

UtilityScan®

Quick Start Guide

A Fast Check List for Field Operation

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Regulatory Information

Please see our website, www.geophysical.com/regulatoryinformation.htm, for current information and FCC Registration Form, including:

FCC Notice for U.S. Customer

Canadian Requirements for RSS-220

Declaration of CE Conformance

Introduction

Thank you for purchasing the UtilityScan by GSSI. GSSI is re-imagining the standard in underground utility locating by pairing cutting-edge sensors with an advanced Android-based user interface to create a high performance product at an affordable cost. The UtilityScan is designed with today's busy subsurface professional in mind. It's a tool that packs a ton of simple-to-learn functionality into a ruggedly reliable package.

What Comes in the Box

- UtilityScan system, pre-assembled
- Your choice of control tablet (NVIDIA Shield or Panasonic ToughPad)
- Two (2) rechargeable lithium ion UtilityScan batteries with charger
- Ethernet cable (2 meters long)
- AC power adaptor and set of international plugs for the tablet
- USB drive for data transfer
- Tablet-specific cable and accessory set (see Appendix A)
- Quick Start Guide (this document)

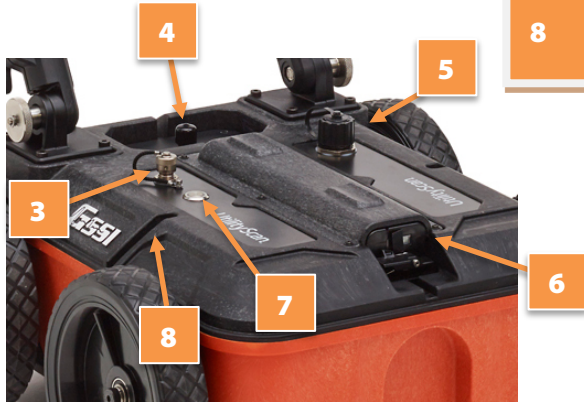
About this Quick Start Guide

This document is provided to get you up and running with your new UtilityScan right out of the box. It details field setup and use of the UtilityScan's applications: Scan EZ and Scan Max. You can download an electronic copy of this guide from GSSI's Support site: www.support.geophysical.com.

GSSI also recommends that you take advantage of one of the training opportunities provided for the UtilityScan. GSSI offers classroom-based training help by our professional training team. Please visit www.geophysical.com or contact training@geophysical.com for more details.

UtilityScan®

- 1 Ergonomic adjustable handle and tablet mount
- 2 350 MHz HyperStacking antenna
- 3 Survey wheel connector for cart config.
- 4 GPS mount attachment point
- 5 Ethernet connector
- 6 Battery slot
- 7 Power button
- 8 Marking grooves



UtilityScan Transport Configurations



Section 1: Getting Started

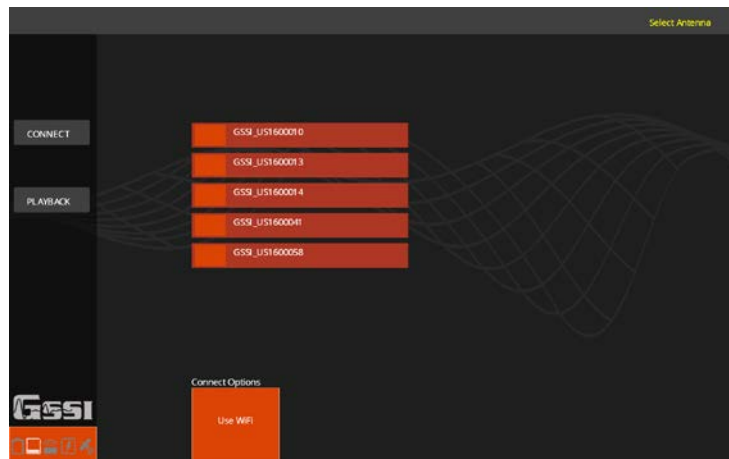
This section assumes that you are using WiFi to connect to the UtilityScan.

- 1** GSSI recommends fully charging the batteries and the tablet prior to use.
- 2** Unfold the UtilityScan cart and place the tablet into the mount.
- 3** Slide a fully charged battery into the battery slot at the top of the UtilityScan until the battery release lever at the front of the battery opening locks into place. The groove along the top side of the battery should face up. To eject the battery, push down on the battery release lever.
- 4** Push the Power button on the top of the UtilityScan housing. A blue ring will illuminate around the button. The UtilityScan is booting up and is ready to connect to the tablet when the blue ring begins to flash.
- 5** Turn on the tablet and tap the UtilityScan icon. You will briefly see the UtilityScan splash screen as the UtilityScan app boots up and then the connection screen will appear.

Note: The blue ring around the power button also indicates the WiFi connection status. A flashing blue ring indicates that the UtilityScan WiFi is broadcasting and ready to connect. A solid blue ring indicates that the system is actively collecting data.

Connecting to the UtilityScan with WiFi

- 1** Make sure that the UtilityScan is turned On and tap the UtilityScan app icon. After a short splash screen, you will see the image at the right. This image shows five UtilityScans are broadcasting nearby. You will likely see only one entry.
- 2** The center of the screen will show one entry for each UtilityScan the app detects. Individual systems are identified by their serial numbers which will show after the zeros.
- 3** Tap the box next to the correct UtilityScan entry and then tap Connect. The connection will establish after a few seconds and UtilityScan Main Menu screen will appear.



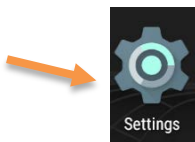
Note: The UtilityScan app will remember the last UtilityScan antenna to which it connected. The next time you open the app, it will auto connect if it detects the last UtilityScan antenna. The connection screen will flash and the go to the Main Menu screen. If you have multiple UtilityScan antennas, be sure to turn them on and connect one at a time. Once connected, the UtilityScan antenna will not connect to another tablet until disconnected from the its current tablet.

Connecting to the UtilityScan via Ethernet

- 1** Make sure that both the tablet and the UtilityScan antenna are powered Off.
- 2** Unscrew the protective cap covering the antenna Ethernet connector and connect the Ethernet cable to the antenna. Connect the other end of the Ethernet cable to the tablet. Note that you may need to use the included adapter cable depending on your tablet.
- 3** Power on the antenna **first** and wait for the blue light around the antenna power button to flash before turning on the tablet.
- 4** Power on the tablet and note the Ethernet symbol <...> in the top-right corner of the Android desktop. If you do not see it wait for it to appear before going on to the next step.
- 5** Tap the UtilityScan app icon. The system is now communicating over Ethernet and the WiFi radio on the UtilityScan antenna will automatically turn off after 15-20 minutes.

Note that the WiFi radio on your tablet will remain on. If you are in an environment where WiFi is not permitted, you can turn it off by following these steps:

- 1** From the Android tablet desktop, tap Settings:
- 2** Tap Wi-Fi from the Wireless & Networks section at the top.
- 3** Tap the slider toggle on the top right to turn WiFi off. Remember to turn it on again to use WiFi in the future.



Connecting/Disconnecting to Another WiFi Network and Navigating WiFi in Android

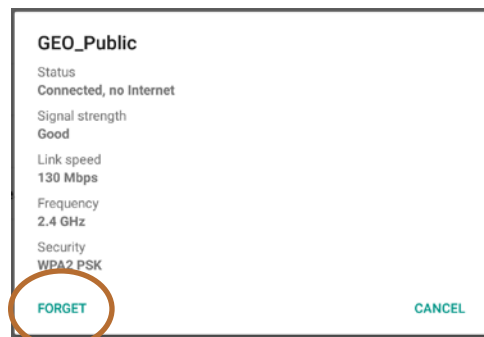
There may be times when you want to connect your tablet to another network to download updates. Bear in mind however, that you should treat this tablet as part of the GPR data collection instrument and avoid loading unnecessary apps such as games, etc.

To connect to a wireless network:

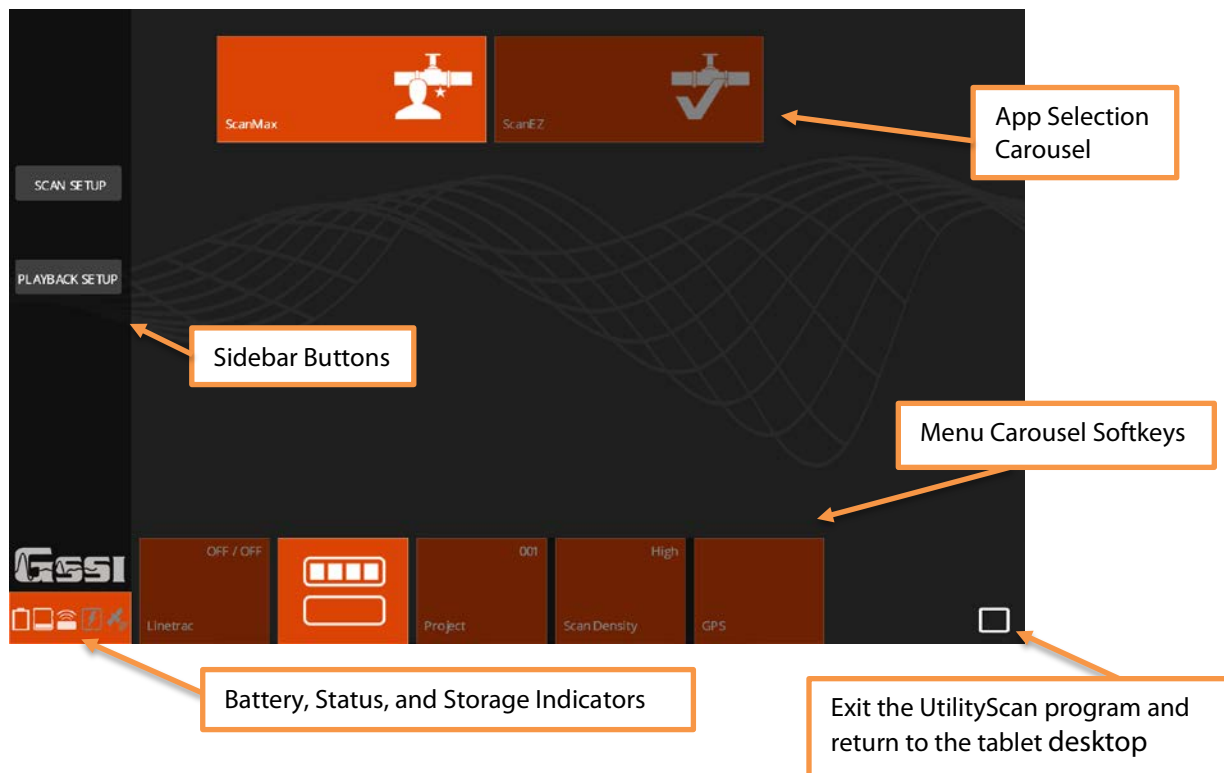
- 1 Turn your UtilityScan antenna Off.
- 2 From the Android tablet desktop, tap Settings.
- 3 Tap Wi-Fi from the Wireless & Networks section at the top. You will see a list of available networks. Tap the one to which you want to connect.
- 4 Input the network password.

Note: You will need to manually disconnect from any non-UtilityScan connections before connecting to the antenna. You will need to do this even if the network you had connected to is off or out of range. Follow these steps to do so:

- 1 From the Android tablet desktop, tap Settings.
- 2 Tap Wi-Fi from the Wireless & Networks section at the top. You will see a list of available networks. Tap the one to which you want to disconnect. A box with the network information will pop up.
- 3 Tap Forget. You can now connect to the UtilityScan antenna normally.



The Main Menu Screen



First Time Setup

- 1 Set Language:** Make sure that the UtilityScan is in the ScanMax App. Tap on the Secondary Menu softkey in the Menu Carousel to display the secondary menu. Tap Select Language and choose your desired language.
- 2 Set Units:** Tap Units from the Menu Carousel to toggle between English (Imperial) and Metric units.
- 3 Calibrate Antenna:** This option will run an auto-calibration routine on the antenna signal position. Assuming a correct dielectric value, this will ensure your depths are more accurate.
- 4 Calibrate Survey Wheel:** While there is minimal manufacturing variation in the survey wheel encoders, it is still a good idea to occasionally calibrate the survey wheel to ensure distance accuracy.
- 5 Save Prompt:** Tap this to toggle the Save File courtesy check on and off. Setting this to Off will cause the UtilityScan to automatically save each file.



Secondary Menu Softkey

The choices you have made here will carry over to the ScanEZ Collection Apps.



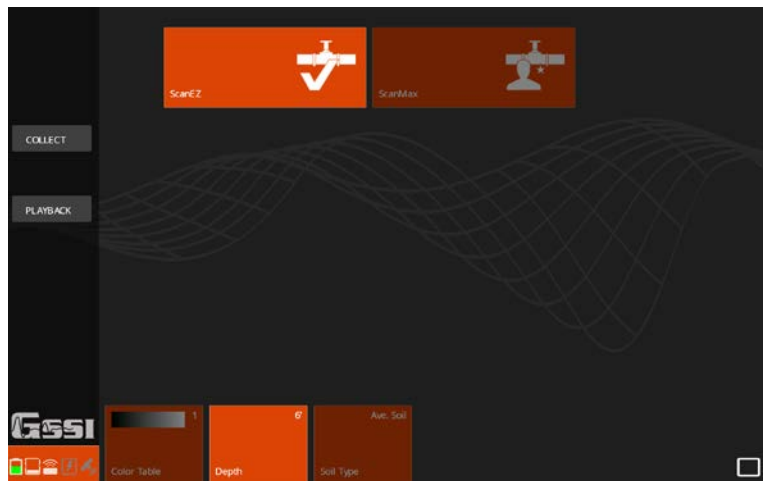
The status indicator shows (from left to right): **1**) Antenna battery power. **2**) Tablet storage. **3**) Antenna connectivity (white = positive, gray = negative). **4**) LineTrac module (white = on, gray = off, crossed = damaged). **5**) GPS indicator.

Section 2: Using ScanEZ Application

Before collecting any data, you may want to configure your UtilityScan. Tap ScanEZ from the App Carousel.

- 1 Choose Inspection Depth:** Tap Depth to toggle through the pre-set depth settings. GSSI recommends setting the inspection depth a little deeper than required.
- 2 Set Soil Type:** GPR energy travels at different speeds though different materials. Setting this close to the material type through which you are scanning will provide more accurate depth readings. These names refer to the majority of material, not just the surface cover. See Appendix A in this guide for details.
- 3 Choose Color Table:** This will set the data display color. GSSI recommends that new users choose Color Table 1.
- 4** Once you have configured the UtilityScan, tap Collect to begin collecting data.

Note: The UtilityScan will detect the direction of first movement as “Forward.” This means that if you pull the cart backwards as the first movement after tapping collect, the UtilityScan will collect data going backwards. This will not change the direction which the data file scrolls on the screen.

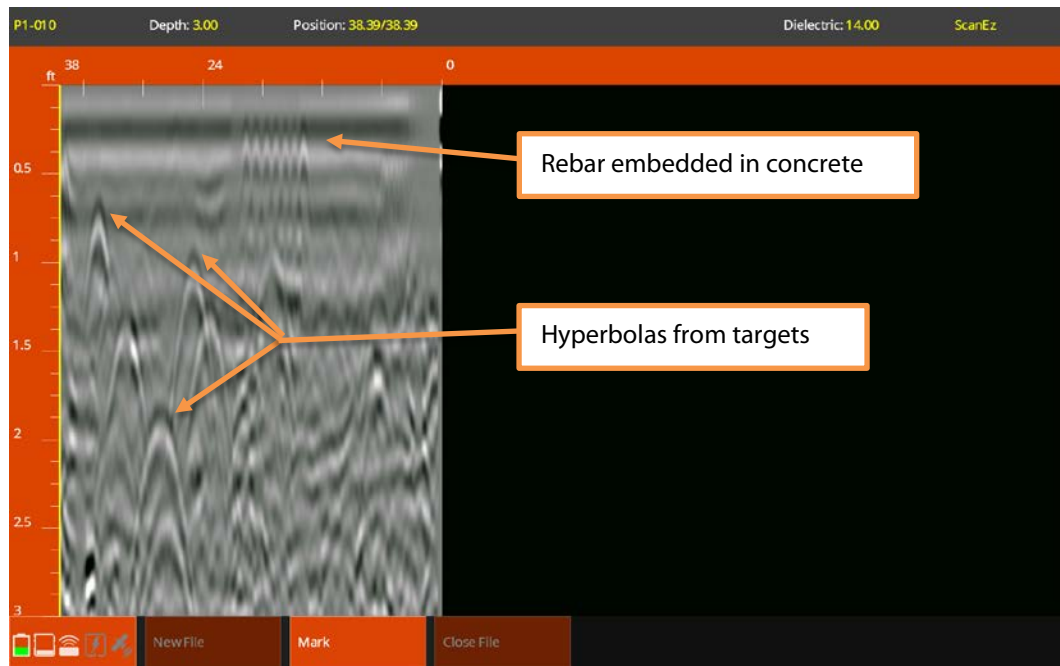


Collecting Data and Marking Targets with Scan EZ

The image at the right shows the tablet screen while the UtilityScan is actively collecting data. Data will be added to the left edge of the screen as you push the cart.

The left edge ruler indicates a depth estimate based on the current dielectric value. The current project number and file name are shown at the top-left corner of the top bar.

The top bar also indicates depth, linear position, dielectric, and current app. Targets such as pipes will appear as hyperbolas when crossed at a 90-degree angle.

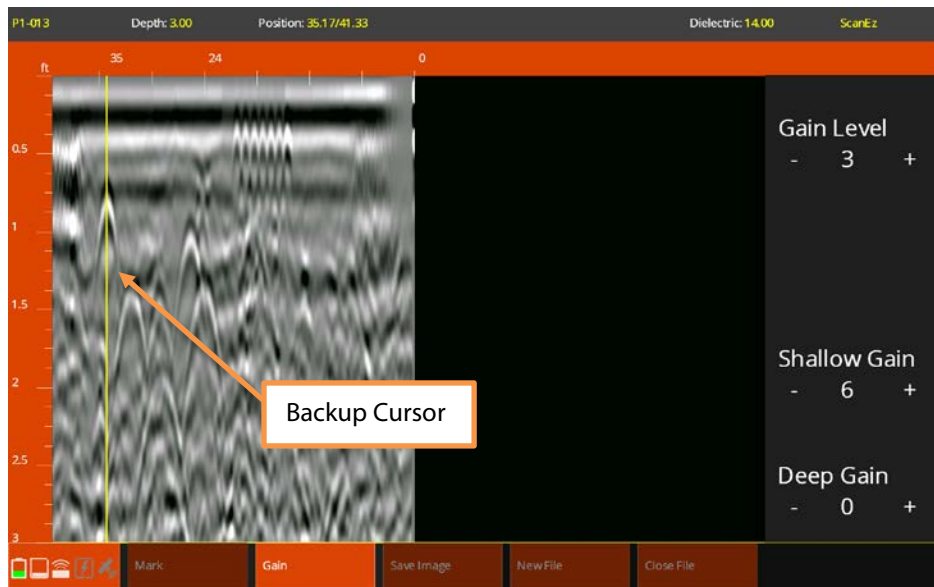


The image at the right shows the buttons active on the bottom Menu Carousel when the UtilityScan is backing up to mark a target.

Once you have identified a target which you want to mark, simply back up the UtilityScan in a straight line. You will see the yellow vertical backup cursor appear on the screen. Move the UtilityScan until the cursor bisects the hyperbola. Draw a mark on the ground lining up with the marking grooves on the side of UtilityScan cart.

The image at the right shows the Gain function. Gain will help to brighten the screen contrast and may make it easier to see targets. Tap Gain to bring up the control sidebar. Gain Level will affect the whole vertical scale while Shallow and Deep will focus on those portions of the image.

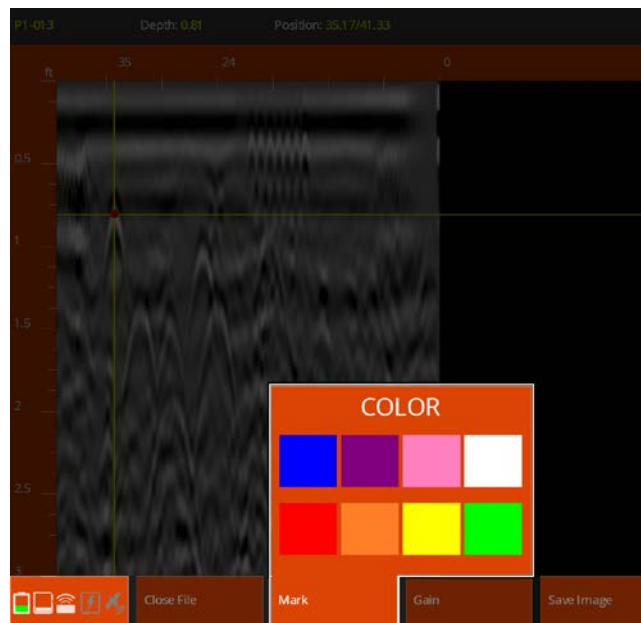
Tap Save Image to save a screen shot of the current view. You must save the data file and transfer it to your PC in order to access the saved image.



Once you have identified a target to mark, use your finger to move a horizontal crosshair to that target's location. Tap Mark to bring up a color selection box. These colors conform to the APWA uniform color code. Tap the color corresponding to the type of utility. The mark dot will change to the selected color. Please note that the GPR does not discriminate between different pipe types, so pipe identification should come from alternate information.

APWA Uniform Color Code:

- **Blue:** Potable water.
- **Purple:** Reclaimed water, irrigation, slurry.
- **Pink:** Temporary survey markings.
- **White:** Proposed excavation.
- **Red:** Electric power.
- **Orange:** Communication or telephone.
- **Yellow:** Gas, oil, steam.
- **Green:** Sewer and drain lines.



Section 3: Using the ScanMax Application

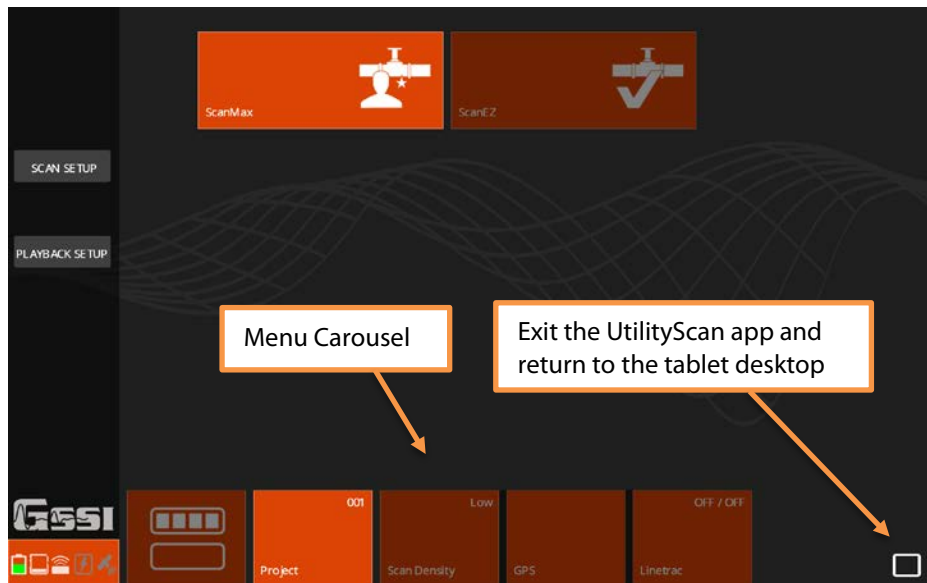
ScanMax is the full-featured application on the UtilityScan. After a job or two, you will likely move quickly from ScanEz to the ScanMax application to take advantage of the wider variety of available features. ScanMax includes a wider variety of tools to help you respond to more complex job situations.

Let's begin by describing the ScanMax app setup screen and the options available in both levels of the Menu Carousel.

Primary Menu

For the primary level of the Menu Carousel (shown) you have:

- **Project:** Think of these as separate folders in the tablet's memory. Different projects can be used to keep separate the files from different jobs. You can toggle through six project slots. Data collected within each project is only viewable when that project is selected.



- **Scan Density:** Toggles through the three settings for scans/ft(m). They are Low = 12/ft (40/m), Normal = 18/ft (60/m), High = 24/ft (100/m).
- **GPS:** Opens the GPS setup screen to allow you to configure an external or internal GPS.
- **LineTrac:** Opens the LineTrac setup screen to allow you to choose the frequency of passive Power Mode and/or Frequency Mode.

Secondary Menu

For the secondary level of the Menu Carousel  you will have the following options:

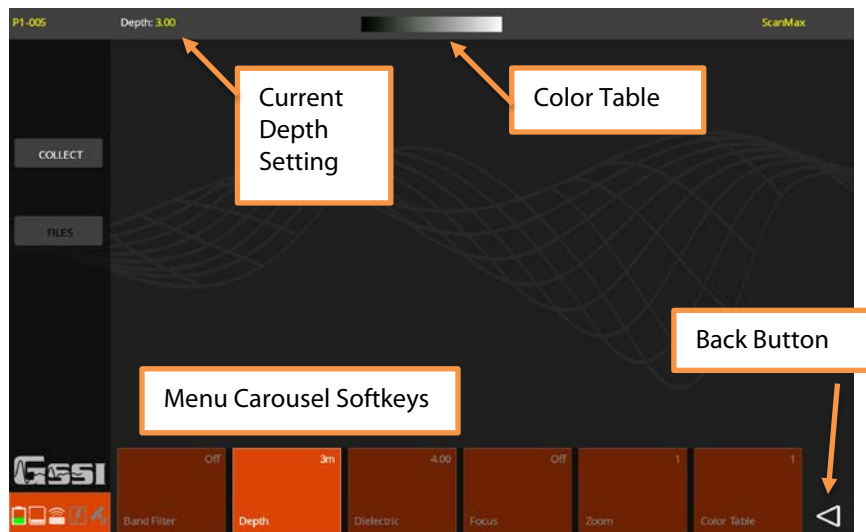
- **Calibrate Antenna:** This option runs the antenna auto calibration routine and re-calculates the overall antenna gain (amplification) level and position of the ground surface.
- **Calibrate Survey Wheel:** Select this to open the survey wheel calibration dialogue. A correct survey wheel calibration will result in more accurate distance measurements and locations. The two options here are Factory Reset and Calibrate. To calibrate, lay out a measured distance with a tape measure (at least 10 ft (3m)) and follow the onscreen instructions.
- **Save Prompt:** This toggles On/Off the courtesy check when you end a file. The UtilityScan will automatically save the file when this is set to Off and it will ask you if you want to save when this is set to On.
- **Display:** This will toggle between the B (2D linescan only) and the A+B (1D O-scope trace and 2D linescan) screen modes.
- **Gain Control:** The UtilityScan incorporates a smart, adaptive auto-gain function. The gain will constantly change to maintain good image quality in changing soil conditions. This toggle changes the rate of change from Slow to Normal to Fast. A fast rate of change is better for extremely variable soil conditions.

- **Factory Reset:** Reset all settings to factory defaults.
- **Version Control:** View the current software user interface and antenna firmware versions. You can also use this to update.
- **Select Language:** Use this to choose your desired language.
- **Units:** Toggle between English (Imperial) and Metric units.
- **Theme:** Toggle through the available user interface color schemes.

Once you have made your choices in the Carousel Menu, tap Scan Setup on the left sidebar to transition to the Scan Setup screen at the right.

The Menu Carousel will have the following options:

- **Depth:** Toggle through a list of preset values for depth of investigation. These are approximate. Exact depths are a function of soil conditions and the dielectric constant you have specified.
- **Dielectric:** This will allow you to enter in the assumed dielectric value of the material through which you are scanning. A correct value will result in an accurate time to depth calculation. The UtilityScan will also use this value to calculate the time range required to reach the specified depth.



- **Focus:** Toggles the Focus Mode On/Off/Plus. Turning the focus on will display a split screen during collection. The top image will show the data with a migration process applied and the bottom will be un-processed data. Migration is a filter which removes the dipping tails from the hyperbolas and collapses them toward the target's center. A more accurate dielectric value will result in a better image.
- Focus Plus applies a Hilbert Transform to the migrated data. The Hilbert Transform will remove the phase information from the signal (whether the wavelet is negative or positive). The Hilbert can sometimes improve visibility in situations where the amplitude magnitude is more important than the phase information.
- **Zoom:** Toggles degrees of a horizontal zoom. This will stretch your data by a factor of 1, 2, or 4.
- **Color Table:** Choose from six color tables. The color table is displayed at the top of the screen. Positive values are to the right.
- **Band Filter:** Toggles On/Off a horizontal band filter. This filter is designed to downplay horizontal noise artifacts resulting from wet or clayey conditions.

Collecting Data and Marking Targets with ScanMax

It is always easier when locating to proceed from the “known” to the “unknown.” With that in mind, spend some time walking over your survey area before turning on your UtilityScan. Note the presence of any surface feature which could indicate the location of buried utilities. Are there manhole covers, power poles, valve caps, fire hydrants, old markouts, etc.? Try to begin your survey at one of these features. In the instance of a manhole cover, move sufficiently far from it to avoid imaging the concrete catch basin or box and move the UtilityScan in straight lines in a box pattern on all four sides. Note the presence of any hyperbolas which could represent a pipe.



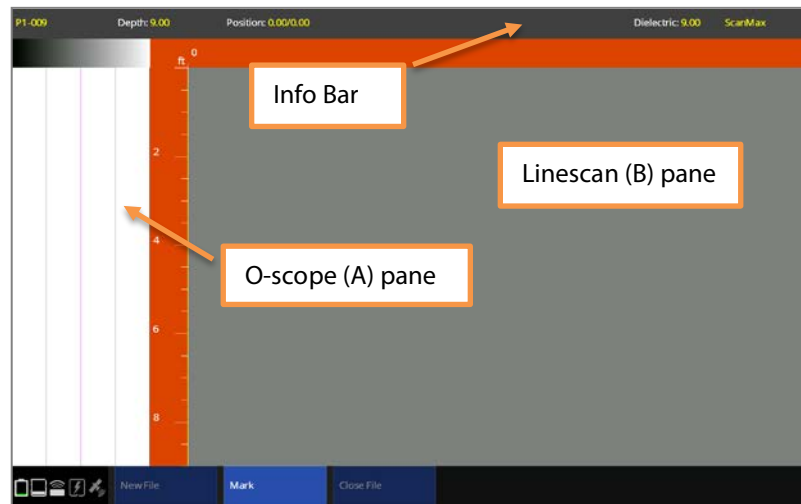
GPR will best image pipes when you cross those pipes at a 90-degree angle. Your survey lines should always be positioned to cross the target you are tracking at a 90-degree angle.

Collecting Data

- 1** Follow the steps on page 3 to boot up, open the UtilityScan app, and select your antenna.
- 2** Tap ScanMax to ensure you are in the correct Collection Mode.
- 3** Select your desired Scan Density, Project Number, Units, GPS and LineTrac settings from the carousel bar at the bottom. See page 24 for LineTrac information. Once those are set, tap Scan Setup from the left sidebar.
- 4** Select your desired Depth penetration, Dielectric, Color Table, Focus, and Band Filter settings from the carousel bar at the bottom. Once those are set, tap Collect from the left sidebar. The image will change to the collection screen below. The example below has A+B scan active.

- 5** Once you see the collection screen at the right, push the cart. The direction in which you first move the cart will be understood by the UtilityScan as “forward” for that file and the system will collect data in that direction.

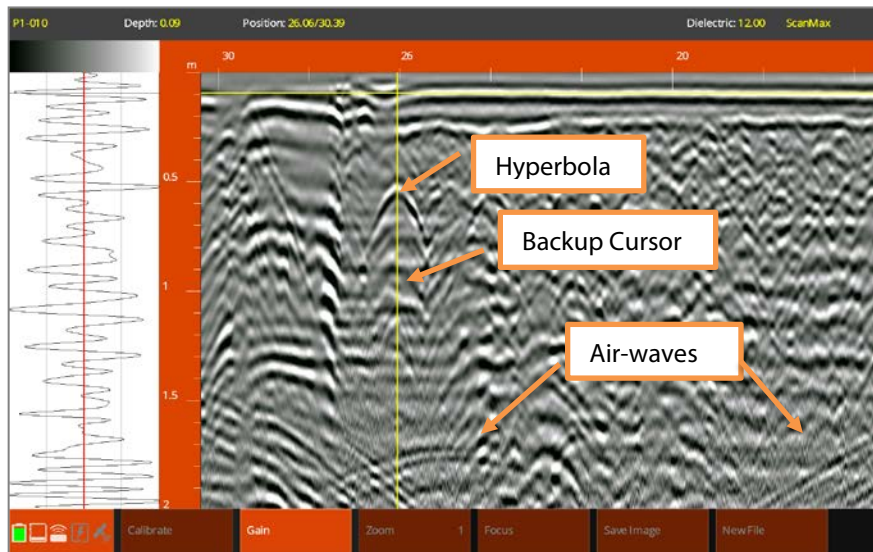
As you move, you will see data begin to scroll on the screen. The UtilityScan will only collect data while the system is moving. It will pause collection if you stop.



Marking Targets

- 1** Push the UtilityScan across your survey area in a straight line. The ground surface will be at the top of the window. The left scale will show an approximate depth.
- 2** Once you see a target that you would like to mark, be sure to go all the way past it in order to get a complete hyperbola.
- 3** Back the UtilityScan in a straight line. You will see a vertical crosshair (the backup cursor) appear. Continue to back the system until the backup cursor bisects the hyperbola. You are now over the center of the object.

Note: In some instances you may notice *air-waves*. Air waves are large, broad hyperbolas which typically occur near the bottom of the window. They are caused by GPR energy leaking out of the bottom of the antenna and reflecting from surface features around you such as trees or power poles.



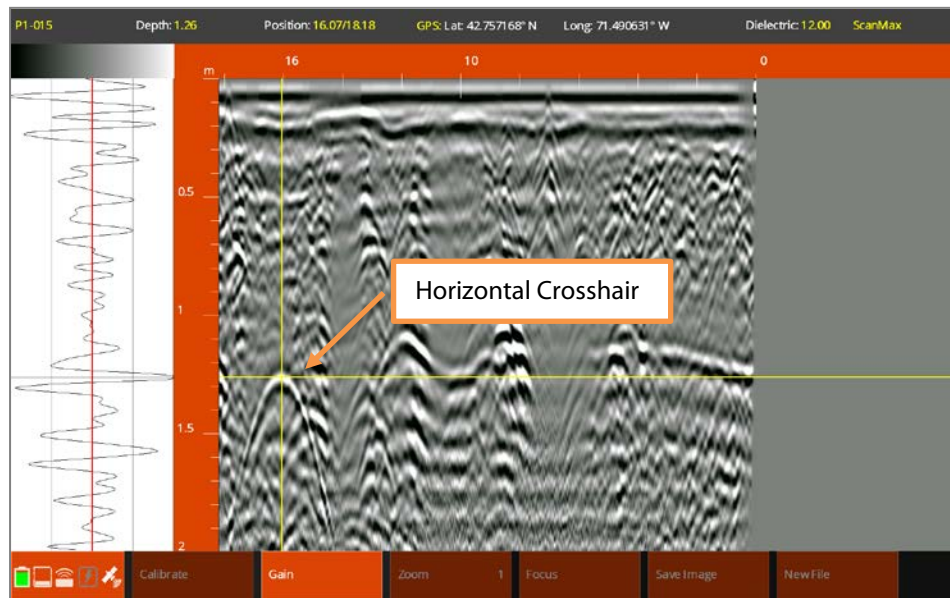
- 4** Mark the ground in line with the marking grooves on the side of the UtilityScan. GSSI recommends marking both sides of the cart.
- 5** Move the UtilityScan back a little more and draw an **"X"** between your side marks and lining up with the marking groove on the front, center of the UtilityScan. The **"X"** represents the point actually imaged on the UtilityScan screen. Note that you have only one point, so you will need more markouts of the same target before you can consider it a utility line (or other linear target).
- 6** Continue to push the UtilityScan forward in a straight line, retracing your steps, to mark additional targets in that file or to collect more data. The UtilityScan will not overwrite data already collected, so you will need to move beyond where you began to back up in order to collect more data.
- 7** Collect more data lines parallel to your previous lines. As you make additional marks you will begin to see a pattern develop.



8 You may also assign a target type in the data. Once you have stopped with the backup cursor over the center of the hyperbola, use your finger or a stylus to move the horizontal crosshair to the target's location along the depth scale. Use the O-scope to match the horizontal crosshair to the center of the first, largest peak (negative or positive) as shown in the image on the right.

9 Tap Mark from the bottom carousel. This will bring up a window with colors conforming to the APWA uniform color code for markouts. Tap the desired color chip to place a dot of that color on the target.

10 Once you are finished, tap Close File to return to the app setup screen or New File to begin collecting a new file with the same parameters.



Calibrating for Depth with ScanMax

GPR works by measuring the two-way travel time (TWTT) of the energy pulse to the target and back. GPR energy moves very rapidly so the TWTT is expressed in nanoseconds (ns) which are billionths of a second. The velocity of GPR energy in soils, sediments, asphalt, rock, etc. can change both with depth and across an area. Since it changes, it can be very difficult to get accurate depth readings with the GPR method. This means that you should always provide a margin of error to your client when quoting depth to target. In homogenous materials the margin of error may be very tight, but if you do not know the subsurface conditions, you should quote a margin of error of at least 10% of the overall depth.

The value used to express GPR velocity in materials is the *dielectric constant*. If you do more research on the GPR method, you may see this referred to as Relative Dielectric Permittivity (RDP) or by the mathematical shorthand of ϵ_r . It is a unit-less measure describing how easily GPR energy moves through a material. The range is 1 (air, close to the speed of light) to 81 (water, 1/9 the speed of light).

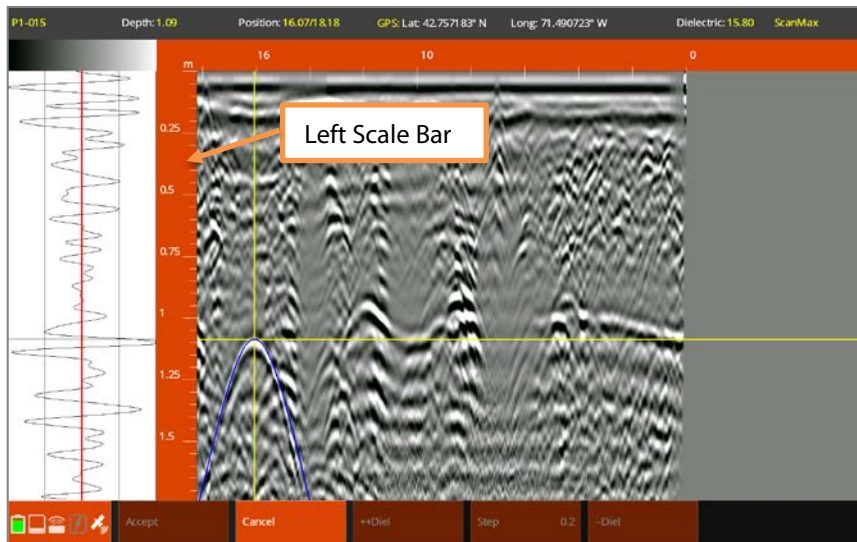
The UtilityScan has two methods of calibrating for depth: Set Depth and Set Dielectric.

Set Depth is used when you have a target at a known depth. You will need to collect some data as close as possible to the point of known depth. This is also known as adding “ground truth” and can result in very accurate depth calculations in homogenous ground conditions.

Set Dielectric uses a software tool called *migration* to calculate the dielectric based on the shape of the hyperbola. You do not need to know the actual depth of the target. In homogenous ground conditions, migration can have equivalent accuracy to ground truth, but in general you should quote a larger depth margin of error than you would if you used Set Depth.

No matter which method you use, you will still need to collect a file of data and place the backup cursor on the target.

- 1** Move the UtilityScan backward to place the backup cursor on the target. Then use your finger or a stylus to place the horizontal cursor on the target.
- 2** Tap Calibrate from the Menu Carousel.
- 3** Choose your calibration method.
 - For **Set Depth**, choose Set Depth and move your finger or a stylus up and down along the left scale bar until the correct depth shows in the info bar at the top of the screen. Alternatively, you can use the +/- Depth buttons in the Menu Carousel to change the value. Tap Accept when done.
 - For **Set Dielectric**, choose Set Dielectric. You will see a blue, hyperbola-shaped border appear on the screen. Using your finger or a stylus, slide up and down on the left scale bar to match the blue hyperbola as close as possible to the shape of the real hyperbola in the data. Alternatively, you can use the +/- Diel buttons. Tap Accept when done.



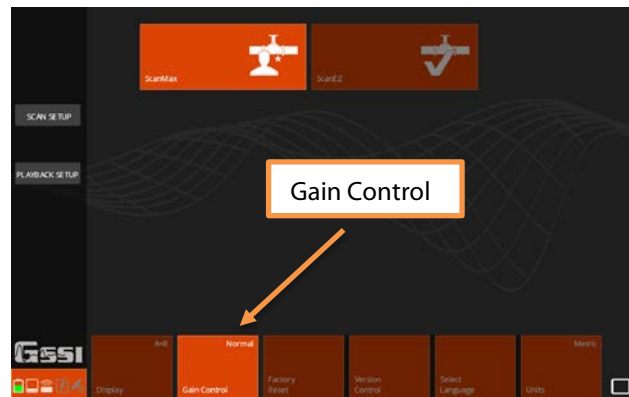
Other Functions in ScanMax: Understanding Gain, Focus, and Save Image

The ScanMax application contains some additional functionality to improve image quality, help you interpret data, and output usable information. Many of these functions are available while collecting data and while playing back data.

Gain

As the GPR signal moves through the ground it will get progressively weaker. This is called *attenuation* and happens because some energy is reflected from targets, some energy is absorbed by the soil, and some energy is lost through the spreading of the signal (dispersion). The deeper you go, the less energy is left. Gain is a mathematical process which works on the received signal to amplify it and counteract the effects of attenuation so you can see deeper targets more easily.

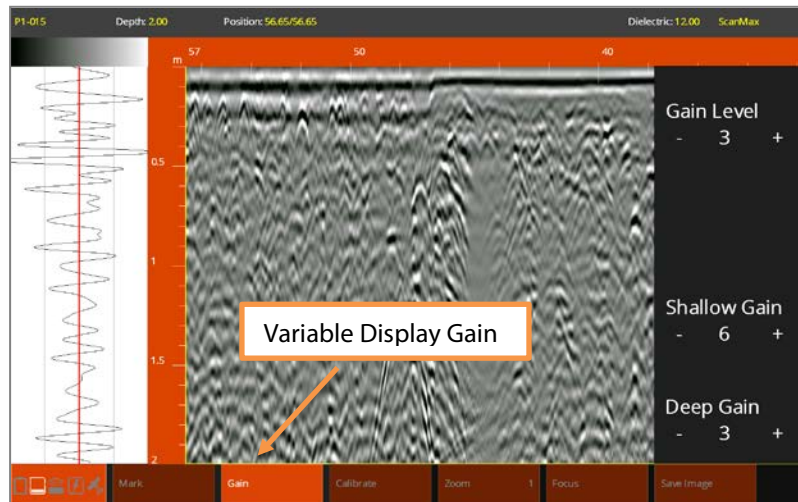
There are two types of gain available on UtilityScan. The first is Automatic Gain Control. It is available in ScanMax setup screen in the secondary level of the Menu Carousel. Gain Control works horizontally, along your survey line. Gain Control has three settings: Slow, Normal, and Fast. Use Normal for most conditions, Fast for conditions which are highly variable, and Slow for situations when you do not want the gain to change dramatically, such as looking for contamination or changes in ground conditions. Automatic Gain Control is available only while collecting data.



The second type of gain is Variable Display Gain (VDG). VDG works in conjunction with automatic gain and provides you with greater personal control over the entire file's gain and the top and bottom sections of the file's depth scale. It is available while collecting data (when the backup cursor is onscreen) and during Playback.

Tap Gain from the Menu Carousel to bring up the VDG gain control pane on the right. By clicking +/- you can change the gain by increments of 3 dB. Adding gain will make the contrast brighter, subtracting will make it weaker. Gain Level will affect the entire vertical scale while Shallow and Deep will affect the top and bottom half respectively.

Note that you must have the backup cursor onscreen to access VDG while you are collecting a file.



Focus

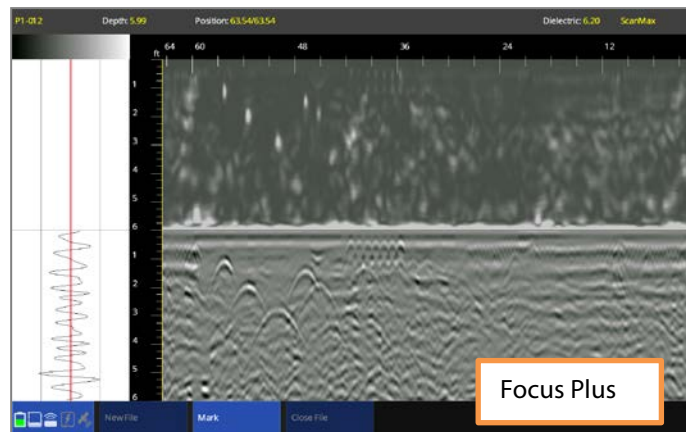
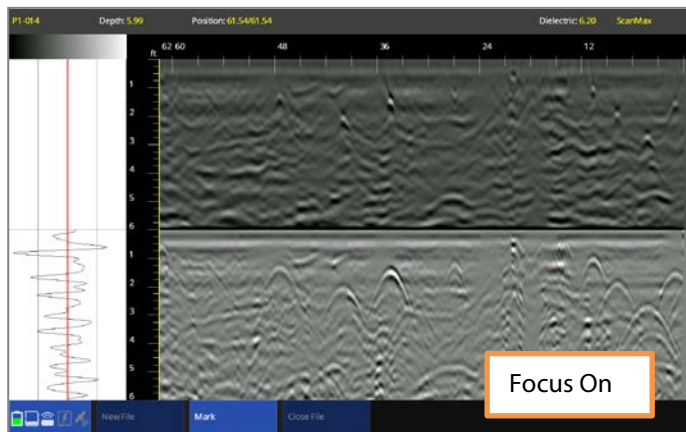
Focus mode is designed to aid visibility by applying a *migration* process to the data and displaying the results in a split screen with the unprocessed data. Migration is a filter which removes the dipping tails from hyperbolas and collapses the reflected energy back to the center of that hyperbola. It is especially useful if you are trying to image utilities through a rebar mat or many tree roots. It is available during data collection and processing. Focus image quality depends on having an accurate dielectric value. GSSI suggests doing a depth calibration with either Set Depth or Set Dielectric prior to using focus.

For collection, choose your Focus type in the Scan Setup screen. The options are On/Off/Plus.

Focus On/Off: This will display focused data in the top pane and remove the tails from hyperbolas. Phase information (white/black color sequence) of the data will be preserved. This is best for locating utilities and attempting to identify the pipe material (metal vs. non-metal) by the phase, or void detection.

Focus Plus: This will also display focused data in the top pane and remove the tails from hyperbolas. In addition, it will perform a Hilbert Transform process and remove the phase information. This is best for situations where you do not need the phase information and only want to know strong vs. weak reflection. Examples would be grave location or utility locating in an environment with many rocks and/or tree roots.

Tapping the focus button while collecting/playing back data will turn your currently selected focus method on and off. During data collection, the Focus button is available whenever the backup cursor is displayed.



Save Image

The Save Image function is available on the Menu Carousel during data collection and playback. For collection, it is active when the backup cursor is onscreen. Tapping Save Image will save a screenshot of the entire viewable screen as a .PNG image file. PNG files are viewable in Windows and Mac OS. To access the image, you will need to save and download the associated GPR data file. It will be saved as FILE###a.png. You can save multiple images from the same data file. Each new file will increment by one letter (a to b to c, etc.).

Using LineTrac

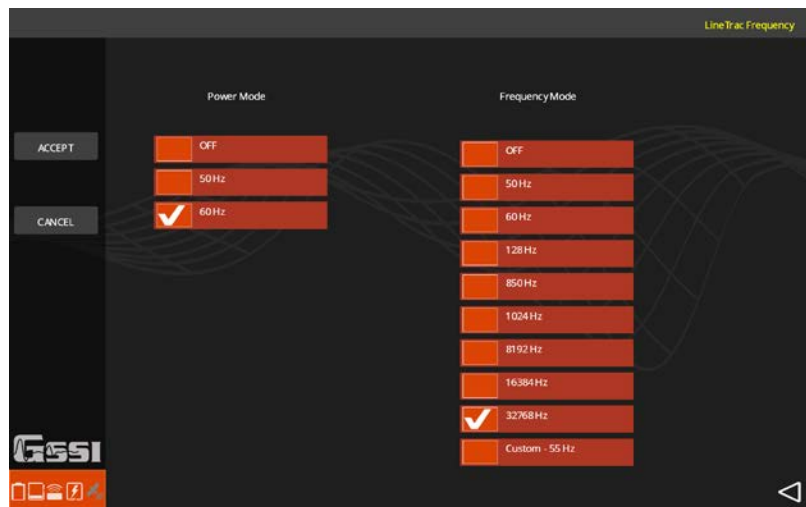
The UtilityScan is available with an optional integrated electromagnetic (EM) line locator. This device is internal and is designed to aid in the detection of certain utilities in two main ways.

Power Mode is a passive AC current detector.

It will detect AC electrical current of either 50 Hz or 60 Hz flowing through a line. The line must be energized and under load to be detectable.

Frequency Mode works in conjunction with an active source to trace a utility. You will need a signal transmitter (not provided by GSSI). This is a commonly available component already owned by many pipe and cable locators. You will need to either direct connect, clamp, or use the transmitter's induction mode to send a signal through a conductive pipe or one that has a tracer wire.

Tap LineTrac from the top level of the Menu Carousel in ScanMax. For Power mode select the AC frequency used in your geographic area. For Frequency mode, tap the frequency corresponding to your transmitter frequency. Tap Accept when done and continue the survey setup as normal.



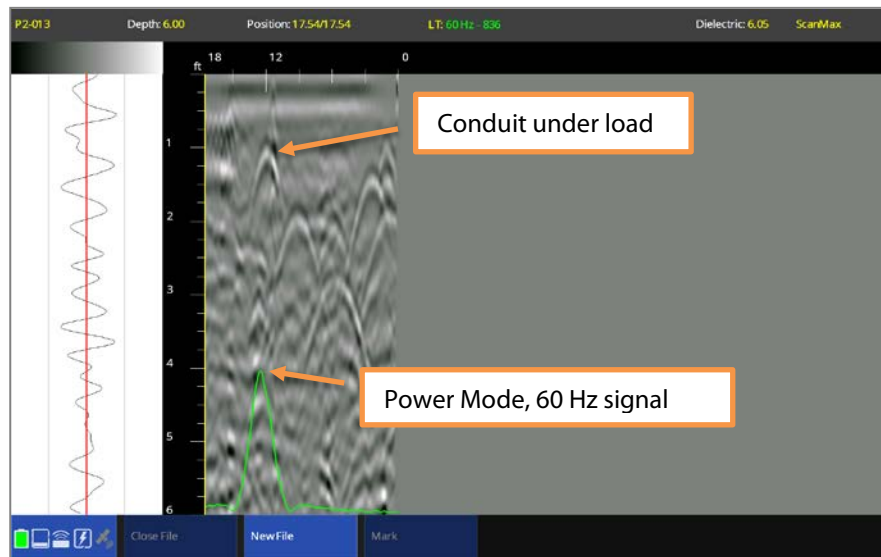
You will see a colored line chart at the bottom of the window while you are collection with LineTrac. The yellow line corresponds to the Frequency mode and the blue line is the Power mode. There is no depth information here, so the line height indicates field strength.

Power mode LineTrac detections will typically show as a peak. The topmost part of the peak represents the strongest part of the EM field which usually corresponds to the target location.

Frequency mode detections may show as an “M” shape. You will want to locate at the deepest part of the “M.”

There is a constant offset applied in software to line up the LineTrac signal with the side marking grooves on the center of the antenna. This means that the hyperbola and Power mode LineTrac peak should line up for a given electrical line.

Note: LineTrac is designed to work best when targets are crossed at a 90-degree angle. You should always orient your survey lines to cross possible utilities at a 90-degree angle.



Using GPS

GPS can be a valuable survey tool but it is best to have realistic expectations of accuracy. Commercial survey-grade systems with centimeter scale accuracy can cost tens of thousands of dollars. The coarser the accuracy, the more affordable GPS systems become. When choosing a system to use with your UtilityScan consider your budget and survey objectives. The UtilityScan communicates with external GPS systems via Bluetooth, so your chosen GPS must have the capability to connect using Bluetooth.

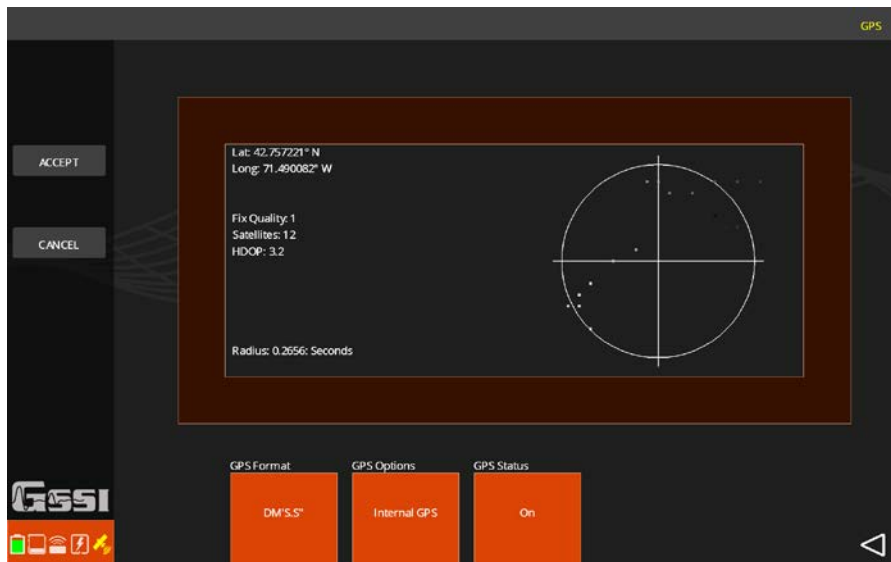
Both tablet options contain an internal consumer grade (3 m accuracy) GPS.

Tap GPS on the ScanMax top level setup screen and the display will switch to the screen on the right. The buttons at the bottom allow you to choose:

GPS Format: Various methods of Lat/Long display and UTM.

GPS Options: Toggle between the internal tablet GPS and external Bluetooth connected GPS.

GPS Status: Turn GPS logging on and off. Once you turn this on, you will not be able to change the format or internal/external GPS, so tap this button last.



Once you tap On you will see information populate the GPS status pane. You will see small dots appear in the crosshair plot at the right. These represent location fixes. The more tightly clustered they are, the better your overall location information. On the left you will see:

Lat/Long (or UTM): Location coordinates displayed in the style you selected in GPS format.

Fix Quality: This is a descriptor which is included in the NMEA-0183 data stream read from the satellites.

- 0: Fix not valid
- 1: GPS fix
- 2: Differential GPS fix.
- 4: Real-Time Kinematic, fixed integers.
- 5: Real-Time Kinematic, float integers.

Satellites: The number of satellites from which the GPS is receiving signal. The more, the better.

HDOP: Stands for Horizontal Dilution of Precision. This is a descriptive value of the quality of your GPS fix. The lower the number, the better the precision. Typically, HDOPs less than 2 are considered excellent. Usually you will have a lower HDOP with more satellites however it is possible to have many satellites and high HDOP if those satellites are clustered together and not spread out. The GPS status icon at the lower-left corner will change color to reflect the HDOP. It will be white for $\text{HDOP} < 2$, yellow for $\text{HDOP} > 2$, and gray for no GPS connectivity.

Note: For external GPS you must connect your GPS to the tablet before starting the UtilityScan app. This will typically be done through the Bluetooth pairing function on the tablet.

Section 4: Playing Back Data

All UtilityScan data are saved on the tablet so you do not need to be connected to the UtilityScan to play back data. While you can play back data in ScanEZ, GSSI suggests using the ScanMax app to play back data. Make sure that the desired Project number is selected in the ScanMax top level setup window.

- 1** To play back previously saved files from the selected project, select Playback from the antenna connection screen or Playback Setup from the ScanMax app. You will have the following options in the Menu Carousel:
 - **Color Table:** Choose from six options.
 - **Band Filter:** Turn On/Off a filter which downplays or removes horizontal banding resulting from noise.
 - **Focus:** Turn the Focus Mode On/Off/Plus.
 - **Zoom:** Toggle a 1,2, or 4 times horizontal stretch for your data.
- 2** Once you have made your selections for these parameters, tap Files on the left sidebar to bring up the File Maintenance screen. You will see a list of all saved files in the currently selected project. Tap the box to the left of the filename you would like to play back. You will see a “check” appear in that box and the Playback button at the left will light up. Tap Playback. The file will display and you will have the following options in the Menu Carousel:
 - **Close File:** Close the current file and return to the Playback Setup screen.
 - **Mark:** Add a mark at the current location of the crosshairs and tag it with a color.
 - **Gain:** Adjust overall, surface, and deep gains to adjust data visibility.
 - **Calibrate:** Use Set Depth or Set Dielectric to refine the time to depth calculation.
 - **Zoom:** Toggles a 1,2, or 4 times horizontal stretch for your data.

- **Focus:** Toggle Focus Mode On/Off/Plus.
- **Save Image:** Snaps a screenshot of your data and saves it as an image file. Transfer the data file to your computer in order to access the image.
- **Next File:** If you have selected more than one file to play back, this option will display the next data file in sequence.

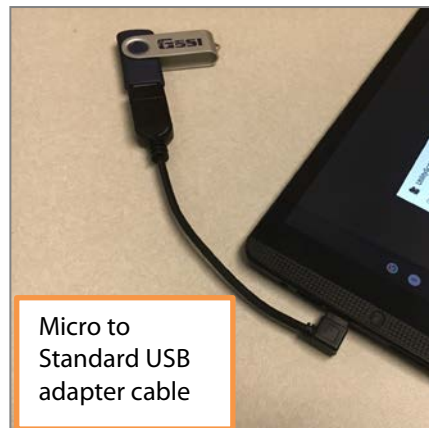
Section 5: Data Transfer to a PC

Data files you collect with the UtilityScan can be processed in GSSI's GPR data processing package, RADAN. Data transfer is done with a USB drive.

If you have purchased a UtilityScan with the **NVIDIA Shield** tablet, you will need a micro USB drive or the micro to standard USB adapter cable. This cable was included with your system. If you have misplaced it, they are commonly available at low cost from many electronics stores.

UtilityScans equipped with the **Panasonic ToughPad** do not require an adapter cable because the ToughPad has a standard-sized USB port. Simply plug the drive into the USB port.

You will get this message the first time you plug a new USB drive into either tablet:

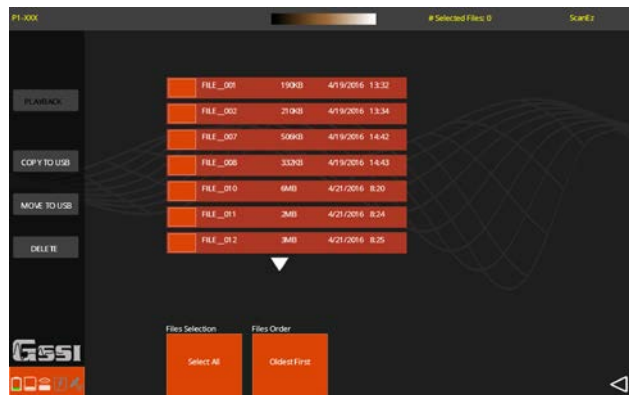


If you tap “Use by default...” then the UtilityScan app will automatically open when this USB is inserted.

Note: Inserting a new USB drive while the UtilityScan app is running will cause the app to instantly close and return you to the tablet desktop. Any data file you are currently collecting will be lost.

Once the drive is inserted, tap UtilityScan (if not already open) from the tablet desktop. It is not necessary to have the antenna nearby and powered up since all the information is stored on the tablet.

- 1** Tap Playback from the antenna connection screen or Playback Setup from the ScanMax, or Playback from ScanEZ.
- 2** Tap Files from the left sidebar to open the file browser screen.
- 3** Select the files you want to copy by tapping the box to the left of each file name. You can also tap Select All to select all files. If you have more files than are shown, use your finger or a stylus to swipe up/down on the list to show more. You can also sort the files by date by tapping File Order.
- 4** Once the files are selected, tap Copy to USB. File copying is done when the status bar disappears. Selecting Copy will preserve the file on the tablet while selecting Move will copy the file to the USB and delete it from the tablet. Files are stored on the USB in a folder named “RADARDATA.”

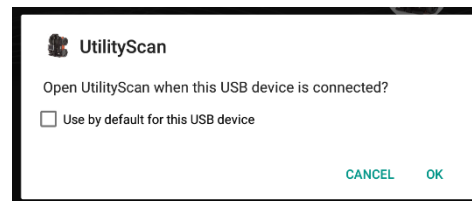


Delete files by performing Steps 1-3 and then tapping Delete.

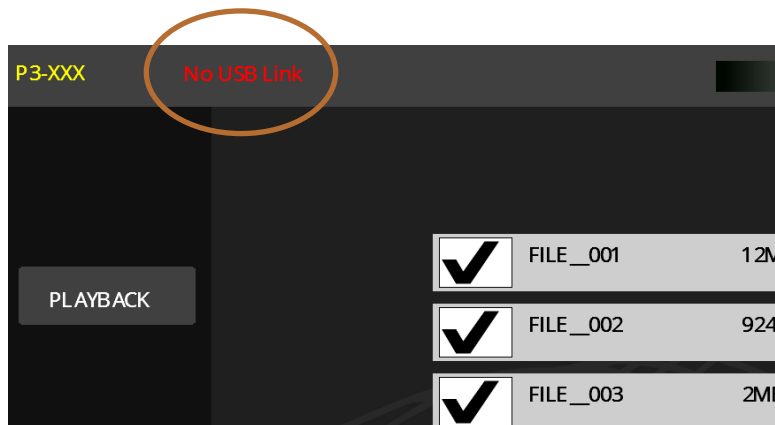
Note: While most USB drives will work fine with the Android tablets, there may be certain brands/models which are formatted differently and thus may not function properly with the Android operating system. USB drives of 32 GB or less are more reliable than very large drives.

There are two checks performed on the drive.

Check #1: When the drive is inserted, the pop up shown at the right will appear. This indicates that the Android OS has detected the drive and has triggered the UtilityScan app. If the drive had been used previously, the app may automatically open. If there is no response from the Android OS than the drive likely cannot be read. You should try another USB drive.



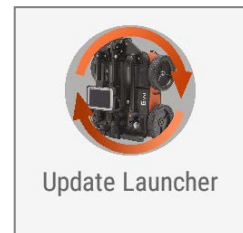
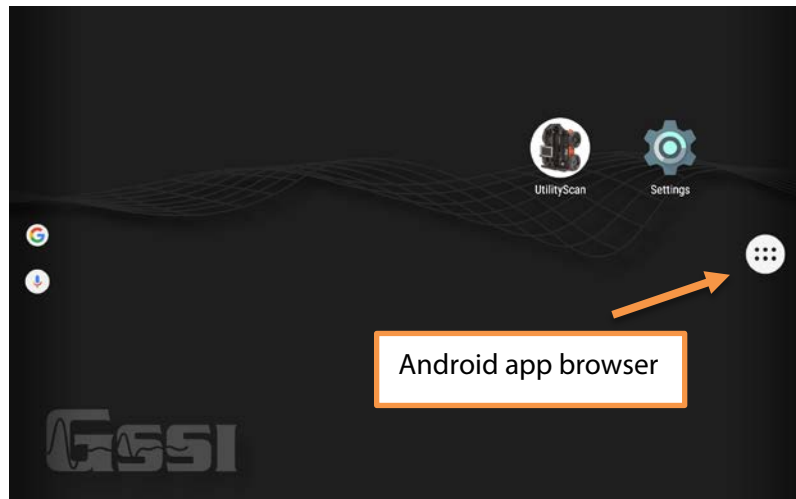
Check # 2: Assuming the USB drive can be read by the Android OS, the next check happens when you transfer data. After selecting the files and tapping copy, look at the top bar for the “No USB Link” message. This indicates that Android OS cannot communicate with the USB to write data. You should try another USB drive.



Section 6: Updating the UtilityScan Software

GSSI will occasionally update the UtilityScan app and/or the software which controls the internal functions of the antenna (firmware). These updates may add functionality or fix new bugs. GSSI has included an update tool on the tablet. You will need to connect to the Internet to download updates. Please see page 5 of this Guide for instructions to connect to the Internet.

Once connected to the Internet, tap the Android app browser to access and scroll through the pre-loaded apps until you find the Update Launcher. Tap the Update Launcher and follow the on-screen instructions to download the correct software update for your tablet model.



Appendix A: Tablet Specific Cable and Accessory Set

Your UtilityScan will come with different cables and accessories depending on which tablet configuration you have purchased. All systems include two batteries for the UtilityScan antenna, dual bay UtilityScan battery charger with universal plug set, and 2-meter long Ethernet cable.

For systems equipped with the NVIDIA Shield, GSSI part numbers FGUTILITYSCAN/LT and FGUTILITYSCAN/B

- Mount for the NVIDIA Shield.
- Shield charger with Micro USB cable.
- Micro USB to Standard USB adaptor.
- Ethernet to Micro USB adaptor.

For systems equipped with the Panasonic Toughpad FZ-B2, GSSI part number FGUTILITYSCAN/RLT

- Mount for the Panasonic Toughpad.
- Panasonic Toughpad AC power supply for charging the tablet.
- Panasonic Toughpad extended battery.
- Sun shade.

Appendix B: Optional Accessories

GSSI offers optional accessories for the UtilityScan system. Please contact your GSSI sales representative for details.



Pelican Transit Case



Tablet Sun Shade



Battery Booster



Battery Booster Installed

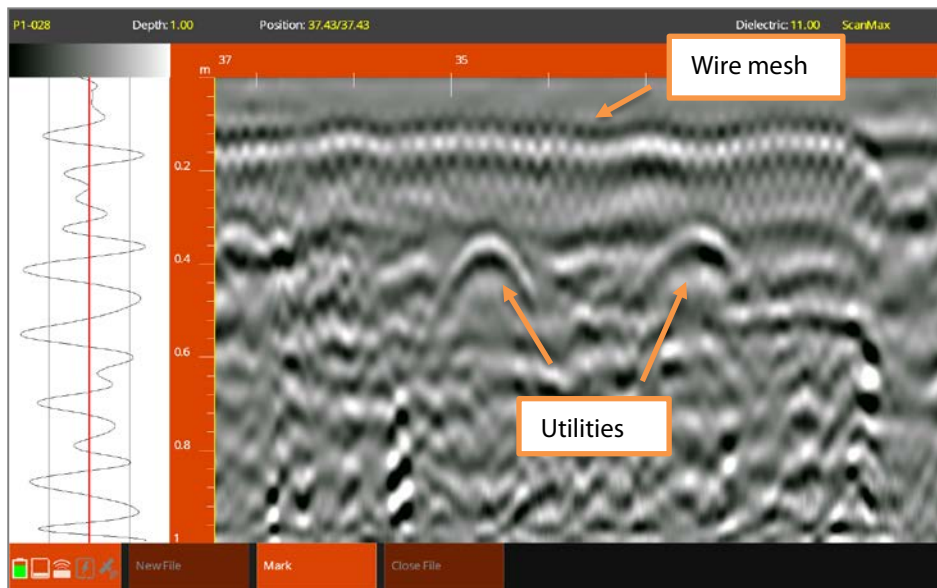
Note: The battery booster accessory will significantly extend the battery life of the NVIDIA Shield tablet. It is strongly recommended for users of the NVIDIA Shield.

Appendix C: Handle Configurations

It is possible to configure the UtilityScan handle in a multitude of different ways for different terrain types or operator comfort. Below are just a few suggested configurations. Note, these are shown with the optional (but recommended) battery life extender for the NVIDIA Shield.



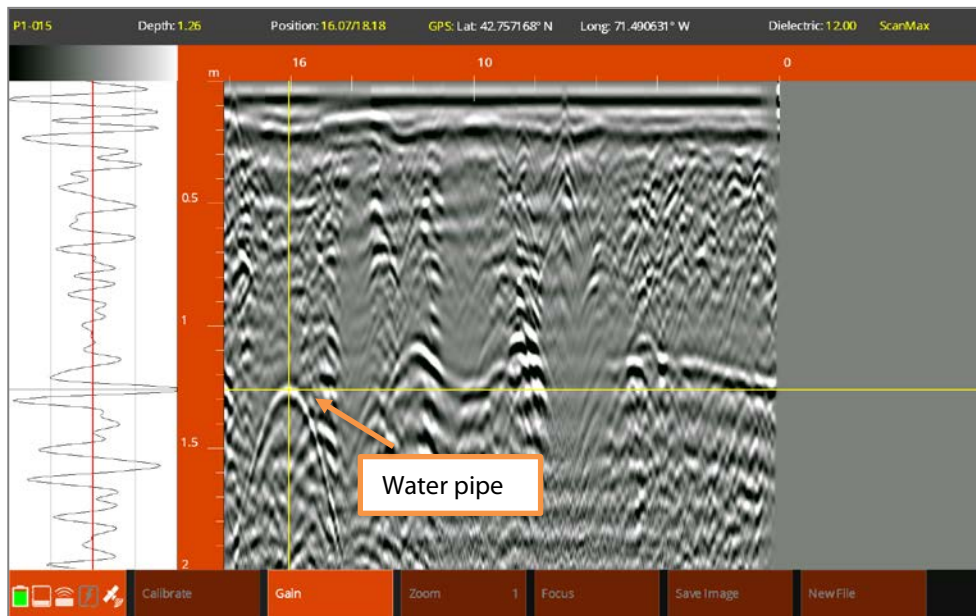
Appendix D: Examples of Common Targets



Utility lines under a reinforced concrete slab

The image at the left shows two utilities located in the grade underneath a concrete slab reinforced with 6" welded wire mesh.

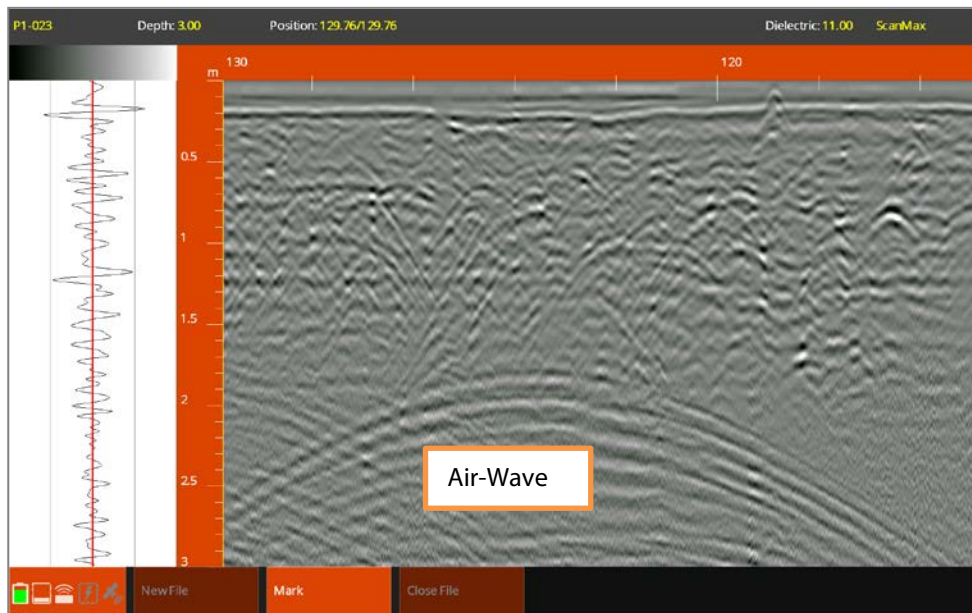
GPR signals are often blocked by near surface metal, however the resolution of the UtilityScan's 350 MHz HyperStacking antenna is fine enough to image the mesh and objects below.



Water Line

This image shows a (likely metal) waterline at roughly 4 feet deep. Note the symmetry of the hyperbola. The brightness and symmetry can sometimes be clues that the target is a pipe and not a rock.

The water line identification comes from non-GPR circumstantial evidence. This survey was performed near to a marked water valve and local construction codes specify that water pipes must be at least 4 feet deep.



Air-Wave

The image at the left shows an air-wave. This reflection is not from an object underground but from above it. In this case the reflection is caused by overhead powerlines.

Air-waves will always be extremely wide hyperbolas. An excellent way to confirm that it is an airwave is to attempt a Set Dielectric calibration on the hyperbola. If you get a number of near 1 for the dielectric value, then the reflection is an air-wave.