Hemisphere®

-

875-0392-10

IronOne/VR500 Grademetrix™

Solutions Manual

Machine Control Systems

Revision: A1
Date: July 28, 2018

Table of Contents

Device Compliance, License and Patents

Device Compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

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.

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

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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:

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Terms & Definitions

Introduction

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

VR500 Terms & definitions

Term	Definition
1PPS	1 pulse-per-second is a pulse output by the receiver precisely once per second and is used for hardware synchronization.
Activation	Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see Subscription.
Atlas	Atlas is a subscription-based service provided by Hemisphere that enables the VR500 to achieve sub-decimeter accuracy without a base station or datalink.
Base Station	The Base Station is a receiver placed over a familiar point, provides real-time observations, and sends those observations to nearby RTK rovers via UHF radio or the internet.
BeiDou	BeiDou is a Chinese satellite-based navigation system.
DGPS/DGNSS	Differential GPS/GNSS refers to a receiver using Differential Corrections.
Differential Corrections	A method of improving precision of a GNSS rover. Two GNSS receivers placed in a nearby area will have similar error. A base station is placed over a known point. As the actual position of the base station is known, error can be calculated, and corrections can be applied to nearby rovers. This differs from RTK.

Continued on next page

Terms & Definitions, Continued

VR500 Terms & definitions, continued

Term	Definition
Elevation Mask	Elevation Mask is the minimum angle between a satellite and the horizon for the receiver to use that satellite in the solution.
Firmware	Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.
GALILEO	Galileo is a global navigation satellite system implemented by the European Union and European Space Agency.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System deployed and maintained by Russia.
GNSS	Global Navigation Satellite System (GNSS) is a system that provides autonomous 3D position (latitude, longitude, and altitude) and accurate timing globally by using satellites. Current GNSS providers are: GPS, GLONASS and Galileo.
GPS	Global Positioning System (GPS) is a global navigation satellite system implemented by the United States.
Heading	Heading is the angle between true north and the vector calculated from the primary to secondary antenna.
Heading Bias	Heading Bias is an offset applied to the heading value calculated by the receiver.
Multipath	Multipath occurs when the GNSS signal reaches the antenna by two or more paths. This causes incorrect pseudo-range measurements and leads to less precise GNSS solutions.
NMEA	National Marine Electronics Association (NMEA) is a marine electronics organization that sets standards for communication between marine electronics.

Continued on next page

Terms & Definitions, Continued

VR500 Terms & definitions, continued

Term	Definition
ROX	ROX is a Hemisphere GNSS propriety RTK message format that can be used as an alternative to RTCM3 when both the base and rover are Hemisphere branded.
RTCM	Radio Technical Commission for Maritime Services (RTCM) is a standard used to define RTK message formats so that receivers from any manufacturer can be used together.
RTK	Real-Time-Kinematic (RTK) is a real-time differential GPS method that provides better accuracy than differential corrections.
SBAS	Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.
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.
WAAS	Wide Area Augmentation System (WAAS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of North America.

Chapter 1: Overview

Overview

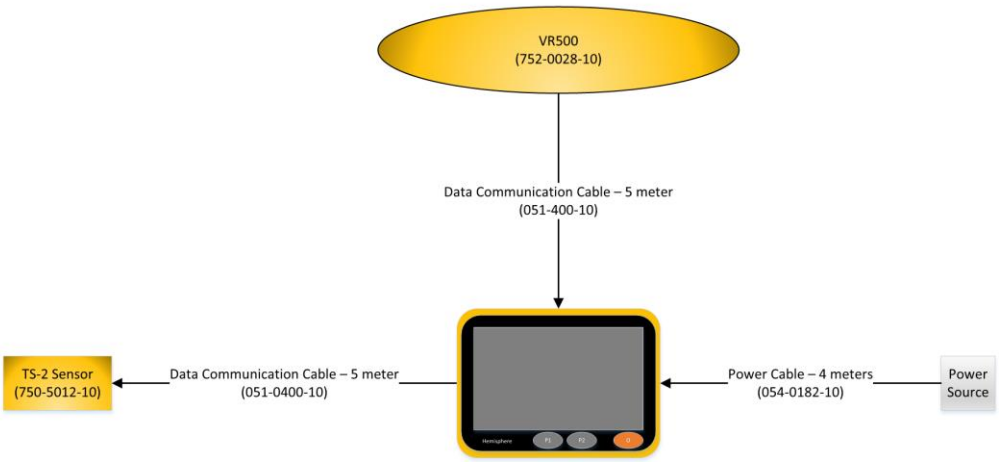
Introduction

Chapter 1 describes the IronOne/GradeMetrix systems integration process. Refer to the harness schematic for a visual representation of the integration process from start-to-finish.

Contents

Harness Schematic

VR500 harness schematic



Chapter 2: Set Up Iron One

Overview

Introduction

Chapter 2 provides information to help you quickly set up and integrate your Vector VR500 GNSS Smart Antenna™ with the IronOne hardware.

You can download this manual from the Hemisphere GNSS website at WWW.HGNSS.COM.

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Installing IronOne

Overview

To install the IronOne refer to the following pin-out and port information:

- Display
- Video
- Communication
- Power
- Video

IronOne pin-out

The IronOne features 12 pin-outs. Refer to Figure 2-1 for the placement of the IronOne pin-outs.

Figure 2-1: IronOne pin-outs

Continued on next page

Installing IronOne, Continued

IronOne display pin-out

Table 2-1 lists the IronOne display pin-outs and directions.

Table 2-1. IronOne display pin-out

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

Installing IronOne, Continued

IronOne video pin-out

Table 2-2 lists the IronOne video pin-outs.

Table 2-2: IronOne video pin-out

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

IronOne communication

Table 2-3 lists the IronOne communication ports.

Table 2-3: IronOne communication ports

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

Continued on next page

Installing IronOne, Continued

IronOne power connector

Table 2-4 lists the IronOne power connectors.

Table 2-4: IronOne power connectors

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

IronOne video communication

Table 2-5 lists the IronOne video ports.

Table 2-5: IronOne video ports

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

IronOne SIM Card

IronOne SIM Card

To remove the weather-tight door on the IronOne, you will need a T10 torx screw driver. This is required for all four screws.

After opening the door, press the SIM card tension tab upwards until it clicks. This allows you to insert the standard GSM SIM Card into the slot. Insert the card and secure the tension tab to its original location.

Return the weather-tight door to the original position. Use the T10 torx screw driver to secure the door to the IronOne enclosure.

Note: Ensure the screws are hand-tight.

For cellular configuration, see Setting Up a Cellular Connection.

Powering the IronOne display

Power On

Press the power button (for less than 10 seconds) until the device powers on.

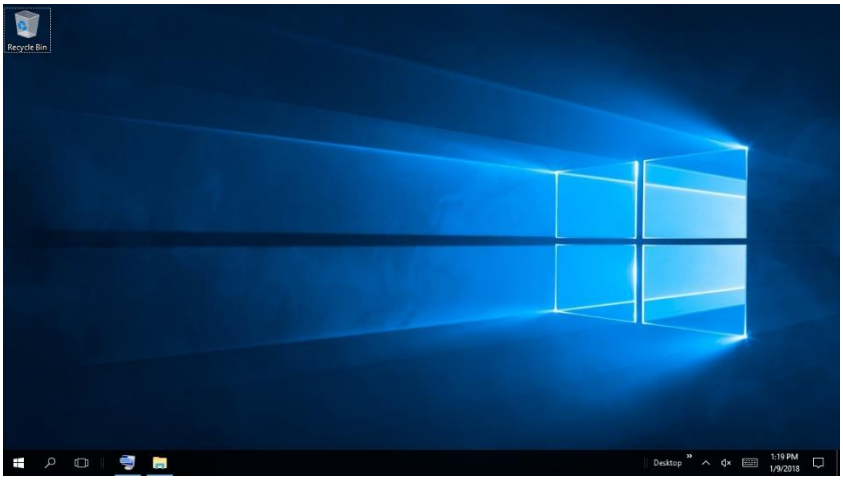
Power Off

To power off the display, exit the software and navigate to the Windows Start Menu and select Shut down.

IronOne Operating System

Using the on-screen keyboard

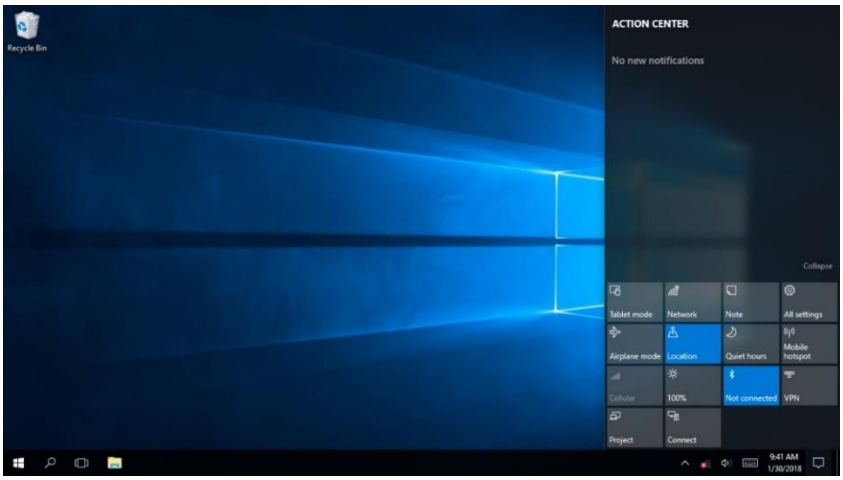
Use the following steps to use the IronOne on-screen keyboard.

Step	Action
1	Starting at the Desktop. 
2	Open the **Action Center**. 

Continued on next page

IronOne Operating System, Continued

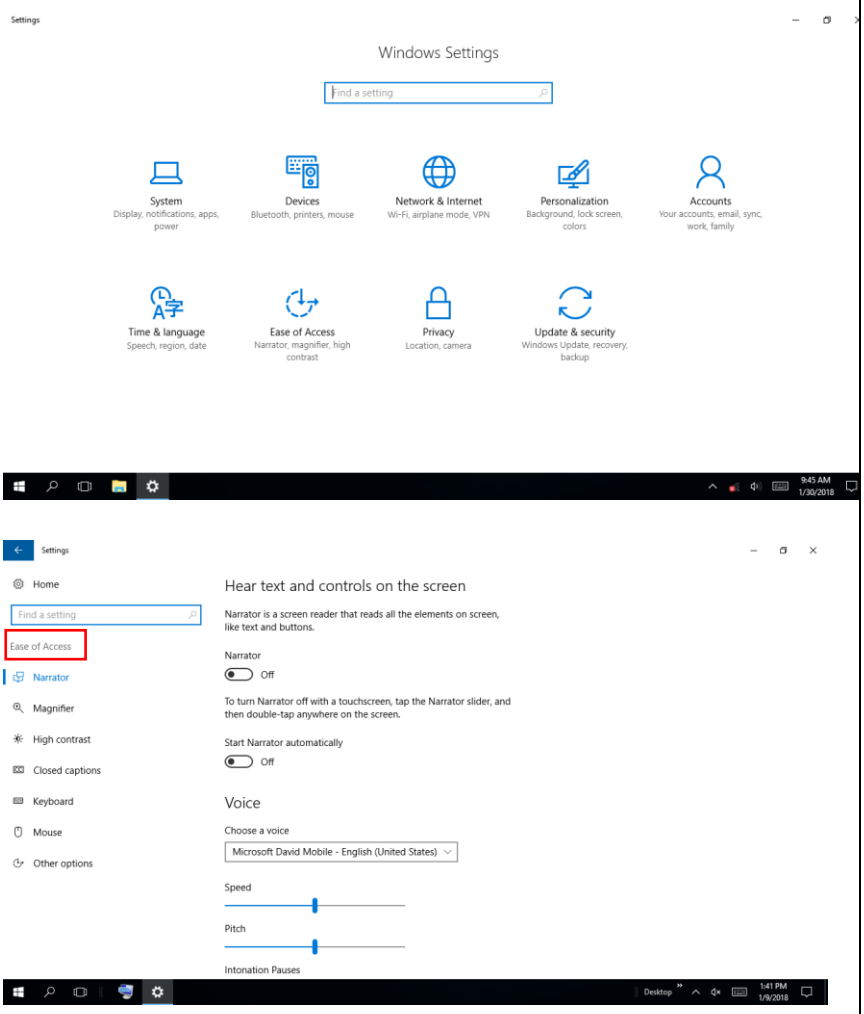
Using the on-screen keyboard, continued

Step	Action
3	Open **All Settings**. 

Continued on next page

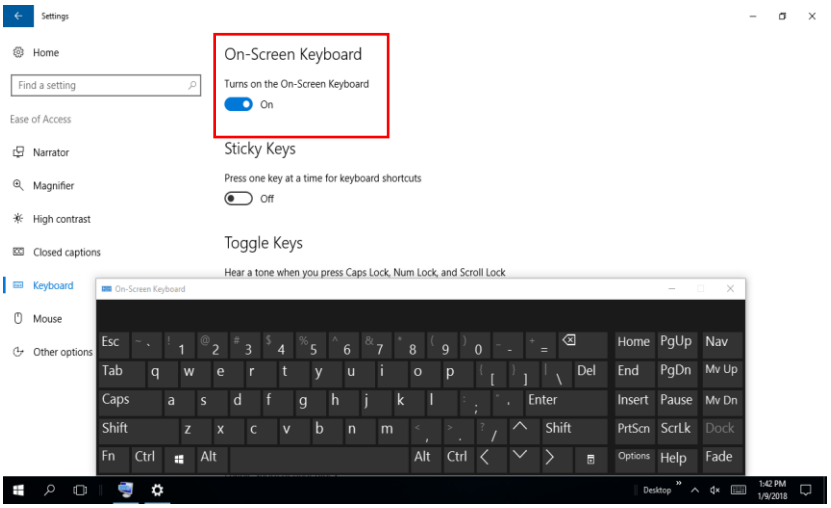
IronOne Operating System, Continued

Using the on-screen keyboard, continued

Step	Action
4	Click **Ease of Access**. 
5	Select **Keyboard** from the side bar menu.

Continued on next page

Using the on-screen keyboard, continued

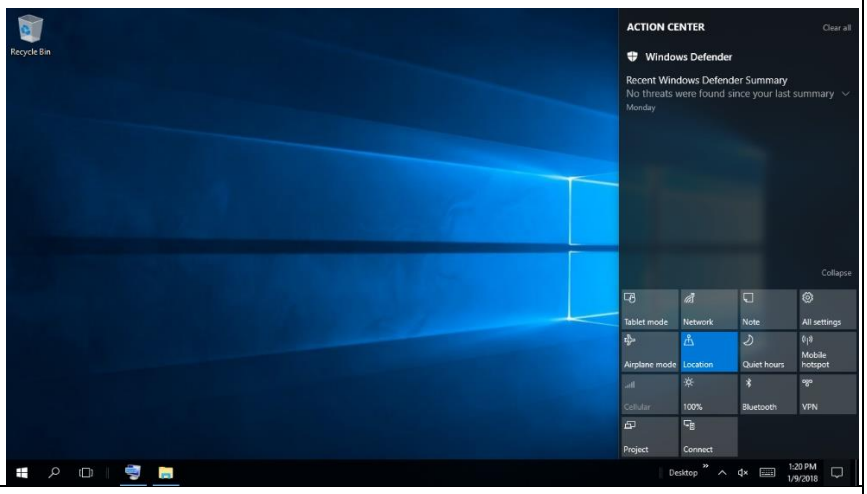
Step	Action
6	Enable the on-screen keyboard. 

Continued on next page

IronOne Operating System, Continued

Setting up a cellular connection

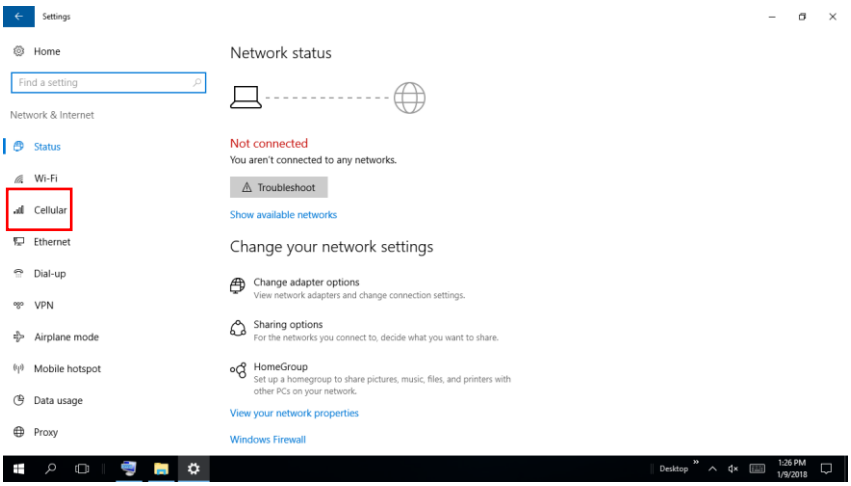
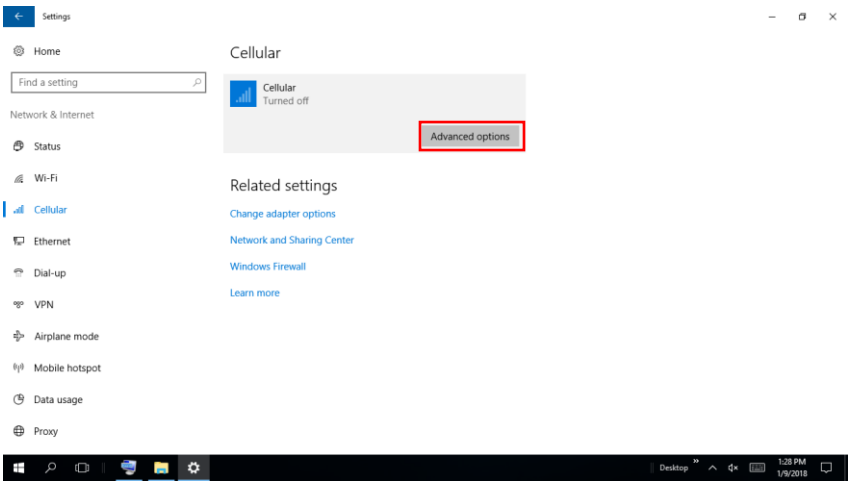
Use the following steps to set up the cellular connection.

Step	Action
1	Starting at the Desktop. 
2	Select **All Settings**. 
3	Click **Network and Internet**.

Continued on next page

IronOne Operating System, Continued

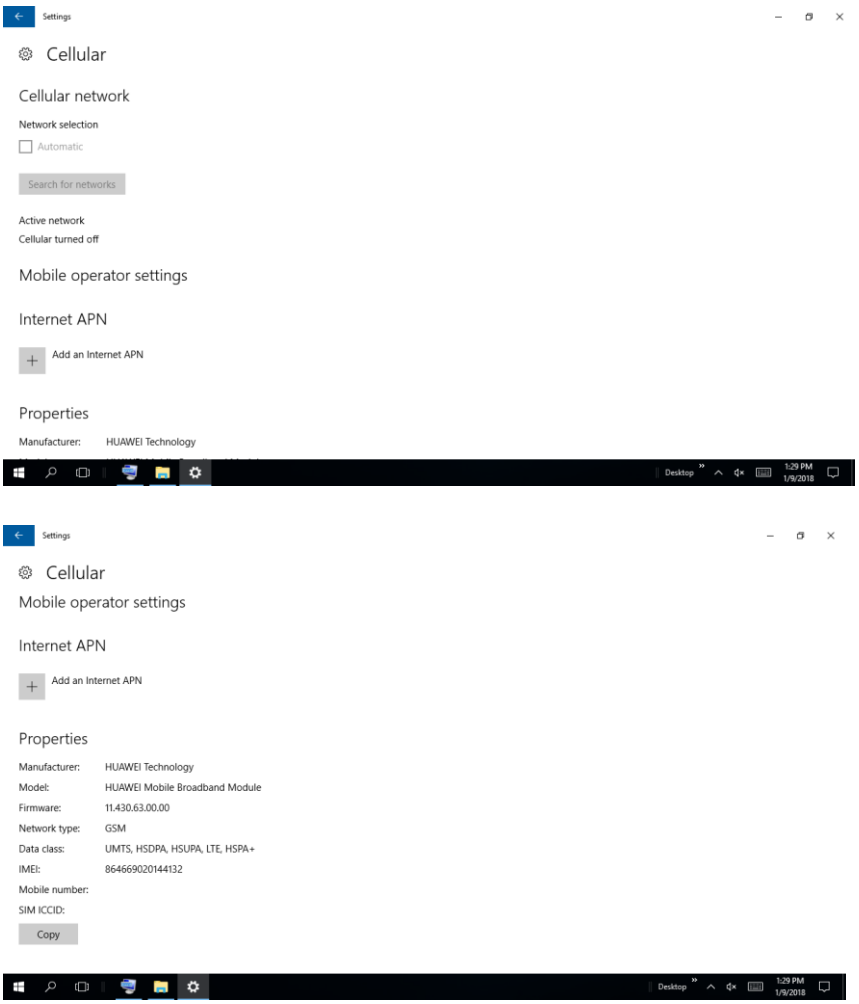
Setting up a cellular connection, continued

Step	Action
4	Select **Cellular** from the side bar menu. 
5	Under Cellular Status, click the **Advanced Options** button. 

Continued on next page

IronOne Operating System, Continued

Setting up a cellular connection, continued

Step	Action
6	The **Advanced Options** displays a window to configure your cellular network. 
7	Enter Network Credentials and APN if required.

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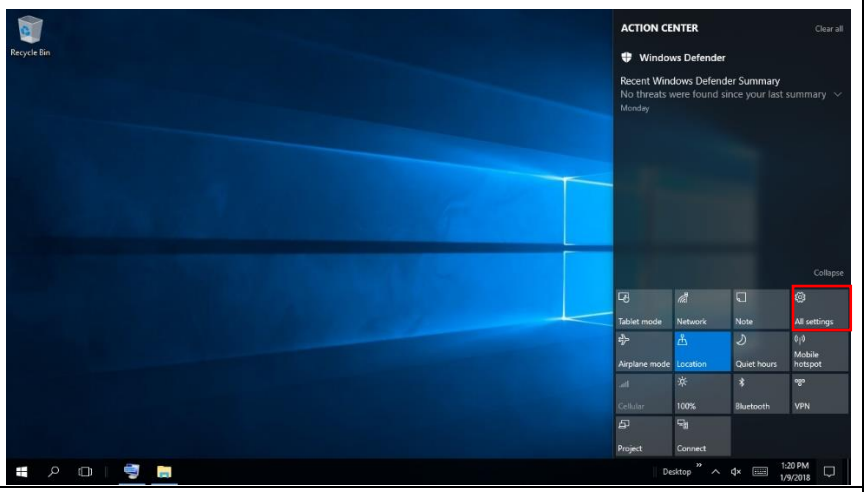
IronOne Operating System, Continued

Bluetooth connecting

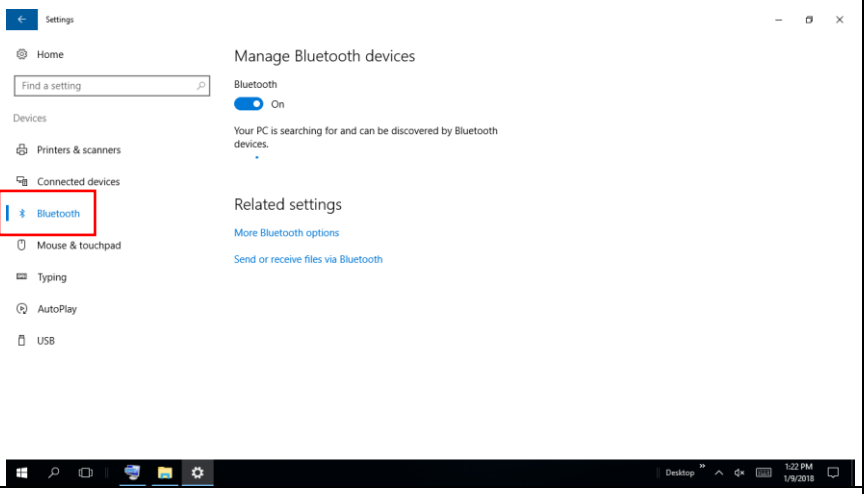
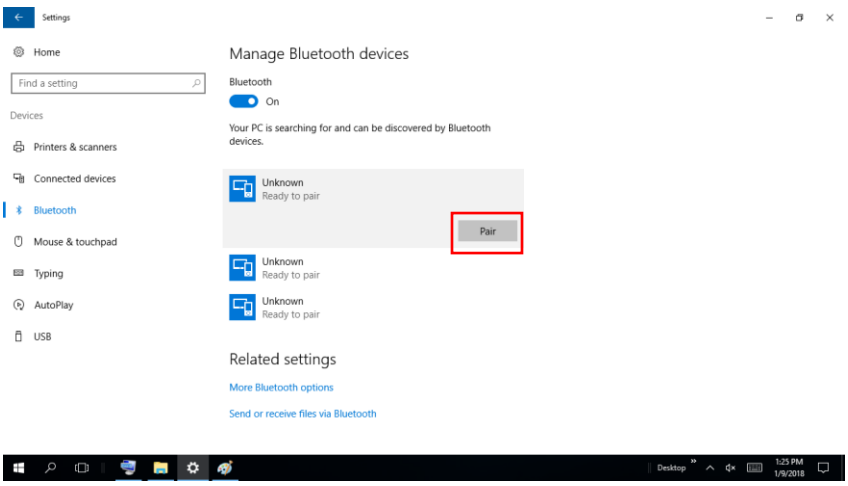
Use the following steps to connect the IronOne Bluetooth.

Step	Action
1	Starting on the Desktop. 
2	Click **All Settings**. 
3	Click **Devices**.

Continued on next page

IronOne Operating System, Continued

Bluetooth connecting, continued

Step	Action
4	Under **Devices**, click **Bluetooth** in the side bar menu.
5	Open **Bluetooth Settings.** 
6	When your Bluetooth device is recognized, initiate the pairing process by clicking on the correct device and push the **Pair** button. 

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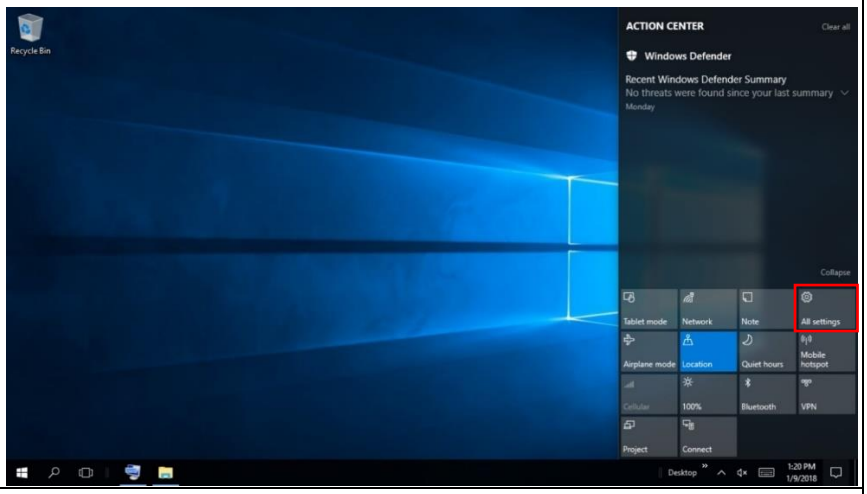
IronOne Operating System, Continued

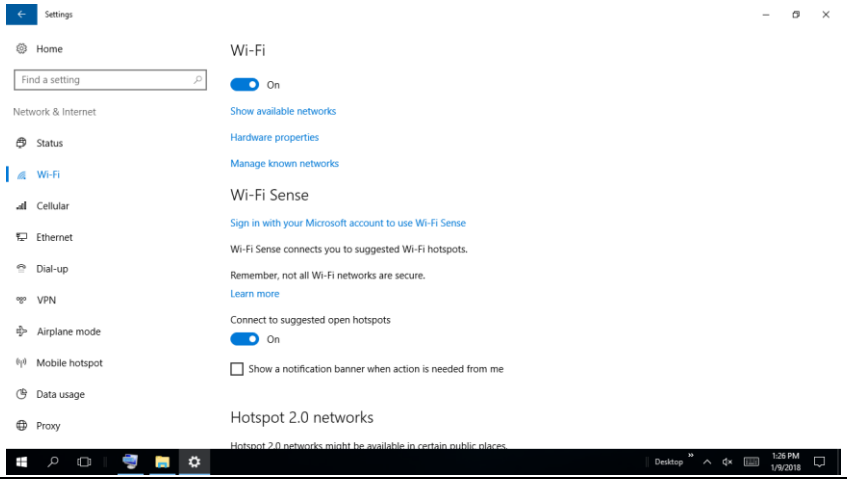
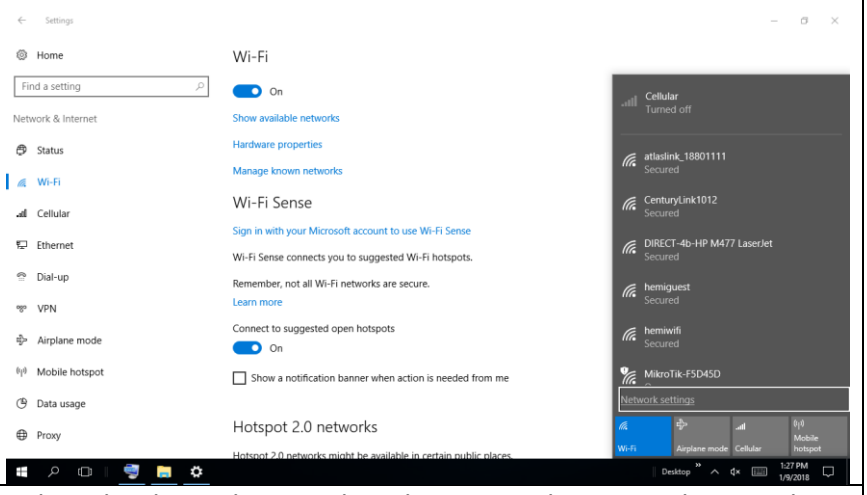
Connect to WIFI Use the following steps to connect the IronOne to a wireless network.

Step	Action
1	Starting at the Desktop. 
2	Select **All settings**. 
3	Click **Network and Internet** from the **Settings** screen.

Continued on next page

IronOne Operating System, Continued

Connect to WIFI, continued

Step	Action
4	From the **Network and Internet** screen, click the **Wi-Fi** link in the side bar menu. This leads you to the Wi-Fi Status screen. 
5	To see available networks in your immediate area, click **Show available networks** on the status page. 
6	Select the desired network and sign into the network using the known credentials.

Chapter 3: Set up VR500 Smart Antenna

Overview

Introduction

Chapter 3 contains the information needed to configure the VR500 Smart Antenna.

Contents

Configure the VR500 Smart Antenna

VR500 kit

Table 3-1 lists the parts included with your VR500. The VR500 GNSS Smart Antenna and the power/data cable (accessory item) are the only two required components.

Note: The VR500's parts comply with IEC 60945 Section 4.4: "Exposed to the weather."

VR500 Parts list

Table 3-1 VR500 Parts list

Part No.	Description	Qty
940-3121-10	HGNSS VR500 Receiver	1
752-0028-10	VR500 Receiver	1

All the following items are available for purchase separately from your VR500 receiver:

Part No.	Description	Qty
054-0181-10	Power/data cable, 15m (includes clamp, screw, washer)	1
710-0147-10	VR500 External UHF, B/T Kit	1

Firmware Upgrades

Overview

Periodically, Hemisphere GNSS releases firmware upgrades to improve performance, fix bugs, or add new features to a product. To update the firmware on the VR500, choose from one of two options:

1. Download the latest version of Hemisphere GNSS RightArm from the following link:
   HTTPS://HEMISPHEREGNSS.COM/RESOURCES-SUPPORT/SOFTWARE
2. Use the internal WebUI.

RightArm Updates

Connect the VR500 to a computer over serial. Firmware can be loaded over either serial port. Set the baud rate of the serial port you are using to 19200.

Launch RightArm.

Click the **Connect** button or navigate to Receiver -> Connect.

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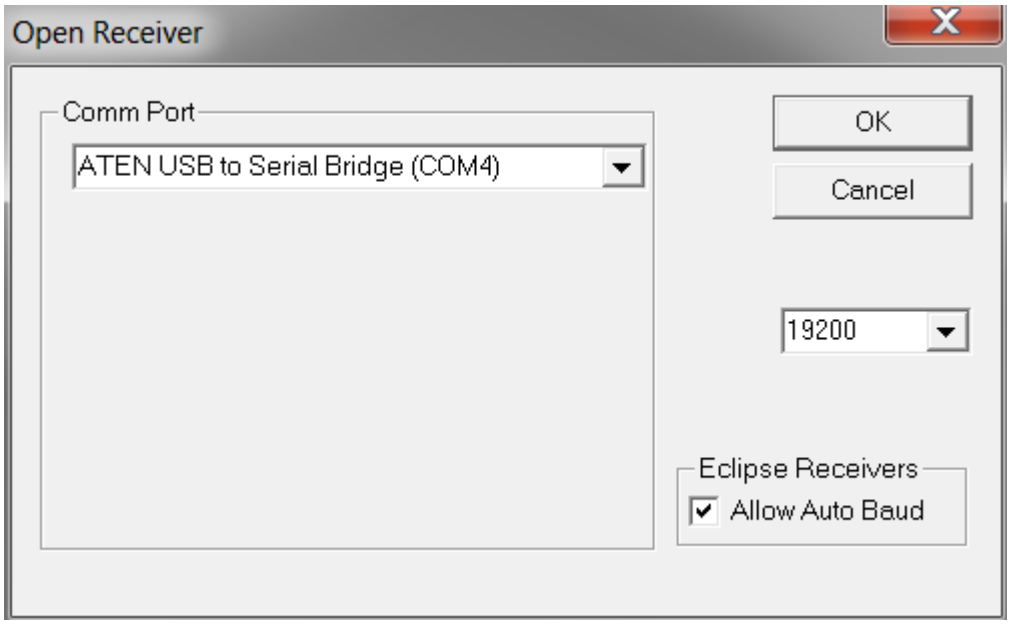
Firmware Upgrades, Continued

RightArm Updates, continued

Choose the COM port connected to the VR500 and click **OK**.



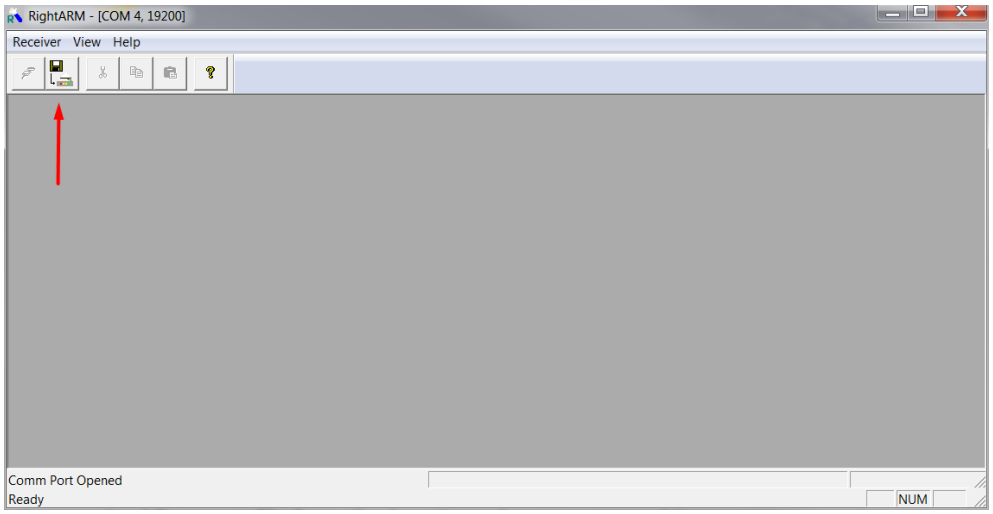
Note: The baud rate of the serial port should be set to 19200 bps. Select **Allow Auto Baud** to change the baud rate during the firmware upgrade for a faster update.

Continued on next page

Firmware Upgrades, Continued

RightArm Updates, continued

Click the **Programming** button.



Select a **Program Type**.

The VR500 has two firmware applications, allowing two different versions of GNSS firmware. Hemisphere GNSS suggests loading the new firmware onto both applications.

After the firmware update is completed, check the current GNSS firmware.

If the current firmware is not the same as the newly loaded firmware, the VR500 could be using the other application. You can switch applications by sending the following command:

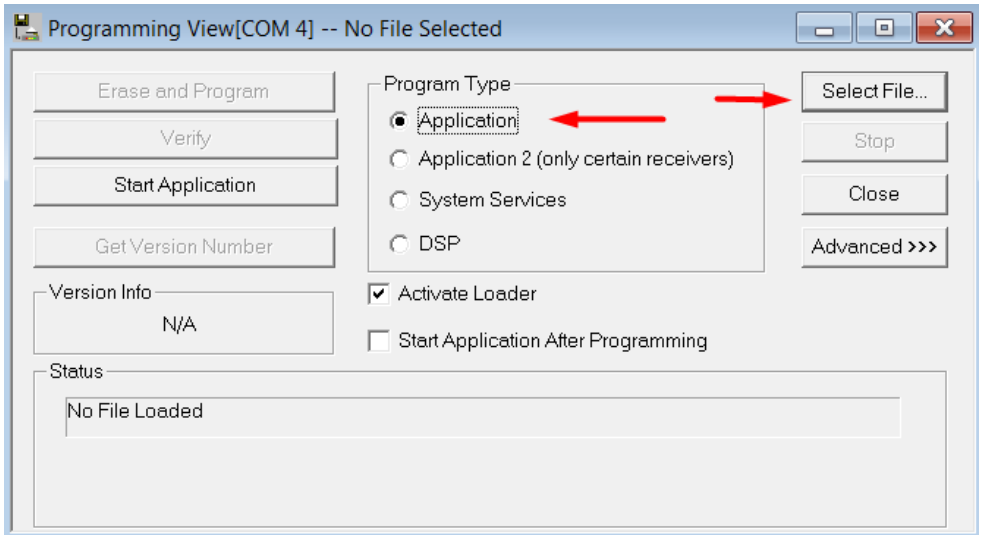
$JAPP,OTHER

Choose the Application, and press **Select File** to select the firmware file.

Continued on next page

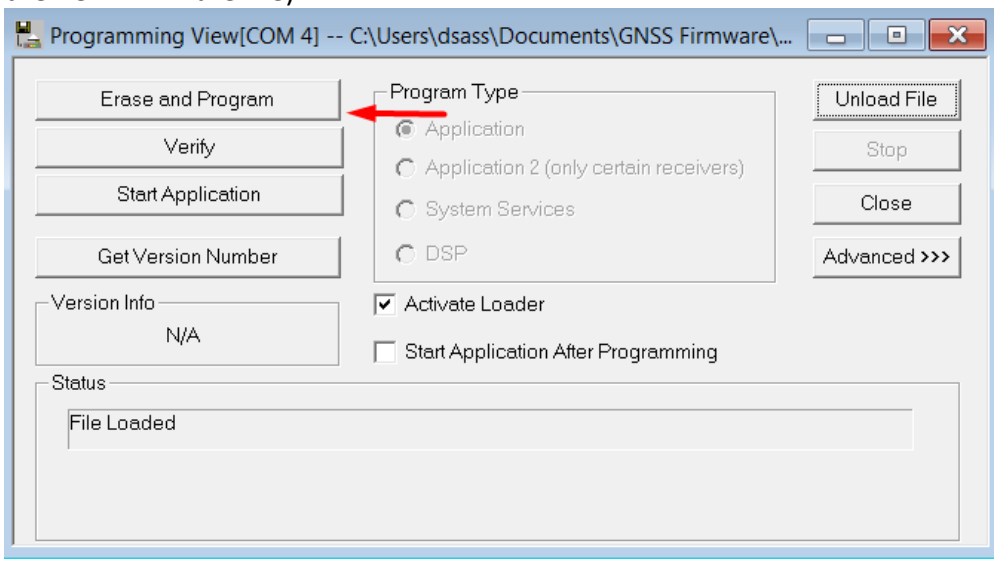
Firmware Upgrades, Continued

RightArm Updates, continued



Choose the firmware, and click **Erase and Program**.

The **Activate Loader** checkbox in the Programming View window is selected. After pressing the Erase and Program button, this checkbox will de-select, and the **Status** field indicates the receiver is in loader mode (ready to receive the new firmware file).



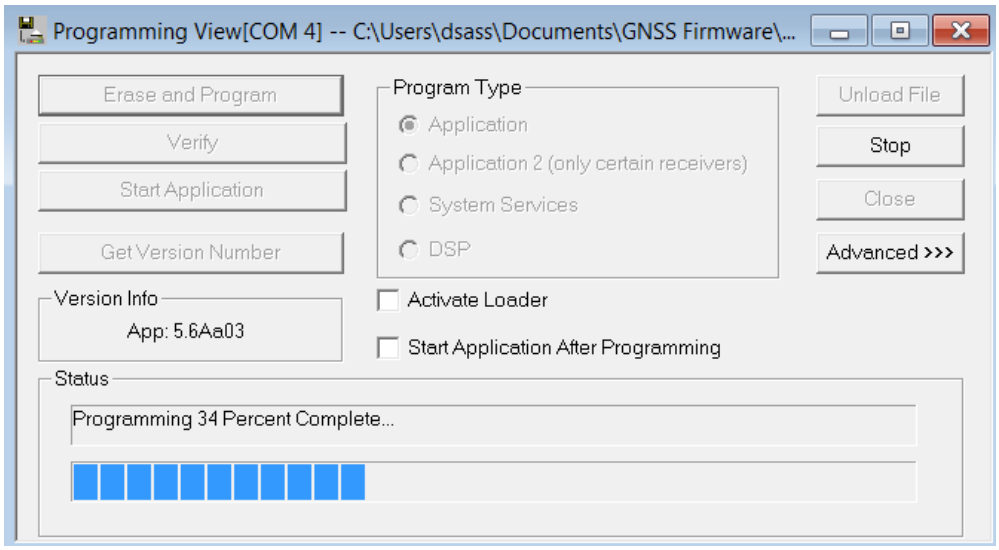
Continued on next page

Firmware Upgrades, Continued

RightArm Updates, continued

Note: If the Activate Loader check box remains selected, power the receiver off and on. When the receiver powers back on, the Activate Loader box should be de-selected.

WARNING: Do not to interrupt the power supply to the receiver, and do not interrupt the communication link between the PC and the receiver until programming is complete. Failure to do so may cause the receiver to become inoperable and will require factory repair.



Note: After completing the firmware update, Hemisphere GNSS suggests repeating this process for the other application.

Mounting the VR500

Introduction

This section provides information on mounting the VR500 in the optimal location, orientation considerations, environmental considerations, and other mounting options.

GNSS satellite reception

When considering where to mount the VR500, consider the following satellite reception recommendations:

- Ensure there is a clear view of the sky available to the VR500 so the GNSS and L-band satellites are not masked by obstructions that may reduce system performance
- Mount the VR500 in a position in respect to the primary GNSS antenna (located on the end opposite the recessed arrow on the underside of the enclosure)
- Locate any transmitting antennas away from the VR500 by at least a few meters to ensure tracking performance is not compromised
- Ensure cable length is adequate to route into the machine to reach a breakout box or terminal strip
- Do not locate the antenna where environmental conditions exceed those specified in Appendix B, Technical Specifications of this document.

Figure 3-2: Recessed arrow

Continued on next page

Mounting the VR500, Continued

Environmental considerations

Hemisphere Vector Smart Antennas are designed to withstand harsh environmental conditions; however, adhere to the following limits when storing and using the VR500:

- 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: IEC 16750-4:2010 Section 5.6 Humid heat, cyclic test

Mounting orientation

The VR500 outputs heading, pitch, and roll readings regardless of the orientation of the antennas. The relation of the antennas to the machine's axis determines if you need to enter a heading, pitch, or roll bias.

The primary antenna is used for positioning and the primary and secondary antennas, working in conjunction, output heading, pitch, and roll values.

Parallel orientation

Parallel installation orients the VR500 parallel to, and along the centerline of, the axis of the machine. **This provides a true heading**. In this orientation:

- If you use a gyrocompass and there is a need to align the Vector smart antenna, you can enter a heading bias in the VR500 to calibrate the physical heading to the true heading of the machine.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.

Perpendicular orientation

You can also install the antennae so they are oriented perpendicular to the centerline of the machine's axis. In this orientation:

- Enter a heading bias of +90° if the primary antenna is on the right side of the machine and -90° if the primary antenna is on the left side of the machine.
- Configure the receiver to specify the GNSS smart antenna is measuring the roll axis using the VR500 WebUI.
- Enter a roll bias to properly output the pitch and roll values.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.

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Mounting the VR500, Continued

Mounting orientation example

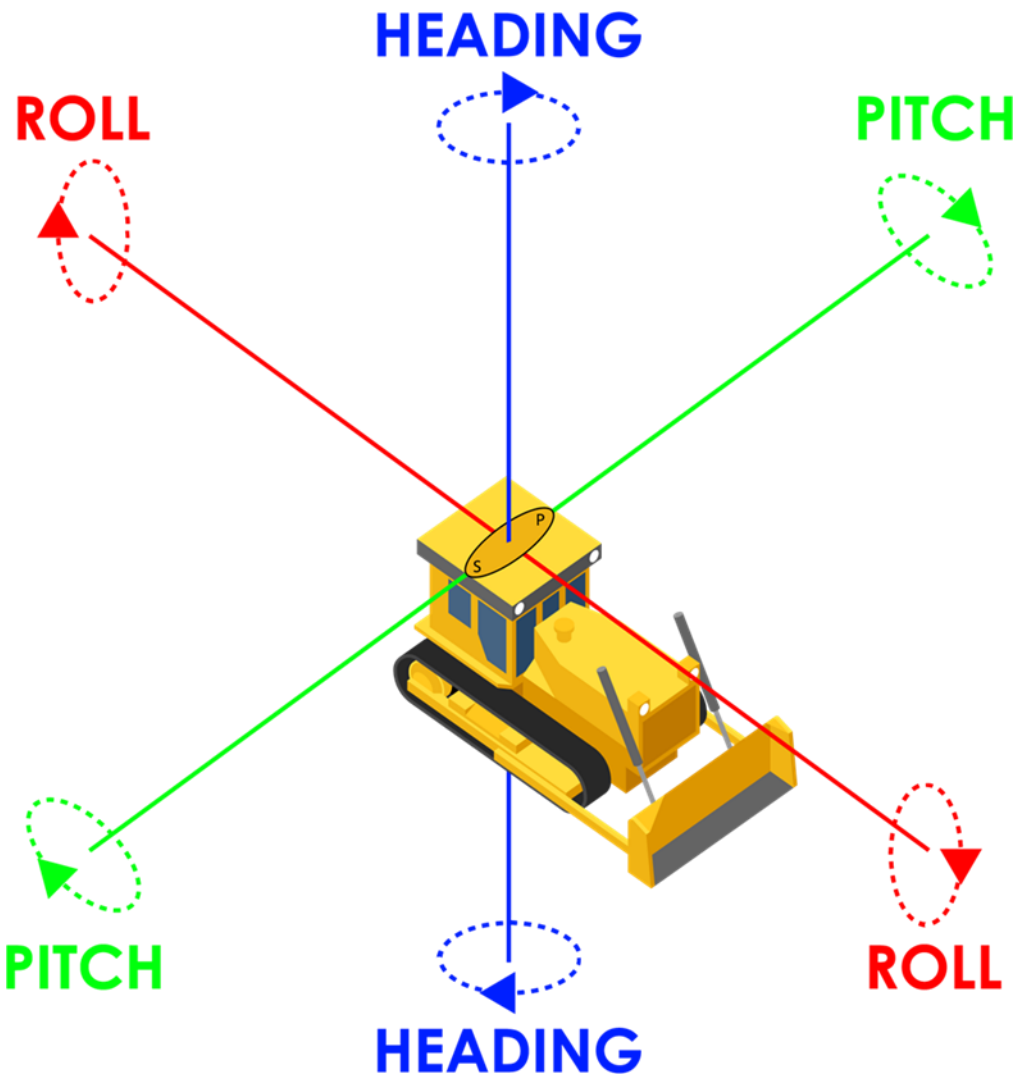

Figure 3-3: Recommended orientation and resulting signs of HPR values

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Mounting the VR500, Continued

Mounting orientation example, continued**Mounting orientation example,**

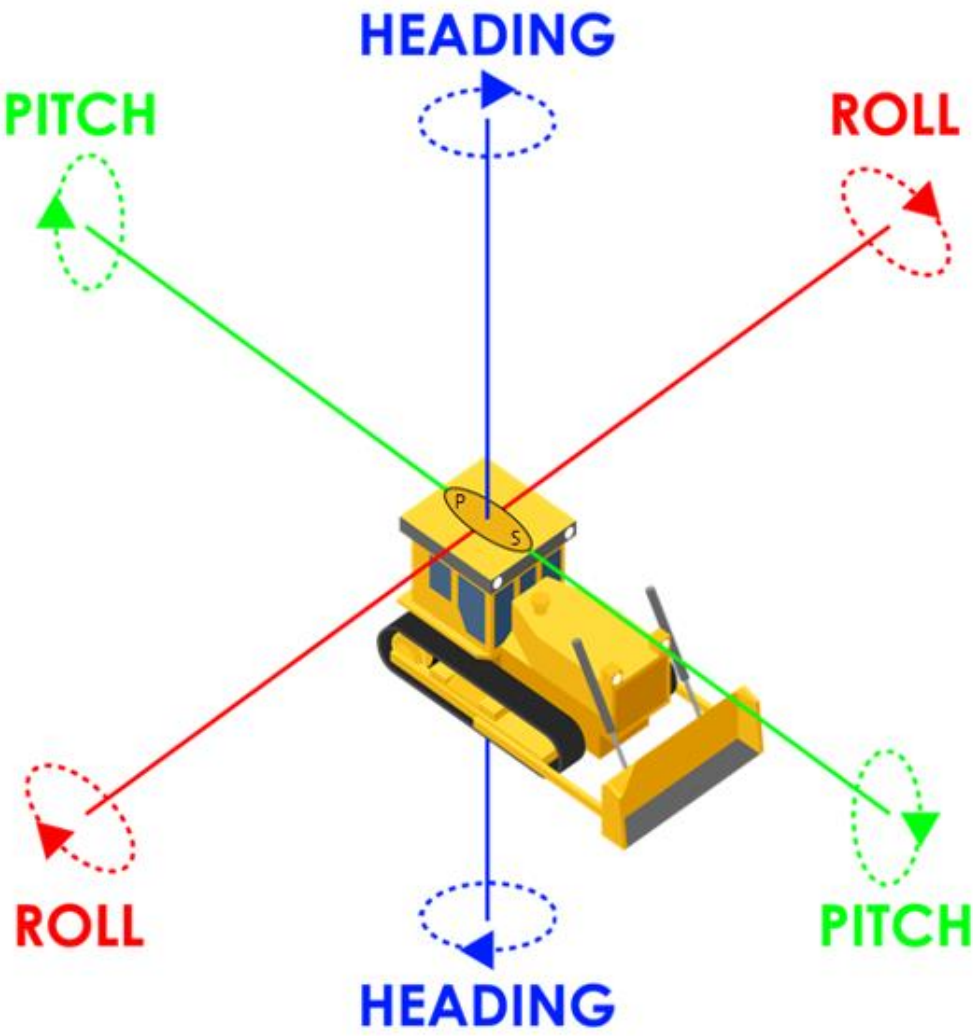


Figure 3-4: Alternate orientation and resulting signs of HPR values

Continued on next page

Mounting the VR500, Continued

Mounting alignment

The top of the VR500 enclosure incorporates sight design features to help you align the enclosure on your machine.

To use the sights, center the small post on the opposite side of the enclosure from you, within the channel made in the medallion located in the center of the enclosure top as shown in Figure 3-5 and Figure 3-6.

The long site alignment accuracy (Figure 3-5) is approximately +/- 1°. Short site alignment accuracy (Figure 3-6) is approximately +/- 2.5°.

Figure 3-5: Long site alignment

Continued on next page

Mounting the VR500, Continued

Mounting alignment, continued

Figure 3-6: Short sight alignment

Mounting options

The VR500 allows for two different mounting options: flush-mount and pole-mount.

1. **Flush-mount**-The bottom of the VR500 contains eight M8-1.25 holes for flush mounting the unit to a flat surface (see Figure 3-11). The eight holes comprise two sets of four holes. Flush mounting does not provide any additional dampening to the receiver. The VR500 can be mounted using an optional mounting bracket. See Table 1-6 for bracket part information.
2. **Pole-mount**-The VR500 can be mounted using a mounting pole.

Note: Hemisphere GNSS does not supply mounting surface hardware or a mounting pole. You must supply the appropriate mounting hardware required to complete VR500 installation.

Continued on next page

Mounting the VR500, Continued

VR500 dimensions

Figure 3-7 illustrates the physical dimensions of the VR500.

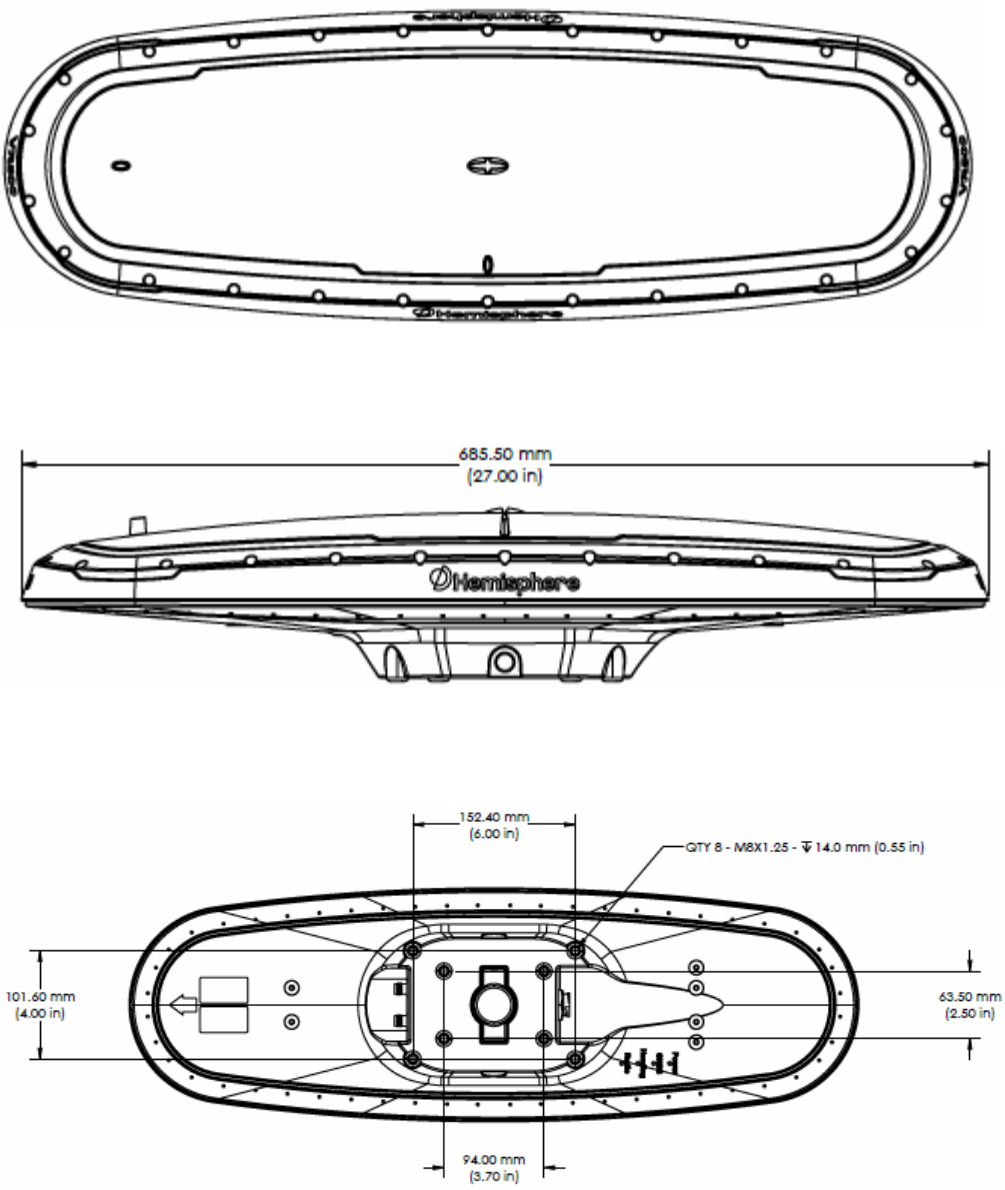


Figure 3-7: VR500 physical dimensions

Continued on next page

Mounting the VR500, Continued

VR500 dimensions, continued

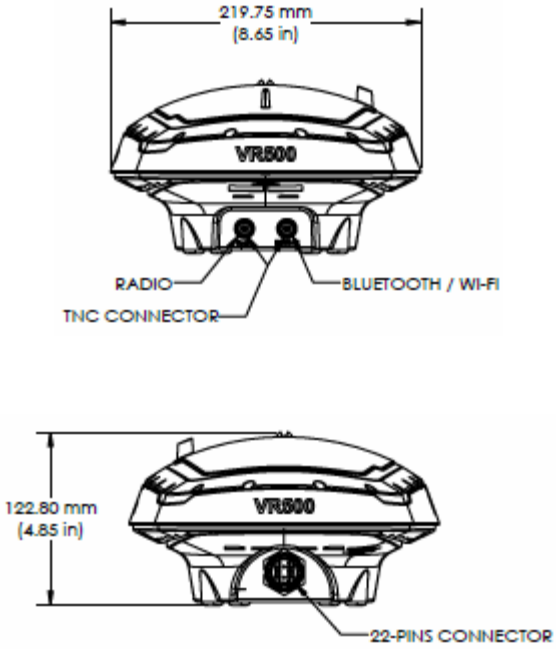


Figure 3-8: VR500 dimensions

Figure 3-9 shows the VR500 with remote antennas dimensions.

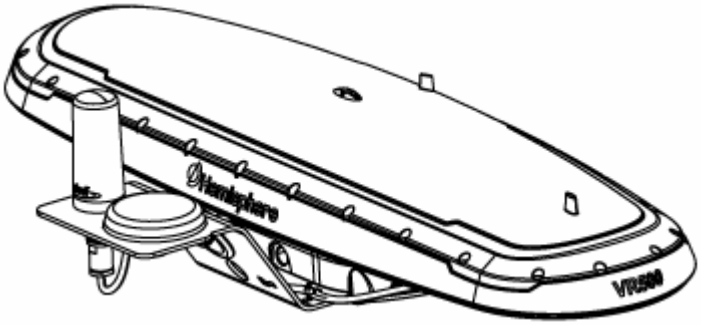


Figure 3-9: VR500 remote antenna dimensions

Continued on next page

Mounting the VR500, Continued

VR500 dimensions, continued

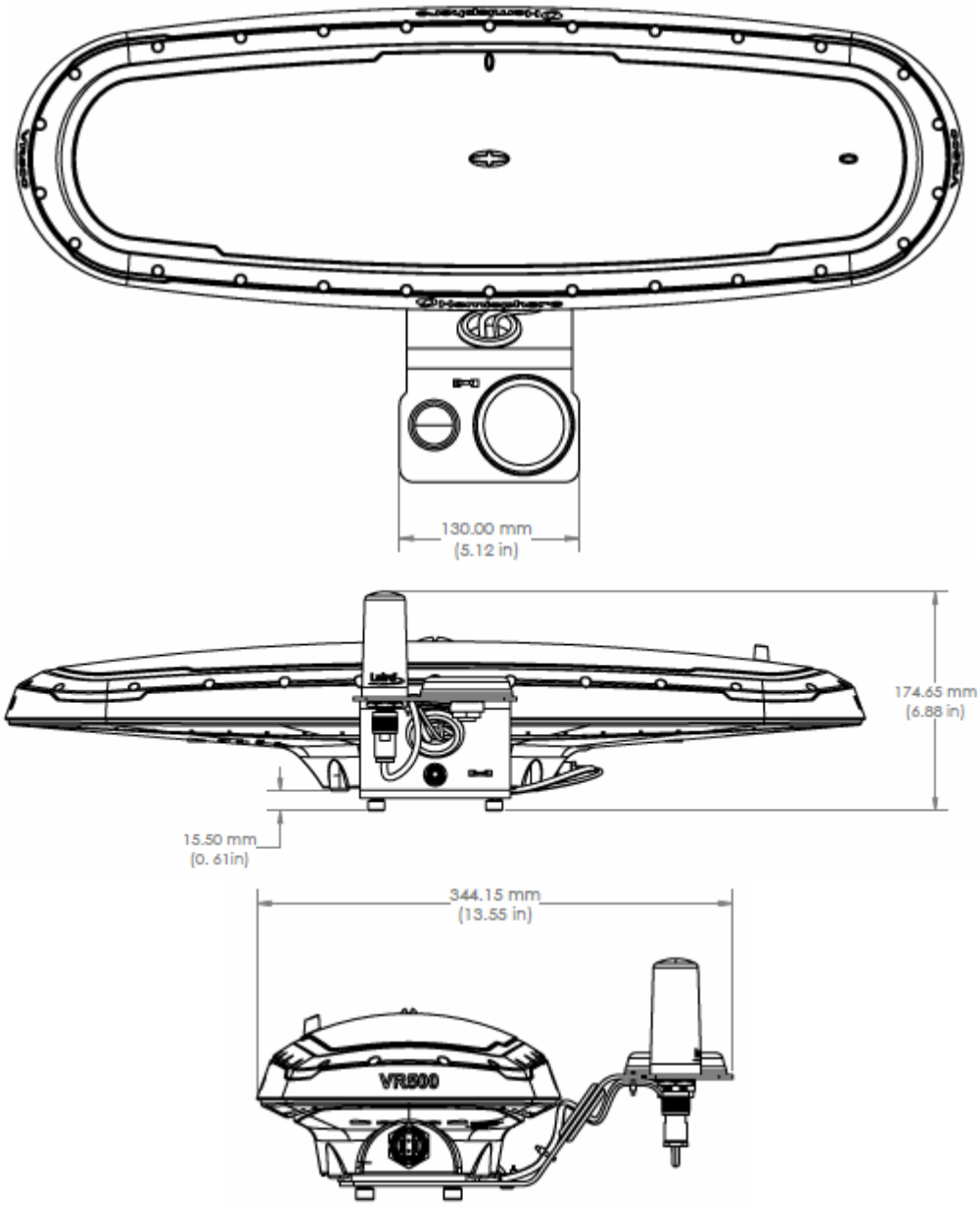


Figure 3-10 VR500 with remote antennas dimensions

Continued on next page

Mounting the VR500, Continued

Power/Data cable considerations

Before mounting the VR500, consider the following regarding power/data cable routing:

Do	Do not
Ensure cable reaches appropriate power source	Run cables in areas of excessive heat
Keep cable away from corrosive chemicals	Run cables through a door or window jams
Connect to a data storage device, computer, or other device that accepts GNSS data	Crimp or excessively bend the cable
Keep cable away from rotating machinery	Place tension on the cable
Remove unwanted slack from the cable at the VR500 end	
Secure along the cable route using plastic wrapping	

WARNING: Improperly installed cable near machinery can be dangerous.

Connecting the Serial Power/Data cable

1. Align the cable connector key-way with the VR500 connector key.
2. Rotate the cable ring clockwise until it locks. The locking action is firm; you will feel a positive “click” when it has locked.
3. Attach the power/data cable to the cable clamp.
4. Fasten the clamp to the bottom of the VR500 using the screw and washer.

Continued on next page

Mounting the VR500, Continued

Flush-mounting the VR500

The bottom of the VR500 contains eight holes (two sets of four holes) for flush-mounting the unit to a flat surface (Figure 3-11).

Figure 3-11: Flush-mounting holes on bottom of VR500

Continued on next page

Mounting the VR500, Continued

Assembly drawing

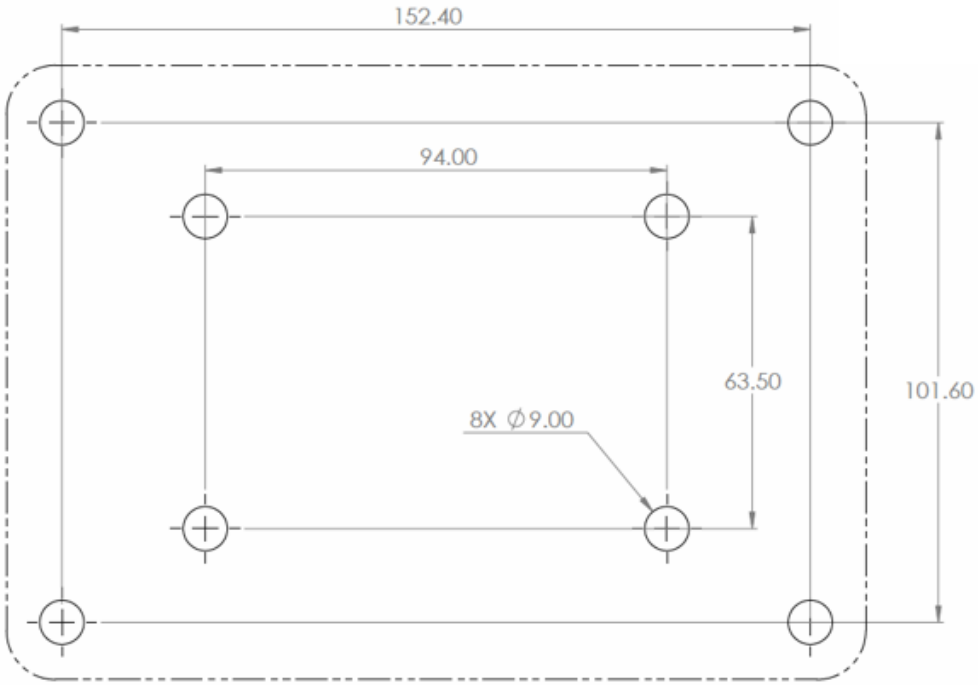


Figure 3-12: Assembly drawing

Assembly drawing, continued

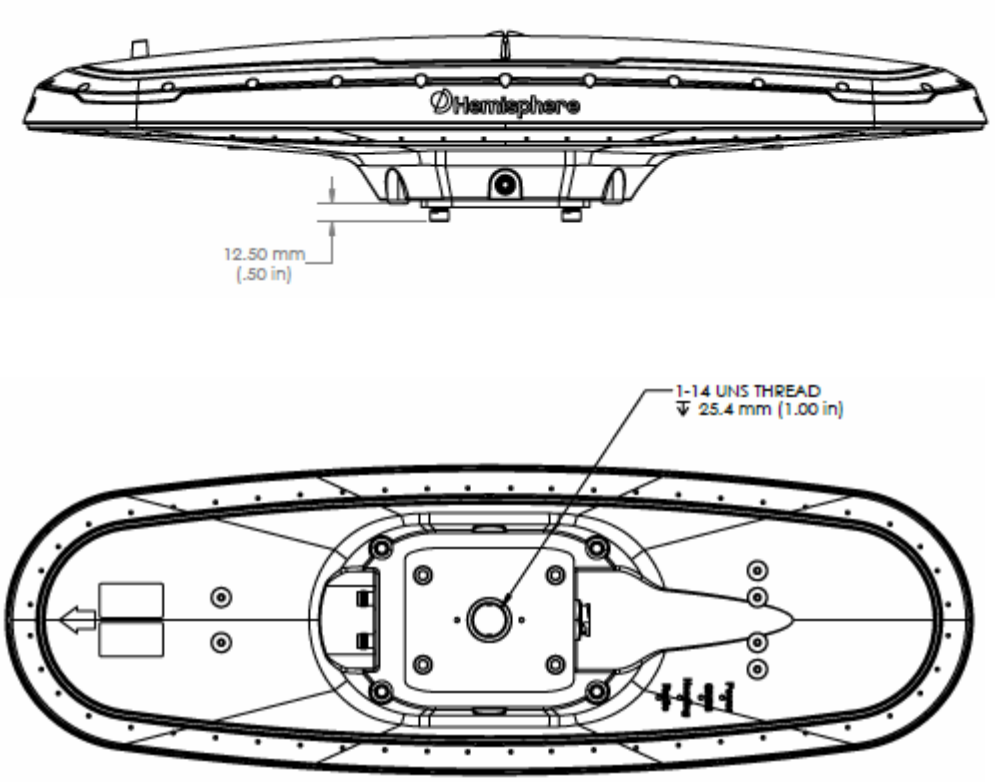


Figure 3-13: Pole-mounting specifications

UHF Radio Antenna

VR500 UHF Radio Antenna

The VR500 has an internal UHF radio for receiving RTK corrections.

The VR500 also has an internal UHF radio antenna to receive RTK with no need for an external radio or antenna.

If the UHF range needs to be increased, an external antenna can be installed using a TNC connector.

If ...	Then ...
RTK corrections are to be sent to the internal UHF radio	an external UHF radio antenna may be installed for increased range, or the internal radio antenna can be used. **Note:** The VR500 has an external TNC connector (opposite side as the power/data cable).
an external antenna is to be used	the UHF antenna should be mounted to the top of the machine and the coaxial cable should be run safely and securely to the VR500.

Figure 3-14: UHF antenna connections

Ports

Overview

The VR500 offers serial port, CAN, and Ethernet port functionality.

Serial ports

The VR500 has two serial ports:

- Port A can be both full-duplex RS-232 and half-duplex RS-422 (transmit only)
- Port B is full-duplex RS-232 or RS-422

You can receive external differential corrections via either Port A (full-duplex RS-232) or Port B (full-duplex RS-232 or full-duplex RS-422). You can connect up to three devices at one time using two ports.

One device can receive data via Port A (RS-422 transmit only) while two devices can transmit and receive data via Ports A and B (one connected to Port A RS- 232 and one connected to Port B).

You can update firmware via Port A (RS-232) or Port B.

Note: The VR500 has maximum baud rate of 115200.

Serial port configuration

You may configure Port A or Port B of the GNSS receiver to output any combination of data.

Port A can have a different configuration from Port B in data message output, data rates, and the baud rate of the port, and configure the ports independently based upon your needs. Both RS-232 and RS-422 output signals may be used simultaneously.

The RS-232 Port A and RS-422 Port A output the same data messages at the same baud rate. If the baud rate or messages for the RS-422 port need to be changed, this needs to be commanded through the RS-232 port.

Note: For successful communications, use the 8-N-1 protocol and set the baud rate of the VR500's serial ports to match that of the devices to which they are connected. Flow control is not supported.

Selecting Baud Rates and Message Types

Baud Rates & Message Types

When selecting your baud rate and message types, use the following formula to calculate the bits/sec for each message and sum the results to determine the baud rate for your required data throughput.

Message output rate * Message length (bytes) * bits in byte = Bits/second (1 character = 1 byte, 8 bits = 1 byte, use 10 bits/byte to account for overhead).

For information on message output rates refer to the Hemisphere GNSS Technical Reference Manual.

Connecting the VR500 to External Devices

Recommend-ations for connecting to other devices

When interfacing to other devices, ensure the transmit data output and the signal grounds from the VR500 is connected to the data input of the other device.

The RS-422 is a balanced signal with positive and negative signals referenced to ground; ensure you maintain the correct polarity.

When connecting the transmit data output positive signal to the receive line of the other device, it should be connected to the receive positive terminal.

The negative transmit data signal from the VR500 is then connected to the receive data negative input of the other device.

For a list of Hemisphere GNSS commands, please refer to the Hemisphere GNSS Technical Reference Manual. To configure the unit through the WebUI, please refer to Configuring the VR500 using WebUI.

Continued on next page

Connecting the VR500 to External Devices, Continued

Power/Data cable considerations

The VR500 uses a single 15m (49 ft) cable for power and data input/ output.

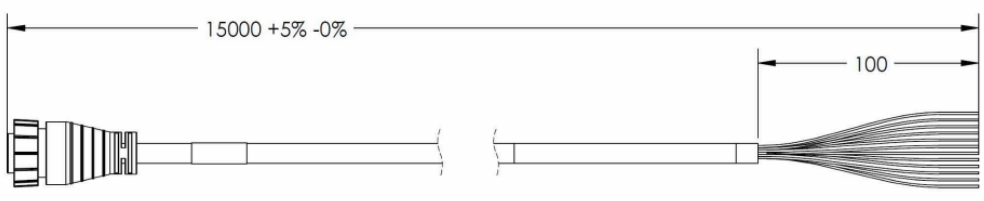


Figure 3-15: Power/Data cable, 15m

Note: Cover drain wire with black shrink tube.

The receiver end of the cable is terminated with an environmentally-sealed 22-pin connection while the opposite end is unterminated and requires field stripping and tinning.

Power/Data cable considerations, continued

Depending on the application and installation needs, you may need to shorten this cable. However, if you require a longer cable run than 15m, you can bring the cable into a break-out box that incorporates terminal strips, within the machine.

When lengthening the cable keep the following in mind:

- To lengthen the serial lines inside the machine, use 20-gauge twisted pairs and minimize the additional wire length.
- When lengthening the power input leads to the VR500, ensure the additional voltage drop is small enough that your power system can continue to power the system above the minimum voltage of the system. Wire of 18-gauge or larger should also be used.
- Minimize RS-232 cable length to ensure reliable communication.

Continued on next page

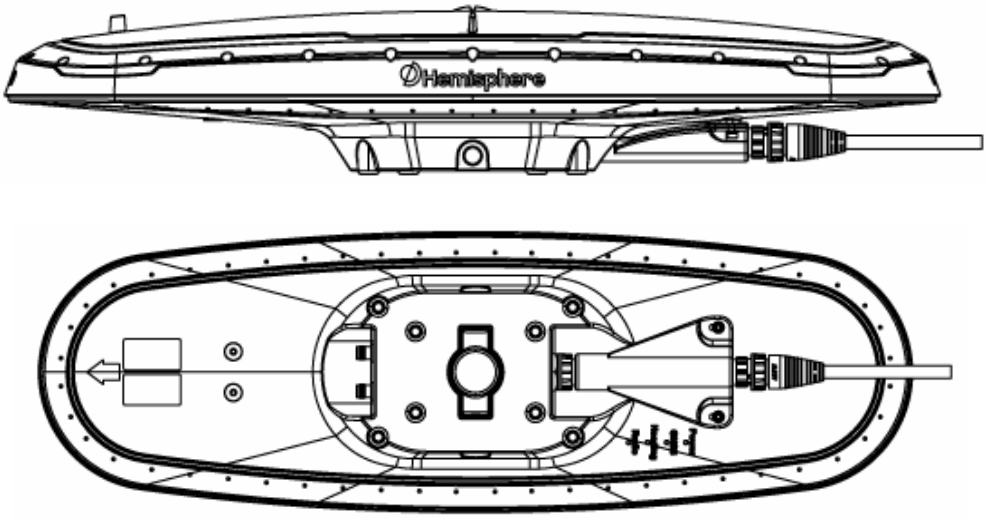
Connecting the VR500 to External Devices, Continued

VR500 with 22 to 18 pins adapter

Use the 22 to 18 pin adapter if you want to use a V320 cable.

Note: Using the adapter will cause you to lose ethernet capability.

Figure 3-16 shows the VR500 with 22 to 18 pins adapter.



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Connecting the VR500 to External Devices, Continued

VR500 with 22 to 18 pins adapter, continued

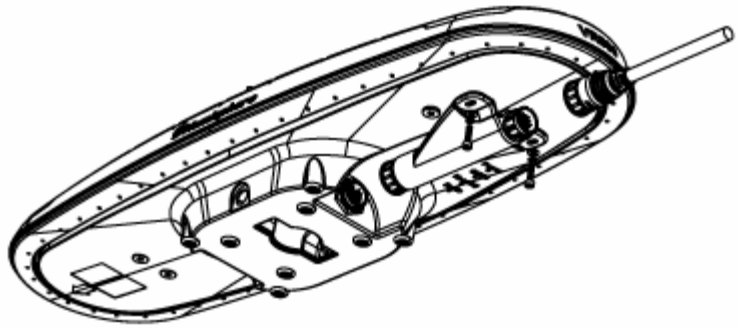


Figure 3-16: VR500 with 22 to 18 pins adapter

Power/data cable pin-out assignments

Figure 3-17 shows the power/data cable pin-out assignments.

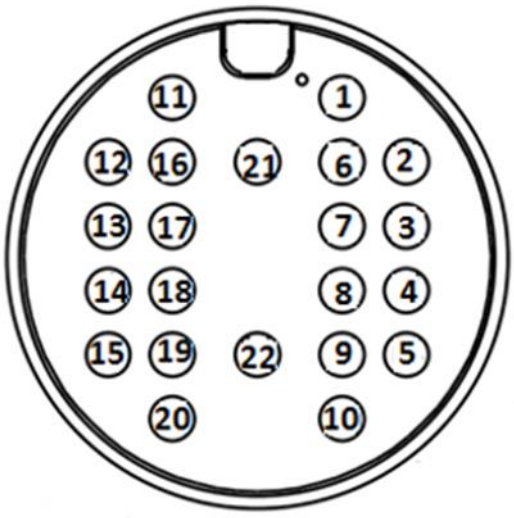


Figure 3-17: VR500 pin-out assignments

Continued on next page

Connecting the VR500 to External Devices, Continued

Power/data cable pin-out specifications

Table 3-7 shows the cable pin-out specifications.

Table 3-7: VR500 pin-out specifications

Pin	Signal	Color
1	Power+	Red
2	CAN1_H	Orange-black stripe
3	CAN1_L	Yellow-black stripe
4	R232_IPT2/RS422_A	Orange
5	RS232_OPT1/RS422_Z	Yellow
6	CAN2_H	Green
7	CAN2_L	Blue
8	RS422_B	Purple
9	RS422_Y	Grey
10	1PPS_OUTPUT	White
11	ECLIPSE-PA-RXD_RS232	Pink
12	ECLIPSE-PA-TXD_RS232	Turquoise
13	GND	Black-white stripe
14	TD+	Brown-white stripe
15	TD-	Red-white stripe
16	HEADING WARNING	Orange-white stripe
17	SPEED_OUTPUT	Green-white stripe
18	RD+	Blue-white stripe
19	RD-	Purple-white stripe
20	MARK_INPUT	Red-black stripe
21	POWER+	Brown
22	POWER-	Black

Powering the Receiver On/Off

Power the receiver on/off

To power on the VR500, connect the ends of the VR500 power cable to a clean power source providing 9 to 32VDC, and hold the soft power switch until the screen illuminates.

The VR500 accepts an input voltage of 9 to 32 VDC via the power cable. The supplied power should be continuous and clean for best performance. Refer to Appendix B Technical Specifications, for the power specifications of the VR500.

⚠WARNING:
Do not apply a voltage higher than 32 VDC. This will damage the receiver and void the warranty. Also, do not attempt to operate the VR500 with the fuse bypassed as this will void the warranty.

The VR500 features reverse polarity protection to prevent damage if the power leads are accidentally reversed. Although the VR500 proceeds through an internal startup sequence when you apply power, it will be ready to communicate immediately.

Initial startup may take 5 to 15 minutes depending on the location. Subsequent startups will output a valid position within 1 to 5 minutes depending on the location and time since the last startup.

The VR500 may take up to 5 minutes to receive a full ionospheric map from SBAS. Optimum accuracy is obtained once the VR500 is processing corrected positions using complete ionospheric information.

Note: Hemisphere GNSS recommends using a weather-tight connection and connector if the connection is located outside.

Electrical isolation

The VR500's power supply is isolated from the communication lines and the enclosure isolates the electronics mechanically from the machine (preventing machine hull electrolysis).

LED Indicators

Overview

The VR500 has four LED lights located bottom of the unit. Table 1-8 below describes each LED indicator.

Figure 3-18: VR500 LED

Table 3-8: LED indicators

Indicator	Description/Function
Power	Solid red light when receiver is powered on
GNSS	Solid amber light when the primary antenna is tracking four or more satellites
Heading	Indicates the Vector has calculated a heading value
UHF	Blinks each time an RTK message is received over UHF

Software Installation

Operating system requirements

GradeMetrix can be installed to a ruggedized field computer or an office PC. The latest software version can be found on the Hemisphere GNSS website.

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

Files and formats used in GradeMetrix

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

GradeMetrix can support:

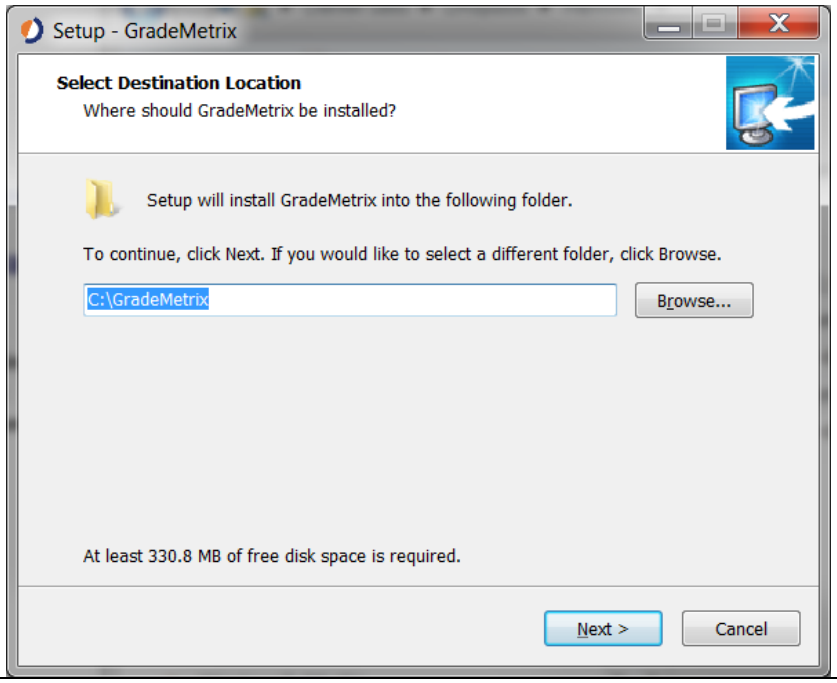
- Site Plan File: DWG, DXF
- Surface Model File: MESH, GRID, TIN, GRD, DWG, DXF, NTD, DTM, FLT, XYZ
- Site Reference File: WKT, DC
- Survey Topo File: TOPO
- Backdrop File: PNG, JPG, BMP
- Tin File: MESH, TIN, NTR, DXF, DWG, FLT
- Grid File: GRID, GRD, DTM, XYZ
- Localization File: LOCAL, LOC

Continued on next page

Software Installation, Continued

Install GradeMetrix software

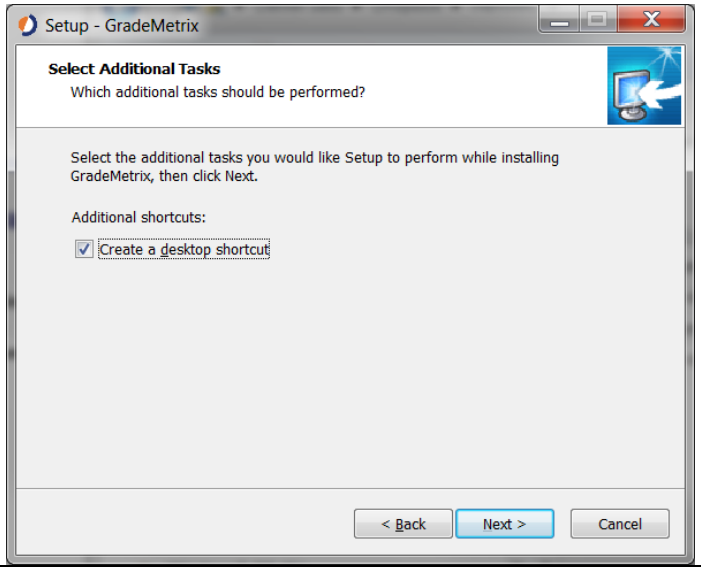
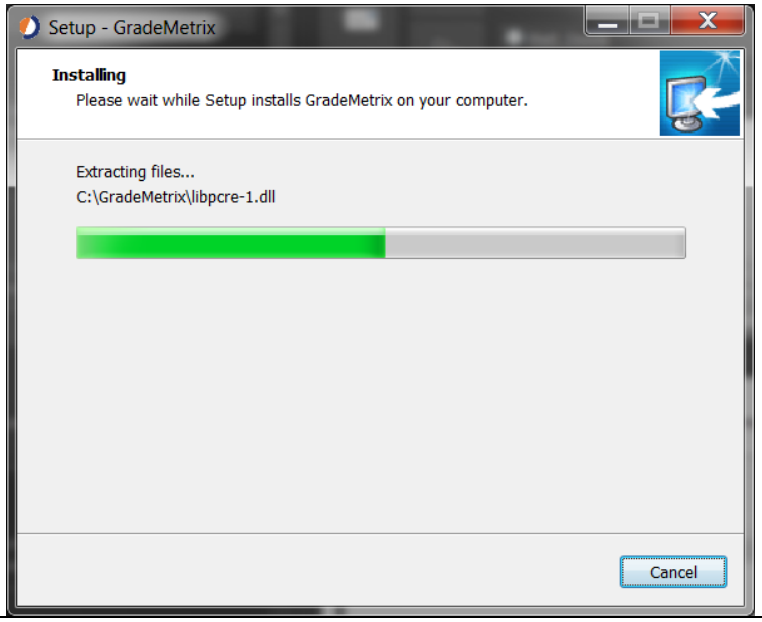
To install your GradeMetrix software, complete the following steps:

Step	Action
1	Click on 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

Files and formats used in GradeMetrix, continued

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

Chapter 4: Set up GradeMetrix with IronOne

Overview

Introduction

Chapter 4 contains the steps needed to integrate GradeMetrix software with the IronOne hardware.

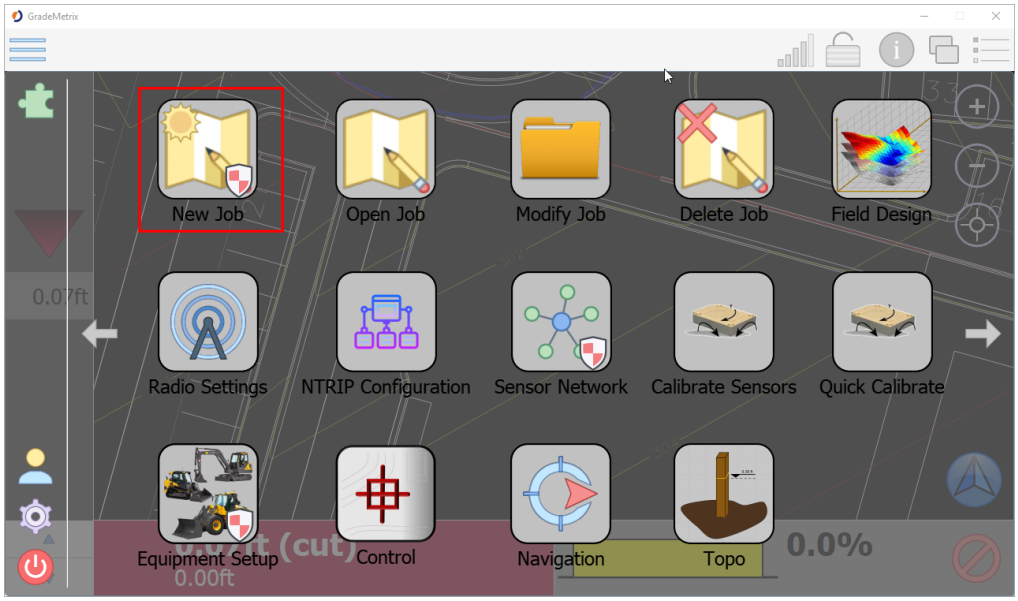
Contents

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 users not logged in as administrator.



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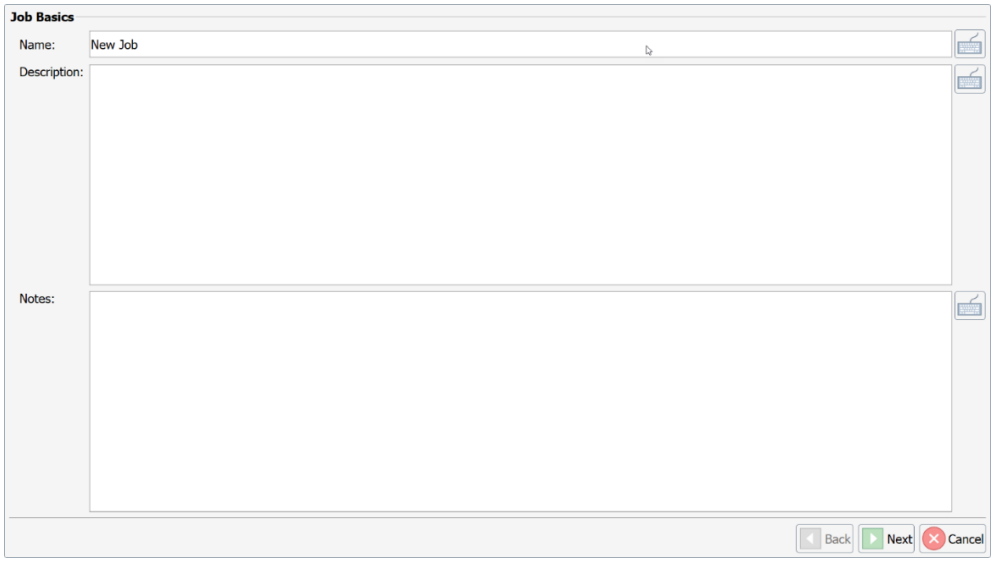
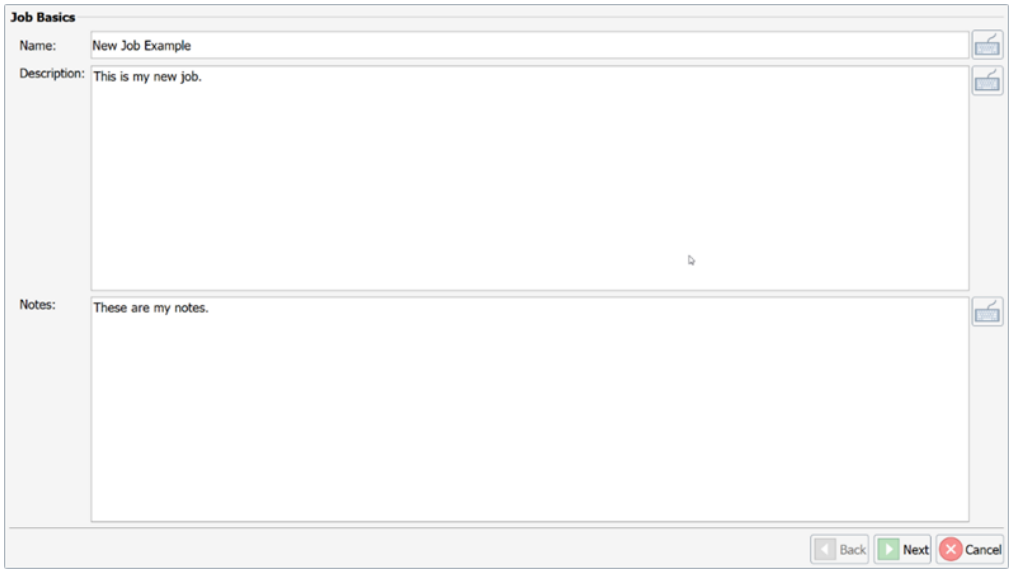
Create a Job, Continued

Job basics screen

Click in a field and type the job name, description and job notes.

Click **Next**.





Continued on next page

Create a Job, Continued

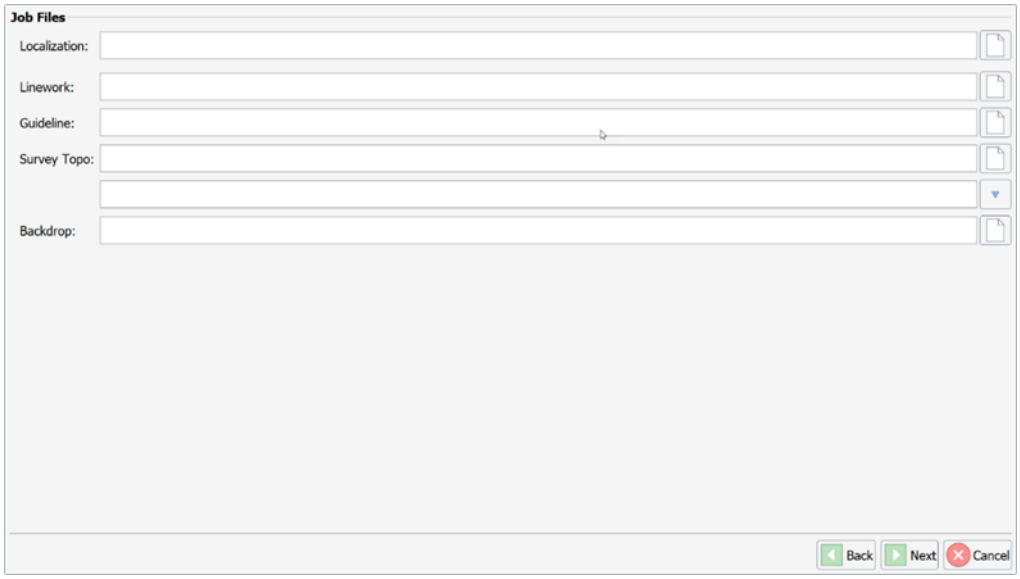
Job files screen

Click the document icon to add job documentation to your GradeMetrix job:

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

(*Required field)

Click **Next**.



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Create a Job, Continued

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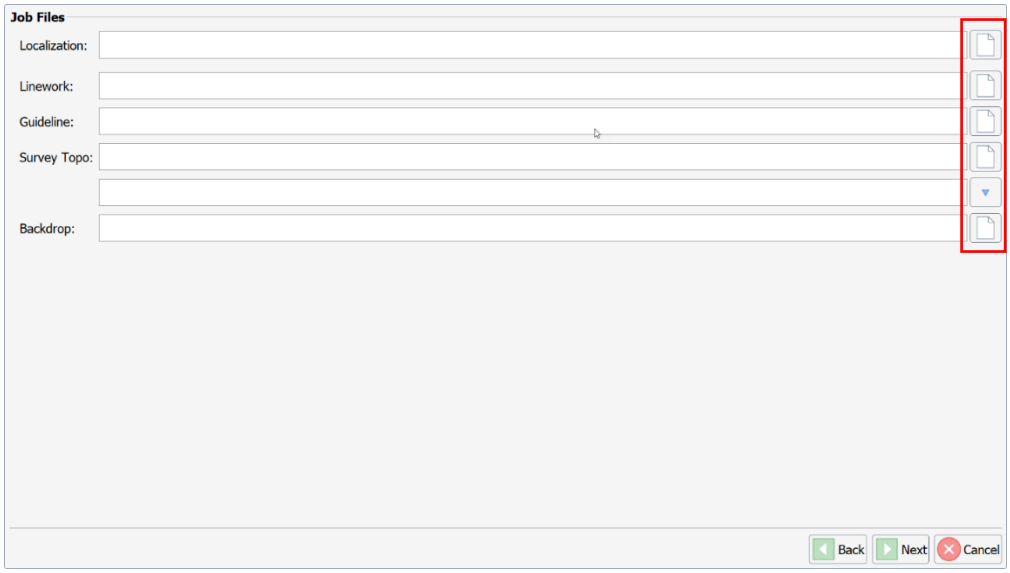
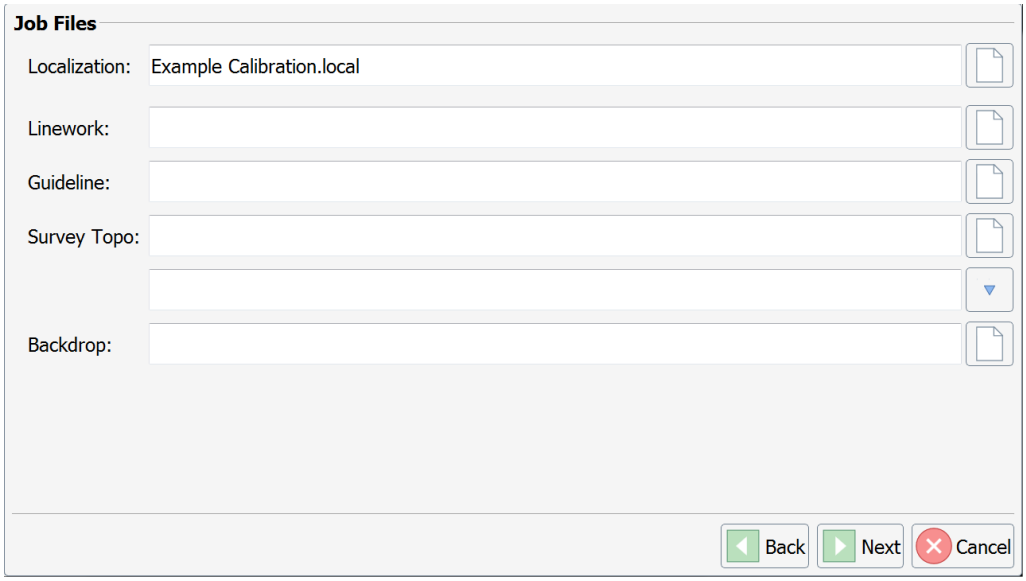
The **Job Files** screen displays.



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



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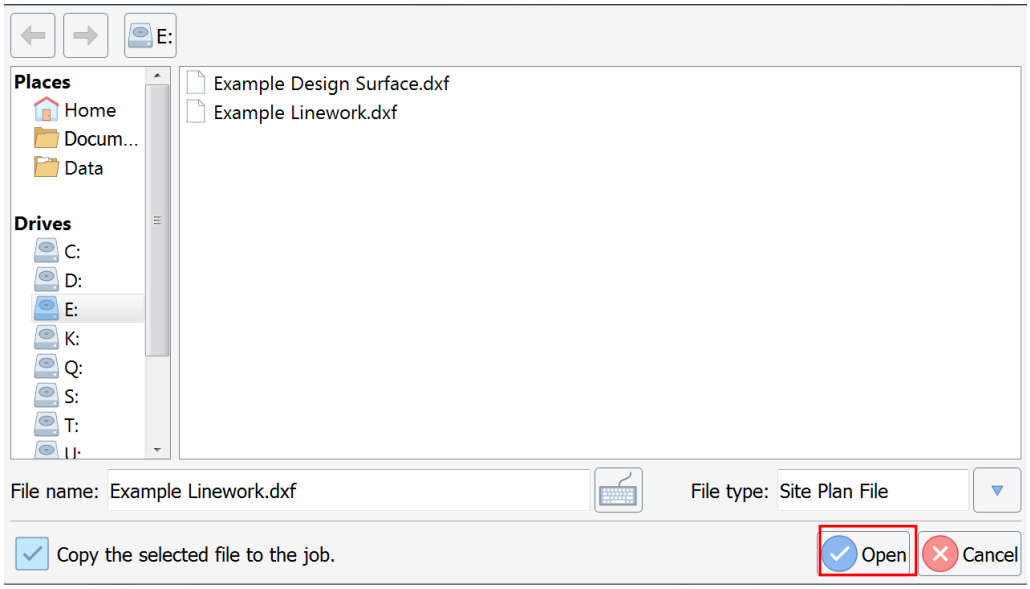
Create a Job, Continued

Job files screen, continued

A list of the available files displays. Click on the filename you wish to add and click **Open**.



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Create a Job, Continued

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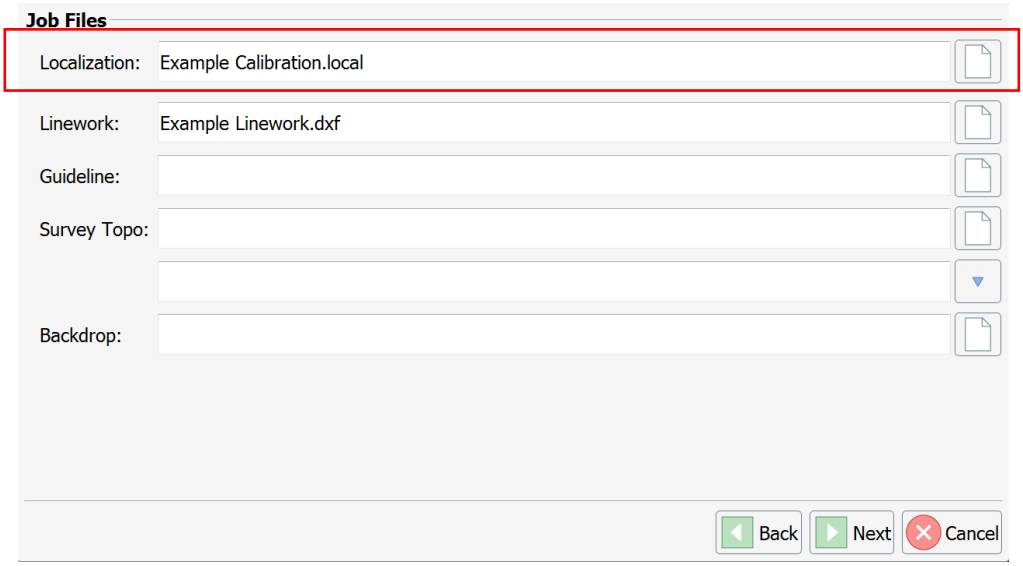
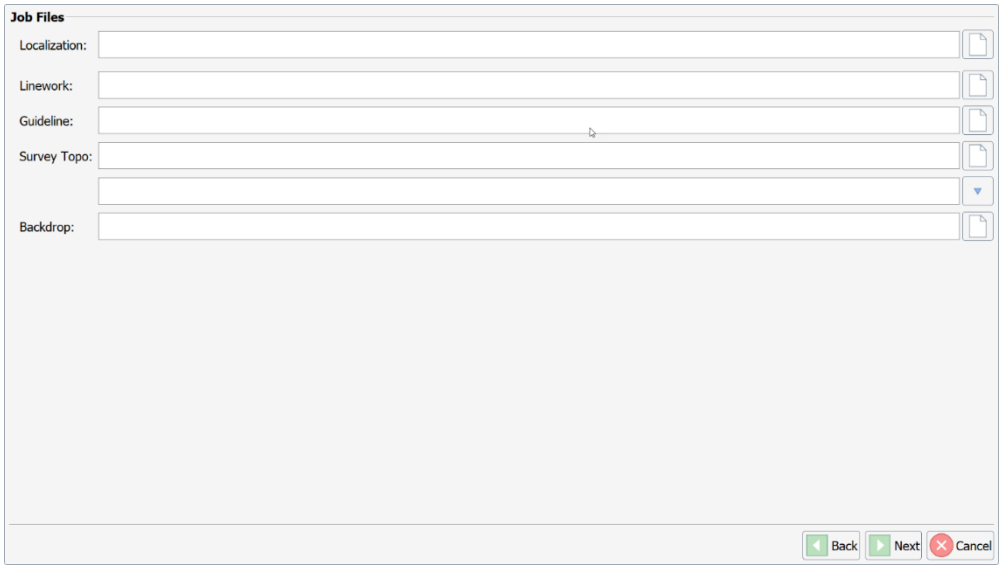
The selected filename displays in the **Linework** field.



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



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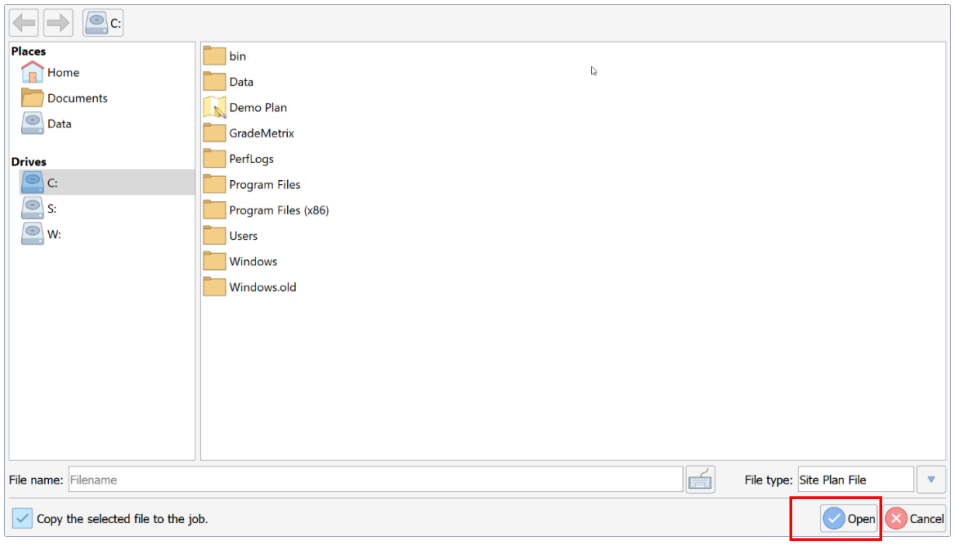
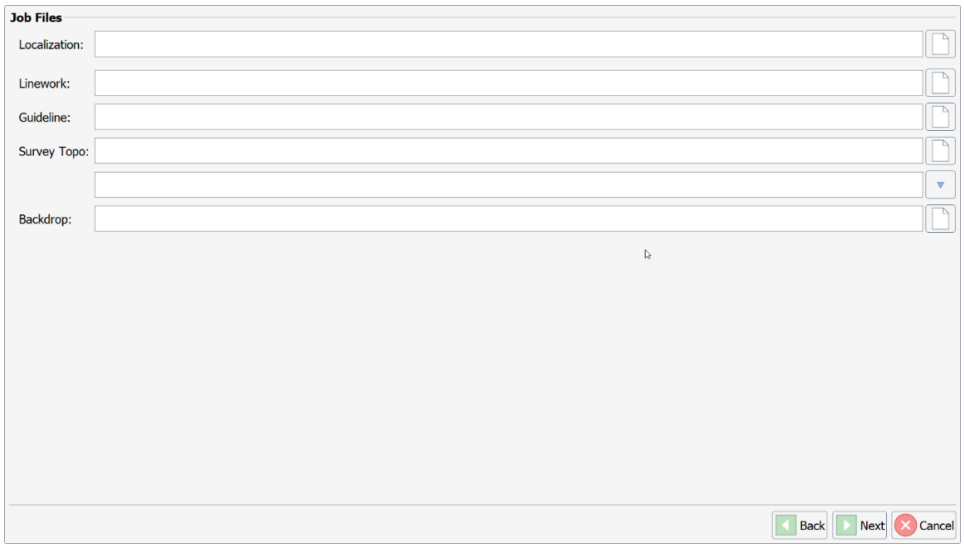
Create a Job, Continued

Job files screen, continued

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



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



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Create a Job, Continued

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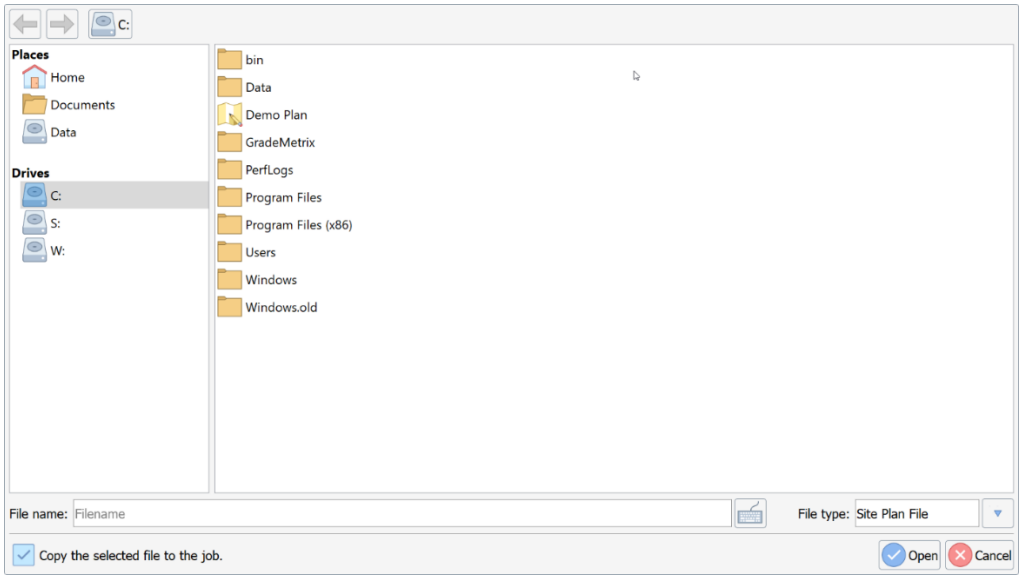
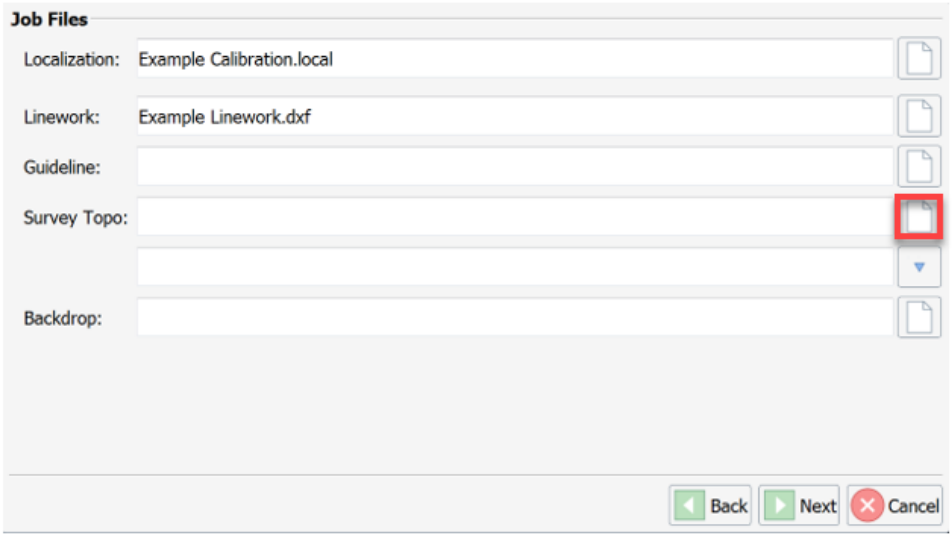
A list of available files is displayed. Click to select the file you wish to add and click **Open**.



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



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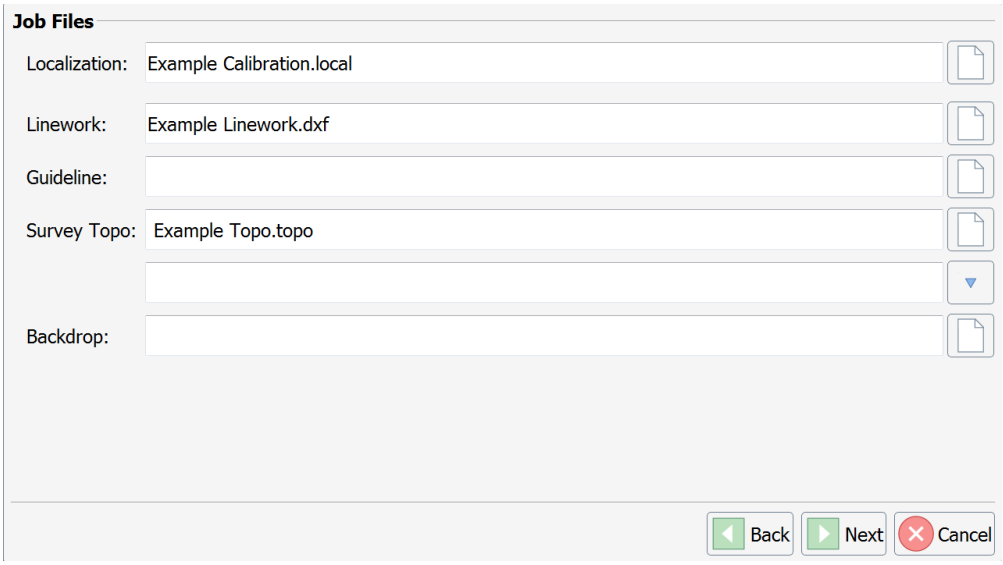
Create a Job, Continued

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.

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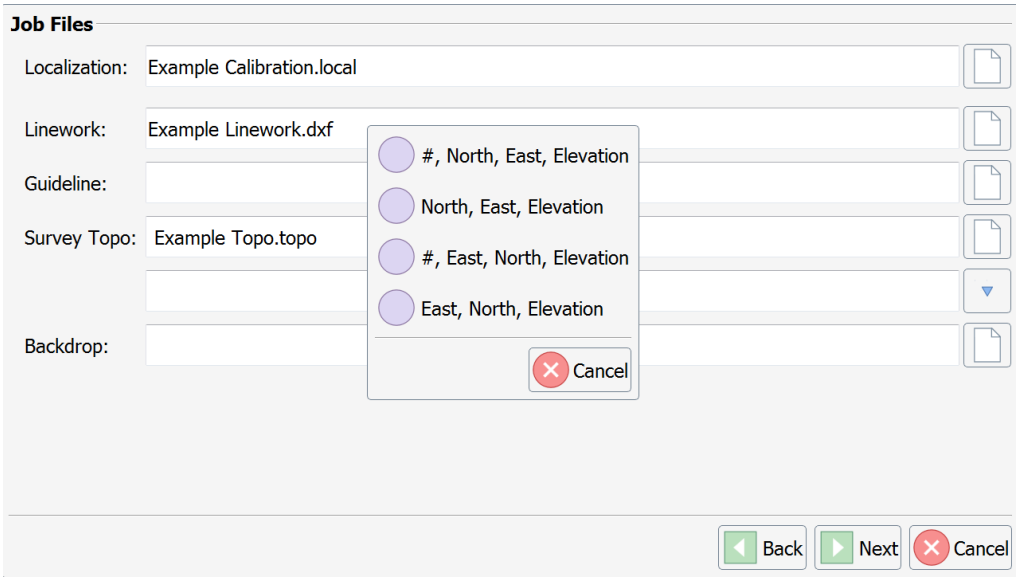
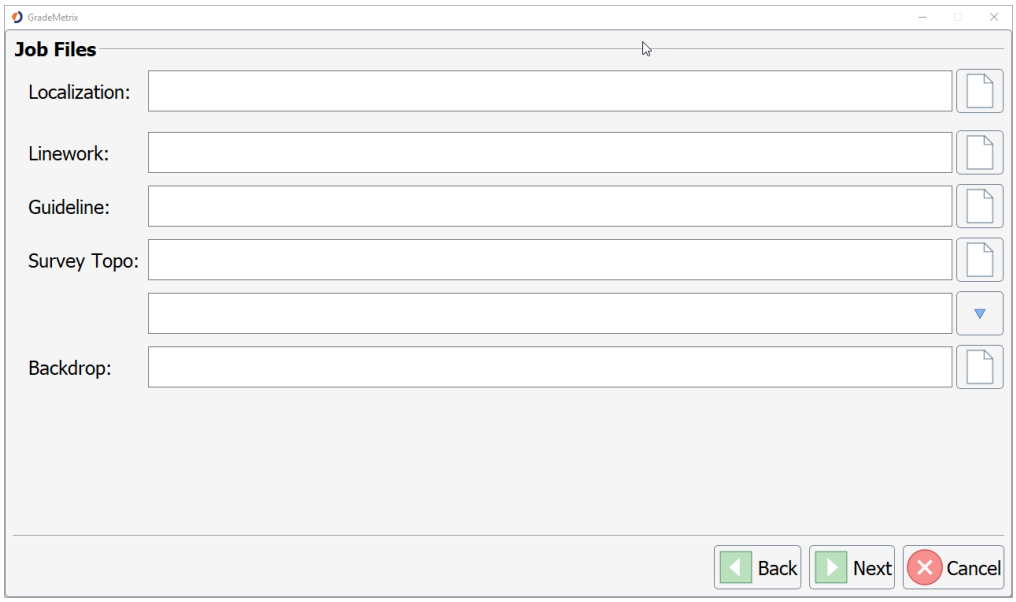
Create a Job, Continued

Job files screen continued



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



Continued on next page

Create a Job, Continued

Job files screen continued

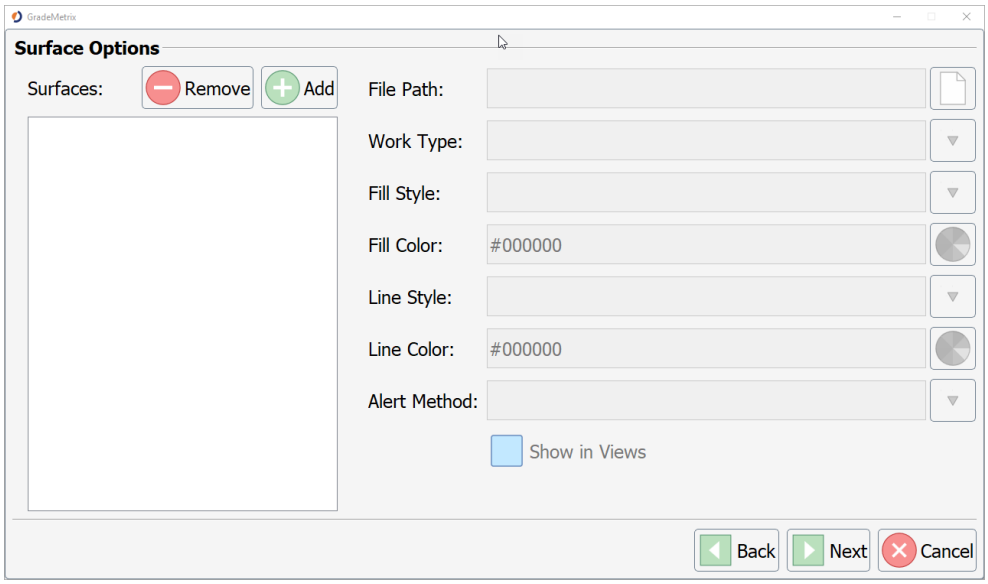
A list of available files is displayed. Click to select the file you wish to add and click **Open**.

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

Click **Next**.

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 the **Work Type**.

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

Note: The following surfaces are in development for GradeMetrix Phase 2 development.

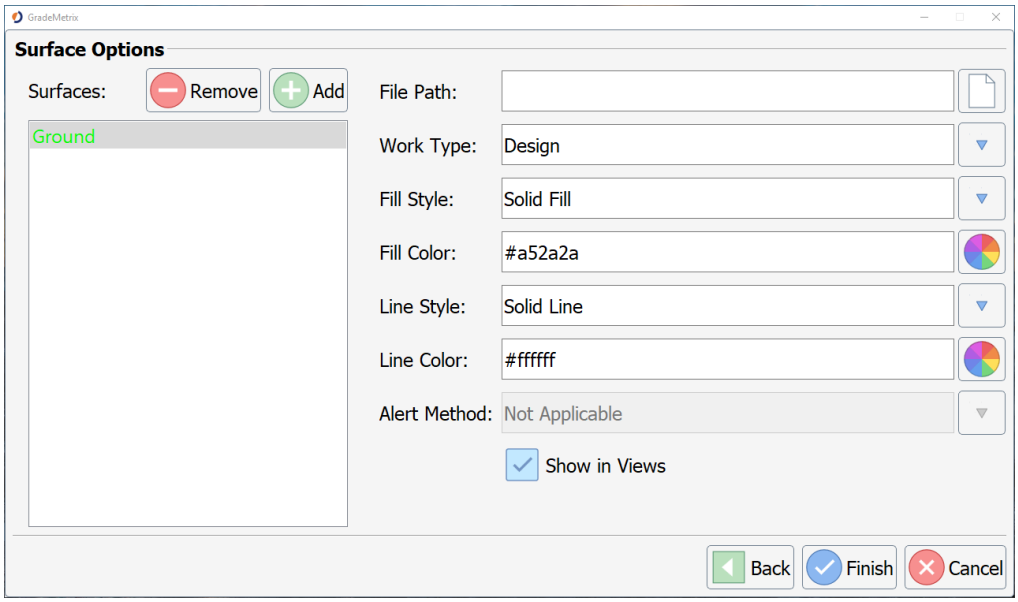
3. **Warning** – select to trigger a warning in the software if your elevation is either above or below (see 'Alert Method' this surface) the uploaded surface.
4. **Watch** – similar to a Warning surface. This allows for two levels of alert (i.e. you can choose to upload a 'Watch' surface to set low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

Continued on next page

Create a Job, Continued

Surface options window, continued

The **Surface Option** name you entered displays in the **Surfaces:** list.



For each **Surface Option** you enter, you must select (set) the following:

- File Path
- Work Type
- 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: **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

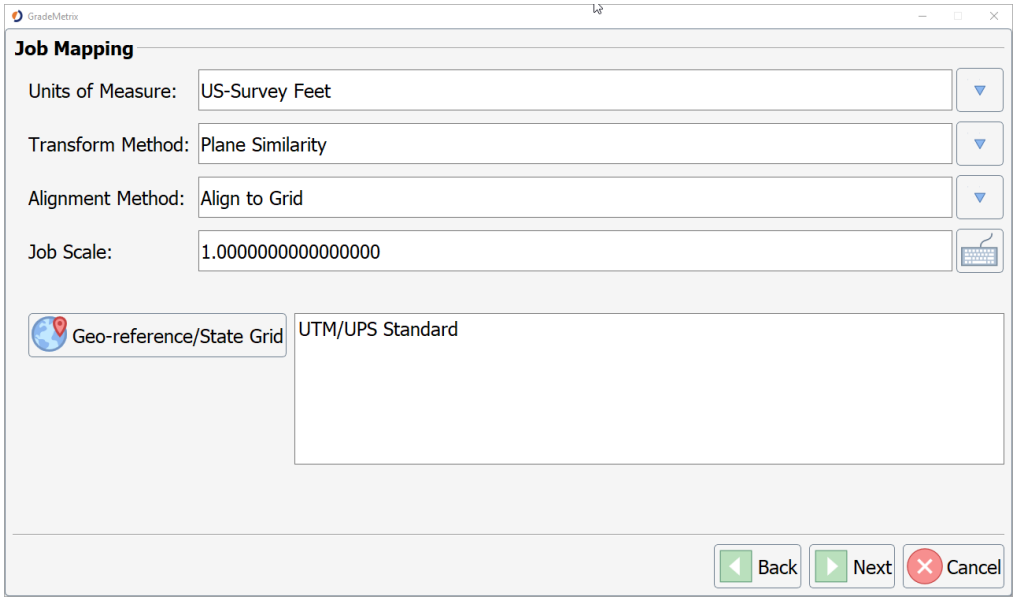
The **Job Mapping** window displays.

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

- Units of Measure
- Transform Method
- Alignment Method
- Job Scale

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

Click **Next**.

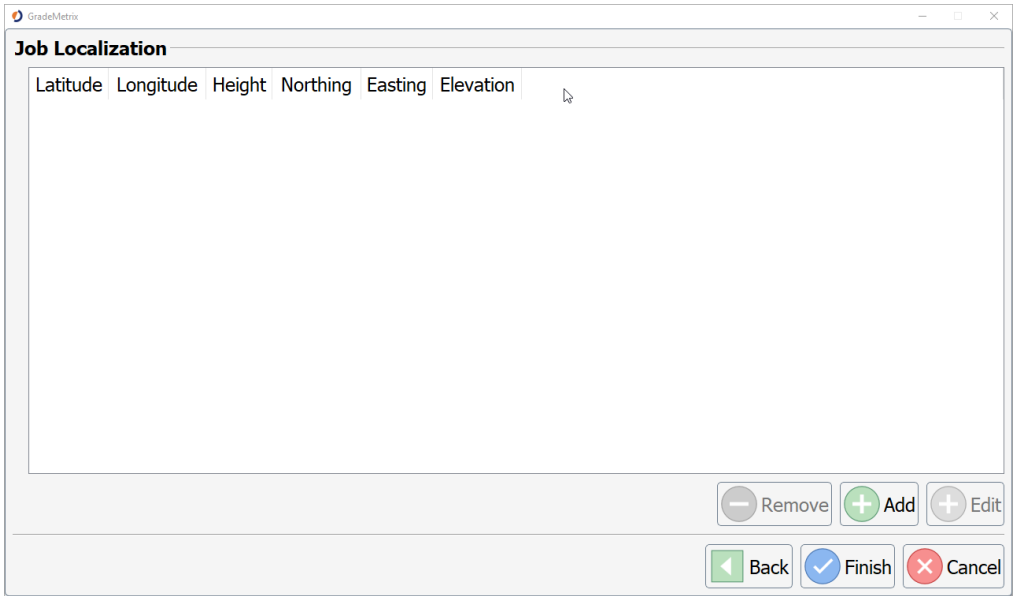


Continued on next page

Create a Job, Continued

Job Localization screen

The Job Localization screen displays.



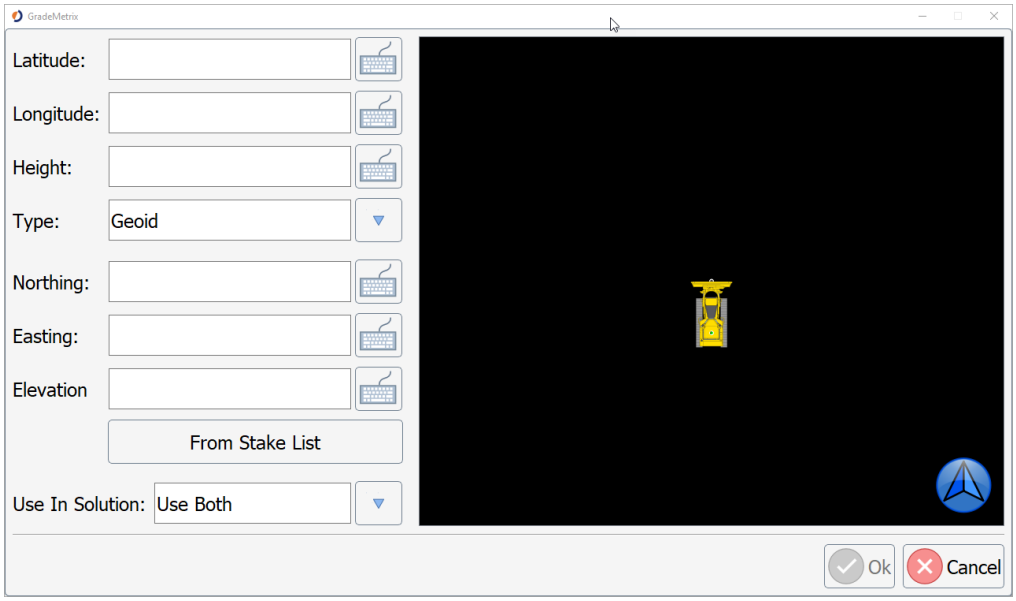
Continued on next page

Create a Job, Continued

Job Localization screen, continued

Click the **Add** button to add the job localization settings:

- Latitude
- Longitude
- Height
- Northing
- Easting
- Elevation



Use the keyboard icon to the right of each field to add values to that field.

Click **Ok**.

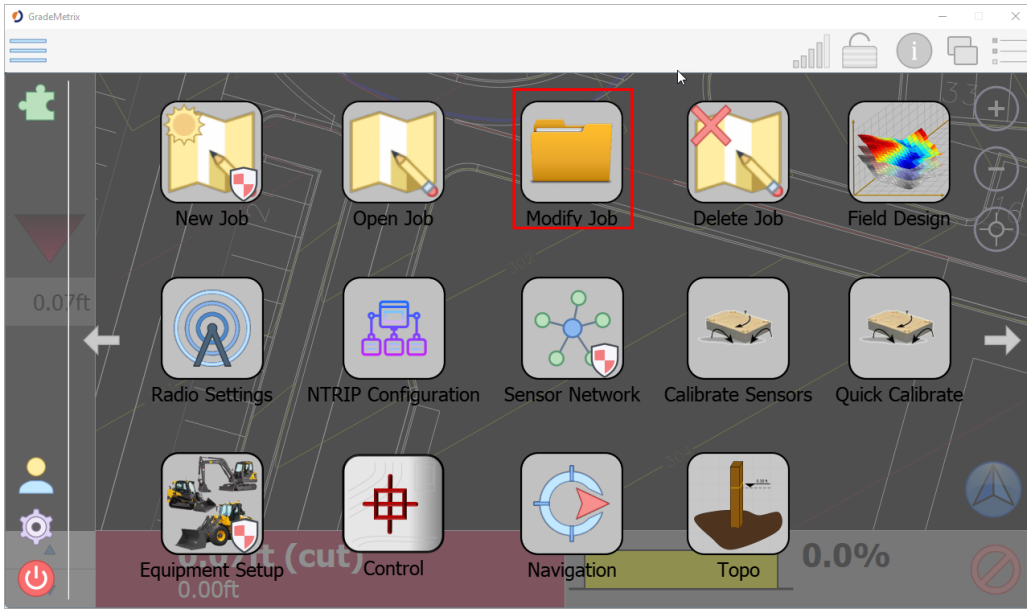
Click **Finish**.

Modify a Job

Modify a job

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

Note: To modify a Job, you must be logged in as “Administrator”.

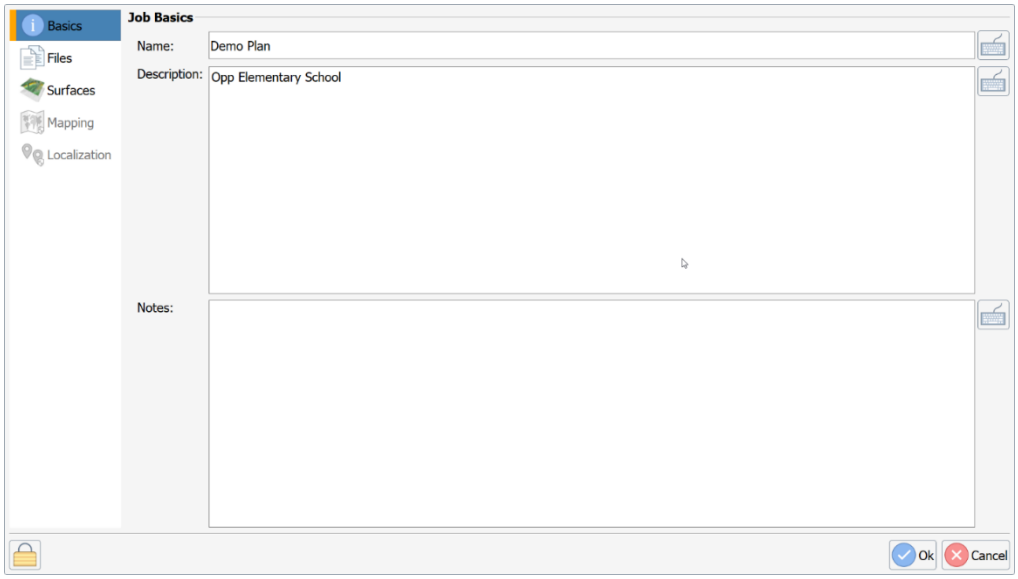


Continued on next page

Modify a Job, Continued

Modify Job basics screen

The **Job Basics** screen displays the **Name**, **Description**, and **Notes** about the job. You can click to select and modify these job fields.



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

- Basics
- Files
- Surfaces
- Mapping
- Localization

Continued on next page

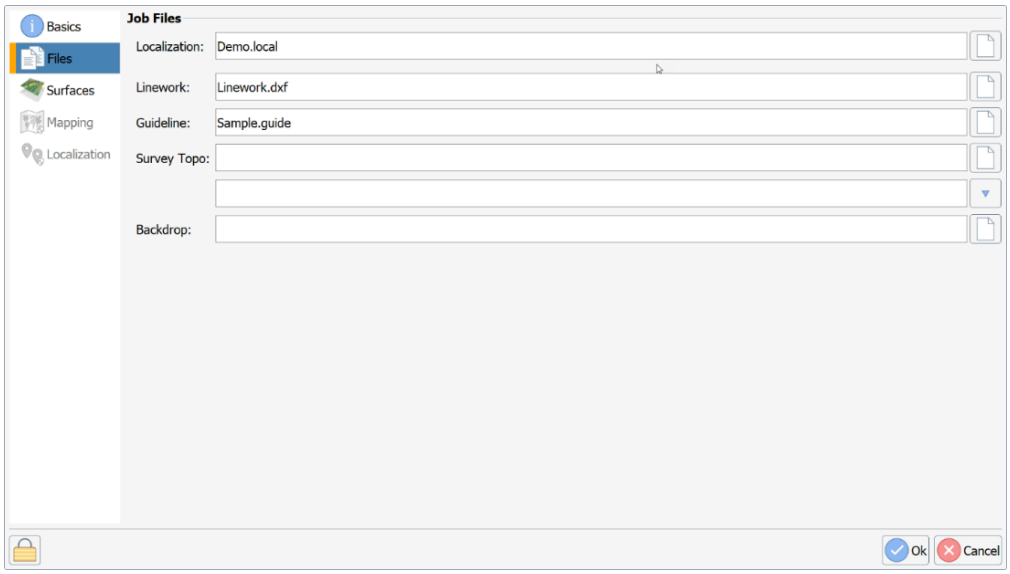
Modify a Job, Continued

Modify Files screen

Click **Files** to modify job file information. The **Job Files** screen display the following job data:

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

(*Required fields)

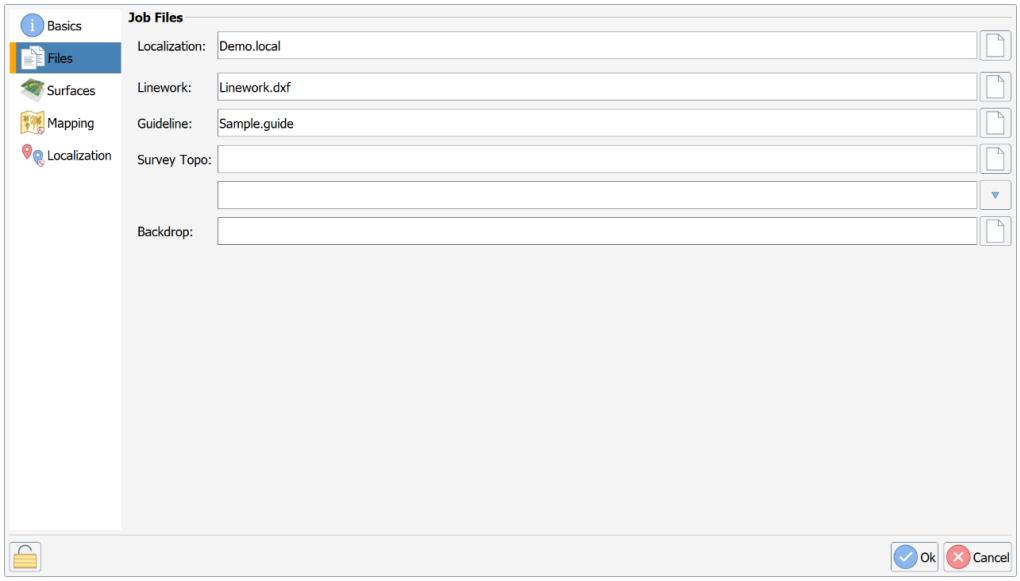


Continued on next page

Modify a Job, Continued

Modify Files screen, continued

To modify the **Localization** file, click the document icon on the right of the **Localization** field.



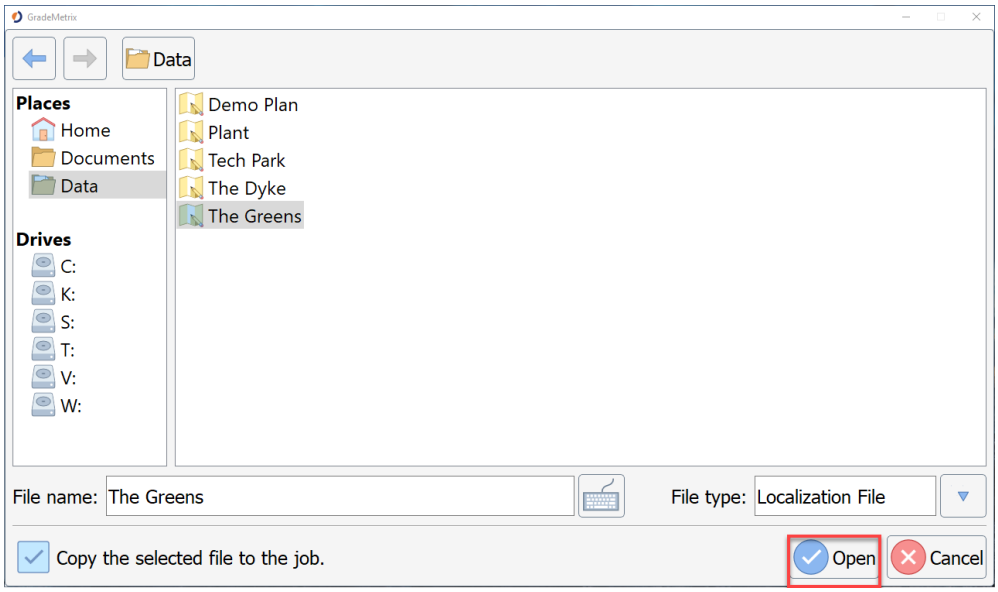
The localization files display. To change the file, click the **Data** folder and click to select a different file name.

Continued on next page

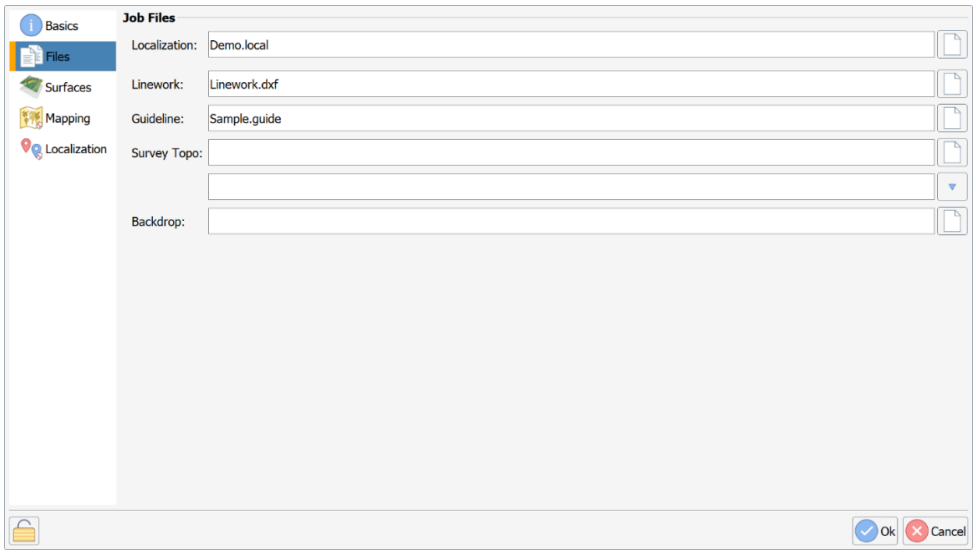
Modify a Job, Continued

Modify Files screen, continued

Click **Open**.



The **Job Files** window display the **Localization** file you selected.



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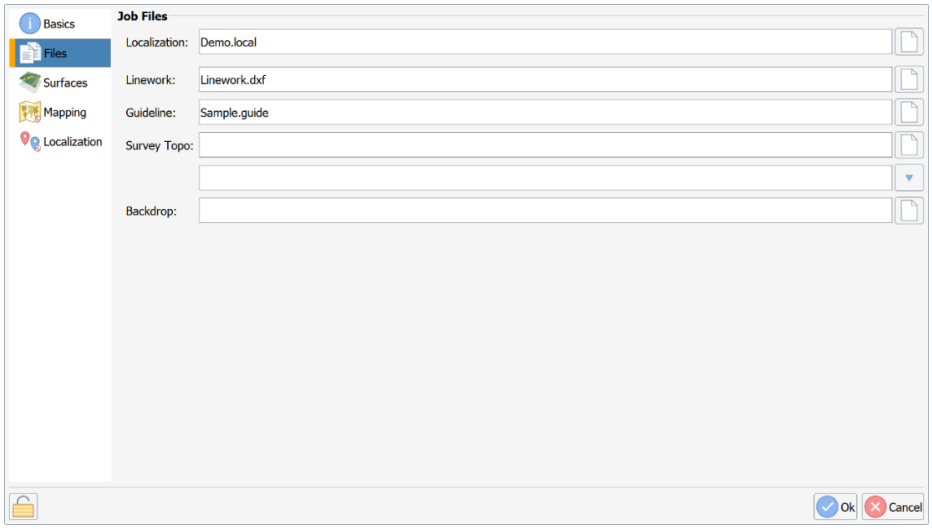
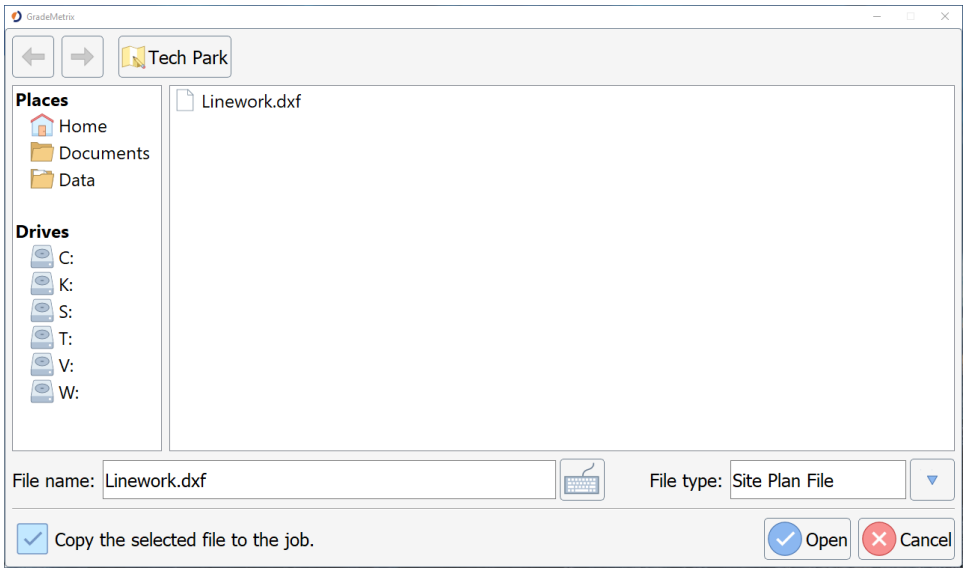
Modify a Job, Continued

Modify Files screen, continued

To modify the **Linework** file, click the document icon on the right side of the **Linework** field.



The **Linework** file list displays.



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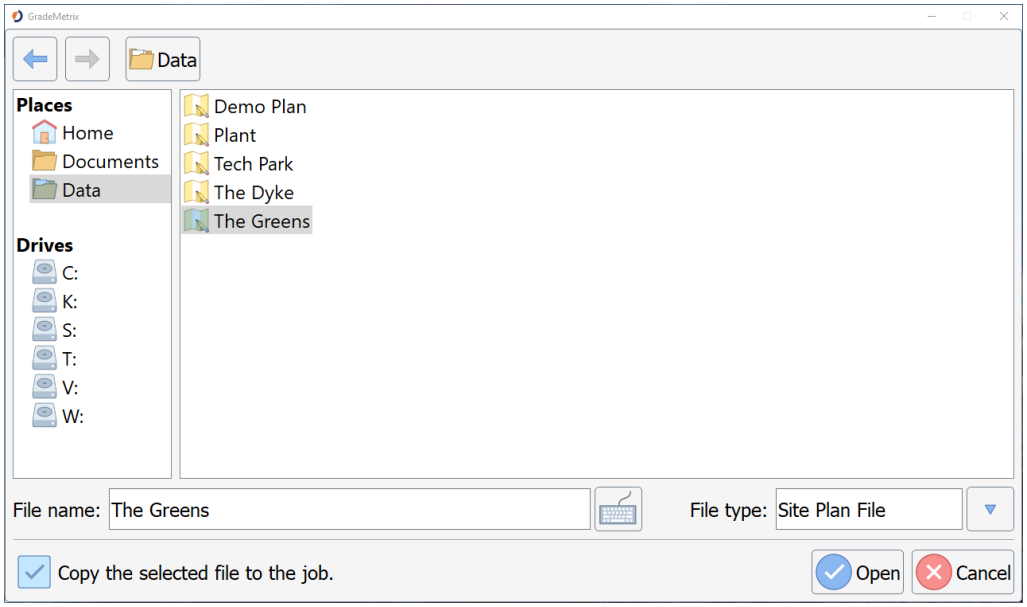
Modify a Job, Continued

Modify Files screen, continued

To select a different **Linework** file, click the **Data** folder, and click to highlight the Job file and double-click.

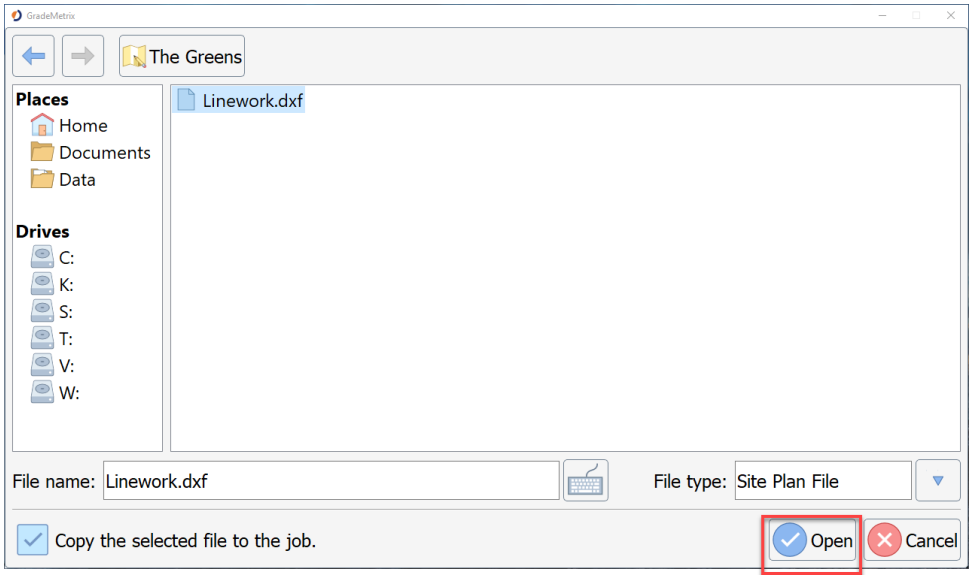


Click to highlight the name of the **Linework** file you wish to use and click **Open**.

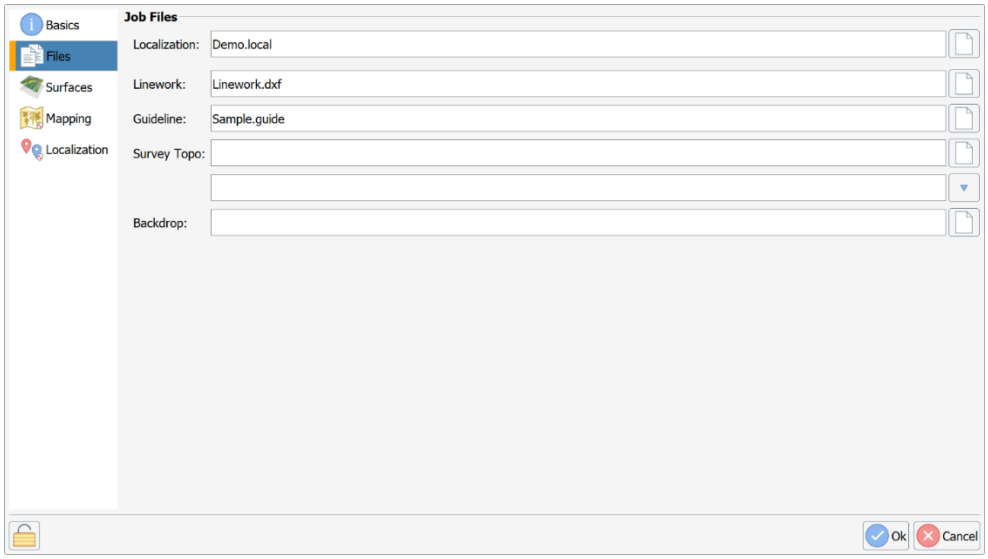
Continued on next page

Modify a Job, Continued

Modify Files screen, continued



The **Linework** file name displays in the **Linework** field.



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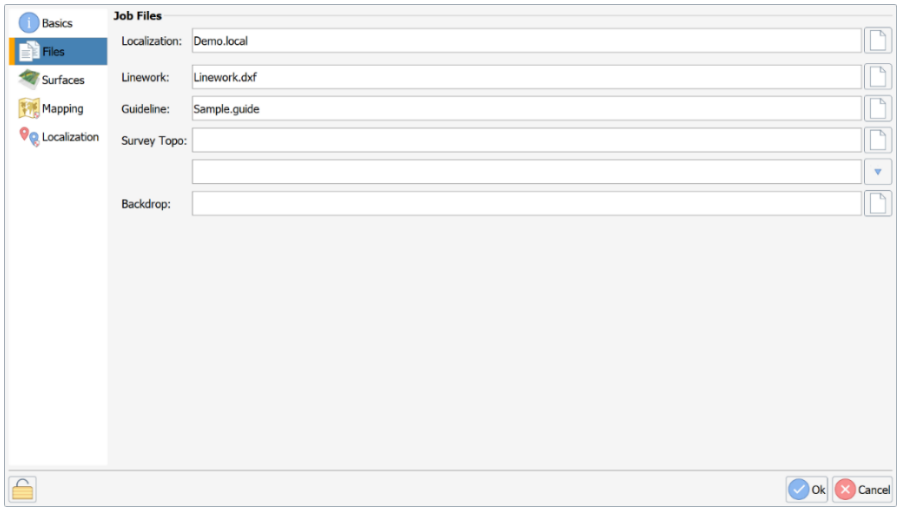
Modify a Job, Continued

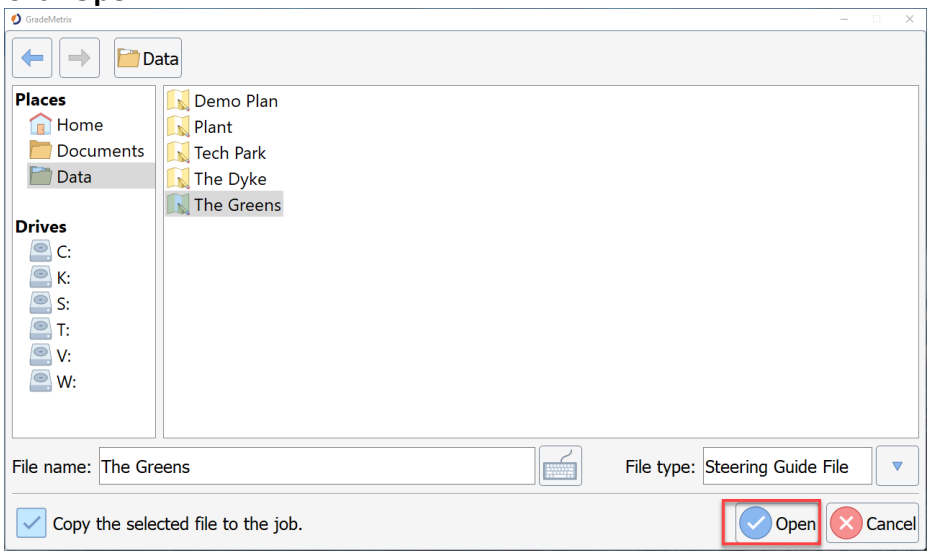
Modify Files screen, continued

To modify the **Guideline** file, click the document icon on the right of the **Guideline** field.



Click the **Data** file in the left navigation menu to display the list of available files and click to highlight the name of the file you wish to use.

Click **Open**.



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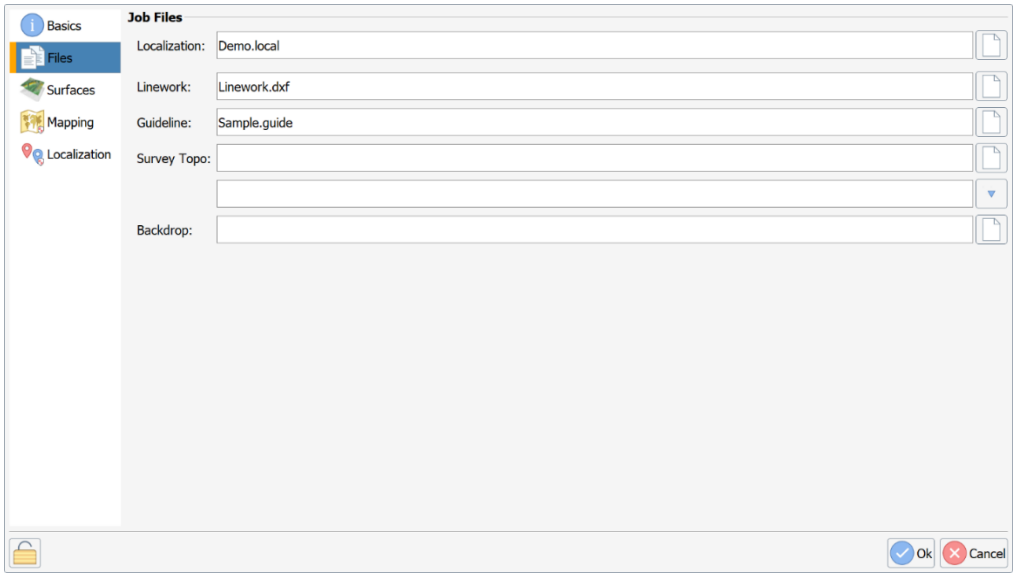
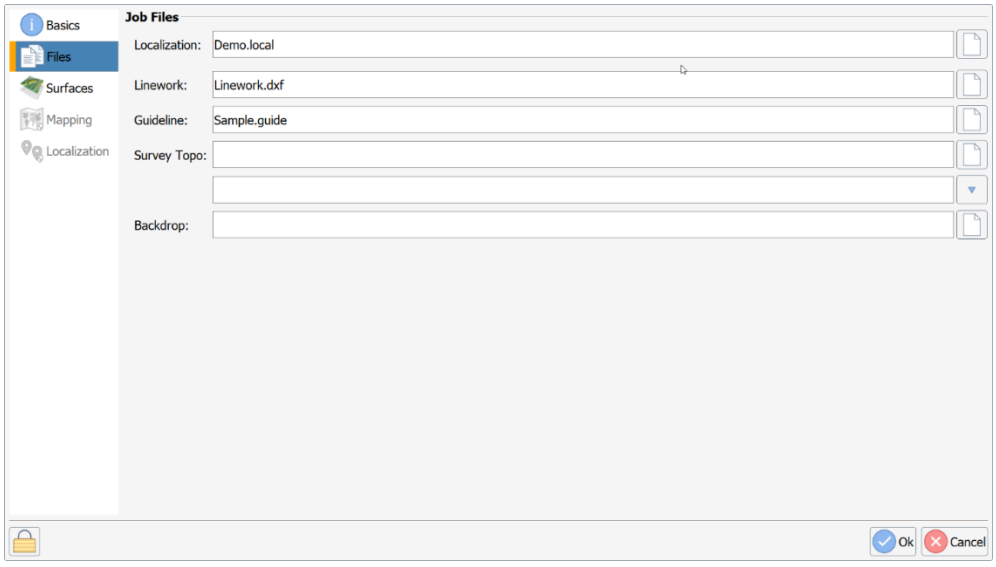
Modify a Job, Continued

Modify Files screen, continued

The **Job Files** screen displays the Guideline filename you selected.



To modify the **Survey Topo** file, click the document icon to the right.

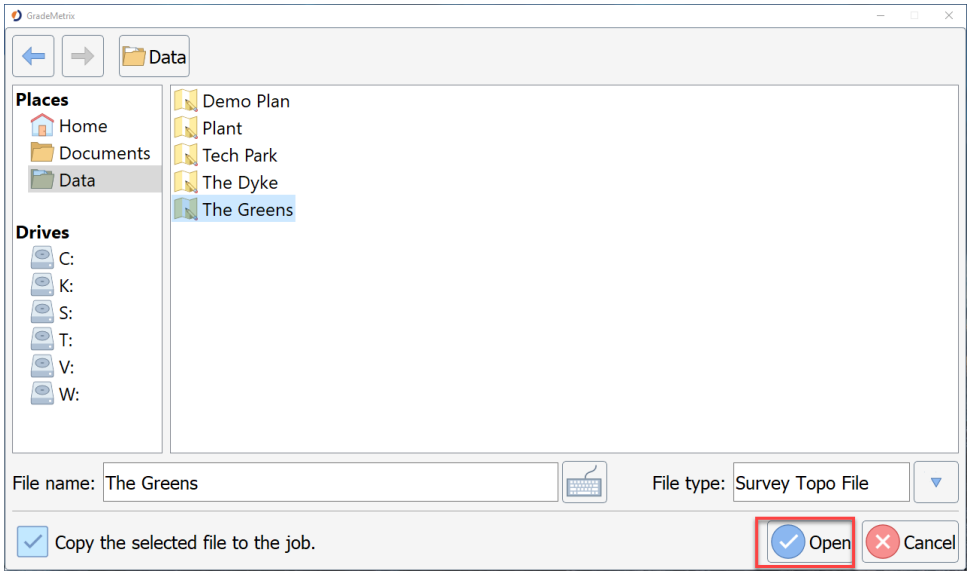


Continued on next page

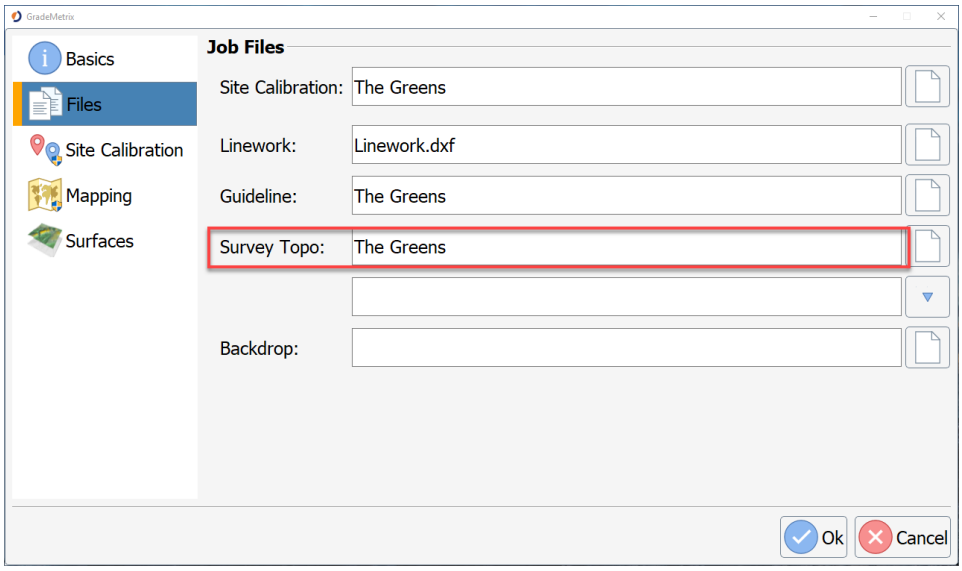
Modify a Job, Continued

Modify Files screen, continued

Click the **Data** file in the left navigation menu to display the list of available files and click to select the file you wish to use. Click **Open**.



The **Survey Topo** file you selected is displayed in the **Job Files** screen field.



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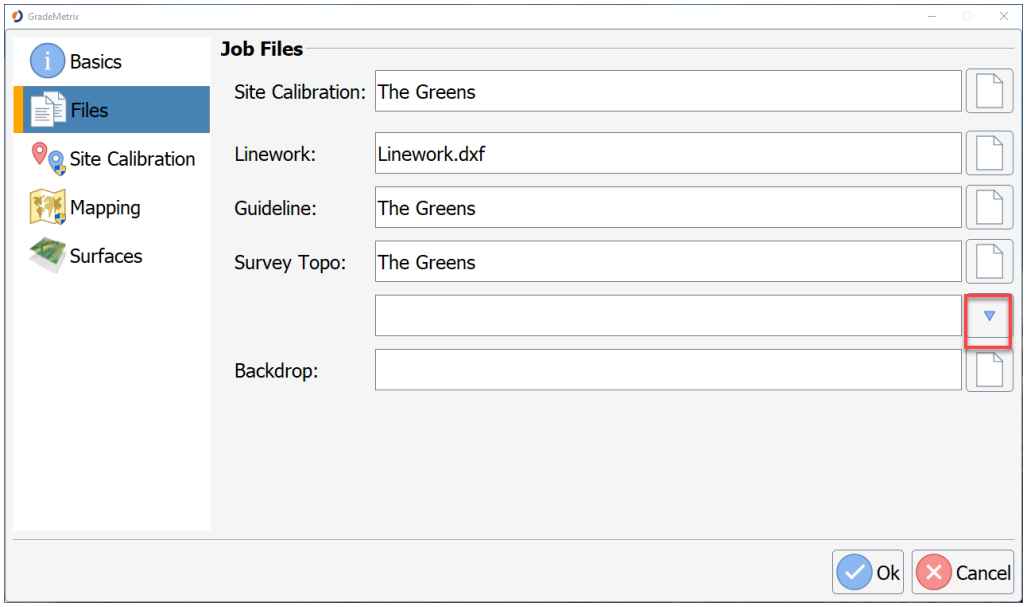
Modify a Job, Continued

Modify Files screen, continued

To change the **Survey Topo** elevation setting, click the down arrow on the right.



A pop-up window displays a list of elevations:

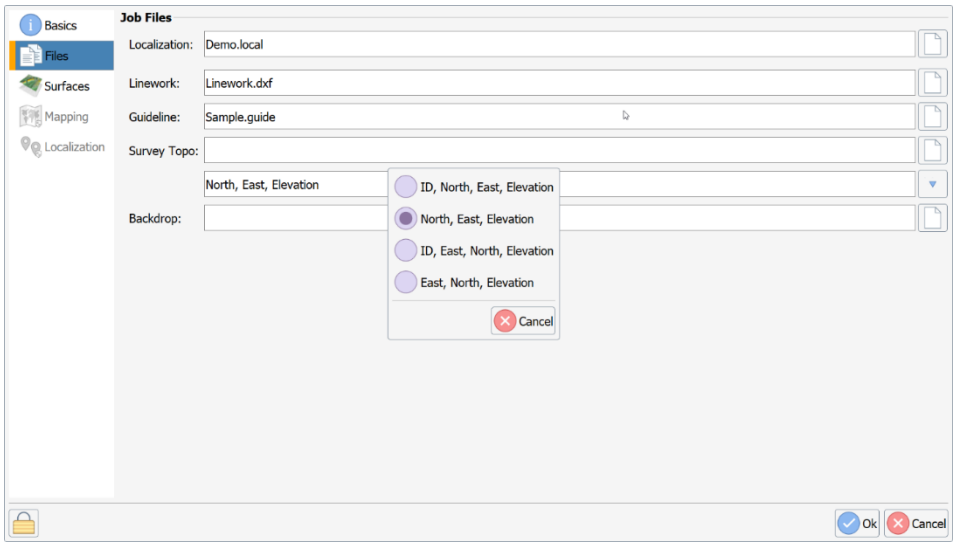
- ID, North, East, Elevation
- North, East, Elevation
- ID, East, North, Elevation
- East, North, Elevation

Continued on next page

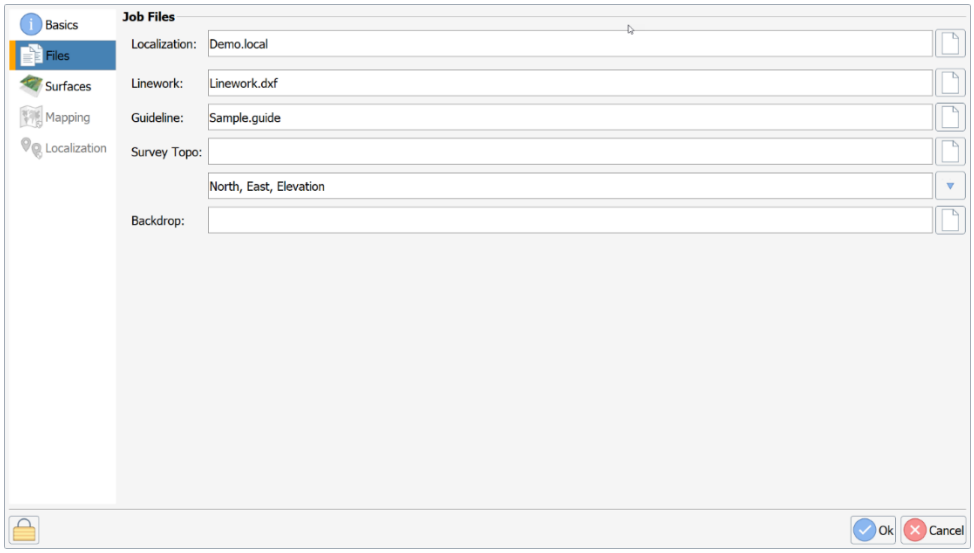
Modify a Job, Continued

Modify Files screen, continued

Select from this list of options and click **Ok**.



The elevation you selected displays in the **Job Files** window.

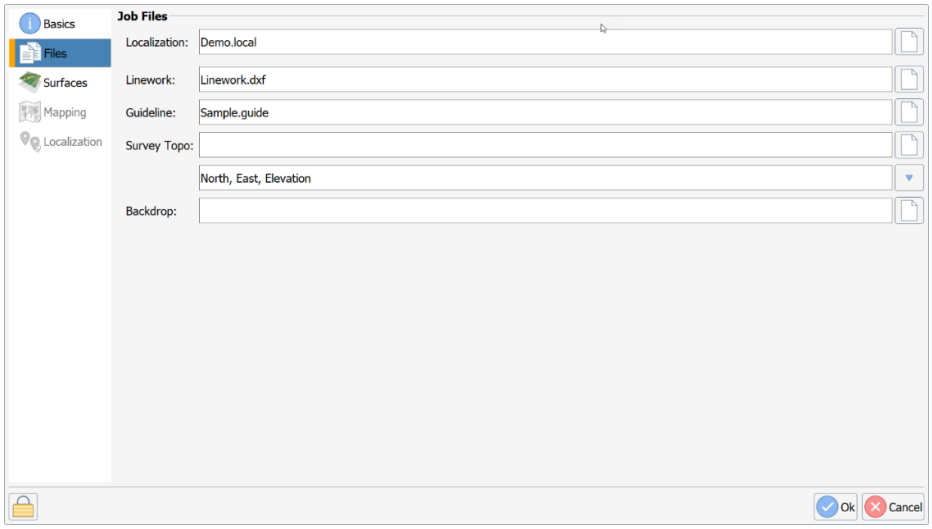


Continued on next page

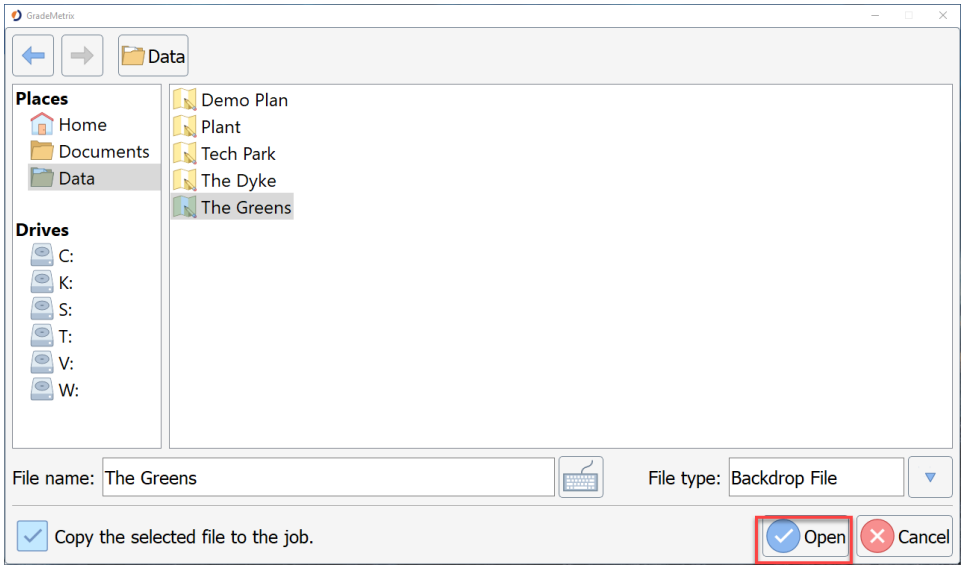
Modify a Job, Continued

Modify Files screen, continued

To change the **Backdrop** file, click the document icon on the right.



On the left navigation menu, click to select the **Data** file to display the list of available files. Click to highlight and select the file you wish to add and click **Open**.



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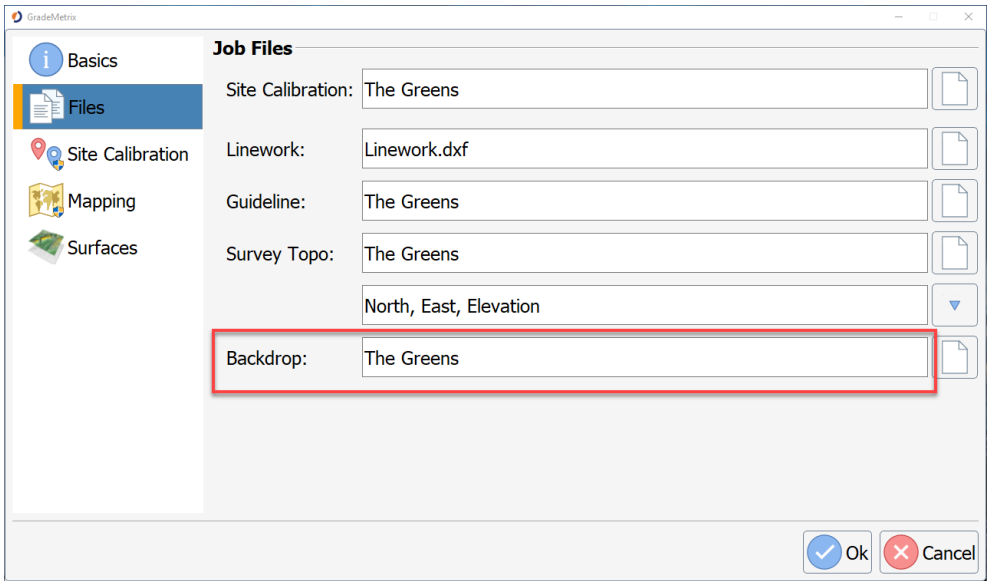
Modify a Job, Continued

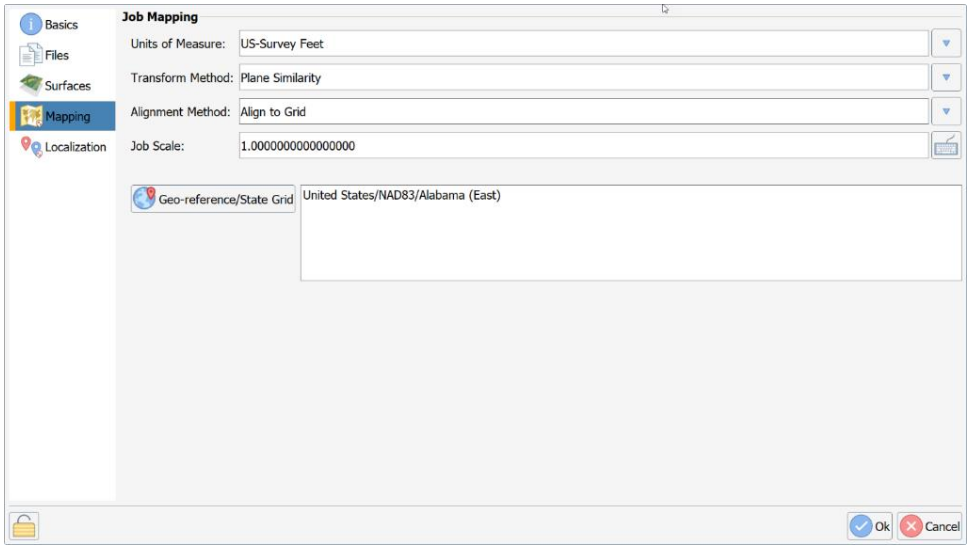
Modify Files screen, continued

The **Backdrop** file you selected is displayed in the Job Files window. Click **Ok**.



Modify Job mapping screen

From the left navigation menu, click the Mapping icon. The **Job Mapping** screen displays.

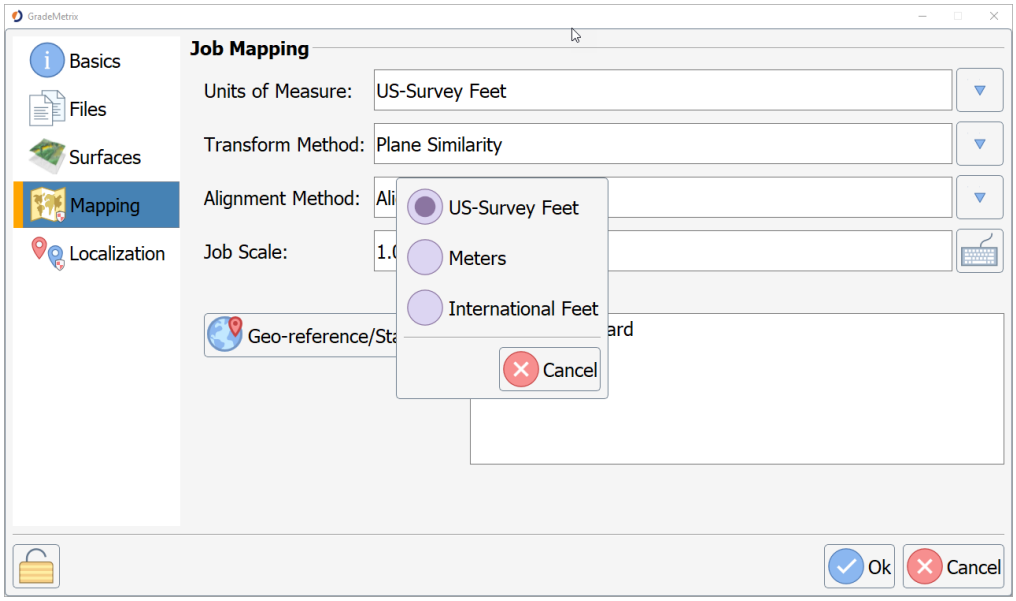


Continued on next page

Modify a Job, Continued

Modify Job mapping screen, continued

To change the **Units of Measure** from the default of setting of **US-Survey Feet**, click the down arrow. Click to select the measurement unit you wish to use. You can choose from **US-Survey Feet**, **Meters**, or **International Feet**.



Click the down arrow to select **Transform Method** from the following options:

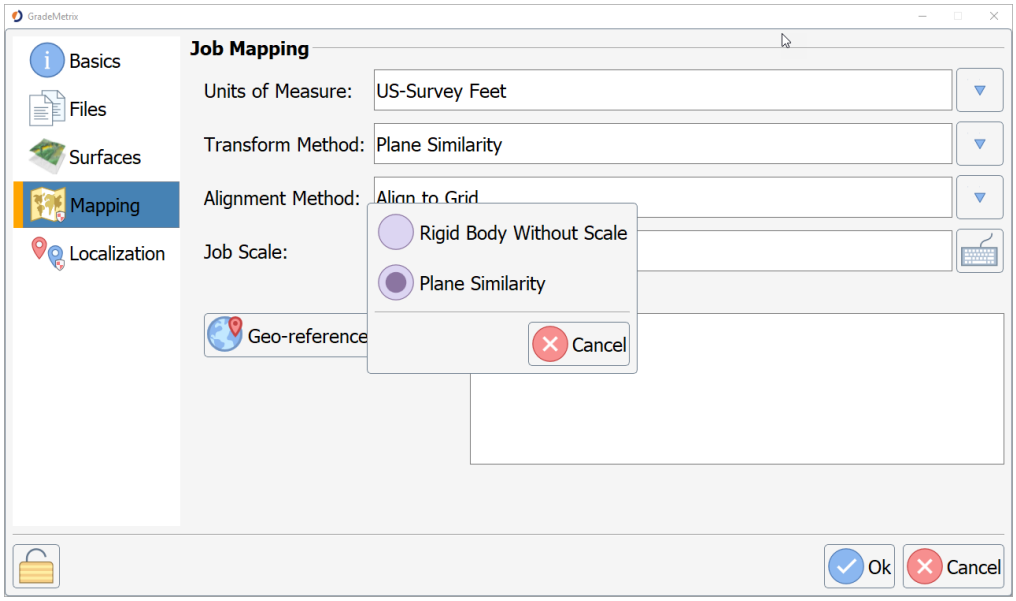
- Rigid Body Without Scale
- Plane Similarity

Continued on next page

Modify a Job, Continued

Modify Job mapping screen, continued

Click to change your selection.



To change the **Alignment Method**, click the down arrow. You can choose from:

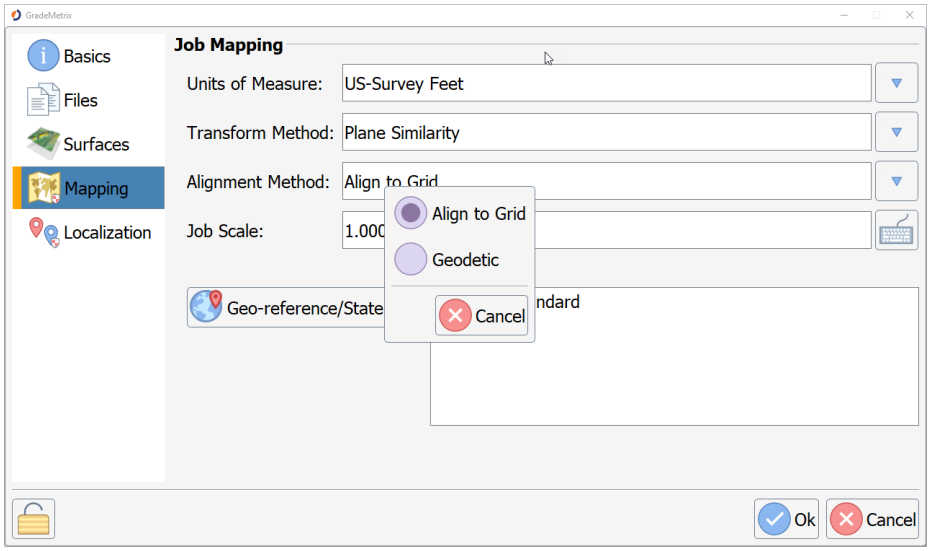
- Align to Grid
- Geodetic

Continued on next page

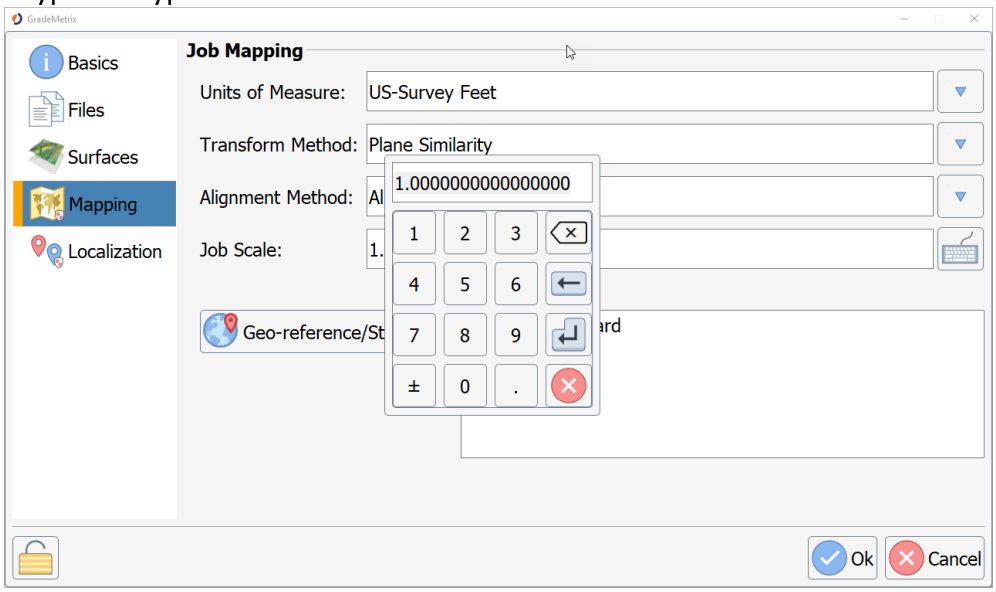
Modify a Job, Continued

Modify Job mapping screen, continued

Click **Ok**.



To type the **Job Scale** value, click the keyboard icon on the right and use the keypad to type the numbers. Click **Next**.



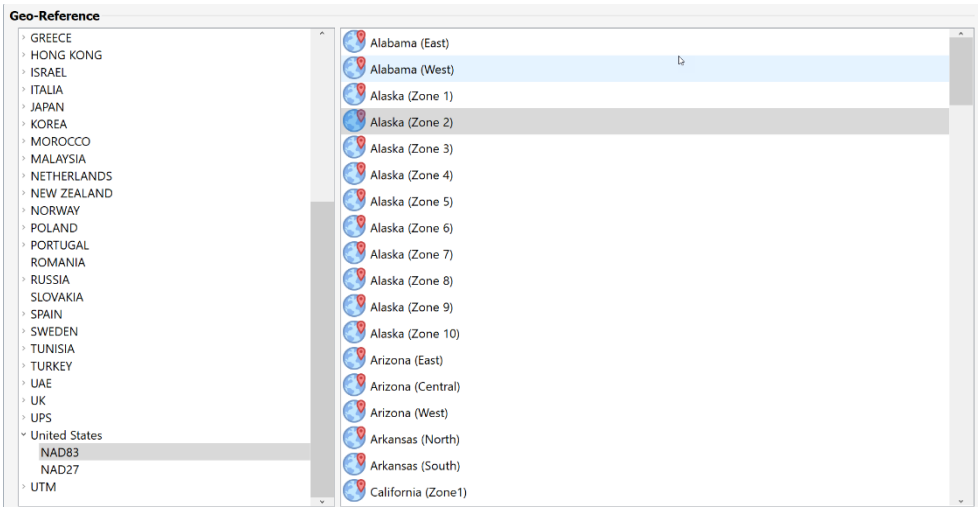
Continued on next page

Modify a Job, Continued

Modify Job mapping screen, continued

If your project is using coordinates from a known coordinate system, click **Geo-reference/State Grid** and select the appropriate projection from the list.

Click **Ok**.



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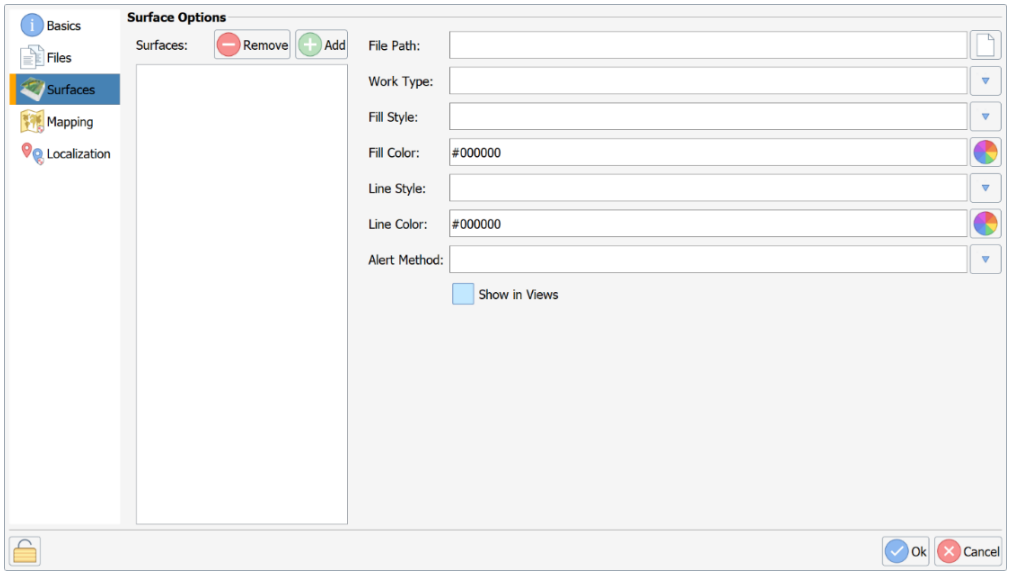
Modify a Job, Continued

Add job surfaces

To modify GradeMetrix **Job Surface** data, click **Surfaces** on the left navigation menu.

The **Surface Options** window displays.

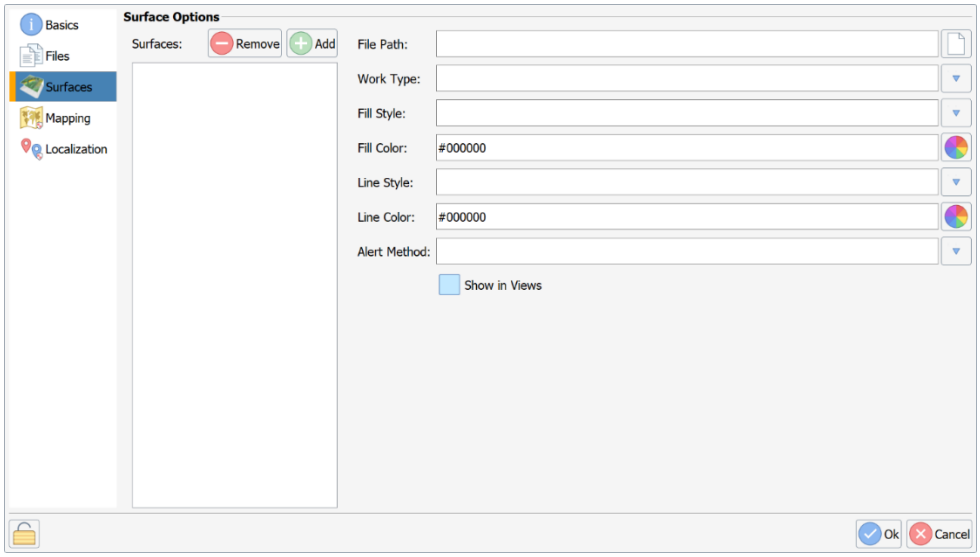


Continued on next page

Modify a Job, Continued

Add job surfaces, continued

To add a **Surface**, click **Add**.

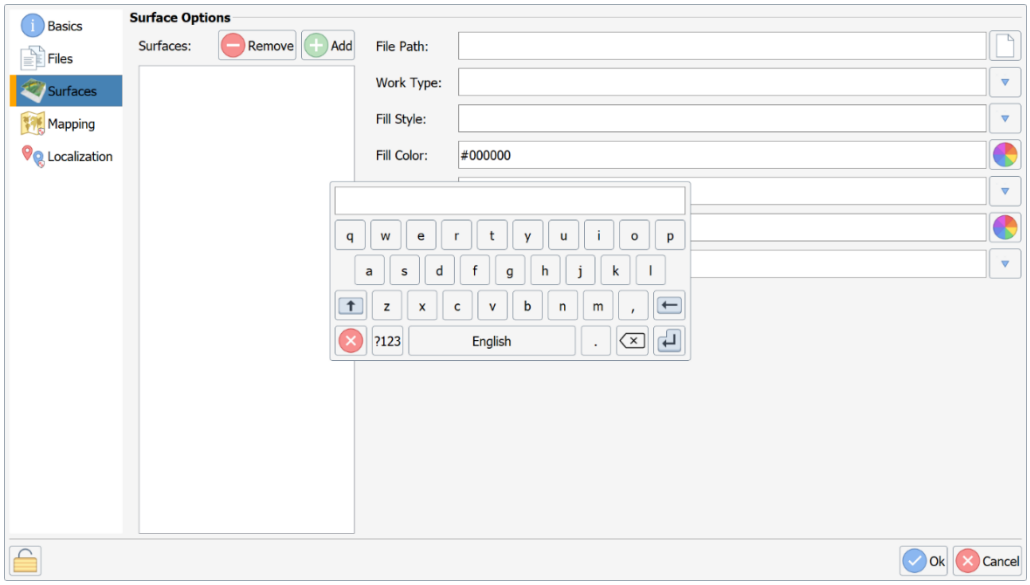


Use the pop-up keyboard to type the name of the **Surface Option** you wish to add. Click the **Enter** key.

Continued on next page

Modify a Job, Continued

Add job surfaces, continued



The added **Surface Option** displays in the **Surfaces:** field.

You can modify the following Surface Options:

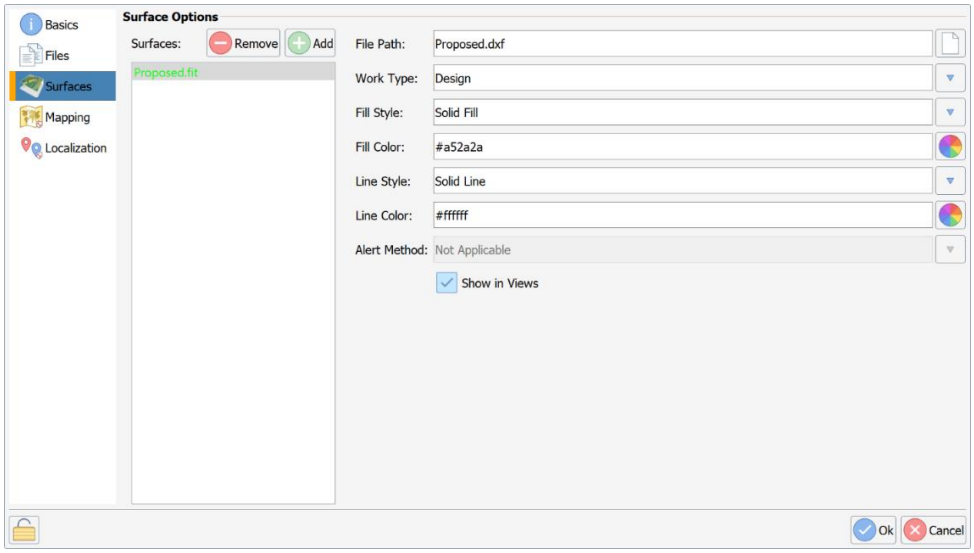
- File Path
- Work Type
- Fill Style
- Fill Color
- Line Style
- Line Color
- Alert Method

Continued on next page

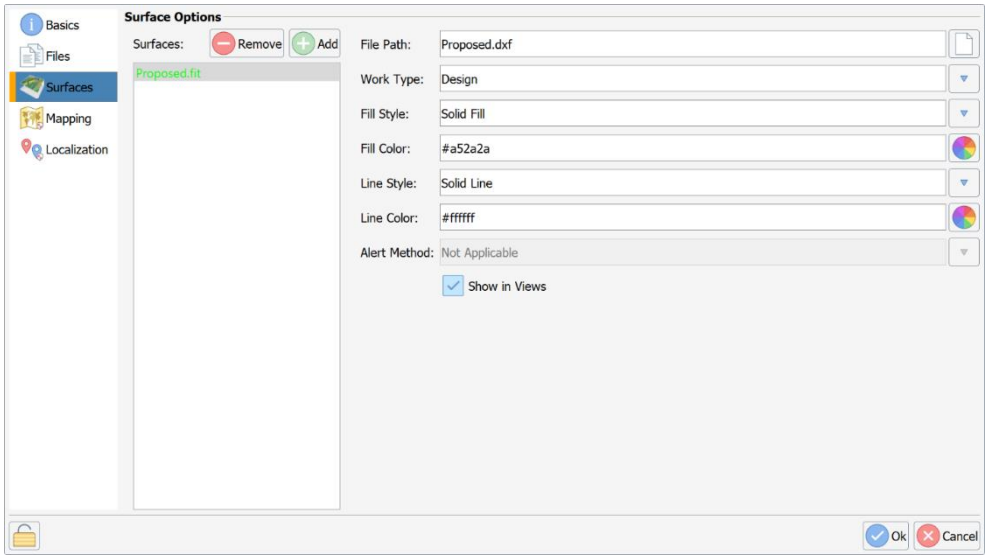
Modify a Job, Continued

Add job surfaces, continued

To modify a Surface option File Path, in the **Surface Options** window, click the document icon to the right of the **File Path** field.



To modify a GradeMetrix Job Work Type, in the **Surface Options** window, click the down-arrow to the right of the **Work Type:** field.



Continued on next page

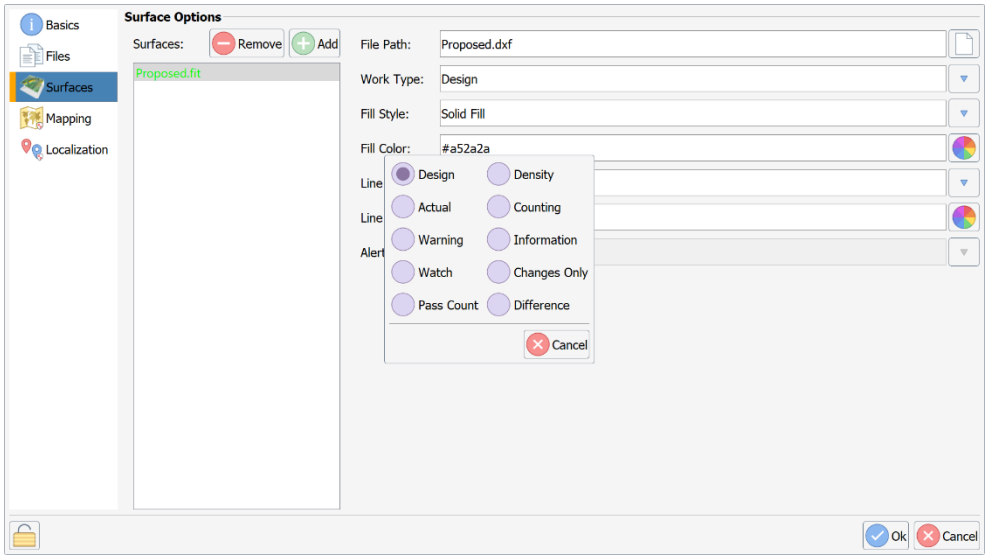
Modify a Job, Continued

Add job surfaces, continued continued

A pop-up window displays the following **Work Type** options:

- Design
- Actual
- Warning
- Watch
- Pass Count
- Density
- Counting
- Information
- Changes Only
- Difference

Click to select the desired **Work Type**. The selected **Work Type** displays in the **Work Type:** field.

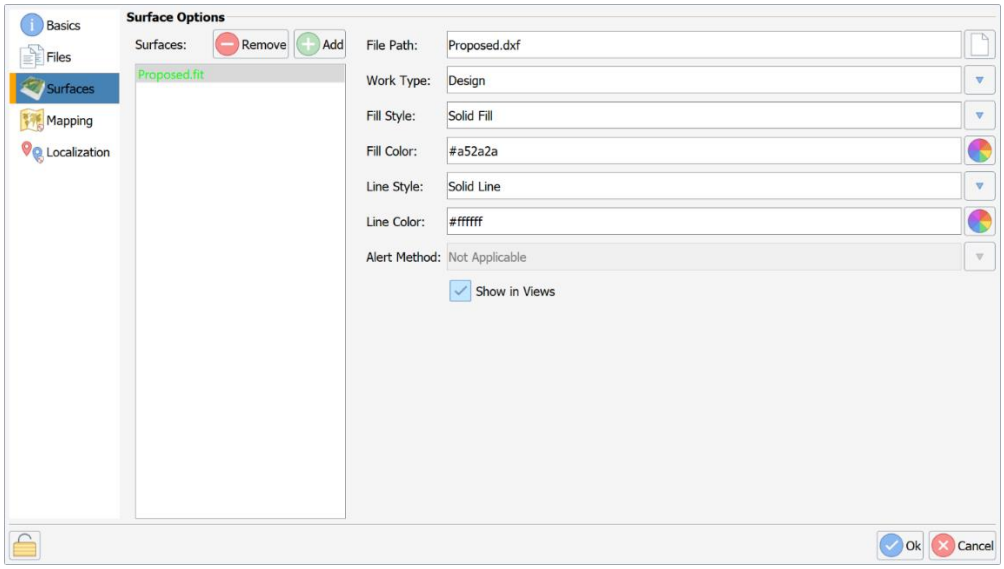


Continued on next page

Modify a Job, Continued

Add job surfaces, continued continued

To modify the **Fill Style** of a **Surface Option**, in the **Surface Options** window, click the down-arrow to the right of the **Fill Style:** field.



A pop-up window displays the following **Fill Style** options:

- Transparent
- Solid Fill
- Backward Diagonal Hatch
- Cross Diagonal Hatch
- Forward Diagonal Hatch
- Cross Hatch
- Horizontal Hatch
- Vertical Hatch
- User Defined

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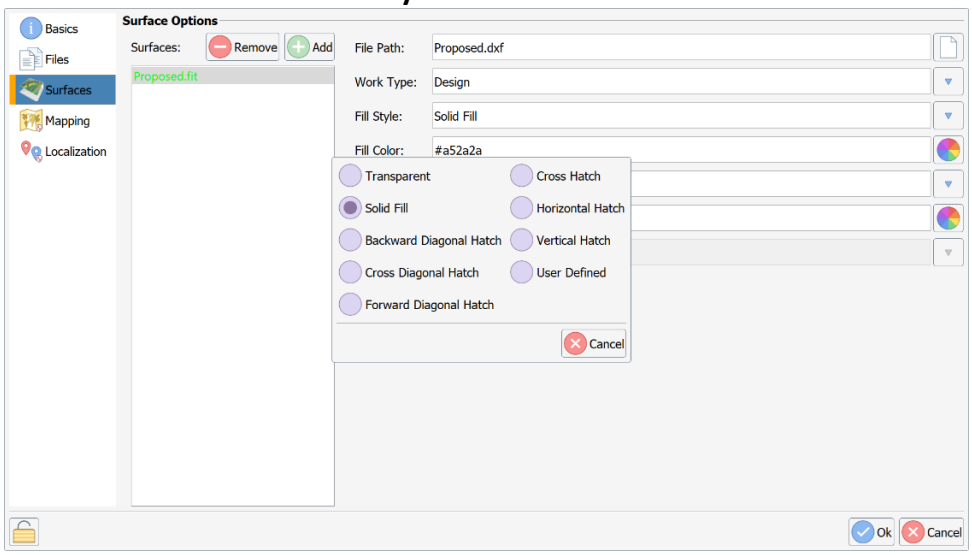
Modify a Job, Continued

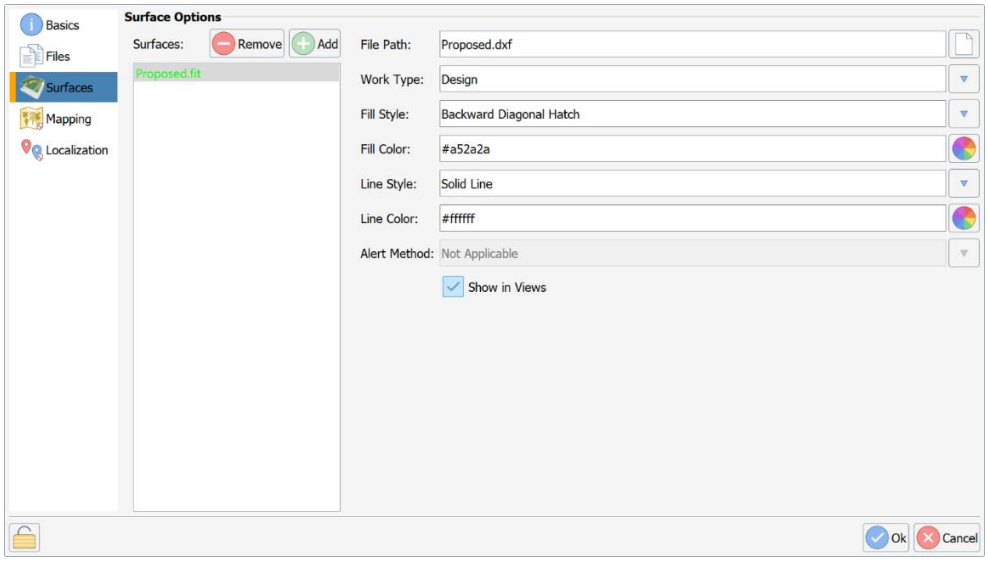
Add job surfaces, continued continuedcontinued

Click to select the desire **Fill Style**.



The selected **Fill Style** displays in the **Fill Style:** field. Click to select and set your preferences for the remaining options:

- Fill Color
- Line Style
- Line Color

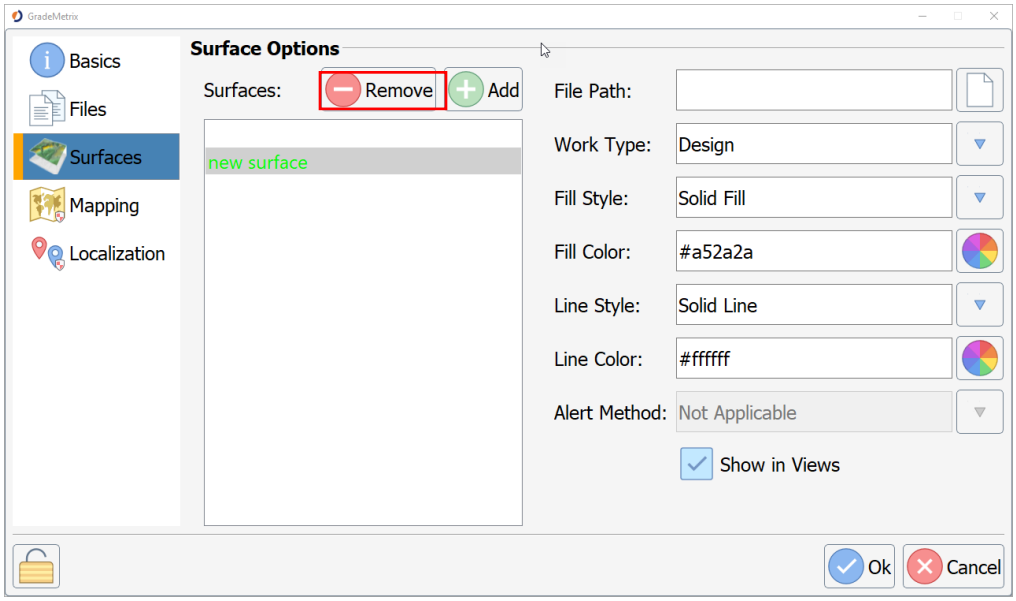


Continued on next page

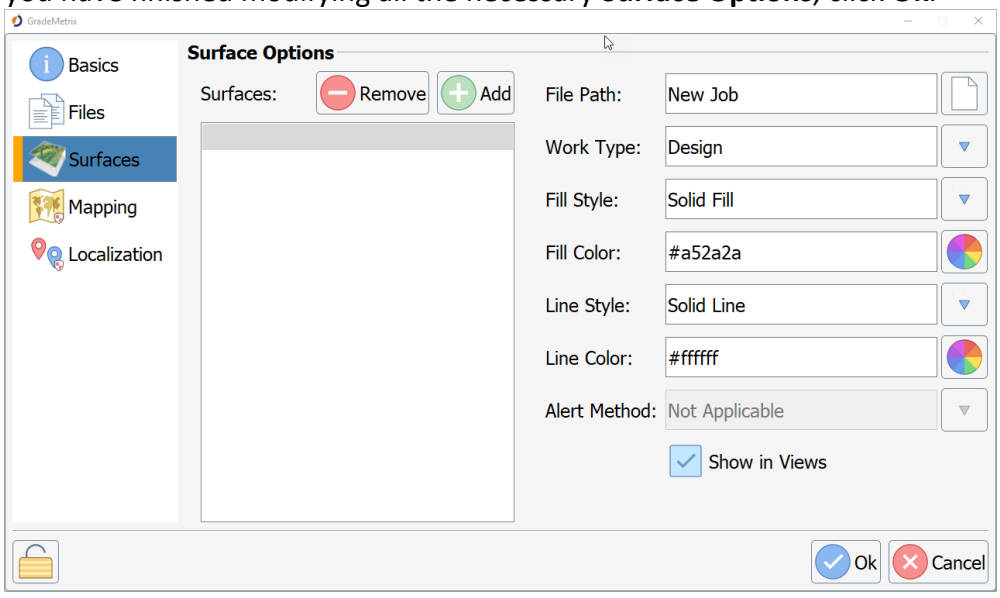
Modify a Job, Continued

Remove a surface option

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



The **Surface Option** is no longer displayed in the **Surface Options** field. When you have finished modifying all the necessary **Surface Options**, click **Ok**.



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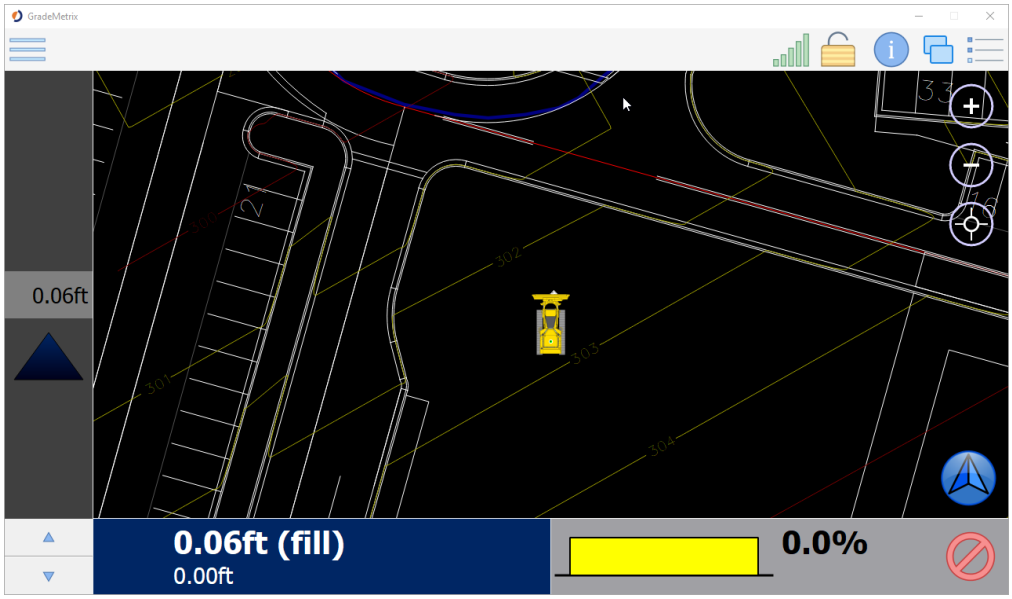
Modify a Job, Continued

Remove a surface option, continued

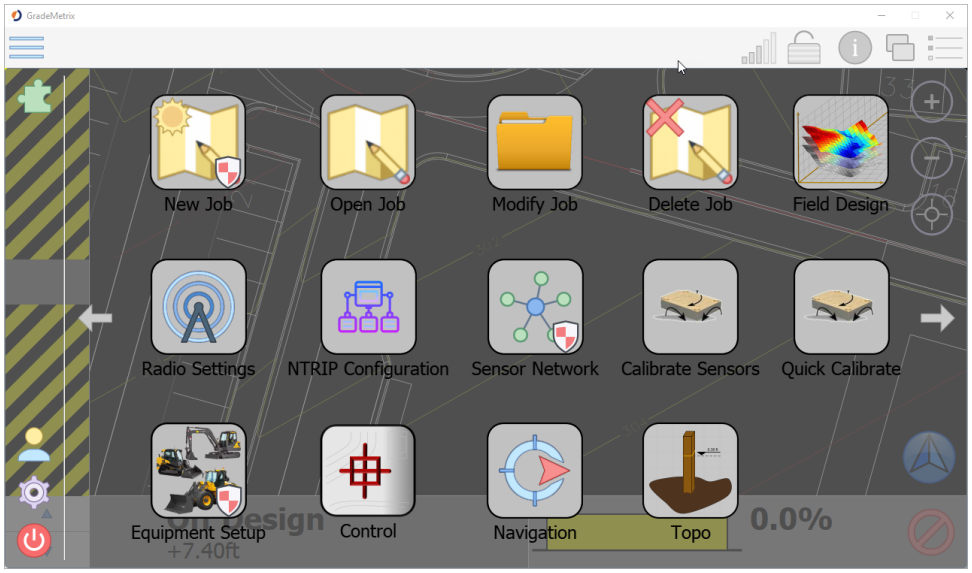
The currently opened GradeMetrix Job appears. A slight system delay will occur, as GradeMetrix applies the job modifications.



Calibrate Sensors

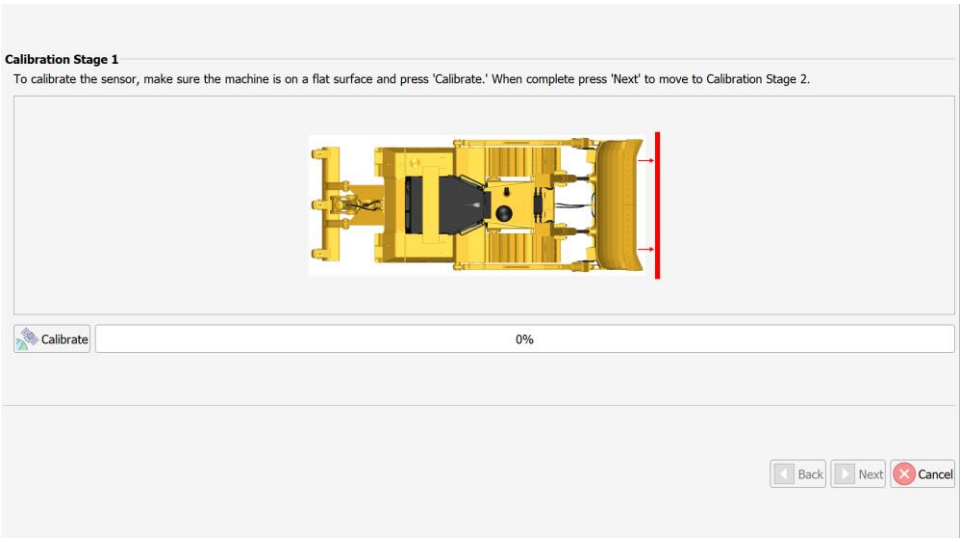
Calibrate sensors

On the GradeMetrix Home screen, click the **Calibrate Sensors** icon.



The **Calibration Stage 1** screen displays. Click **Calibrate**.

To calibrate a body sensor, line up the machine up and press Calibrate to average results over a few seconds.



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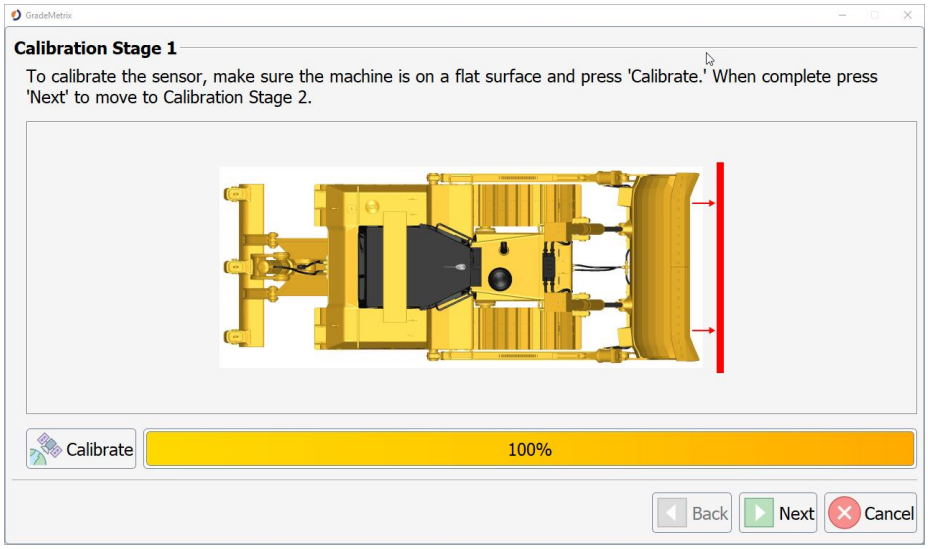
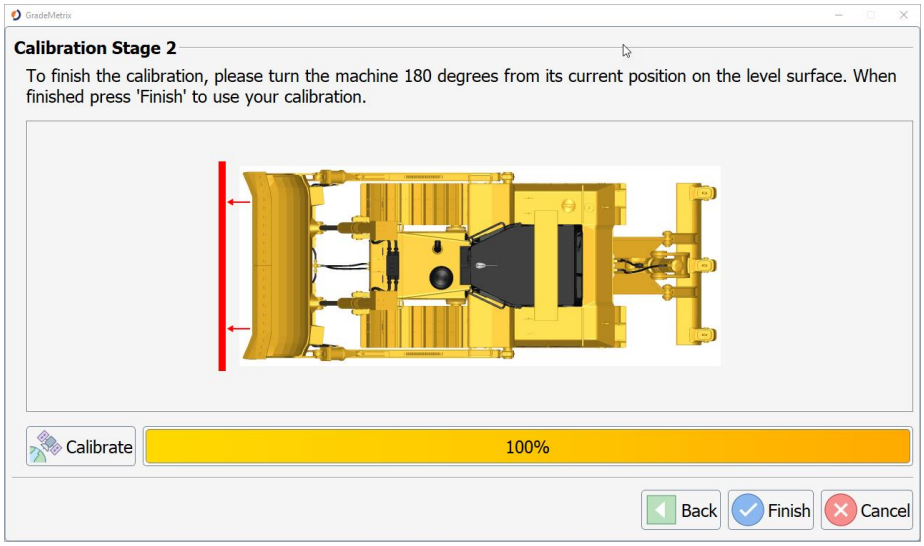
Calibrate Sensors, Continued

Calibrate sensors, continued



Click **Next**. The **Calibration Stage 2** screen displays. Click **Calibrate** and click **Finish.**

Then turn the machine 180 degrees and place the blade in the same location and press **Calibrate** again.



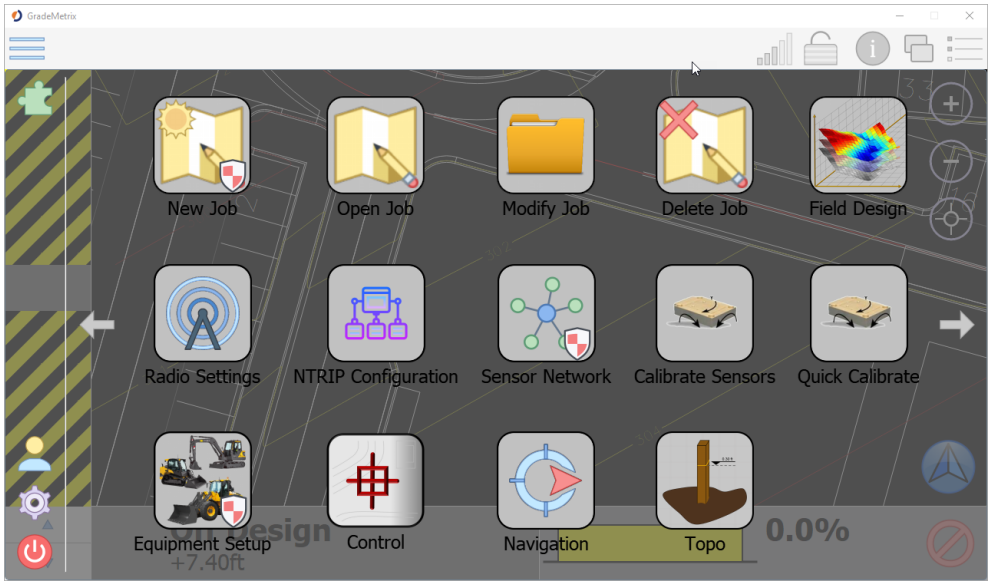
Quick Calibrate

Quick calibrate

The Quick Calibrate function allows users to manually enter a slope. On the GradeMetrix Home screen, click the **Quick Calibrate** icon.

Use **Quick Calibrate** if you have the long and cross slope of your machine or blade.

The previous section of this User Guide provides instructions for calculating the delta values for cross and long slope, so offsets can be applied.



Appendix A: Troubleshooting

Overview

Introduction

Appendix A provides troubleshooting for common problems.

Contents

Appendix A Troubleshooting

Troubleshooting

Symptom	Possible Solution
Incorrect position	First, check the 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

Appendix A Troubleshooting, Continued

Troubleshooting, continued

Symptom	Possible Solution
No GPS position	5. First check to see if the VR500 or VR1000 is powered on. 6. If the receiver isn't powered, disconnect the cable and use a multimeter to verify it is receiving power from the IronOne. 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. 7. 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

Appendix A Troubleshooting, Continued

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. 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. 8. Check to see if the UHF light at the rover is blinking once per second. If it isn't, refer to (3.). 9. 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. 10. 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

Appendix A Troubleshooting, Continued

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 it 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	11. 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. 12. If using a VR1000, check your MSEP. Your MSEP is the distance, in meters, between the two antennas, and should be accurate to within 2cm.

Appendix B: Technical Specifications

Overview

Introduction

Appendix B provides the technical specifications for the IronOne hardware, the VR500 Smart Antenna, and GradeMetrix software.

Contents

IronOne Technical Specifications

IronOne technical specifications

The following details technical specifications for the IronOne.

Table B-1: IronOne system specifications

System	
Processor	Intel Atom dual-core CPU E3825 @ 1.33 GHz
Storage	SSD 32GB, RAM 2GB, 128 GB with Micro SD
Operating System	Windows 10

Table B-2: IronOne screen specifications

Screen	
Display Type	8” TFT-LCD capacitive touchscreen
Size	192.8 mm × 116.9 mm (7.59” × 4.6”)
Resolution	1280 × 720, 16:9
Luminance	750 nit

Table B-3: IronOne input specifications

Input	
Start button	1× mechanical waterproof button
Function button	2× mechanical waterproof buttons
Ignition Input	Yes

Continued on next page

IronOne Technical Specifications, Continued

IronOne technical specifications, continued

Table B-4: IronOne communication specifications

Communication	
Serial Port	1x RS232×1, 1x RS422/RS485/RS232 (switch by software)
Camera Interface	2× CVBS
USB	1× USB2.0
Ethernet	10M/100M
Wi-Fi	IEEE 802.11b/g/n
Bluetooth	Bluetooth 4.0
Cellular	4G LTE (optional with SIM card port)
Data I/O Protocol	NMEA 0183

Continued on next page

IronOne Technical Specifications, Continued

IronOne technical specifications, continued

Table B-5: IronOne mechanical specifications

Mechanical	
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-6: IronOne environmental specifications

Environmental	
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-7: IronOne power specifications

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

Table B-8: IronOne sensor and multimedia specifications

Sensor and Multimedia
1x 2W Buzzer
1x Headphone Jack

VR500 Technical Specifications

VR500 sensor specifications

Table B-9: VR500 sensor specifications

Item	Specification
Receiver type	GPS, GLONASS, BeiDou, Galileo and RTK with carrier phase and L-band dual antenna
Channels	788
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 Technical Specifications, Continued

VR500 sensor specifications specifications, continued

Table B-9: VR500 sensor specifications (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, 20 Hz and 50 Hz available
Horizontal accuracy	<table><tr><th></th><th>RMS (67%)</th><th>2DMRS (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	< 0.17º RMS @ 0.5 m antenna separation < 0.09º RMS @ 1.0 m antenna separation < 0.04º RMS@ 2.0 m antenna separation < 0.02º RMS @ 5.0 m antenna separation
Pitch/roll accuracy	< 1° RMS
Heave accuracy	30 cm[4]
ROT	145°/s maximum
Timing (1PPS) accuracy	20 ns
Cold start time	< 60 s typical (no almanac or RTC)
Warm start time	< 30 s typical (almanac and RTC)
Hot start time	< 10 s (almanac, RTC, and position)
Maximum speed	1,850 km/h (999 kts)

Continued on next page

VR500 Technical Specifications, Continued

VR500 sensor specifications, continued

Table B-9: VR500 sensor specifications (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-10: VR500 communication specifications

Item	Specification
Serial ports	3x full-duplex UART's 2x 3.3V CMOS 1x RS-232
CAN	2 CAN ports NMEA2000, ISO-11783
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, CAN, Hemisphere GPS 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
USB	1 USB Device, OTG with future firmware update
Ethernet	1x 10/100 base-T

VR500 power specifications

Table B-11: VR500 power specifications

Item	Specification
Input voltage	9-32 VDC
Power consumption	10.5W Maximum (All signals and L-band)
Current consumption	1.2A Maximum
Antenna voltage input	5 VDC Maximum
Antenna short circuit	Yes
Antenna input	50 Ω

Continued on next page

VR500 Technical Specifications, Continued

VR500 environmental specifications

Table B-12: VR500 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°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[4]	**Vibration:** EP455 Section 5.15.1 Random **Mechanical Shock:** EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC[5]	CE (ISO 14982 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

VR500 mechanical specifications

Table B-13: VR500 mechanical specifications

Item	Specification
Dimensions	100 L x 60 W x 10 H mm (2.81 L x 1.60 W x 0.40 H in)
Weight	35-37 grams
Status indication	Power, GNSS lock, Differential lock, DGNSS position, Heading lock
Power/Data connector	24-pin (12x2) male header 0.078 in (2 mm) pitch 16-pin (8x2) male header 0.078 in (2 mm) pitch
Antenna connector	MMCX, female, straight

Continued on next page

VR500 Technical Specifications, Continued

VR500 L-band sensor specifications

Table B-14: VR500 L-band sensor specifications

Item	Specification
Receiver type	Single Channel
Channels	1525 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-15: VR aiding device specifications

Device	Description
Gyro	Provides smooth heading, fast heading reacquisition, and reliable < 3° heading for periods up to 3 minutes when loss of GPS has occurred.[5]
Tilt sensor	Provide pitch and roll data and assist in fast startup and reacquisition of heading solution.

[1] Depends on multi-path environment, number of satellites in view, satellite geometry, and ionospheric activity

[2] Depends also on baseline length

[3] Receive only, does not transmit this format

[4] When integrated in conjunction with the recommended shielding and protection as outlined in this guide

[5] Under static conditions

TS2 Sensor Technical Specifications

TS2 sensor technical specifications

Table B-16: TS2 sensor specifications

Feature	Specification
Measurement Range	**Pitch:** ± 180° **Roll:** ± 90°
Sensor Accuracy	**Angular Precision:** ±0.1° over the full angle range **Resolution:** ±0.01° **Repeatability:** ±0.1° **Refresh Rate:** 10-100HZ, software selectable **Base Sensor Cycle:** 5ms **Hysteresis:** ±0.1°
Interface	**Protocol:** CANopen **Profile:** DS-410 **Transmission Rate:** Default 250 kB **Connector:** M12 male, 5-pin, a-code **Input Voltage**: 12V/24V DC **Firmware:** Updated via CANbus
Electrical	**Supply Voltage:** 5.5 – 30 VDC **Current:** ≤ 10mA @ 24 VDC **EMC Emittance:** DIN EN 61000-6-4 **EMC Immunity:** DIN EN 61000-6-2
Environmental	**Operating Temperature:** -40°C to 85°C; -40°F to 185°F **Storage Temperature:** -40°C to 85°C; -40°F to 185°F **Ingress Protection:** IP68 / IP69K Shock: MIL-STD-883 Method 2002-B **Vibration:** 1.5mm (10-59Hz) and ≤20g (58-2000Hz)
Size and Weight	**Dimensions:** 90mm(L) x 30mm(W) x 20mm(D); 3.54” (L) x 1.18” (W) x 0.79”(D) **Weight:** 120g; 4.2oz
Materials	**Industrial Version:** Aluminum Housing and Zinc Connectors (fully encapsulated electronics) **Marine Version:** 316 Stainless Steel (fully encapsulated electronics)

Continued on next page

TS2 Sensor Technical Specifications, Continued

TS2 sensor technical specifications, continued

Feature	Specification
Pinouts	1. CAN GND 2. Power Supply 3. GND 4. CAN High 5. CAN Low

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End User License Agreement, Continued

End User license agreement, continued

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21. **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.
22. **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.
23. **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.
24. **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.
25. **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.
26. **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.

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Warranty Notice, Continued

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:

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