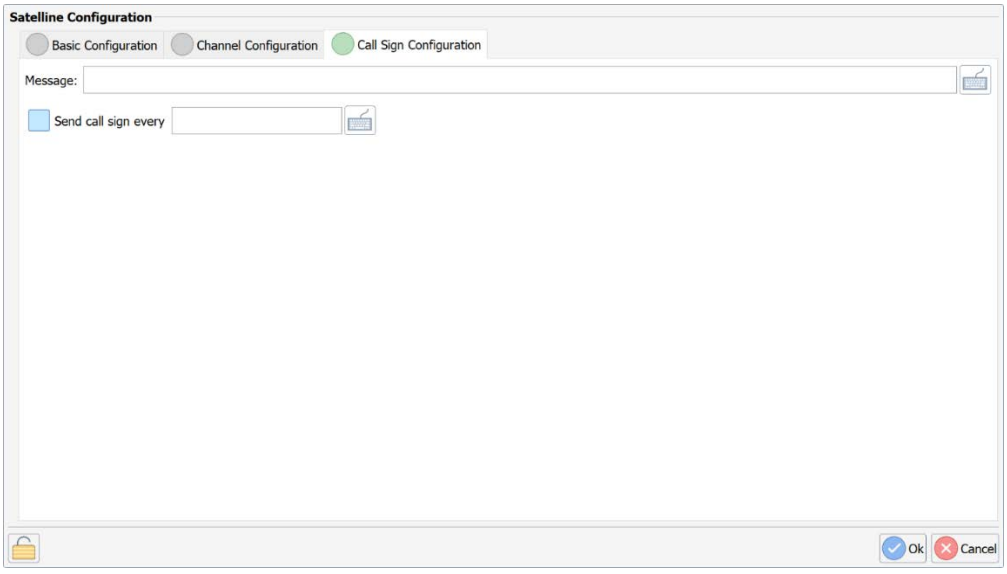
Radio Settings, Continued

Satelline configuration, continued



When finished making selections, click **Ok**.

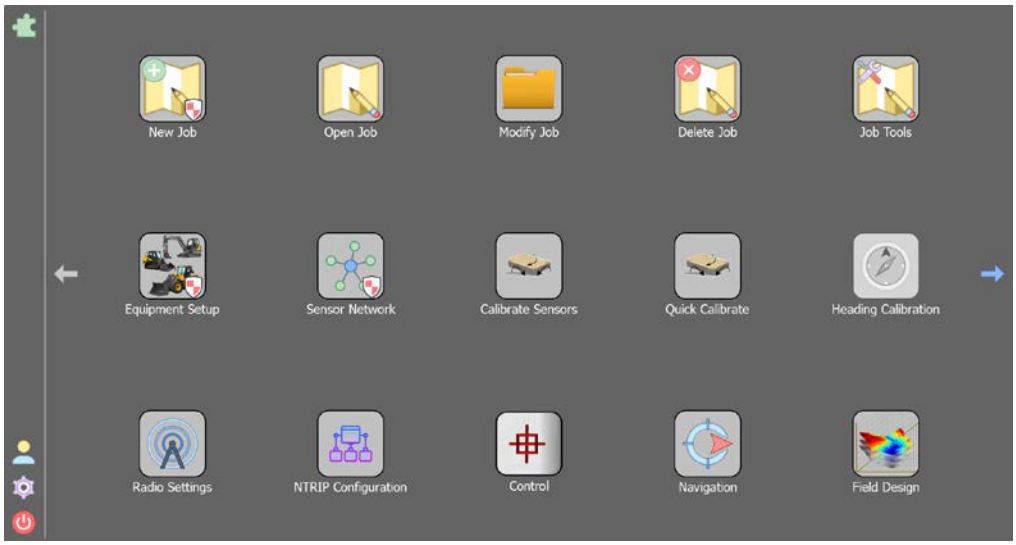
On the **Call Sign Configuration** tab, type a call sign message and select message rate frequency. Click **Ok**.



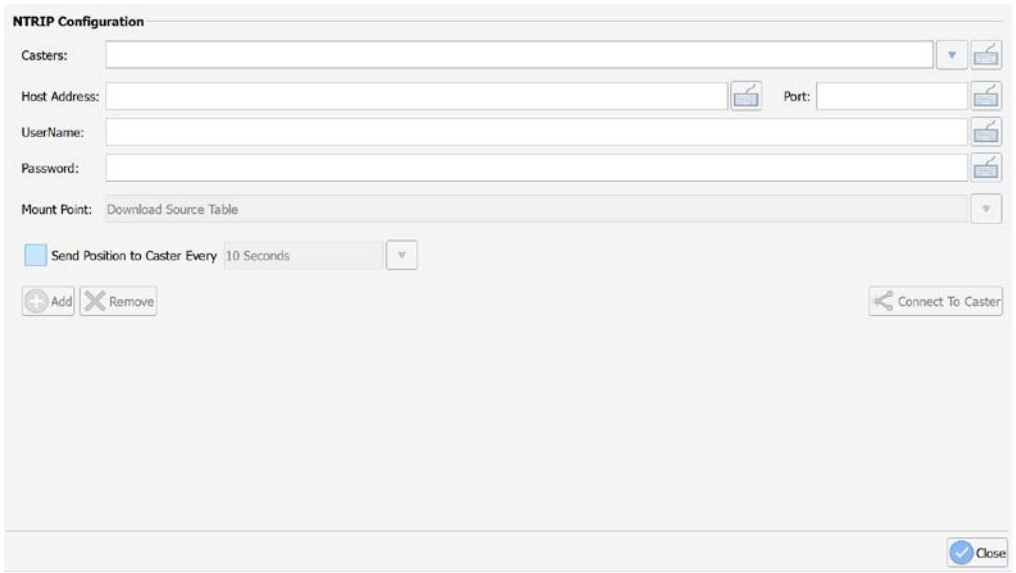
NTRIP Configuration

NTRIP configuration

If receiving RTK over network, use the embedded NTRIP client to receive RTK corrections from an NTRIP caster. On the GradeMetrix Home screen, click the **NTRIP Configuration** icon.



The **NTRIP Configuration** screen displays.



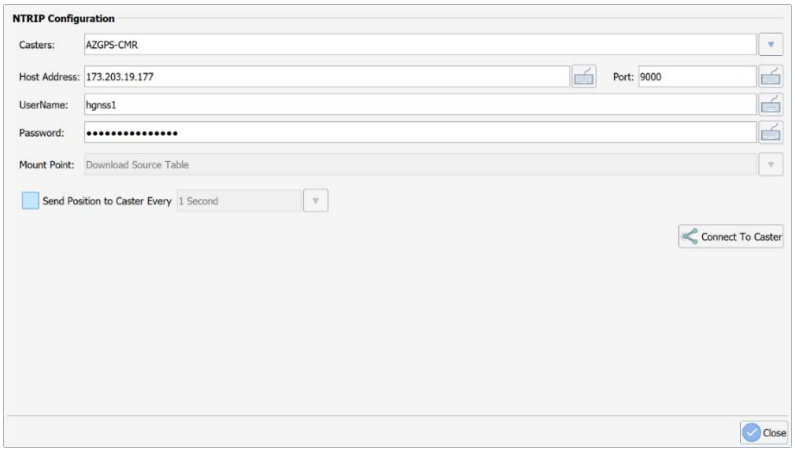
Continued on next page

NTRIP Configuration, Continued

NTRIP configuration, continued

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

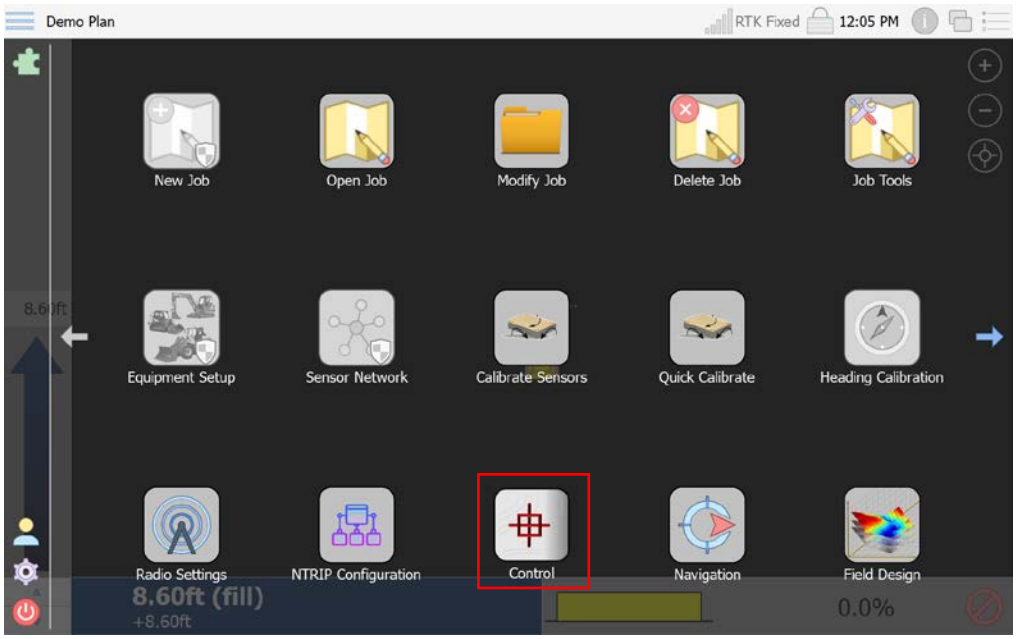
Step	Action
1	Type the IP (or DNS), port, username, and password.
2	Note the option to upload a GGA message to the NTRIP caster.
3	Verify Mount Point displays **Download Source Table**.
4	Click **Connect to Caster** to download the source table.
5	Select a mount point.
6	Click Connect to Caster a second time.



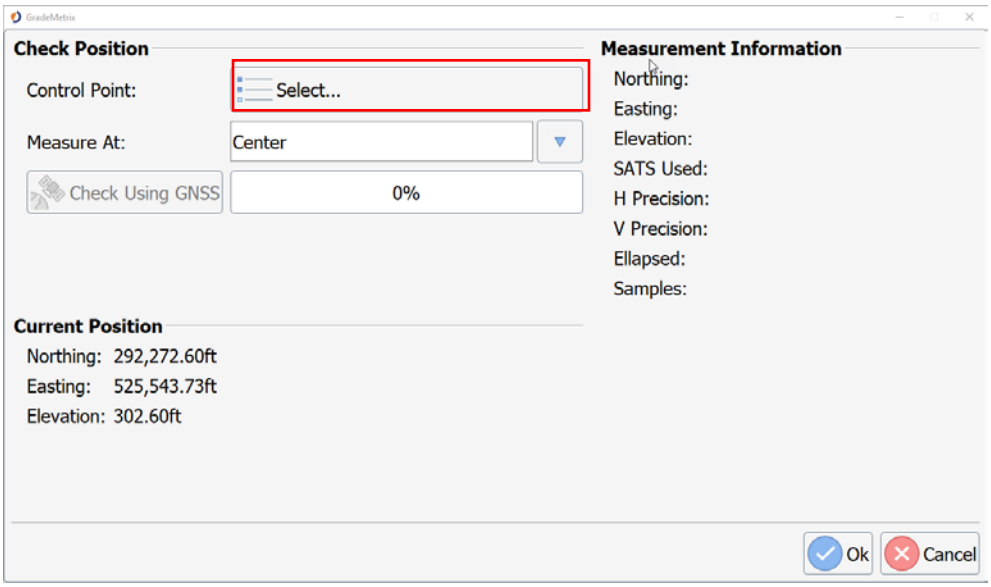
Control

Control

On the GradeMetrix Main Menu, click the **Control** icon.



The **Check Position** screen displays. Click **Select …** to set the **Control Point**.

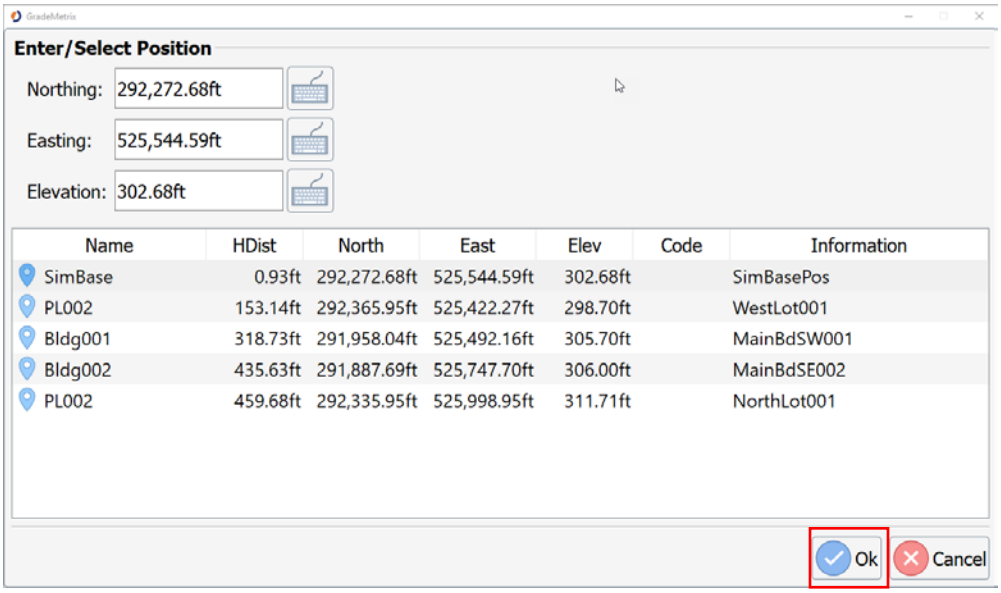


Continued on next page

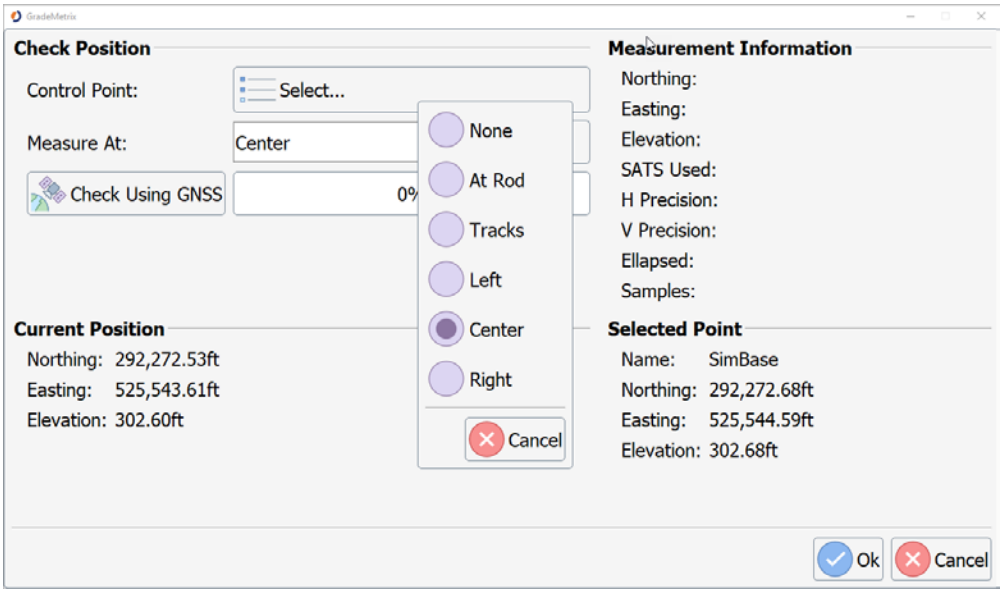
Control, Continued

Control, continued

Click to highlight the point name and click **Ok**.



Click the down arrow to select the **Measure At:** reference point, and select from the following options:

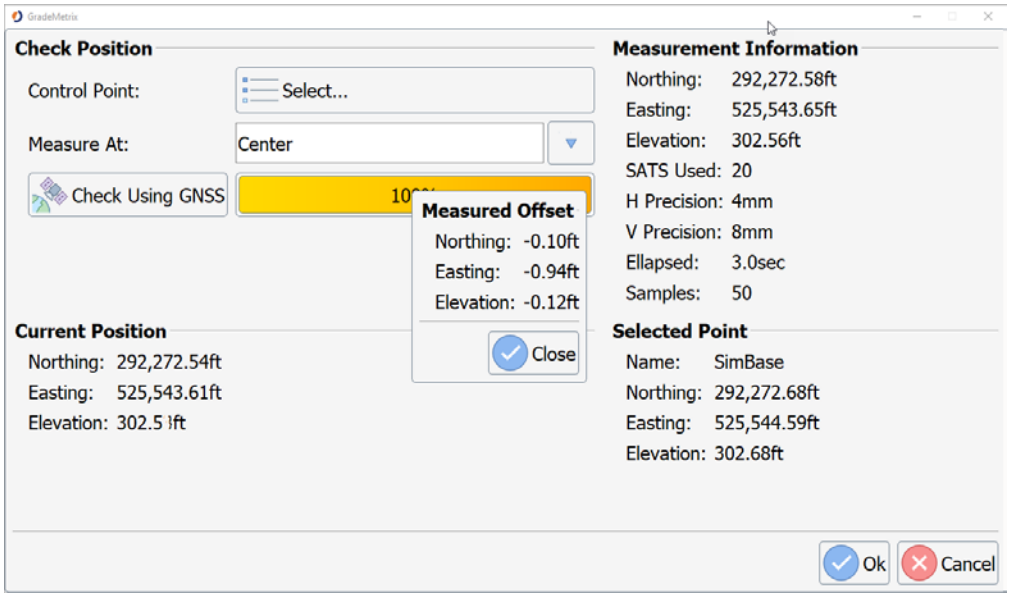


Continued on next page

Control, Continued

Control, continued

Press **Check Using GNSS**.



A pop-up window displays the **Measured Offset** of your reference point.

For **Current Position**, refer to the bottom left of the screen. Note the current position values continuously update due to standard GNSS error (machine vibration, etc.)

Refer to the **Measurement Information** column on the right side for the number of satellites used, the horizontal and vertical position, how many seconds averaged, and how many samples were collected.

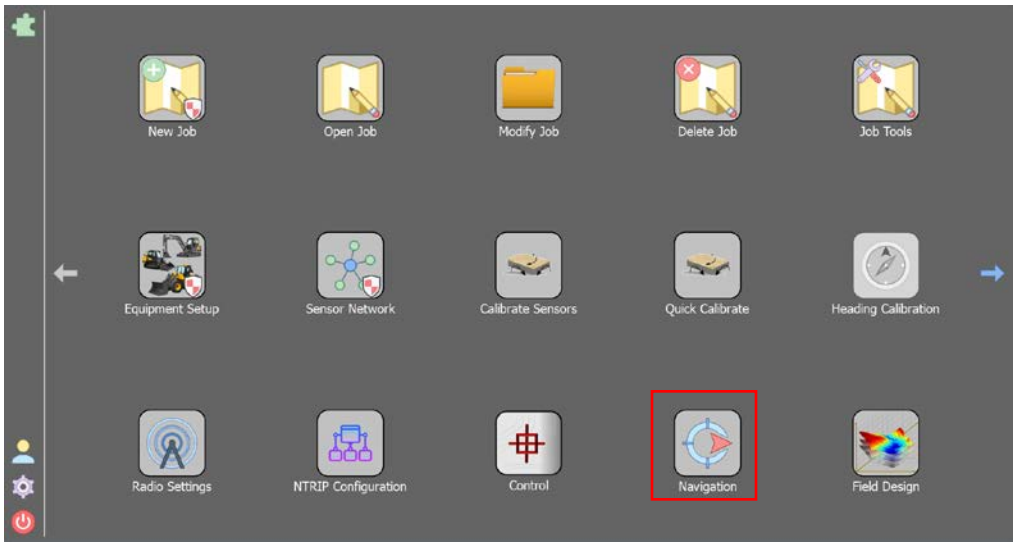
- **Measurement Information-**the position of the point just measured.
- **Selected Point-** the points you selected to check.

Navigation

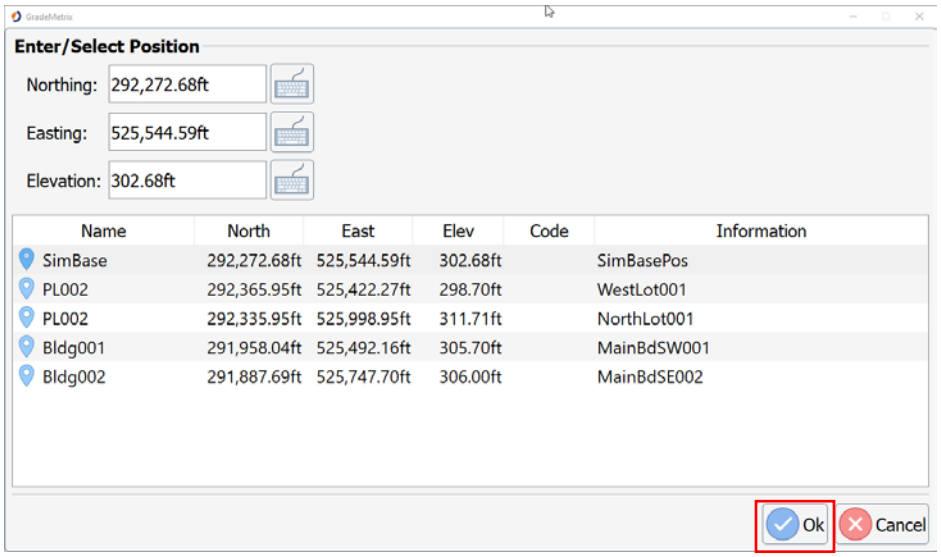
Navigation

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

On the GradeMetrix Main Menu, click the **Navigation** icon.



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



Continued on next page

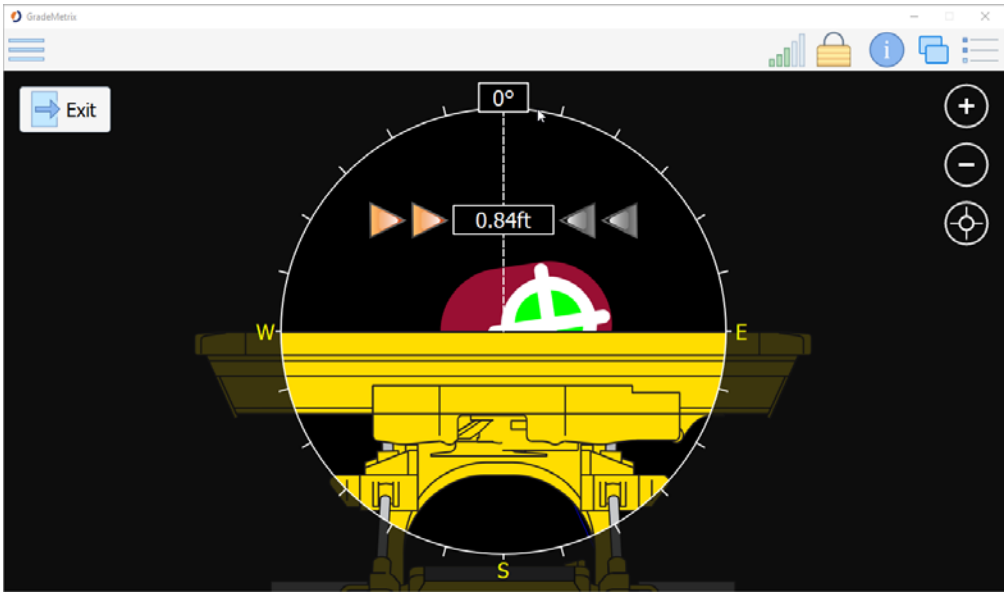
Navigation, Continued

Navigation, continued

A navigation screen displays showing the read line, or 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 on the left side, depending upon which direction the machine needs to move.

Distance shows how far the machine is from the point.

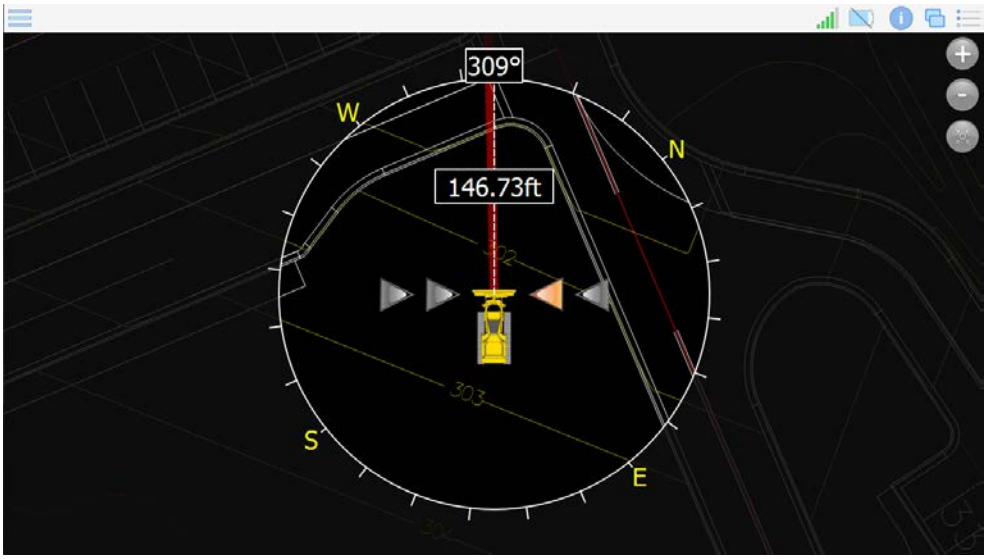


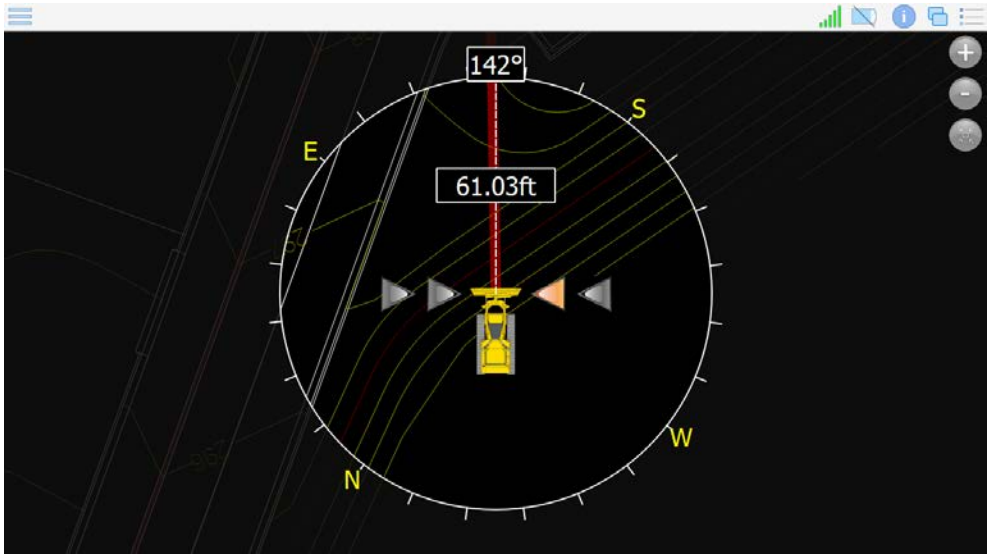
Continued on next page

Navigation, Continued

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 read line.



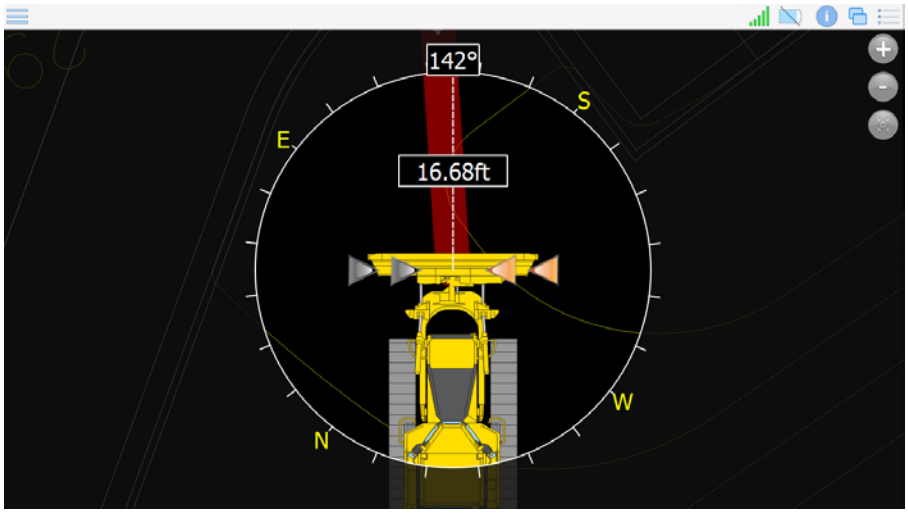


Continued on next page

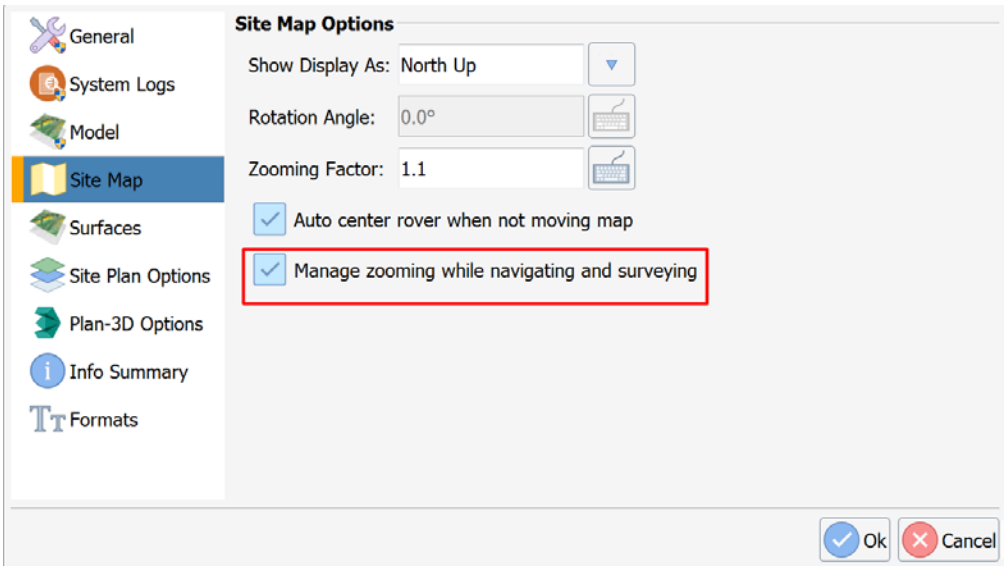
Navigation, Continued

Navigation, continued

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



Note: To disable auto-zoom, you must be logged on as an admin. Go to **Settings -> Site Map -> Manage zooming while navigating and surveying**.



Continued on next page

Navigation, Continued

Navigation, continued

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

The main screen displays.

Design a Job

Field design

To set job design settings. Click the **Field Design** icon in the GradeMetrix Main Menu.

Flat pad

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

To set your flat pad elevation:

1. Type a name for the 'pad.'
2. Type the average elevation

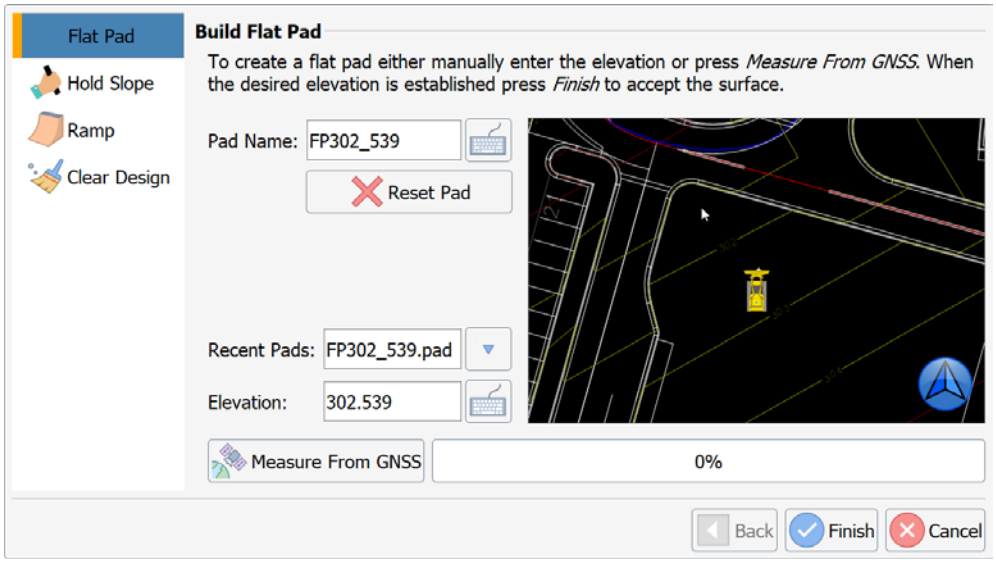
Note: Naming the pad allows you to save and edit the elevation at any time.

Continued on next page

Design a Job, Continued

Flat pad, continued

Click **Finish**. Design elevation is set to 300’ in the following example.

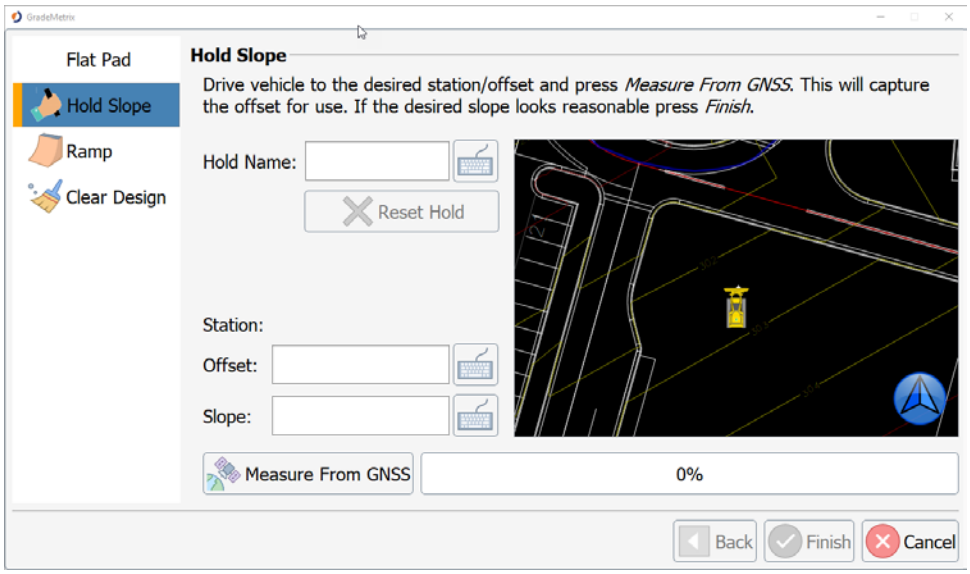


Continued on next page

Design a Job, Continued

Hold slope

Select **Hold Slope** to extend the surface at the current slope angle



Continued on next page

Design a Job, Continued

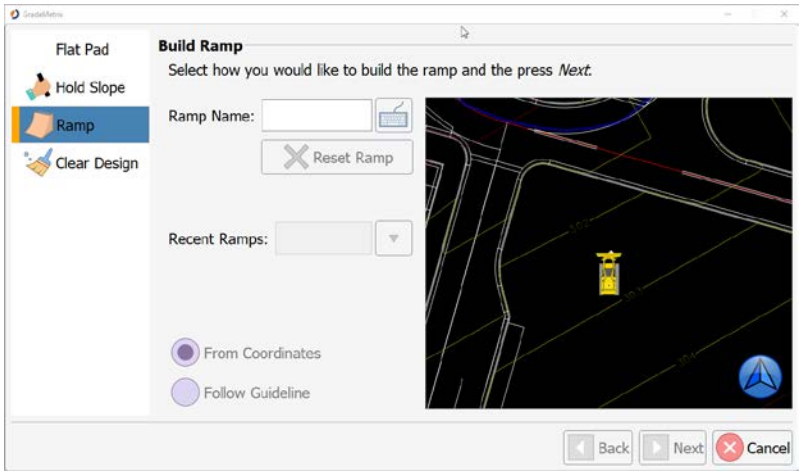
Ramp

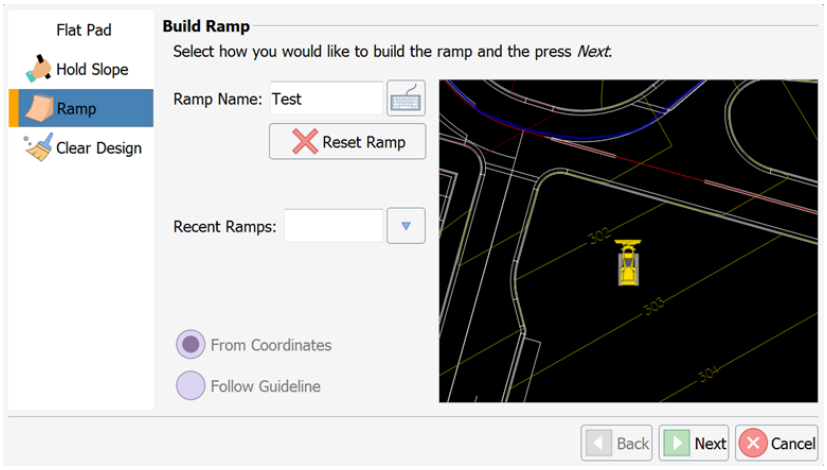
Choose **Ramp** to build the ramp by using coordinates for following a set guideline.

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

To set your ramp type a **Ramp Name** using the keyboard icon

Press **Next**.



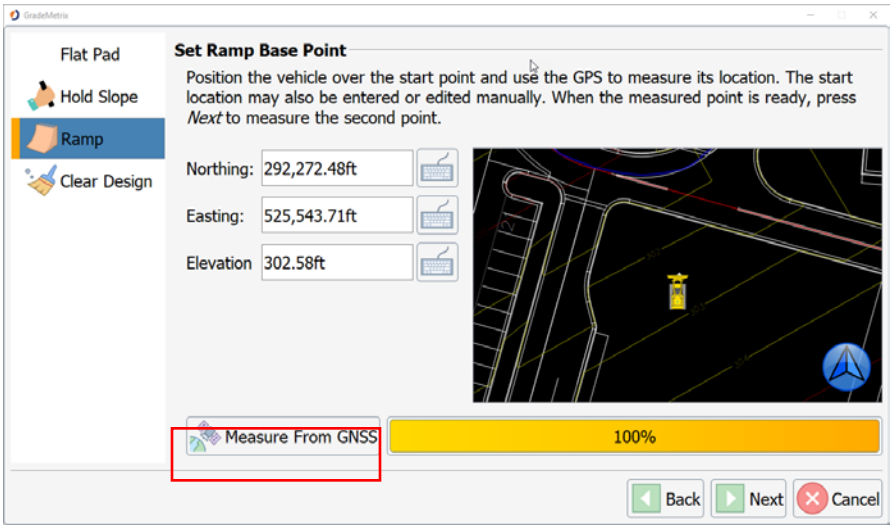


Continued on next page

Design a Job, Continued

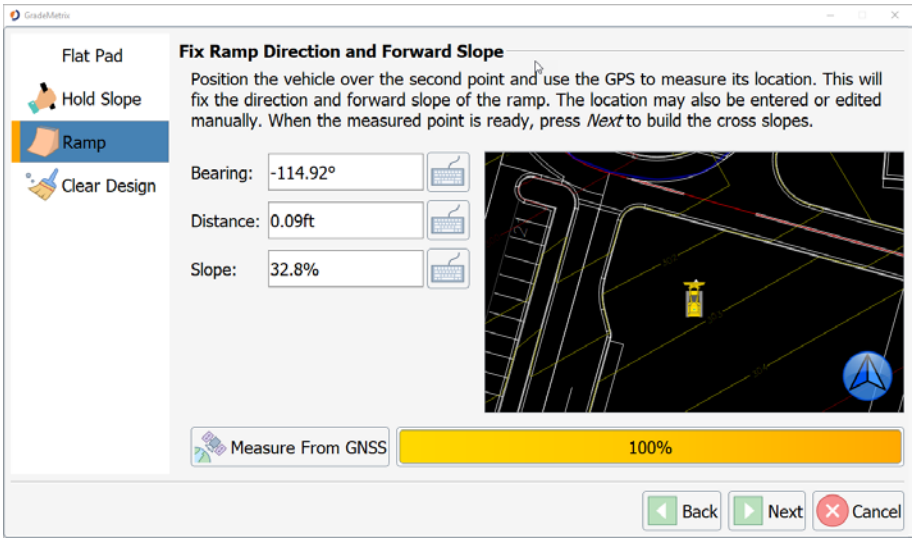
Ramp, continued

Drive to the starting point and click **Measure from GNSS**.



Drive to the second point (calculates heading). Click **Measure from GNSS**.

Note: If you wish this ramp to exceed the length the vehicle has driven, edit the distance. You can also edit the calculated heading (bearing) and slope.

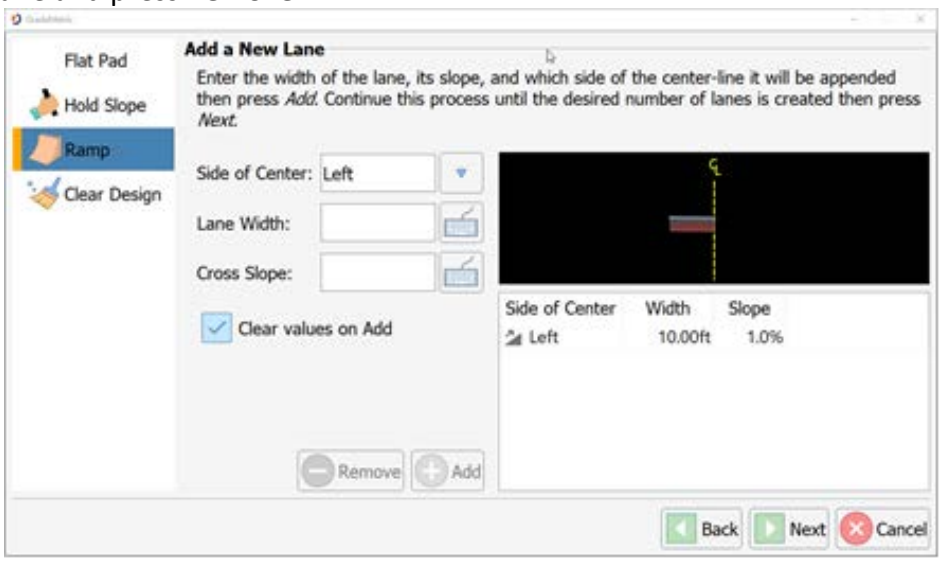


Continued on next page

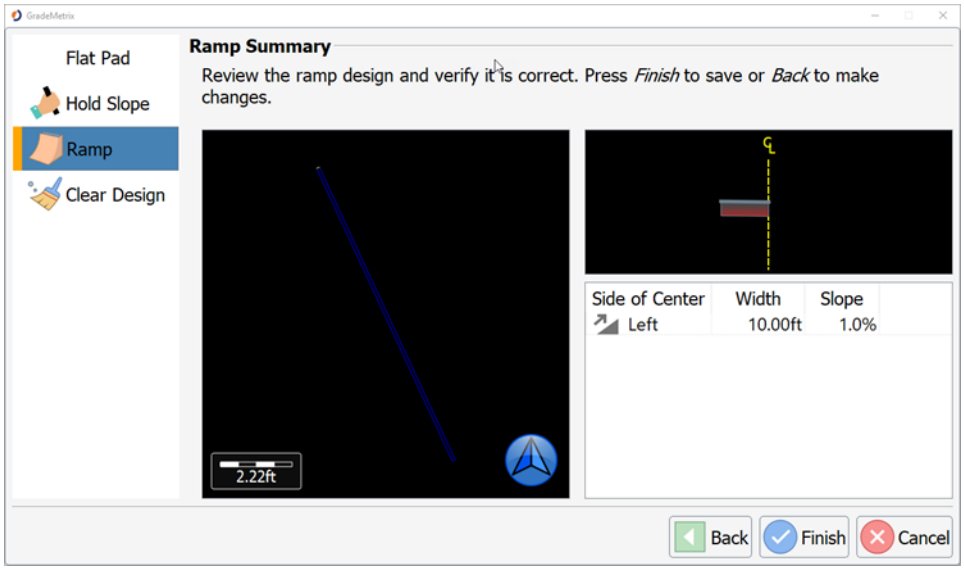
Design a Job, Continued

Ramp, continued

To remove cross slope fields, click **Clear values on Add**. This will clear the field a new value can be added each time the **Add** button is pressed. Click on a lane and press **Remove**.



Review ramp and press **Finish**.



Continued on next page

Design a Job, Continued

Ramp, continued

The example below shows the newly created ramp (in blue). To make the ramp longer, edit the distance towards the beginning.

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

The below example shows the machine blade exceeding the edge, and no longer on the job design.

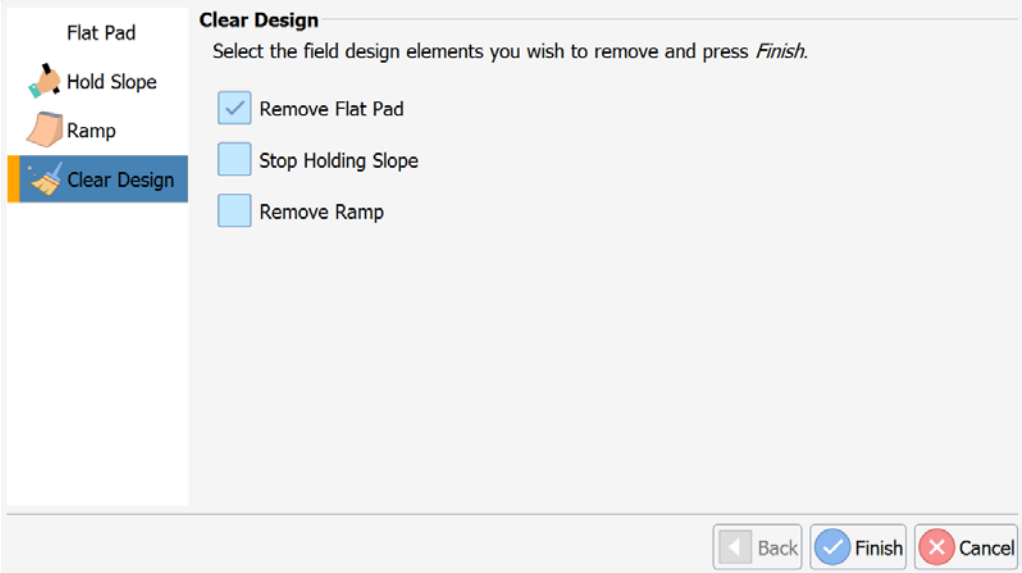
Continued on next page

Design a Job, Continued

Clear design

If you wish to remove a field design element, click to select one of the options in the **Clear Design** list.

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

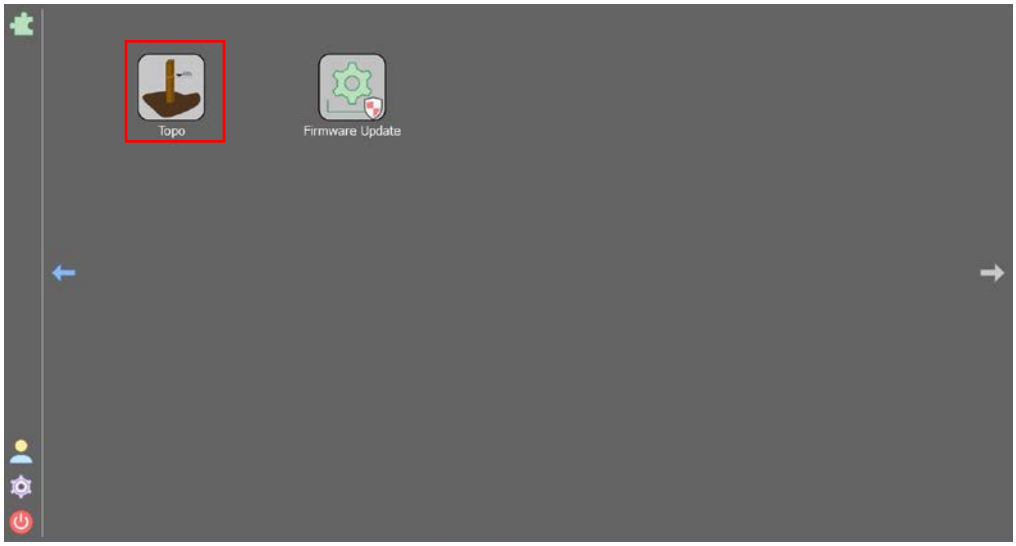


Your design elevation returns to the previously loaded Digital Terrain Model (DTM) file.

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

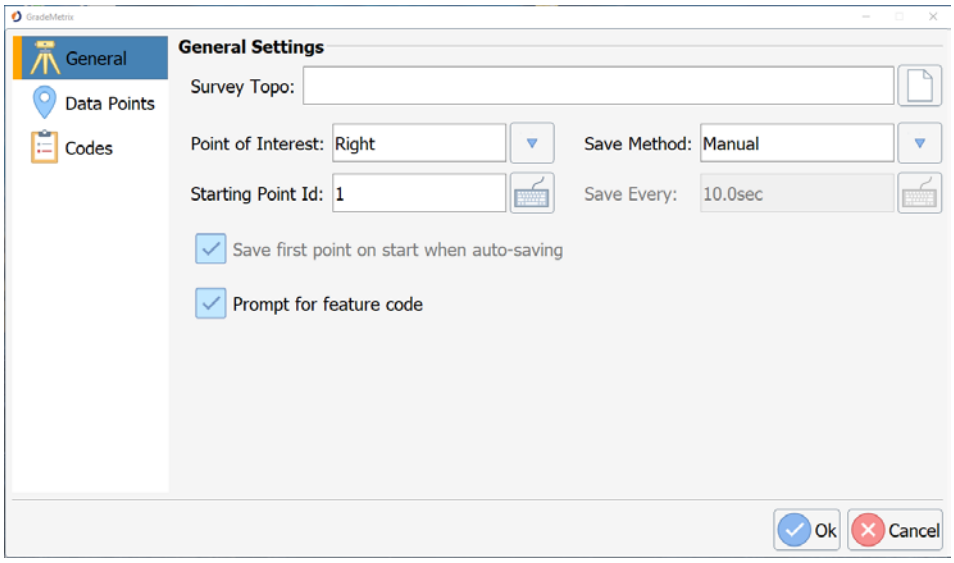
The **General Settings** window displays the following selections:

Setting	Description
Survey Topo:	Create a Survey Topo to store points. Click the icon to the right of the dialogue box and name the 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. Starting Point ID increments by 1 each time you shoot a point. The value entered indicates the ID of the first stored point.
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.
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	*(under development)* The software prompts to select from one of the available feature codes.

Continued on next page

Topo, Continued

General Settings, continued



Storing points

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

Continued on next page

Topo, Continued

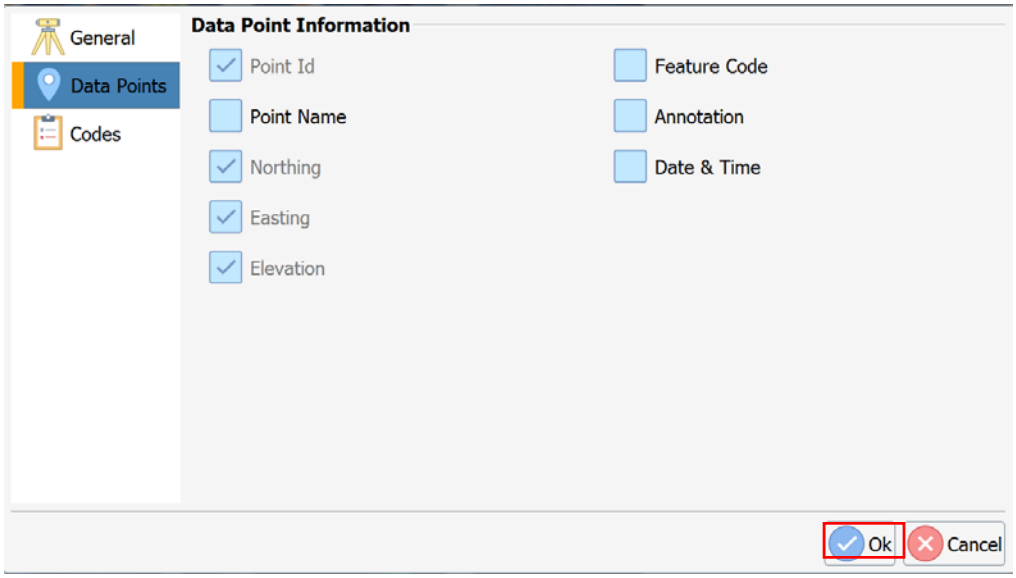
Storing points, continued

Click or type to select the following options:

- **Point of Interest:** choose where to store the point from
- **Save Method:** set to store a point manually, or autosave every several seconds or several feet driven
- **Starting Point Id:** each point has an ID and increments

Click **Data Points**. The **Data Point Information** screen displays.

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



Codes

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

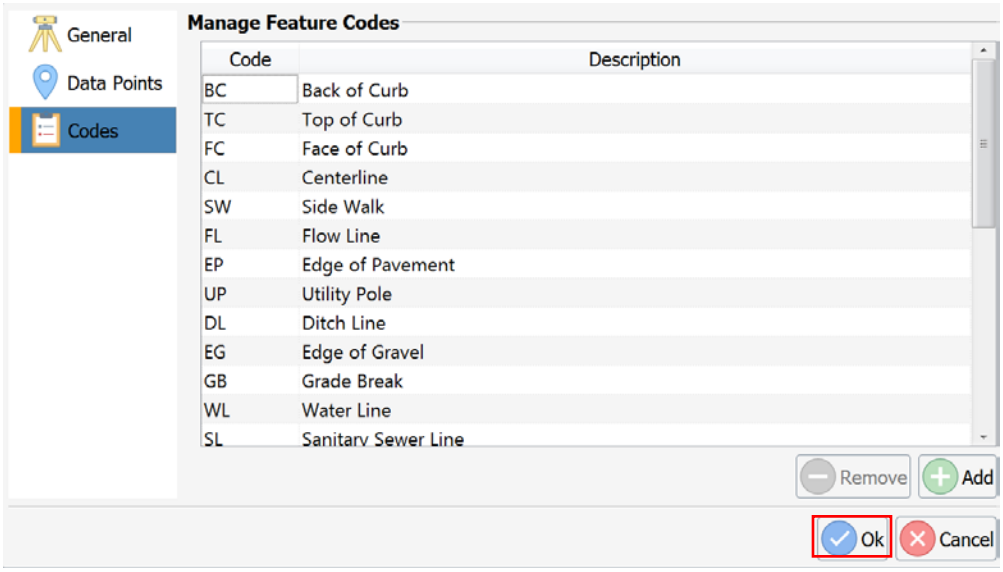
The **Manage Feature Codes** screen displays the listing of feature codes. Click to highlight the Feature Code you wish to add and click **Add**. Press **OK**.

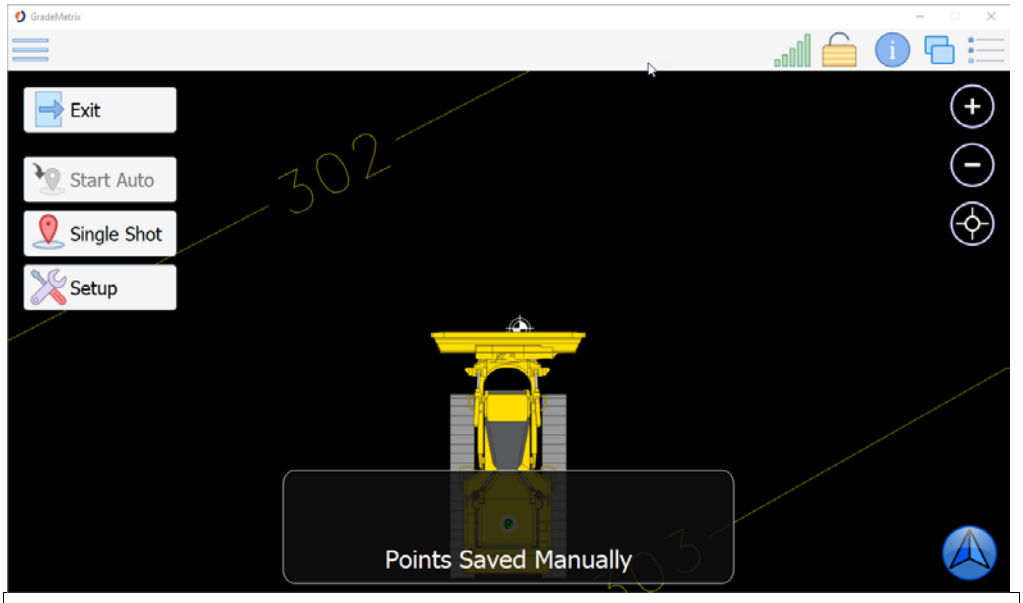
Note: Do not select this feature if auto storing points.

Continued on next page

Topo, Continued

Codes, continued





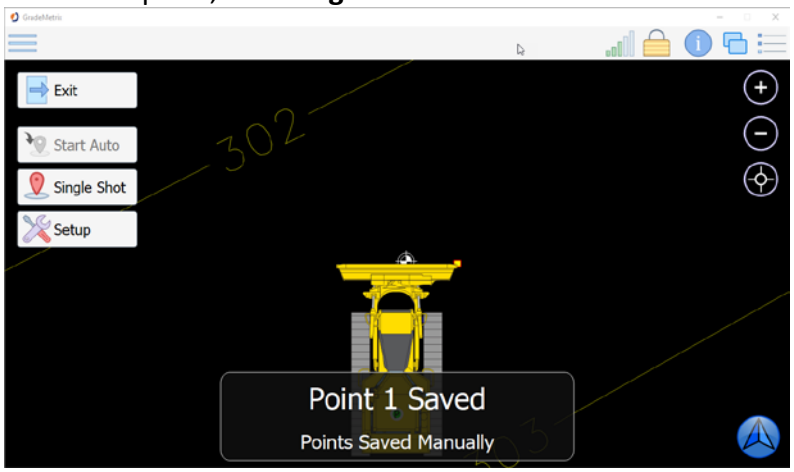
Continued on next page

Topo, Continued

Codes, continued

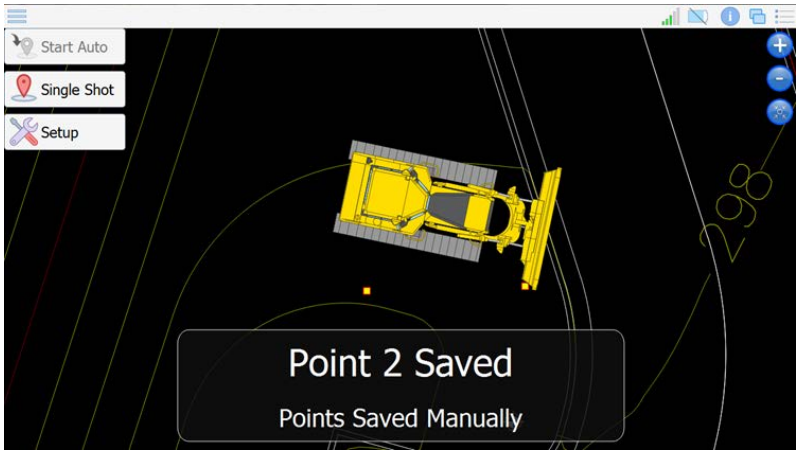
Note: If storing points manually, **Start Auto** is disabled.

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



In the example above, locate the orange square on right side of blade. This is the point just stored. Note it is on the right, as you set up in settings, and the message reads “Point 1 Saved, because you started with 1. If for example, you start with 50, the message would read “Point 50 Saved”.

Drive a few feet and click **Single Shot** to store a second point.



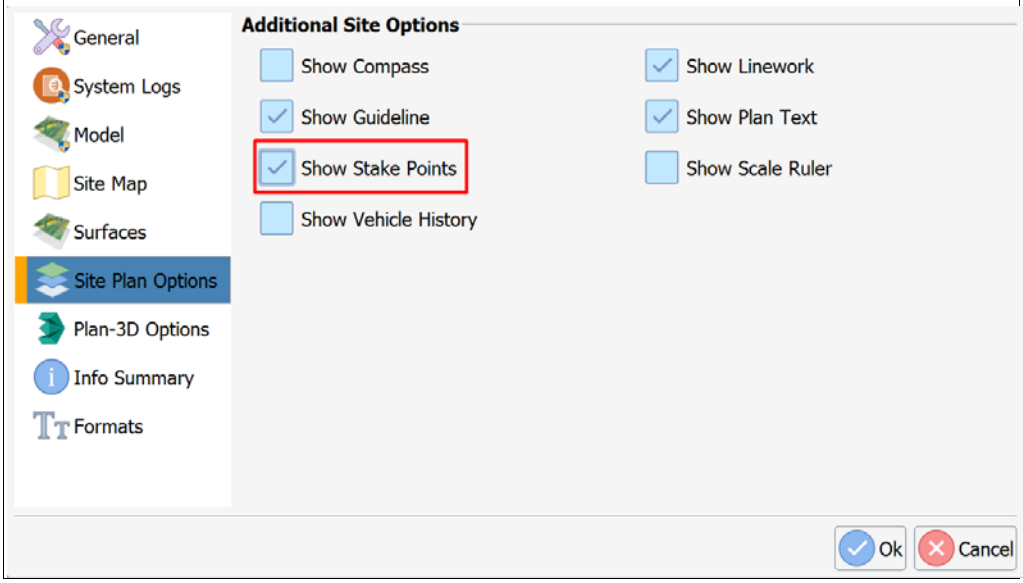
Topo, Continued

Codes, continued

To exit, press the button on top right 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** (logged in as administrator) **-> Site Plan Options -> Show Stake Points**.

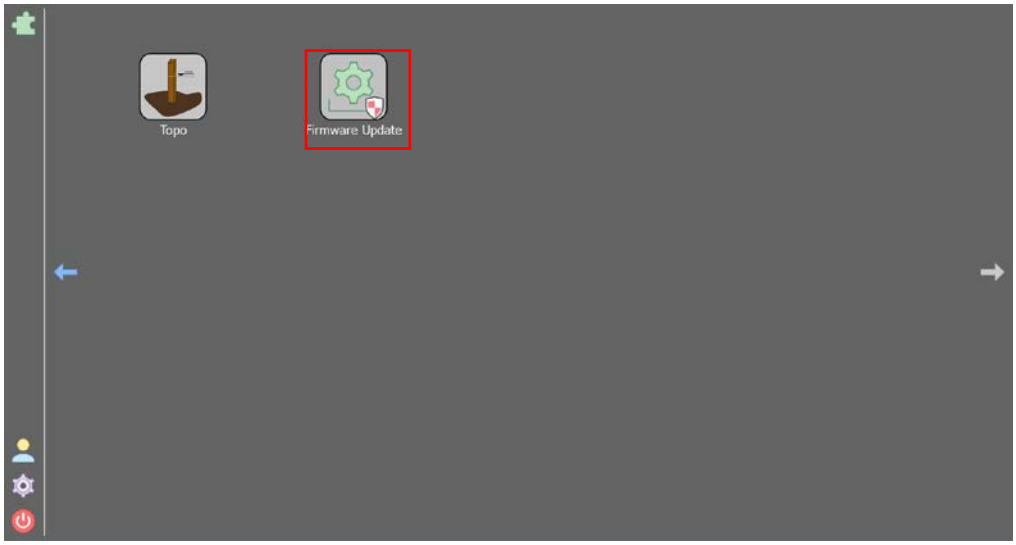


Continued on next page

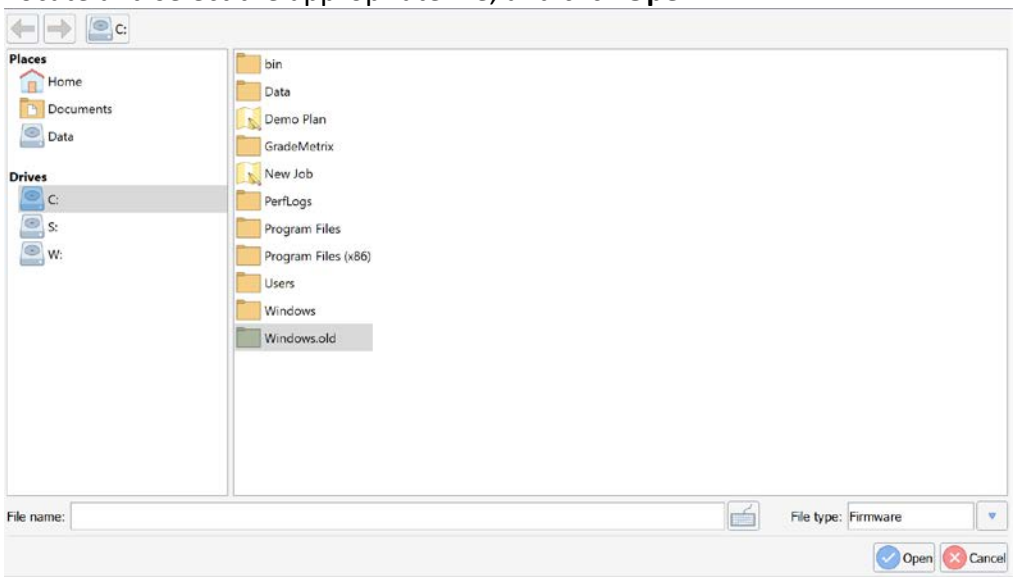
Firmware Update

Firmware Update

To access available GradeMetrix firmware updates, click the **Firmware Update** icon on the Main Menu.



Locate and select the appropriate file, and click **Open**.



Appendix A - Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for common problems.

Contents

Topic	See Page
GradeMetrix Troubleshooting	139

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: 1. Check your machine measurements/offsets. If any of these are incorrect, your projected position will be off 2. 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 (this can make huge differences) If there is an inconsistent position bust, check: 3. Sensor mounting was incorrectly chosen and/or sensor was not calibrated a. The above is evident if your position is correct when flat, but not if you are on a slope 4. 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.

Continued on next page

GradeMetrix Troubleshooting, Continued

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
No GPS position	1. First check to see if the VR500 or VR1000 is powered on. 2. If the receiver isn't powered, disconnect the cable and use a multimeter to verify it is receiving power and ground. 3. 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. 5. 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 isn't any voltage, it may be a damaged cable or bulk head connector.

Continued on next page

GradeMetrix Troubleshooting, Continued

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
No RTK	1. If using a base station onsite (versus an NTRIP service), first check to verify the base station is turned on. 2. 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. 3. Verify that the other rovers on the job site are receiving RTK corrections, if available. 3. 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. 6. Check to see if the UHF light at the rover is blinking once per second. If it is, refer to (3.). 7. The receiver may be out of 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. 8. 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

GradeMetrix Troubleshooting, Continued

Troubleshooting, continued

Table A-1: Troubleshooting (continued)

Symptom	Possible Solution
IronOne will not power on	1. 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. 2. Disconnect the cable and refer to the pinout to see if 12V or 24V (depending on machine) is going into the IronOne by using a multi-meter. If the multimeter reads 12V or 24V, then power is confirmed, and the IronOne may need to be serviced. If you don't have any power, then check your power source, ground, and all fuses.
No heading	1. 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 bulk head connector. 2. 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 2cm.

Appendix B: Supported Hardware

Overview

Introduction

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

Contents

Topic	See Page
VR500 Vector Smart Antenna	143
VR1000 GNSS Receiver	150
IronOne OEM Hardware	157

VR500 Vector Smart Antenna

VR500 pin-out

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

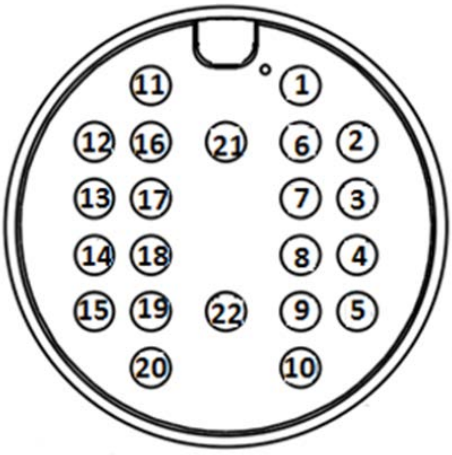


Figure B-1: VR500 pin-out assignments

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	1PPS 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 Vector Smart Antenna, Continued

VR500 data specifications

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

Table B-2: VR500 Sensor

Item	Specification
Receiver type	GPS, GLONASS, BeiDou, Galileo and RTK with carrier phase and L-band dual antenna
Channels	1059
Satellites	12 L1CA GPS 12 L1P GPS 12 L2P GPS 12 L2C GPS 15 L5 GPS 12 G1 GLONASS 12 G2 GLONASS 12 G3 GLONASS 22 B1 BeiDou 22 B2 BeiDou 14 B3 BeiDou 12 Galileo E1 12 Galileo E5a 12 Galileo E5b 3 SBAS or 3 additional L1CA GPS 2 L-band
Primary antenna	GPS L1,L1P,L2C,L2P,L5 GLONASS G1,G2,Pcode BeiDou B1,B2,B3 Galileo E1,E5a,E5b L-band

Continued on next page

VR500 Vector Smart Antenna, Continued

VR500 data specifications, continued

Table B-2: VR500 Sensor (continued)

Item	Specification
Secondary antenna	GPS L1,L1P,L2C,L2P GLONASS G1,G2 BeiDou B1,B2 Galileo E1,E5b L-band
GPS sensitivity	-142 dBm
SBAS tracking	3-channel, parallel tracking
Update rate	10 Hz standard, and 20 Hz available
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 (WAAS)[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 (1PPS) 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)

Continued on next page

VR500 Vector Smart Antenna, Continued

VR500 data specifications, continued

Table B-2: VR500 Sensor (continued)

Item	Specification
Maximum altitude	18,288 m (60,000 ft)
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3, L-band (Atlas), and DGPS
Antenna LNA gain input	10 to 40 dB

VR500 communication specifications

Table B-3: VR500 Communication

Item	Specification
Serial ports	2x full-duplex 1x RS-232, 1x RS-232/RS-422
CAN	2 CAN ports NMEA2000, ISO-11783
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, CAN, Hemisphere GNSS binary
Correction I/O protocol	Hemisphere GNSS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+3, and Atlas
Timing output	1 PPS CMOS, active high, rising edge sync, 10 kΩ, 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 kΩ 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 Vector Smart Antenna, Continued

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 Vector Smart Antenna, Continued

VR500 L-band sensor specifications

Table B-7: VR500 L-band sensor

Item	Specification
Receiver type	Single Channel
Channels	1530 to 1560 MHz
Sensitivity	-140 dBm
Channel spacing	5.0 kHz
Satellite selection	Manual and Automatic
Reacquisition time	15 seconds (typical)

VR500 aiding device specifications

Table B-8: VR 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.

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 GNSS Receiver, Continued

VR1000 pin-out, continued

Table B-7 lists the VR1000 connector pin-out.

Table B-7: 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 GNSS Receiver, Continued

VR1000 data specifications

Table B-8: VR1000 receiver

Item	Specification
Receiver Type	GNSS Position & Heading RTK Receiver
Signals Received	GPS, GLONASS, BeiDou, Galileo, QZSS, IRNSS and Atlas
Channels	1059
GPS Sensitivity	-142 dBm
SBAS Tracking	3-channel, parallel tracking
Update Rate	10 Hz standard, 20 Hz optional
Timing (1PPS) 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 GNSS Receiver, Continued

VR1000 accuracy specifications

Table B-9: VR1000 Accuracy

Item	Specifications
Positioning	<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>
Heading (RMS)	< 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
Pitch/Roll (RMS)	1°
Heave (RMS)	30 cm (DGPS) [3],10 cm (RTK) [3]

Continued on next page

VR1000 GNSS Receiver, Continued

VR1000 communication specifications

Table B-10: VR1000 Communication

Item	Specification
Ports	1x full-duplex RS-232/RS-422, 1x full-duplex RS232, 2x CAN, 1x Ethernet
Baud Rates	4800 - 115200
Radio Interfaces	Bluetooth 2.0 (Class 2), Wi-Fi 2.4 GHz, UHF (400 MHz)
Correction I/O Protocol	Atlas, Hemisphere GNSS proprietary, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+
Data I/O Protocol	NMEA 0183, Hemisphere GNSS binary
Timing Output	1PPS, CMOS, active high, rising edge sync, 10kΩ, 10 pF load
Event Marker Input	CMOS, active low, falling edge sync, 10 kΩ, 10pF load

VR1000 power specifications

Table B-11: VR1000 Power

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

Continued on next page

VR1000 GNSS Receiver, Continued

VR1000 environmental specifications

Table B-12: 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	7.7Grms (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-13: 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 GNSS Receiver, Continued

VR1000 L-band sensor specifications

Table B-14: 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-15: 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
[5] Hemisphere GNSS proprietary

IronOne OEM Hardware

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-16: 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 OEM Hardware, Continued

IronOne pin-outs, continued

Table B-17: 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-18: IronOne communications

Comm DT15-12PA
CAN x 1
UART（RS232 x 1）
RS422/RS485/RS232 x 1（Software switch）
GPIO x 1（Default input pullup 5V）
12V/0.75A Power output

Table B-19: IronOne power connector

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

Continued on next page

IronOne OEM Hardware, Continued

IronOne pin-outs, continued

Table B-20: 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-21: 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-22: 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

Table B-23: Power

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

Table B-24: Sensor and Multimedia

Specification
1x 2W Buzzer
1x Headphone Jack

Index

Administrator Settings 40
Alert Method..... 73
Atlas 147
BeiDou..... 145, 146
Control 11
Description..... 61, 80
Equipment Setup steps..... 88
Ethernet 147
Files 11, 80
Fill Color 73
Fill Style 73
Formats 41
GLONASS 145, 146
GPS 145, 146, 147, 149
Guideline 62
Heading 146
Home screen 40, 41, 56, 57, 60, 78, 79
Job Basics 60, 80
Line Color 73
Line Style 73
Linework..... 62, 65
Name..... 80
Navigation 117
NMEA 147
Open Job 78
Pitch 146
Plan, Section, & Cut/Fill 18
Plan, Section, & Profile 20
ROX..... 147
RTCM..... 147
RTK 145, 147
SBAS 145, 146, 147
Serial ports 147
Settings..... 41
Show in Views 73
Shut down 57
Site Calibration..... 80
Status 148
Surface Options 82
Surface options window 71
Surfaces..... 73
Survey Top..... 62
Survey Topo 67, 68, 70
WAAS 146

End User License Agreement

End User license agreement

IMPORTANT - This is an agreement (the "**Agreement**") between you, the end purchaser ("**Licensee**") and Hemisphere GNSS Inc. ("**Hemisphere**") which permits Licensee to use the Hemisphere software (the "**Software**") that accompanies this Agreement. This Software may be licensed on a standalone basis or may be embedded in a Product. Please read and ensure that you understand this Agreement before installing or using the Software Update or using a Product.

In this agreement any product that has Software embedded in it at the time of sale to the Licensee shall be referred to as a "**Product**". As well, in this Agreement, the use of a Product shall be deemed to be use of the Software which is embedded in the Product.

BY INSTALLING OR USING THE SOFTWARE UPDATE OR THE PRODUCT, LICENSEE THEREBY AGREES TO BE LEGALLY BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THESE TERMS, (I) DO NOT INSTALL OR USE THE SOFTWARE, AND (II) IF YOU ARE INSTALLING AN UPDATE TO THE SOFTWARE, DO NOT INSTALL THE UPDATE AND PROMPTLY DESTROY IT.

HEMISPHERE PROVIDES LIMITED WARRANTIES IN RELATION TO THE SOFTWARE. AS WELL, THOSE WHO USE THE EMBEDDED SOFTWARE DO SO AT THEIR OWN RISK. YOU SHOULD UNDERSTAND THE IMPORTANCE OF THESE AND OTHER LIMITATIONS SET OUT IN THIS AGREEMENT BEFORE INSTALLING OR USING THE SOFTWARE OR THE PRODUCT.

1. **LICENSE**. Hemisphere hereby grants to Licensee a non-transferable and non-exclusive license to use the Software as embedded in a Product and all Updates (collectively the "**Software**"), solely in binary executable form.
2. **RESTRICTIONS ON USE**. Licensee agrees that Licensee and its employees will not directly or indirectly, in any manner whatsoever:
    a. install or use more copies of the Software than the number of copies that have been licensed;
    b. use or install the Software in connection with any product other than the Product the Software was intended to be used or installed on as set out in the documentation that accompanies the Software.
    c. copy any of the Software or any written materials for any purpose except as part of Licensee's normal backup processes;
    d. modify or create derivative works based on the Software;
    e. sub-license, rent, lease, loan or distribute the Software;
    f. permit any third party to use the Software;
    g. use or operate Product for the benefit of any third party in any type of service outsourcing, application service, provider service or service bureau capacity;
    h. reverse engineer, decompile or disassemble the Software or otherwise reduce it to a human perceivable form;
    i. Assign this Agreement or sell or otherwise transfer the Software to any other party except as part of the sale or transfer of the whole Product.
3. **UPDATES**. At Hemisphere's discretion Hemisphere may make Updates available to Licensee. An update ("**Update**") means any update to the Software that is made available to Licensee including error corrections, enhancements and other modifications. Licensee may access, download and install Updates during the Warranty Period only. All Updates that Licensee downloads, installs or uses shall be deemed to be Software and subject to this Agreement. Hemisphere reserves the right to modify the Product without any obligation to notify, supply or install any improvements or alterations to existing Software.
4. **SUPPORT.** Hemisphere may make available directly or through its authorized dealers telephone and email support for the Software. Contact Hemisphere to find the authorized dealer near you. As well, Hemisphere may make available user and technical documentation regarding the Software. Hemisphere reserves the right to reduce and limit access to such support at any time.

Continued on next page

End User License Agreement, Continued

End User license agreement, continued

1. **BACKUPS AND RECOVERY.** Licensee shall back-up all data used, created or stored by the Software on a regular basis as necessary to enable proper recovery of the data and related systems and processes in the event of a malfunction in the Software or any loss or corruption of data caused by the Software. Licensee shall assume all risks of loss or damage for any failure to comply with the foregoing.
2. **OWNERSHIP.** Hemisphere and its suppliers own all rights, title and interest in and to the Software and related materials, including all intellectual property rights. The Software is licensed to Licensee, not sold.
3. **TRADEMARKS**. "Hemisphere GNSS", "Crescent", "Eclipse" and the associated logos are trademarks of Hemisphere. Other trademarks are the property of their respective owners. Licensee may not use any of these trademarks without the consent of their respective owners.
4. **LIMITED WARRANTY**. Hemisphere warrants solely to the Licensee, subject to the exclusions and procedures set forth herein below, that for a period of one (1) year from the original date of purchase of the Product in which it is embedded (the "Warranty Period"), the Software, under normal use and maintenance, will conform in all material respects to the documentation provided with the Software and any media will be free of defects in materials and workmanship. For any Update, Hemisphere warrants, for 90 days from performance or delivery, or for the balance of the original Warranty Period, whichever is greater, that the Update, under normal use and maintenance, will conform in all material respects to the documentation provided with the Update and any media will be free of defects in materials and workmanship. Notwithstanding the foregoing, Hemisphere does not warrant that the Software will meet Licensee's requirements or that its operation will be error free.
5. **WARRANTY EXCLUSIONS**. The warranty set forth in Section (8) will not apply to any deficiencies caused by (a) the Product not being used as described in the documentation supplied to Licensee, (b) the Software having been altered, modified or converted in any way by anyone other than Hemisphere approved by Hemisphere, (c) any malfunction of Licensee's equipment or other software, or (d) damage occurring in transit or due to any accident, abuse, misuse, improper installation, lightning (or other electrical discharge) or neglect other than that caused by Hemisphere. Hemisphere GNSS does not warrant or guarantee the precision or accuracy of positions obtained when using the Software (whether standalone or embedded in a Product). The Product and the Software is not intended and should not be used as the primary means of navigation or for use in safety of life applications. The potential lpositioning and navigation accuracy obtainable with the Software as stated in the Product or Software documentation serves to provide only an estimate of achievable accuracy based on specifications provided by the US Department of Defense for GPS positioning and DGPS service provider performance specifications, where applicable.
6. **WARRANTY DISCLAIMER.** EXCEPT AS EXPRESSLY SET OUT IN THIS AGREEMENT, HEMISPHERE MAKES NO REPRESENTATION, WARRANTY OR CONDITION OF ANY KIND TO LICENSEE, WHETHER VERBAL OR WRITTEN AND HEREBY DISCLAIMS ALL REPRESENTATIONS, WARRANTIES AND CONDITIONS OF ANY KIND INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, ACCURACY, RELIABILITY OR THAT THE USE OF THE SOFTWARE WILL BE UNINTERRUPTED OR ERROR-FREE AND HEREBY DISCLAIMS ALL REPRESENTATIONS, WARRANTIES AND CONDITIONS ARISING AS A RESULT OF CUSTOM, USAGE OR TRADE AND THOSE ARISING UNDER STATUTE.
7. **LIMITS ON WARRANTY DISCLAIMER.** Some jurisdictions do not allow the exclusion of implied warranties or conditions, so some of the above exclusions may not apply to Licensee. In that case, any implied warranties or conditions which would then otherwise arise will be limited in duration to ninety (90) days from the date of the license of the Software or the purchase of the Product. The warranties given herein give Licensee specific legal rights and Licensee may have other rights which may vary from jurisdiction to jurisdiction.
8. **CHANGE TO WARRANTY.**No employee or agent of Hemisphere is authorized to change the warranty provided or the limitation or disclaimer of warranty provisions. All such changes will only be effective if pursuant to a separate agreement signed by senior officers of the respective parties.

Continued on next page

End User license agreement, continued

1. **WARRANTY CLAIM.** In the event Licensee has a warranty claim Licensee must first check for and install all Updates that are made available. The warranty will not otherwise be honored. Proof of purchase may be required. Hemisphere does not honor claims asserted after the end of the Warranty Period.
2. **LICENSEE REMEDIES.** In all cases which involve a failure of the Software to conform in any material respect to the documentation during the Warranty Period or a breach of a warranty, Hemisphere's sole obligation and liability, and Licensee's sole and exclusive remedy, is for Hemisphere, at Hemisphere's option, to (a) repair the Software, (b) replace the Software with software conforming to the documentation, or (c) if Hemisphere is unable, on a reasonable commercial basis, to repair the Software or to replace the Software with conforming software within ninety (90) days, to terminate this Agreement and thereafter Licensee shall cease using the Software. Hemisphere will also issue a refund for the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.
3. LIMITATION OF LIABILITY. IN NO EVENT WILL HEMISPHERE BE LIABLE TO LICENSEE FOR ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES INCLUDING ARISING IN RELATION TO ANY LOSS OF DATA, INCOME, REVENUE, GOODWILL OR ANTICIPATED SAVINGS EVEN IF HEMISPHERE HAS BEEN INFORMED OFTHE POSSIBILITY OF SUCH LOSS OR DAMAGE. FURTHER, IN NO EVENT WILL HEMISPHERE'S TOTAL CUMULATIVE LIABILITY HEREUNDER, FROM ALL CAUSES OF ACTION OF ANY KIND, EXCEED THE TOTAL AMOUNT PAID BY LICENSEE TO HEMISPHERE TO PURCHASE THE PRODUCT. THIS LIMITATION AND EXCLUSION APPLIES IRRESPECTIVE OF THE CAUSE OF ACTION, INCLUDING BUT NOT LIMITED TO BREACH OF CONTRACT, NEGLIGENCE, STRICT LIABILITY, TORT, BREACH OF WARRANTY, MISREPRESENTATION OR ANY OTHER LEGAL THEORY AND WILL SURVIVE A FUNDAMENTAL BREACH.
4. LIMITS ON LIMITATION OF LIABILITY. Some jurisdictions do not allow for the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply to Licensee and Licensee may also have other legal rights which may vary from jurisdiction to jurisdiction.
5. BASIS OF BARGAIN. Licensee agrees and acknowledges that Hemisphere has set its prices and the parties have entered into this Agreement in reliance on the limited warranties, warranty disclaimers and limitations of liability set forth herein, that the same reflect an agreed-to allocation of risk between the parties (including the risk that a remedy may fail of its essential purpose and cause consequential loss), and that the same forms an essential basis of the bargain between the parties. Licensee agrees and acknowledges that Hemisphere would not have been able to sell the Product at the amount charged on an economic basis without such limitations.
6. PROPRIETARY RIGHTS INDEMNITY. Hemisphere shall indemnify, defend and hold harmless Licensee from and against any and all actions, claims, demands, proceedings, liabilities, direct damages, judgments, settlements, fines, penalties, costs and expenses, including royalties and attorneys' fees and related costs, in connection with or arising out of any actual infringement of any third party patent, copyright or other intellectual property right by the Software or by its use, in accordance with this Agreement and documentation, PROVIDED THAT: (a) Hemisphere has the right to assume full control over any action, claim, demand or proceeding, (b) Licensee shall promptly notify Hemisphere of any such action, claim, demand, or proceeding, and (c) Licensee shall give Hemisphere such reasonable assistance and tangible material as is reasonably available to Licensee for the defense of the action, claim, demand or proceeding. Licensee shall not settle or compromise any of same for which Hemisphere has agreed to assume responsibility without Hemisphere's prior written consent. Licensee may, at its sole cost and expense, retain separate counsel from the counsel utilized or retained by Hemisphere. 19. INFRINGEMENT. If use of the Software may be enjoined due to a claim of infringement by a third party then, at its sole discretion and expense, Hemisphere may do one of the following: (a) negotiate a license or other agreement so that the Product is no longer subject to such a potential claim, (b) modify the Product so that it becomes non- infringing, provided such modification can be accomplished without materially affecting the performance and functionality of the Product,

Continued on next page

End User license agreement, continued

(c) replace the Software, or the Product, with non-infringing software, or product, of equal or better performance and quality, or (d) if none of the foregoing can be done on a commercially reasonable basis, terminate this license and Licensee shall stop using the Product and Hemisphere shall refund the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.

5. The foregoing sets out the entire liability of Hemisphere and the sole obligations of Hemisphere to Licensee in respect of any claim that the Software or its use infringes any third party rights.
6. INDEMNIFICATION. Except in relation to an infringement action, Licensee shall indemnify and hold Hemisphere harmless from any and all claims, damages, losses, liabilities, costs and expenses (including reasonable fees of lawyers and other professionals) arising out of or in connection with Licensee's use of the Product, whether direct or indirect, including without limiting the foregoing, loss of data, loss of profit or business interruption. TERMINATION. Licensee may terminate this Agreement at any time without cause. Hemisphere may terminate this Agreement on 30 days notice to Licensee if Licensee fails to materially comply with each provision of this Agreement unless such default is cured within the 30 days. Any such termination by a party shall be in addition to and without prejudice to such rights and remedies as may be available, including injunction and other equitable remedies. Upon receipt by Licensee of written notice of termination from Hemisphere or termination by Licensee, Licensee shall at the end of any notice period (a) cease using the Software; and (b) return to Hemisphere (or destroy and provide a certificate of a Senior Officer attesting to such destruction) the Software and all related material and any magnetic or optical media provided to Licensee. The provisions of Sections 6), 7), 8), 9), 10), 15), 21), 26) and 27) herein shall survive the expiration or termination of this Agreement for any reason.
7. **EXPORT RESTRICTIONS**. Licensee agrees that Licensee will comply with all export control legislation of Canada, the United States, Australia and any other applicable country's laws and regulations, whether under the Arms Export Control Act, the International Traffic in Arms Regulations, the Export Administration Regulations, the regulations of the United States Departments of Commerce, State, and Treasury, or otherwise as well as the export control legislation of all other countries.
8. **PRODUCT COMPONENTS.** The Product may contain third party components. Those third party components may be subject to additional terms and conditions. Licensee is required to agree to those terms and conditions in order to use the Product.
9. **FORCE MAJEURE EVENT.** Neither party will have the right to claim damages as a result of the other's inability to perform or any delay in performance due to unforeseeable circumstances beyond its reasonable control, such as labor disputes, strikes, lockouts, war, riot, insurrection, epidemic, Internet virus attack, Internet failure, supplier failure, act of God, or governmental action not the fault of the non-performing party.
10. **FORUM FOR DISPUTES**. The parties agree that the courts located in Calgary, Alberta, Canada and the courts of appeal there from will have exclusive jurisdiction to resolve any disputes between Licensee and Hemisphere concerning this Agreement or Licensee's use or inability to use the Software and the parties hereby irrevocably agree to attorn to the jurisdiction of those courts. Notwithstanding the foregoing, either party may apply to any court of competent jurisdiction for injunctive relief.
11. **APPLICABLE LAW**. This Agreement shall be governed by the laws of the Province of Alberta, Canada, exclusive of any of its choice of law and conflicts of law jurisprudence.
12. **CISG.** The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement or any transaction hereunder.

GENERAL. This is the entire agreement between Licensee and Hemisphere relating to the Product and Licensee's use of the same, and supersedes all prior, collateral or contemporaneous oral or written representations, warranties or agreements regarding the same. No amendment to or modification of this Agreement will be binding unless in writing and signed by duly authorized representatives of the parties. Any and all terms and conditions set out in any correspondence between the parties or set out in a purchase order which are different from or in addition to the terms and conditions set forth herein, shall have no application and no written notice of same shall be required. In the event that one or more of the provisions of this Agreement is found to be illegal or unenforceable, this Agreement shall not be rendered inoperative but the remaining provisions shall continue in full force and effect.

Warranty Notice

Warranty notice

COVERED PRODUCTS: This warranty covers all products manufactured by Hemisphere GNSS and purchased by the end purchaser (the "Products"), unless otherwise specifically and expressly agreed in writing by Hemisphere GNSS.
LIMITED WARRANTY: Hemisphere GNSS warrants solely to the end purchaser of the Products, subject to the exclusions and procedures set forth below, that the Products sold to such end purchaser and its internal components shall be free, under normal use and maintenance, from defects in materials, and workmanship and will substantially conform to Hemisphere GNSS's applicable specifications for the Product, for a period of 12 months from delivery of such Product to such end purchaser (the ”Warranty Period”). Repairs and replacement components for the Products are warranted, subject to the exclusions and procedures set forth below, to be free, under normal use and maintenance, from defects in material and workmanship, and will substantially conform to Hemisphere GNSS's applicable specifications for the Product, for 90 days from performance or delivery, or for the balance of the original Warranty Period, whichever is greater.
EXCLUSION OF ALL OTHER WARRANTIES. The LIMITED WARRANTY shall apply only if the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS relevant User’s Manual and Specifications, AND the Product is not modified or misused. The Product is provided “AS IS” and the implied warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and ALL OTHER WARRANTIES,
express, implied or arising by statute, by course of dealing or by trade usage, in connection with the design, sale, installation, service or use of any products or any component thereof, are EXCLUDED from this transaction and shall not apply to the Product. The LIMITED WARRANTY is IN LIEU OF any other warranty, express or implied, including but not limited to, any warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, title, and non-infringement.
LIMITATION OF REMEDIES. The purchaser’s EXCLUSIVE REMEDY against Hemisphere GNSS shall be, at Hemisphere GNSS's option, the repair or replacement of any defective Product or components thereof. The purchaser shall notify Hemisphere GNSS or a Hemisphere GNSS's approved service center immediately of any defect. Repairs shall be made through a Hemisphere GNSS approved service center only. Repair, modification or service of Hemisphere GNSS products by any party other than a Hemisphere GNSS approved service center shall render this warranty null and void. The remedy in this paragraph shall only be applied in the event that the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Hemisphere GNSS's relevant User’s Manual and Specifications, AND the Product is not modified or misused. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE
TO PURCHASER, even if Hemisphere GNSS has been advised of the possibility of such damages. Without limiting the foregoing, Hemisphere GNSS shall not be liable for any damages of any kind resulting from installation, use, quality, performance or accuracy of any Product.
HEMISPHERE IS NOT RESPONSIBLE FOR PURCHASER’S NEGLIGENCE OR UNAUTHORIZED USES OF THE PRODUCT. IN NO EVENT SHALL Hemisphere GNSS BE IN ANY WAY RESPONSIBLE FOR ANY DAMAGES RESULTING FROM PURCHASER’S OWN NEGLIGENCE, OR FROM OPERATION OF THE PRODUCT IN ANY WAY OTHER THAN AS SPECIFIED IN Hemisphere GNSS's RELEVANT USER’S MANUAL AND SPECIFICATIONS. Hemisphere GNSS is NOT RESPONSIBLE for defects or performance problems resulting from (1) misuse, abuse, improper installation, neglect of Product; (2) the utilization of the Product with hardware or software products, information, data, systems, interfaces or devices not made, supplied or specified by Hemisphere GNSS; (3) the operation of the Product under any specification other than, or in addition to, the specifications set forth in Hemisphere GNSS's relevant User’s Manual and Specifications; (4) damage caused by accident or natural events, such as lightning (or other electrical discharge) or fresh/ salt water immersion of Product; (5) damage occurring in transit; (6) normal wear and tear; or (7) the operation or failure of operation of any satellite-based positioning system or differential correction service; or the availability or performance of any satellite-based positioning signal or differential correction signal.
THE PURCHASER IS RESPONSIBLE FOR OPERATING THE VEHICLE SAFELY. The purchaser is solely responsible for the safe operation of the vehicle used in connection with the Product, and for maintaining proper system control settings. UNSAFE DRIVING OR SYSTEM CONTROL SETTINGS CAN RESULT IN PROPERTY DAMAGE, INJURY, OR DEATH.

Continued on next page

Warranty notice, continued

The purchaser is solely responsible for his/her safety and for the safety of others. The purchaser is solely responsible for maintaining control of the automated steering system at all times. THE PURCHASER IS SOLELY RESPONSIBLE FOR ENSURING THE PRODUCT IS PROPERLY AND CORRECTLY INSTALLED, CONFIGURED, INTERFACED, MAINTAINED, STORED, AND OPERATED IN ACCORDANCE WITH Hemisphere GNSS's RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GNSS does not warrant or guarantee the positioning and navigation precision or accuracy obtained when using Products. Products are not intended for primary navigation or for use in safety of life applications. The potential accuracy of Products as stated in Hemisphere GNSS literature and/or Product specifications serves to provide only an estimate of achievable accuracy based on performance specifications provided by the satellite service operator (i.e. US Department of Defense in the case of GPS and differential correction service provider. Hemisphere GNSS reserves the right to modify Products without any obligation to notify, supply or install any improvements or alterations to existing Products.

GOVERNING LAW. This agreement and any disputes relating to, concerning or based upon the Product shall be governed by and interpreted in accordance with the laws of the State of Arizona.

OBTAINING WARRANTY SERVICE. In order to obtain warranty service, the end purchaser must bring the Product to a Hemisphere GNSS approved service center along with the end purchaser's proof of purchase. Hemisphere GNSS does not warrant claims asserted after the end of the warranty period. For any questions regarding warranty service or to obtain information regarding the location of any of Hemisphere GNSS approved service center, contact Hemisphere GNSS at the following address:

Hemisphere GNSS
8515 E. Anderson Drive Scottsdale, AZ 85255, USA
Phone: +1-480-348-6380
Fax: +1-480-270-5070
TECHSUPPORT@HGNSS.COM
WWW.HGNSS.COM

Hemisphere GNSS Inc.
8515 East Anderson Drive, Suite A
Scottsdale, Arizona, US 85255
Phone: 480-348-6380
Fax: 480-270-5070
PRECISION@HGNSS.COM
WWW.HGNSS.COM