EM Equipment Operations

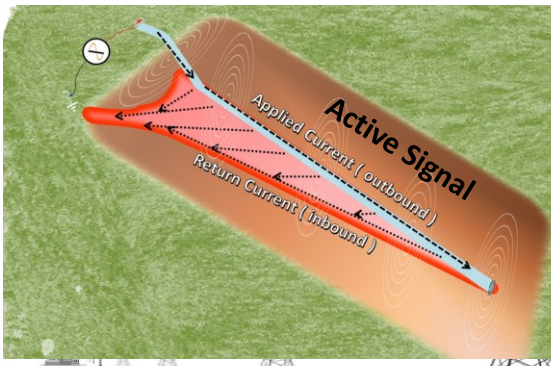
Signal Transmitter

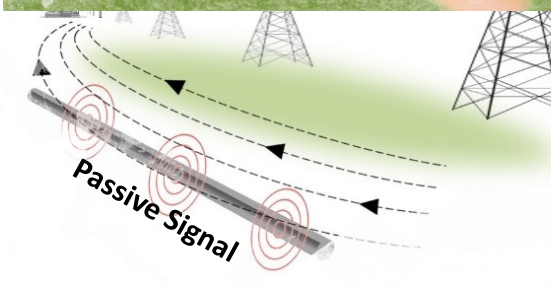
Signal Receiver

Sweep, Pinpoint, Tracing Techniques

1

2 Types of Detectable EM Signals





- Active Signals are applied by transmitter
- Passive Signals are already present on many buried conductors and are detectable by a signal receiver programed to detect their specific frequencies.

2

Active Signal Transmitter

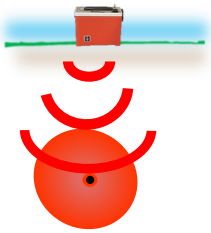
Active Signal Application Methods

- Direct Connection: (metal to metal contact) is made between the transmitter's wire leads attached to the conductor and the ground stake
- Utilizes the signal wave as the force that creates the current. Signal induced by ring clamp or using the transmitter to broadcast signal to buried conductor.

Direct Connection

Signal Induction

Broadcast Induction

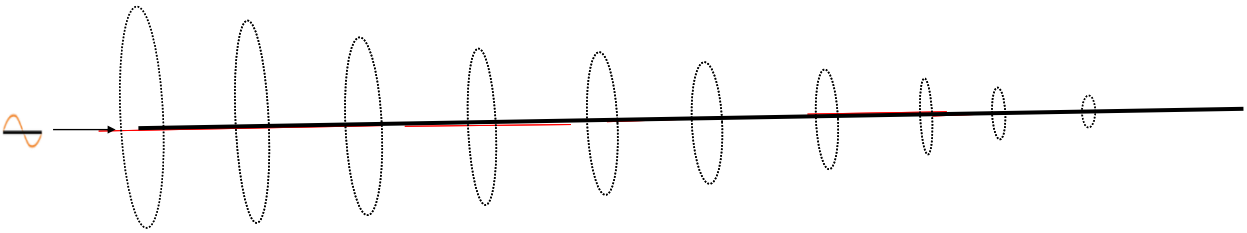


Signal Clamping

3

Signals Applied By Transmitter Will Attenuate

The applied EM force weakens with distance from the source of its potential. The force is met with resistance along the circuit and eventually attenuates or cease to exist.



4

Direct Connection Method (metal to metal contact)

"Locating Best Practice" should be first choice for applying an active signal is to directly connect to your target line

Applied current will flow along the path of least resistance within a conductive circuit

- When attaching transmitter clips, insure good metal to metal connection between clip and conductor.
- Place ground stake at 90-degree angle from the expected path of the line
- Better grounding = better signal

(add water to temporary ground stake, if necessary, to increase signal current)

5

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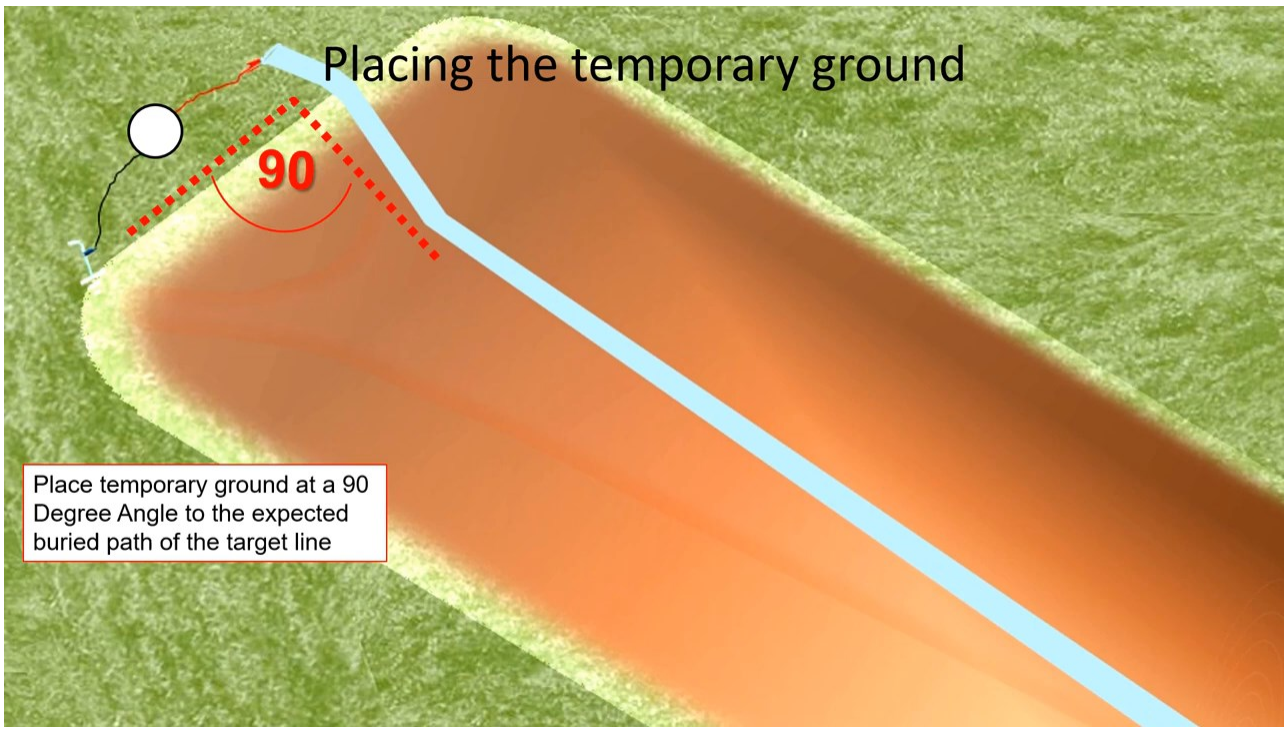
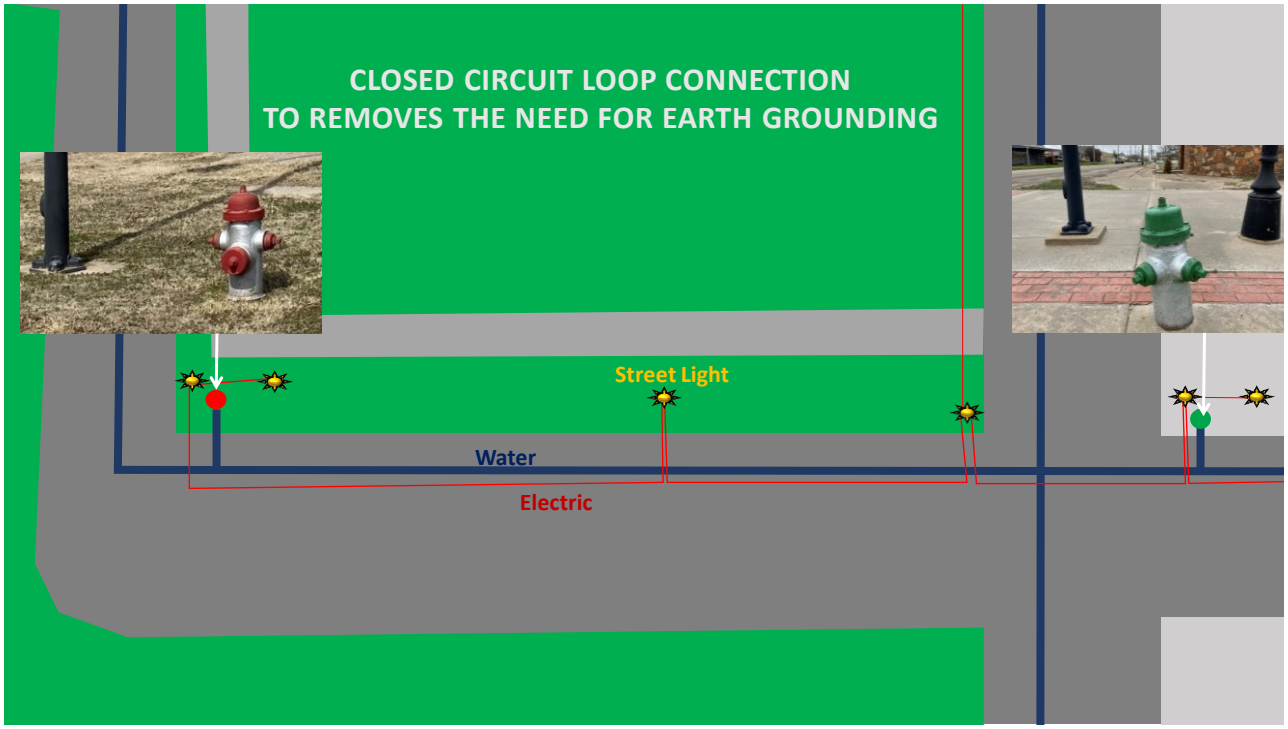

Placing the temporary ground
90
Place temporary ground at a 90 Degree Angle to the expected buried path of the target line

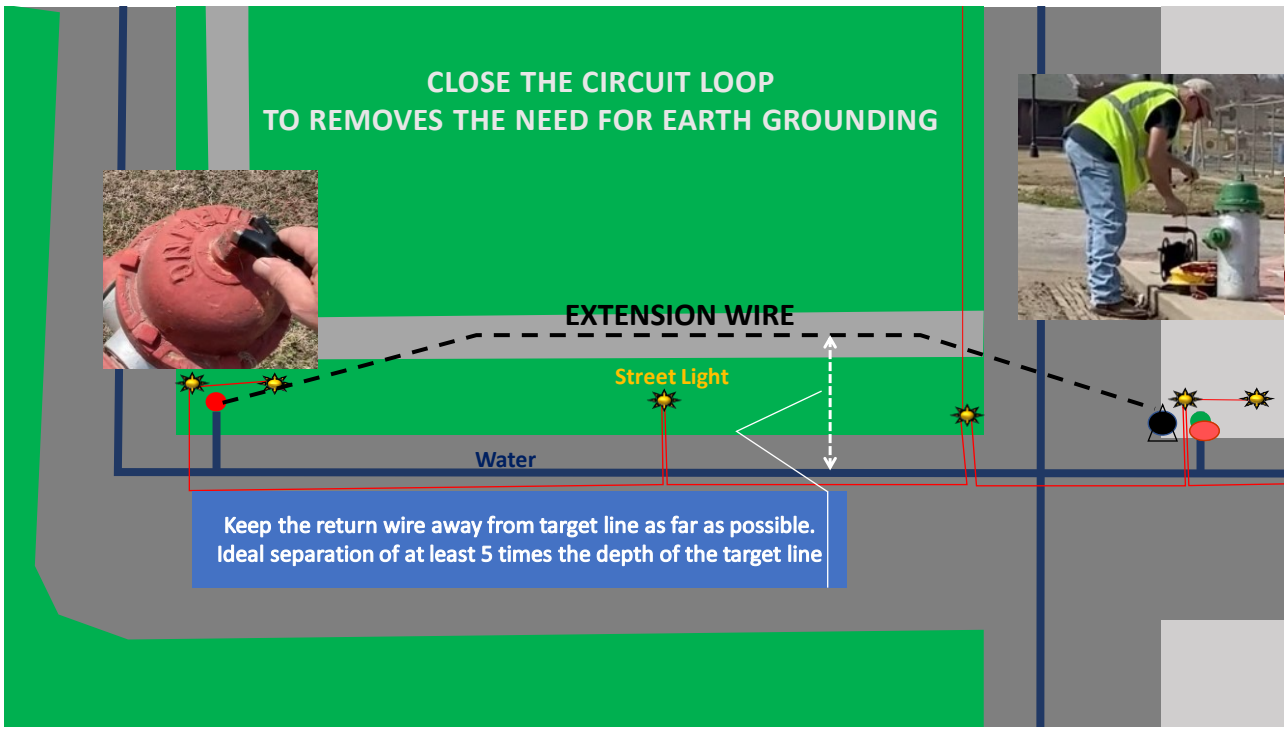
10

A few more tips on grounding

- Do not place ground over or towards adjacent buried lines
- Do not place ground on the other side of adjacent lines
- Do not place ground close to metallic fences that run parallel with target line
- A shovel or probe usually provides a better grounding results due to a larger surface to earth contact.
- Add water to temporary ground stake to improve grounding conditions.


CLOSED CIRCUIT LOOP CONNECTION
TO REMOVES THE NEED FOR EARTH GROUNDING
Street Light
Water
Electric

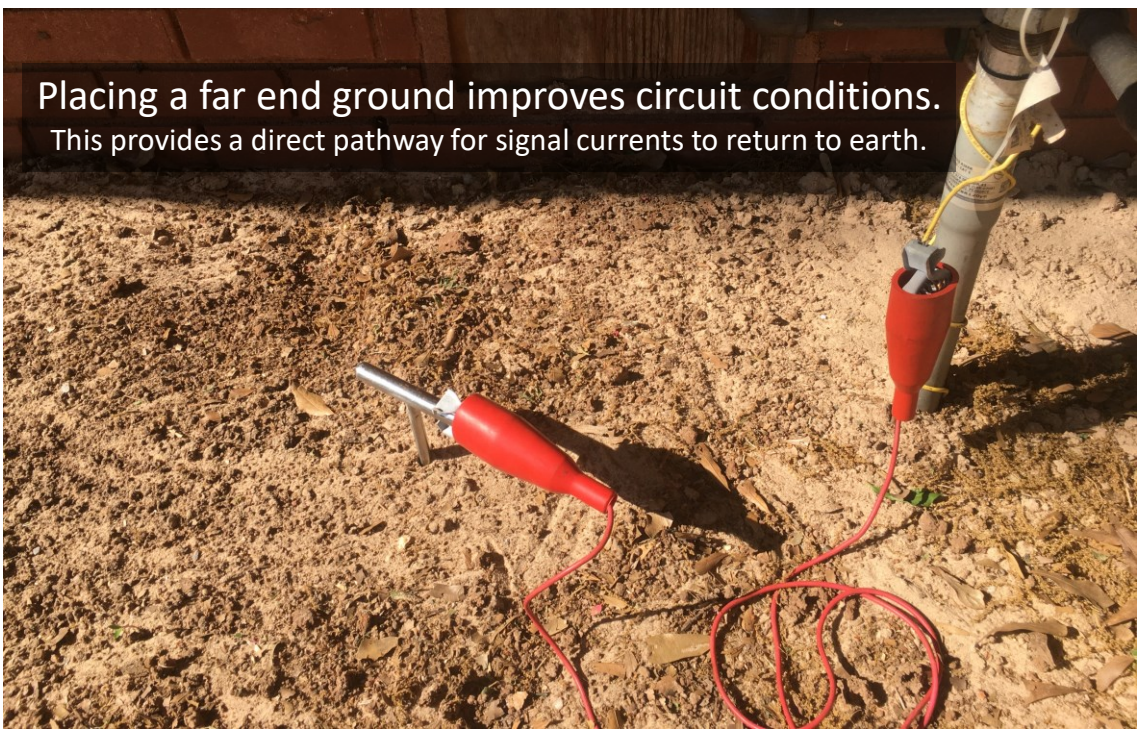
13


CLOSE THE CIRCUIT LOOP
TO REMOVES THE NEED FOR EARTH GROUNDING
EXTENSION WIRE
Street Light
Water
Keep the return wire away from target line as far as possible.
Ideal separation of at least 5 times the depth of the target line

14


N Depot Ave
N Seay Ave
W Broadway St
W Broadway St

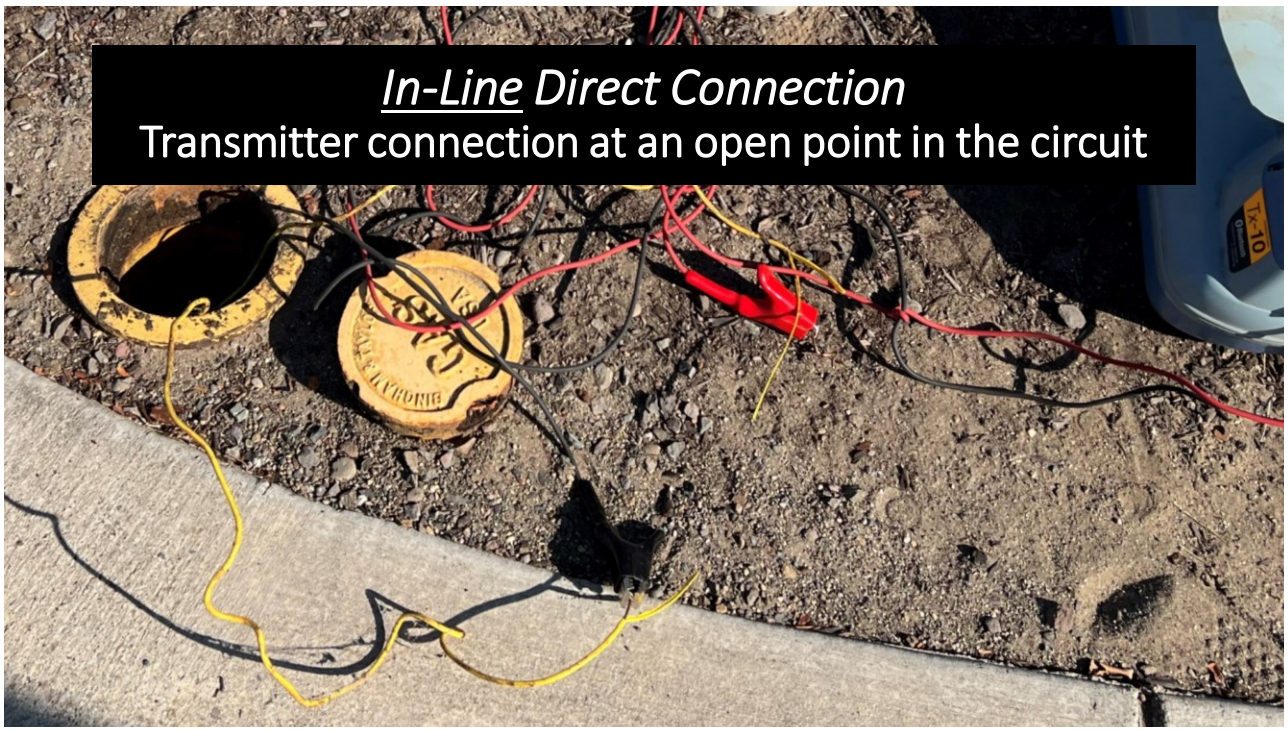
15


Placing a far end ground improves circuit conditions.
This provides a direct pathway for signal currents to return to earth.

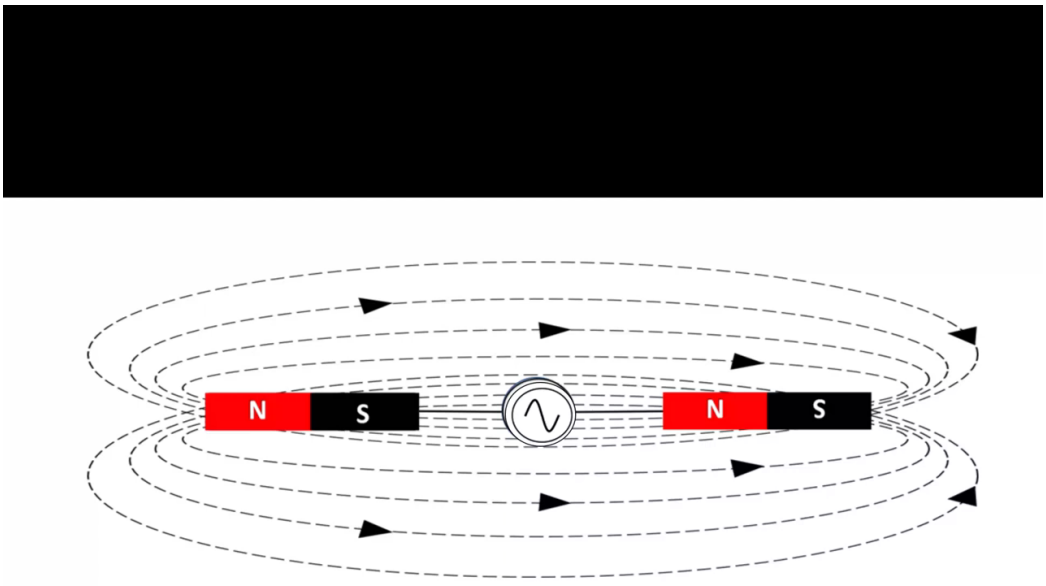
16


VIVAX METROTECH
vLoc3-Pro
42.5
124dB 145mA
32.8kHz
The end of a tracer wire represents an open in the circuit loop
Connect the tracer wire to the ground to complete the circuit loop
17

17


In-Line Direct Connection
Transmitter connection at an open point in the circuit

18



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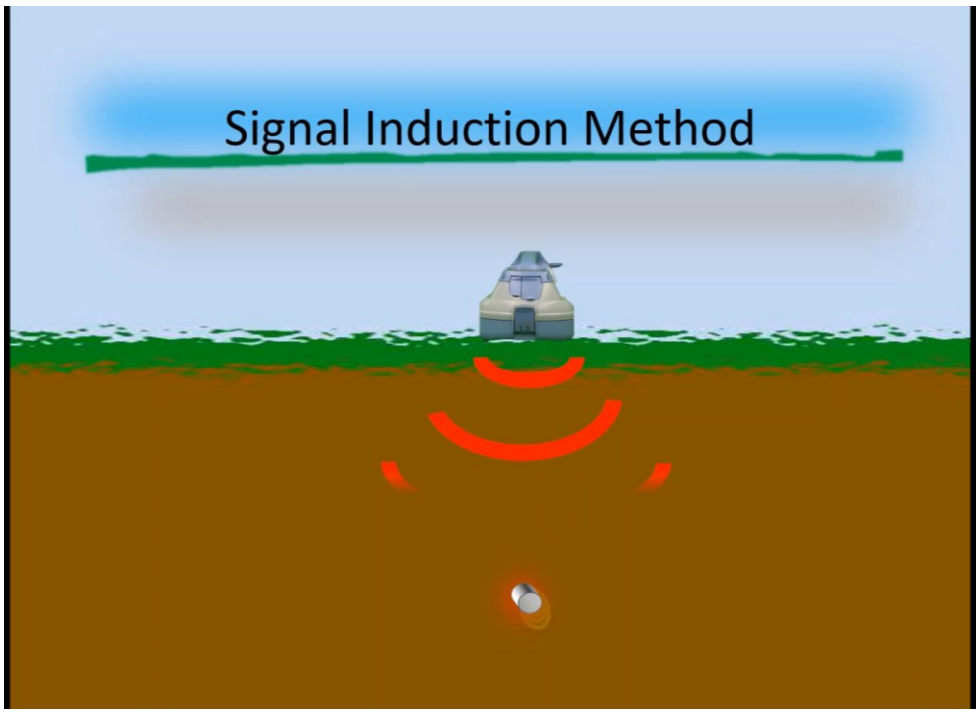

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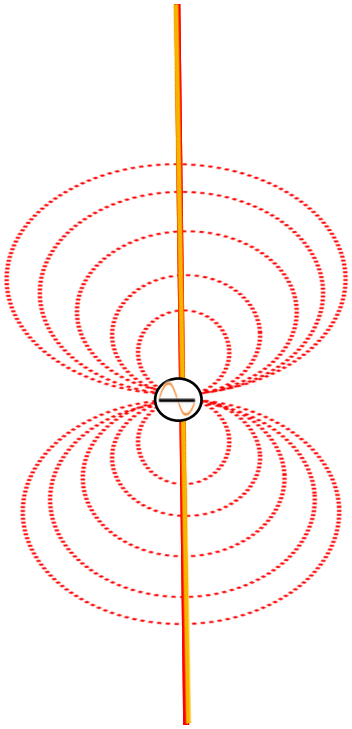

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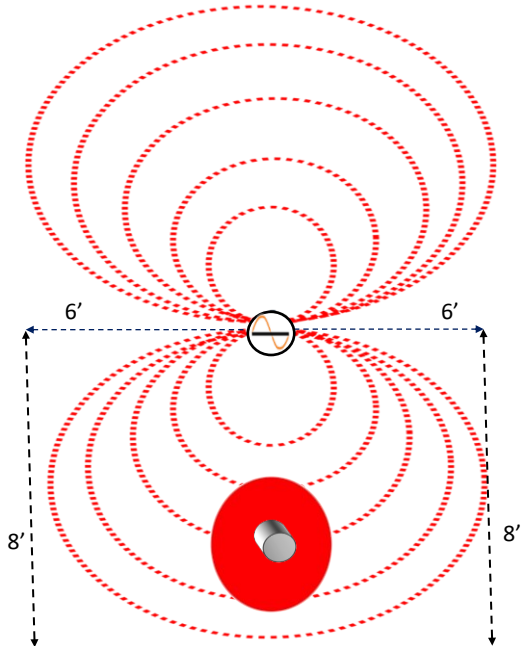

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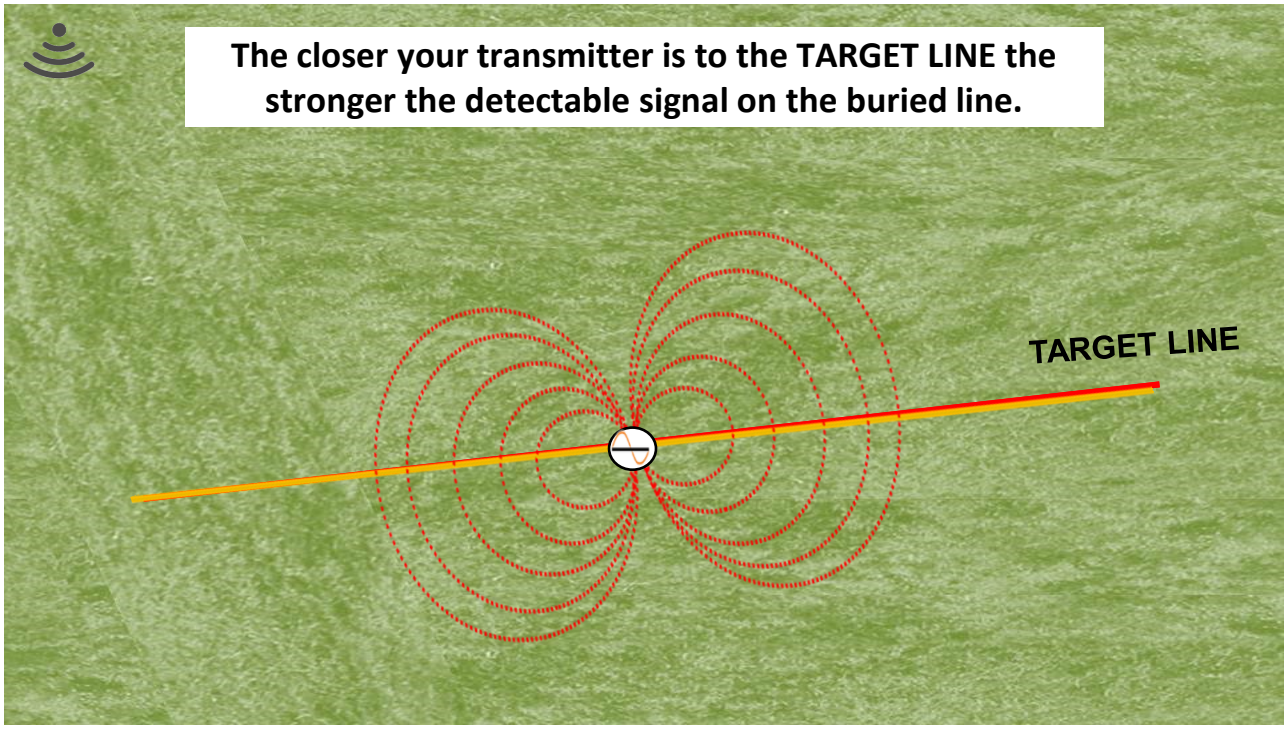
The closer your transmitter is to the TARGET LINE the stronger the detectable signal on the buried line.
TARGET LINE

23

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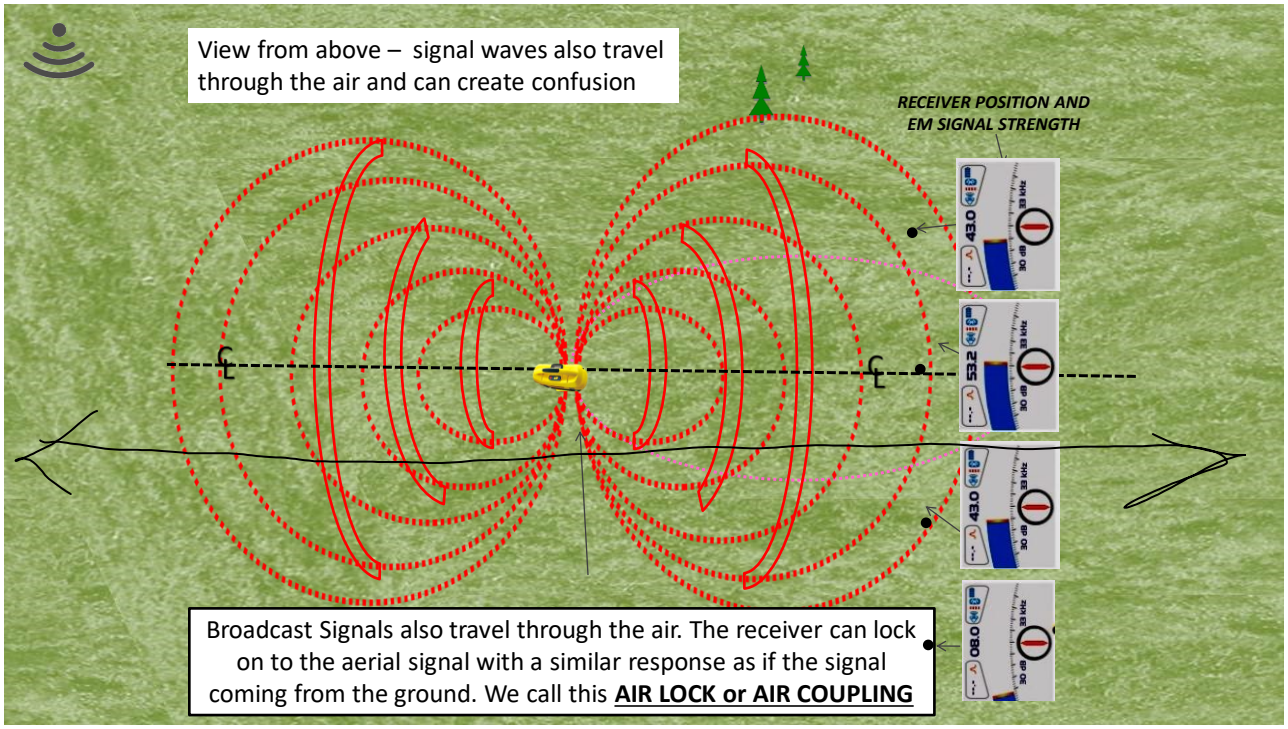
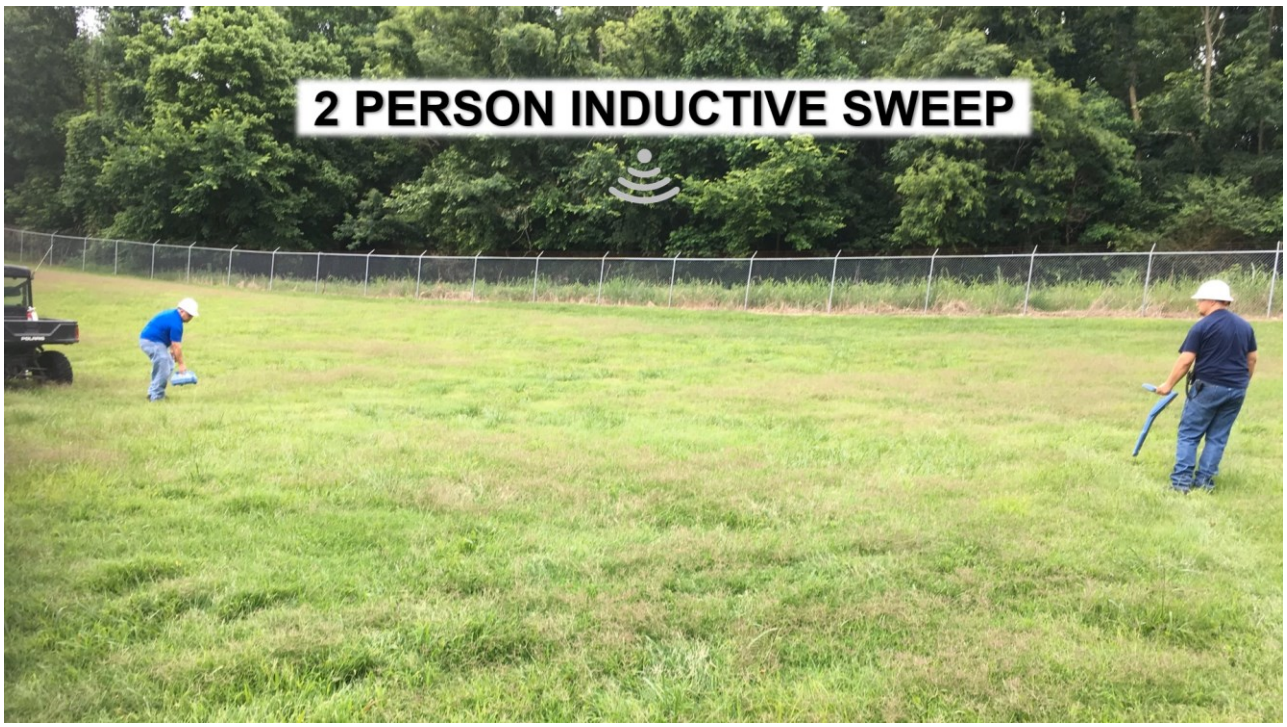

View from above – signal waves also travel through the air and can create confusion
RECEIVER POSITION AND EM SIGNAL STRENGTH
Broadcast Signals also travel through the air. The receiver can lock on to the aerial signal with a similar response as if the signal coming from the ground. We call this AIR LOCK or AIR COUPLING

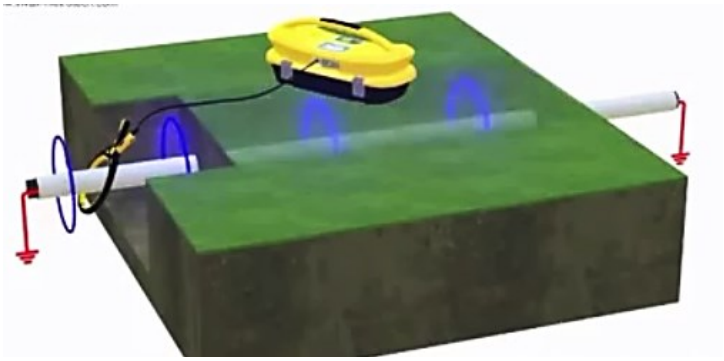
25


2 PERSON INDUCTIVE SWEEP

26

Active Signal Ring Clamp Accessory

- Primarily used for cable locating
- Ring clamp should be placed between two grounding points of the cable



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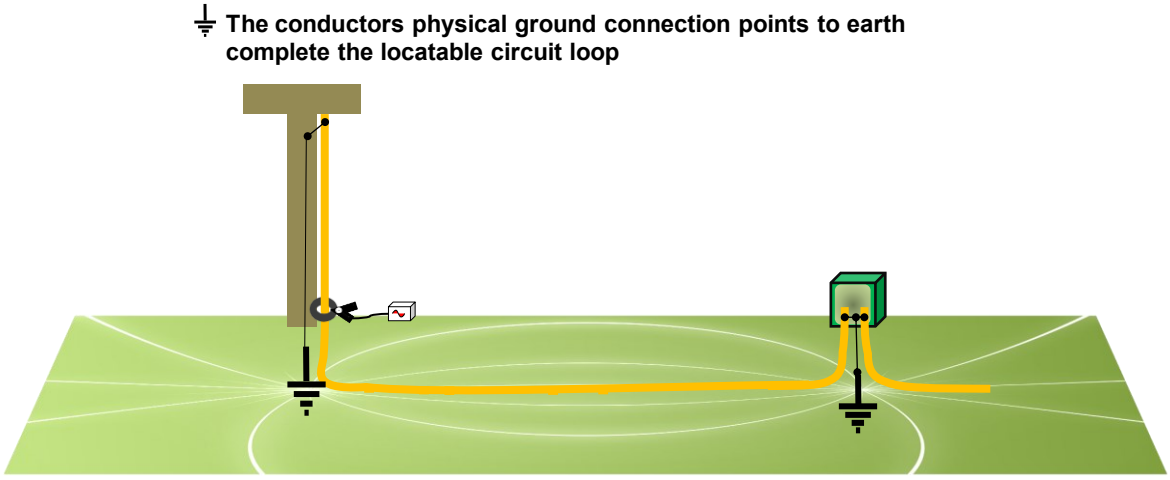

28

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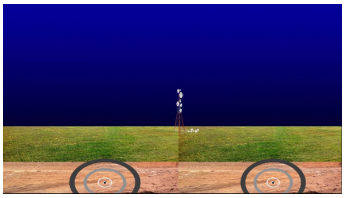
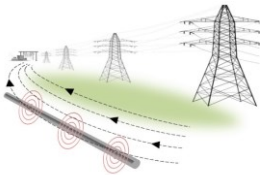
Passive Signals

- Occur “naturally” on underground lines as the result of signal broadcast or radiation from outside sources
- Created by various sources
  - CPS /CP120 (cathodic protection signal)
  - 60Hz Power
  - Radio (radio signal radiation)
- Underground facilities provide paths of least resistance for passive currents to flow along
- Almost always present to some level on most metallic underground facilities including steel gas lines, telephone cables and power cables and abandon lines.





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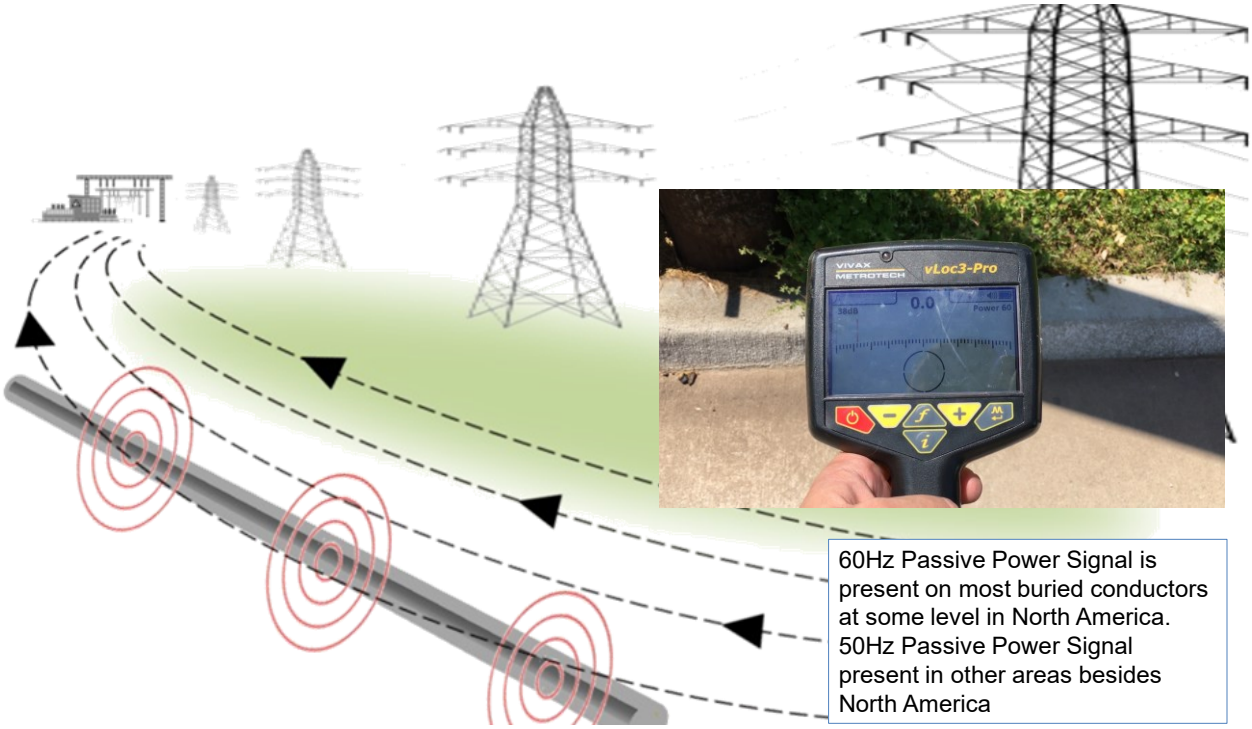

60Hz Passive Power Signal is present on most buried conductors at some level in North America. 50Hz Passive Power Signal present in other areas besides North America

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Cathodic Protection Signal
Created by Corrosion Prevention System
Channel CPS, CP120, 120Hz

32

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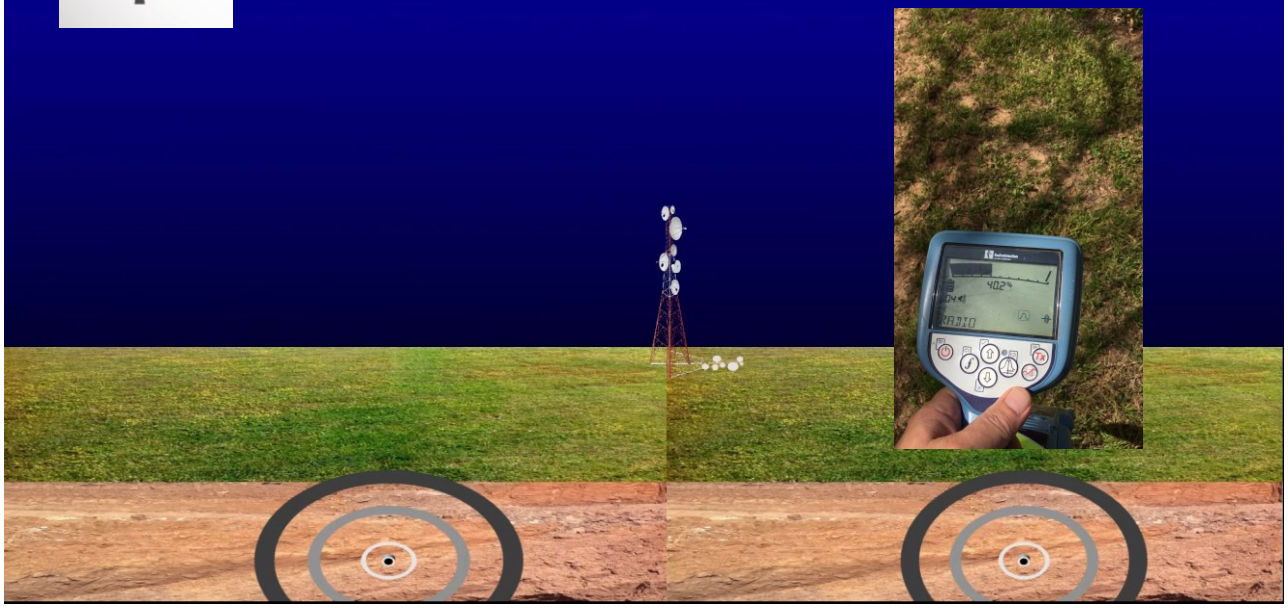
Radio Signal Detection



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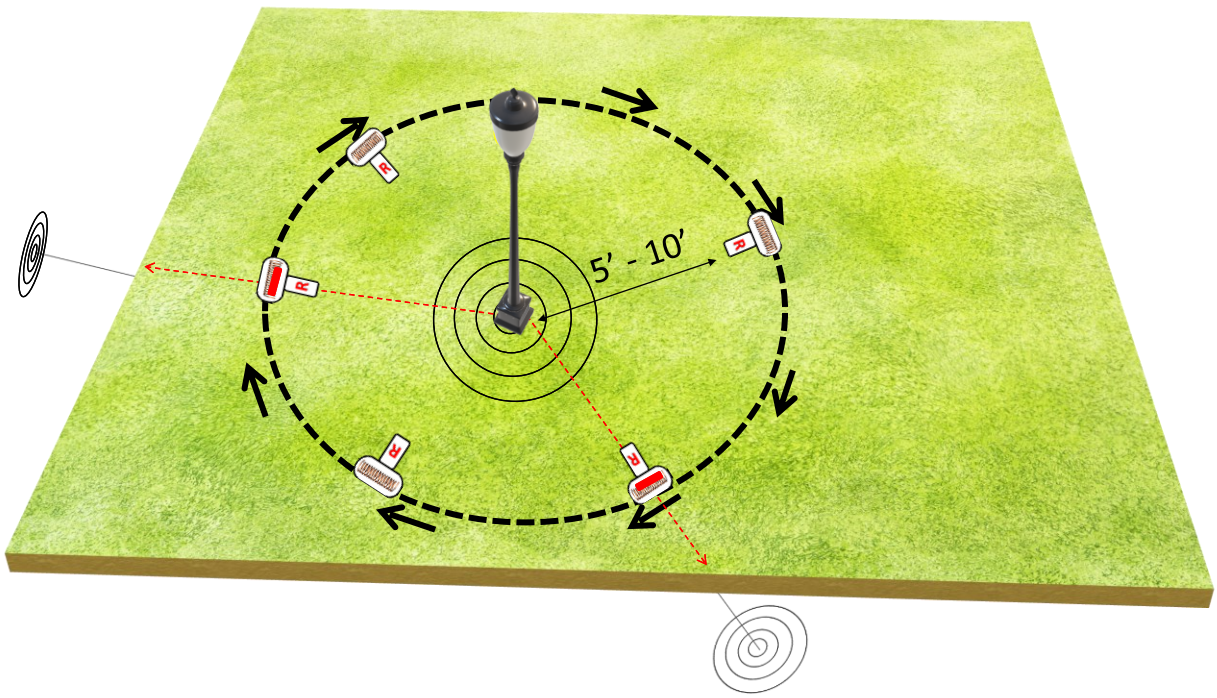

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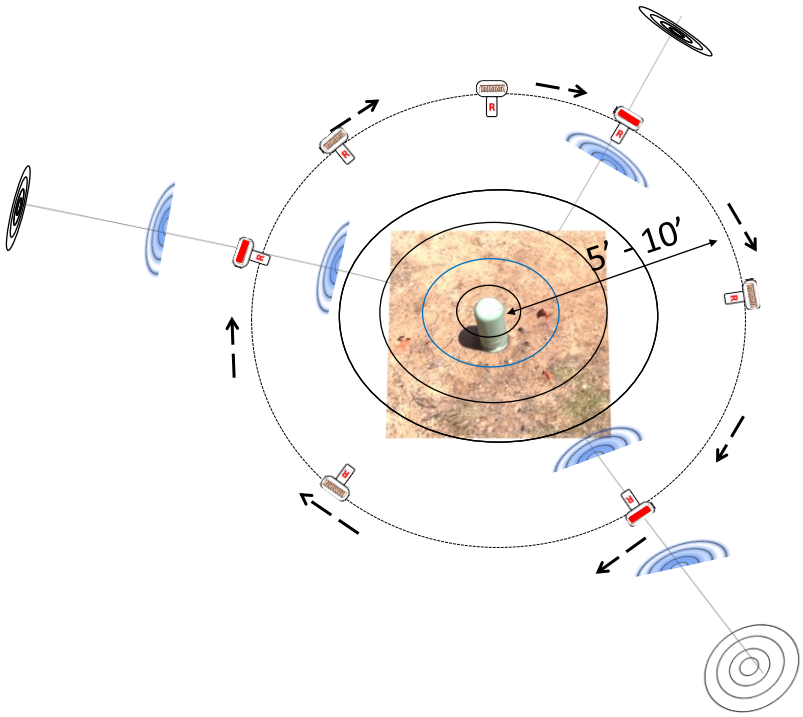

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36

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EM Signal Receivers

- Detect signal fields broadcasting at a known frequency
- Designed to find (TDC) Top-Dead-Center of a perfectly round signal field
- Can determine location, orientation and depth
- Have auto or manual gain to adjust sensitivity

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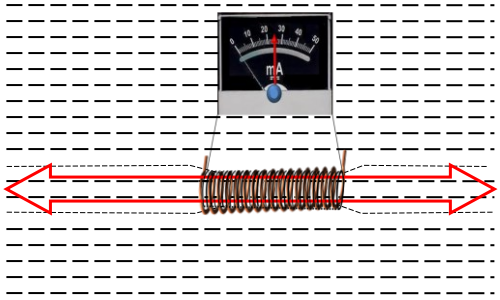
Receiving Antenna



- A receiver's sensor or receiving antenna is constructed of a coil of wire normally wrapped around a metal or ferrous rod which channels more magnetic field through the coil
- Magnetic field is channeled through coil in antenna and induces current onto the coil of wire" which is read as signal strength

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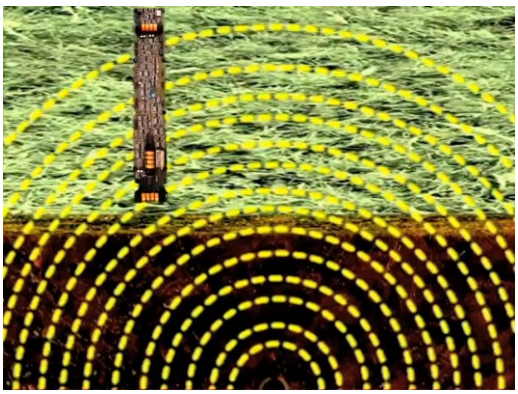
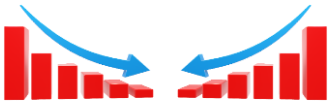
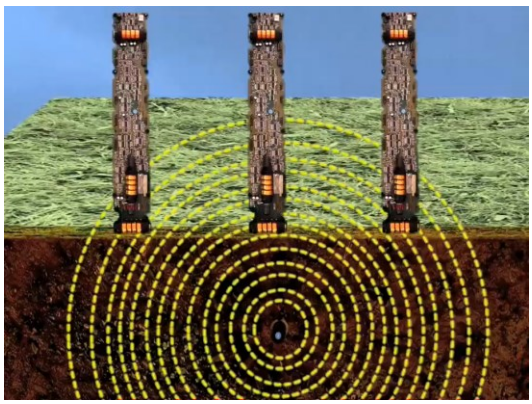
PEAK AND NULL RECEPTION MODES

PEAK



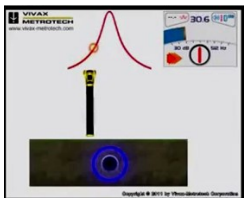
NULL



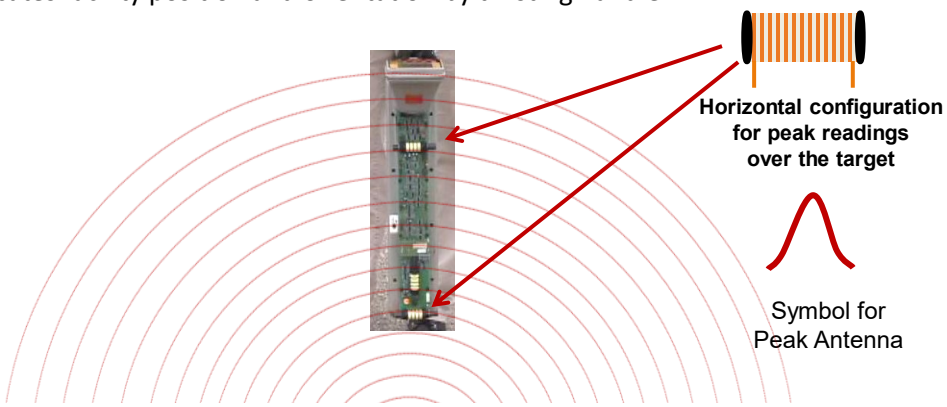


40

Twin Peak Mode

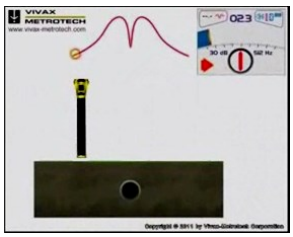


- Primary antenna for locating and pinpointing signals
- Most accurate mode when dealing with signal distortion
- Strongest response occurs when directly above facility at right angle
- Indicates facility position and orientation by twisting handle

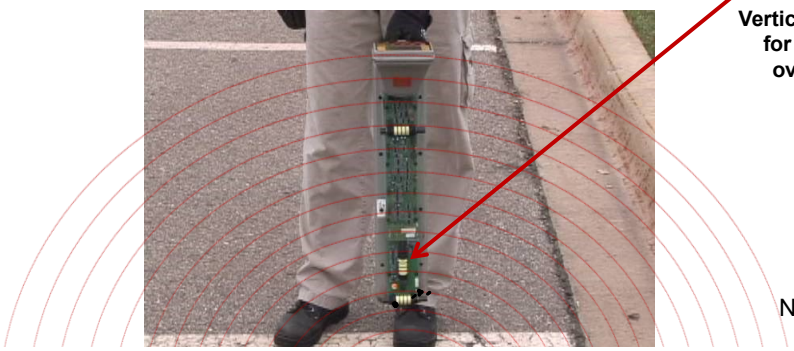


41

Null



- Provides null response (zero or null reading)
- Used to verify peak response
- Null response occurs when directly above facility
- Indicates facility position only



42

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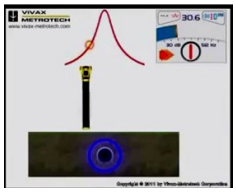
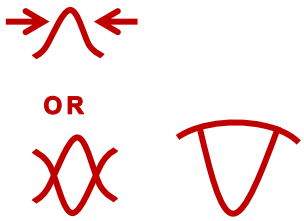
Combination Response Mode



- Both Peak and Null Mode Activated
- Peak response meters the signal strength
- NULL response mode provides the directional arrow guidance to centerline



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Combination Response Mode

Omni Directional Antenna

360-Degree Antenna View

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Combination Response Mode

360-Degree Antenna View

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Signal Strength Reading

- Is a measurement of overall signal strength being detected by the signal receiver
- Signal strength level depends on the orientation of the receiver's antennas detecting the signal, the distance between the signal receiver and target/source
- The overall signal strength or intensity level of the signal at ground level and the sensitivity/gain setting of the signal receiver

PAINT ON PEAK !!!

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Sensitivity Gain Control

The Gain setting controls sensitivity of receiving antenna

- **Manual Gain** *controlled by user (up and down adjustment)
  - Adjust gain/sensitivity to match the intensity of the signal
  - You are in control of the volume level heard by the receiver gain control amplifies or pads down the amount of signal field traveling through the receiver coils.
- **Auto Gain** *controlled by receiver
  - Smart Sound
  - Built in sensitivity control of the sensitivity of antenna coils
  - Receiver is in control of the level of sensitivity it chooses for any given signal.

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A few reasons to adjust gain control

- Adjustment is needed to keep signal reading “on scale” or within meters signal range
- Adjustments are needed when walking away from or toward transmitter
- Depth changes of utility or cover
- Drop in signal due to signal energy reduction at (signal splits) example: tee in pipe”

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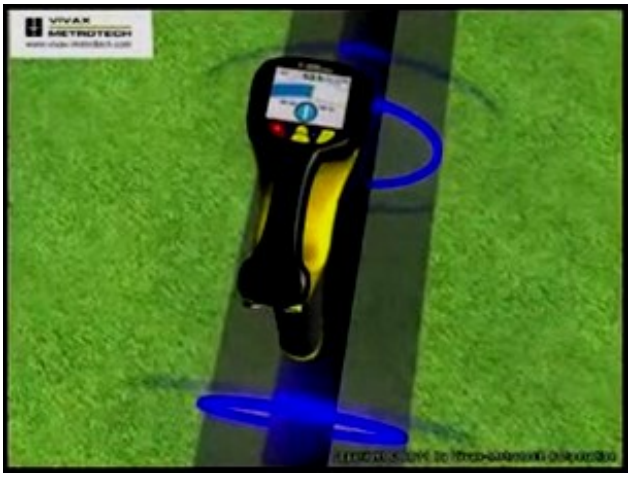
Signal Orientation (using compass antenna)



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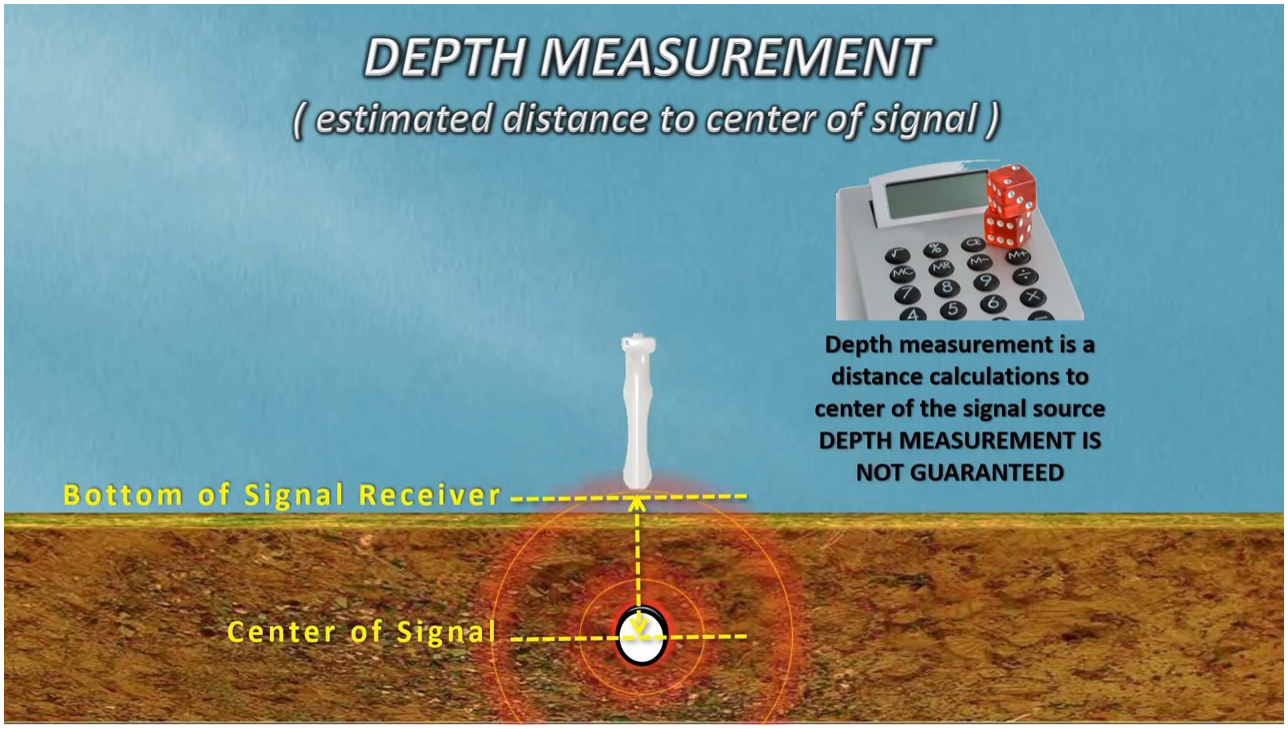
DEPTH MEASUREMENT
(estimated distance to center of signal)
Depth measurement is a distance calculations to center of the signal source
DEPTH MEASUREMENT IS NOT GUARANTEED
Bottom of Signal Receiver
Center of Signal

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Steel toed boots and other metal objects can influence the depth measurement

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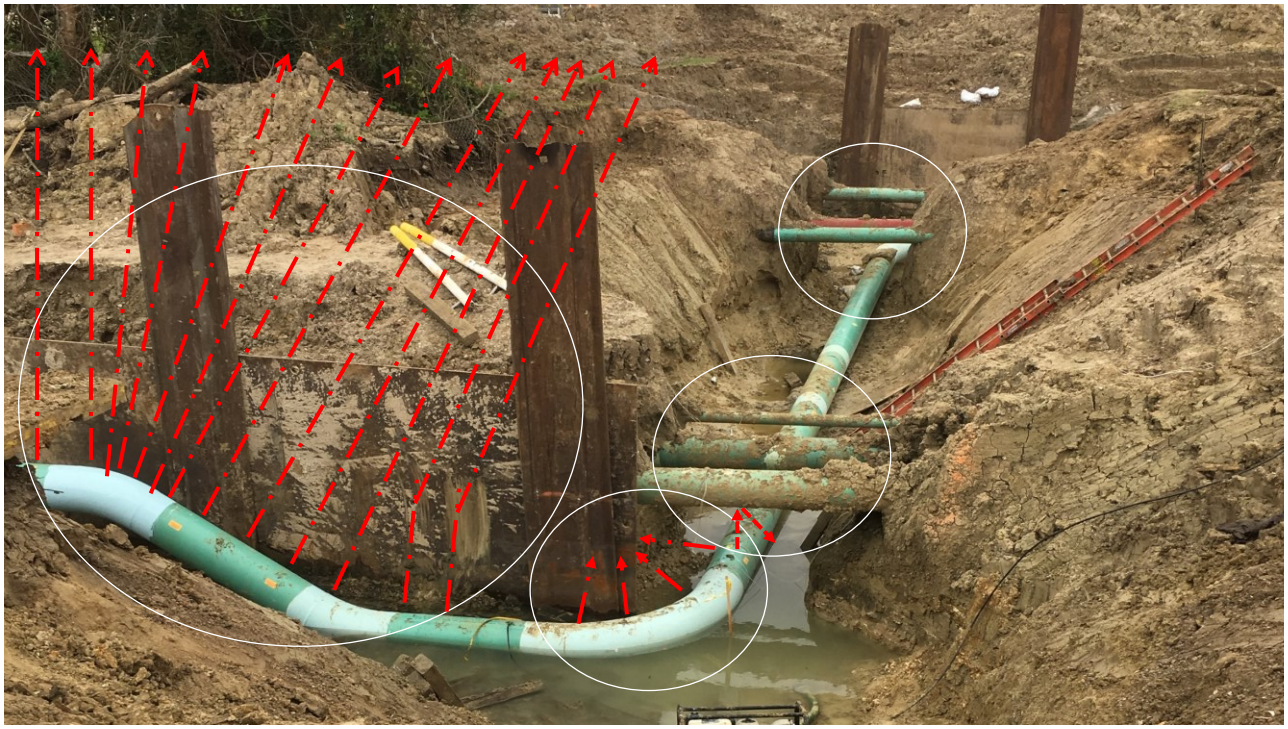

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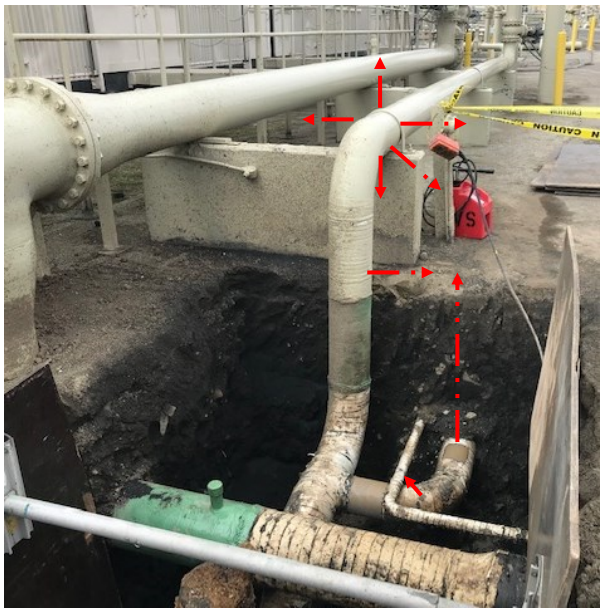

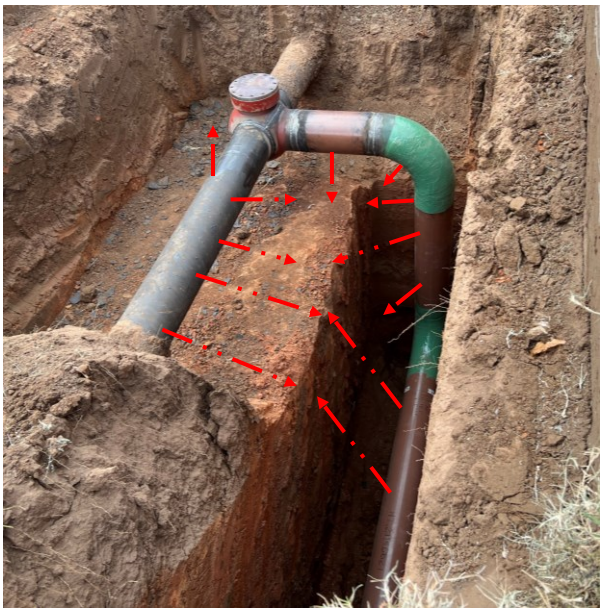

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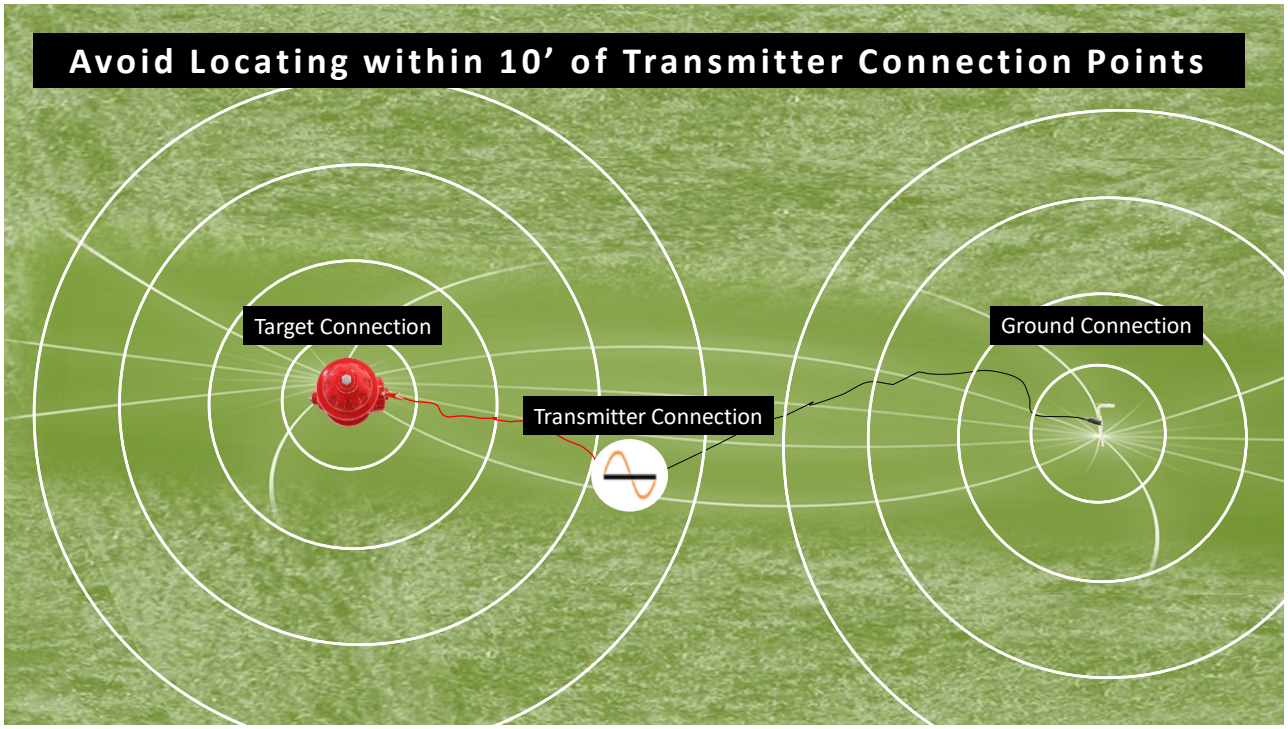
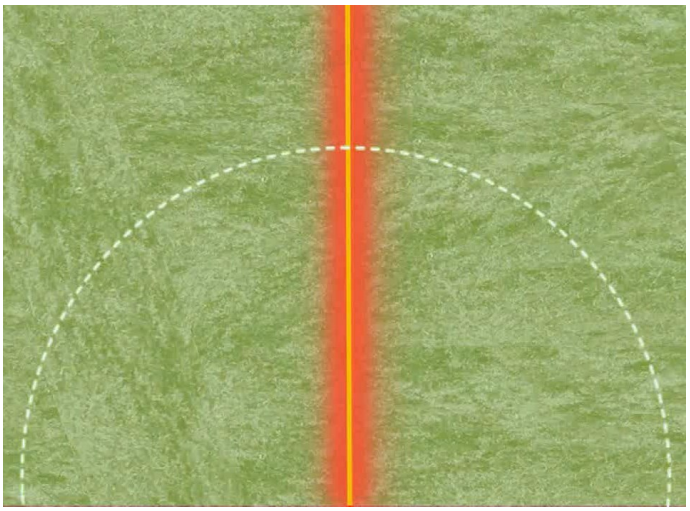
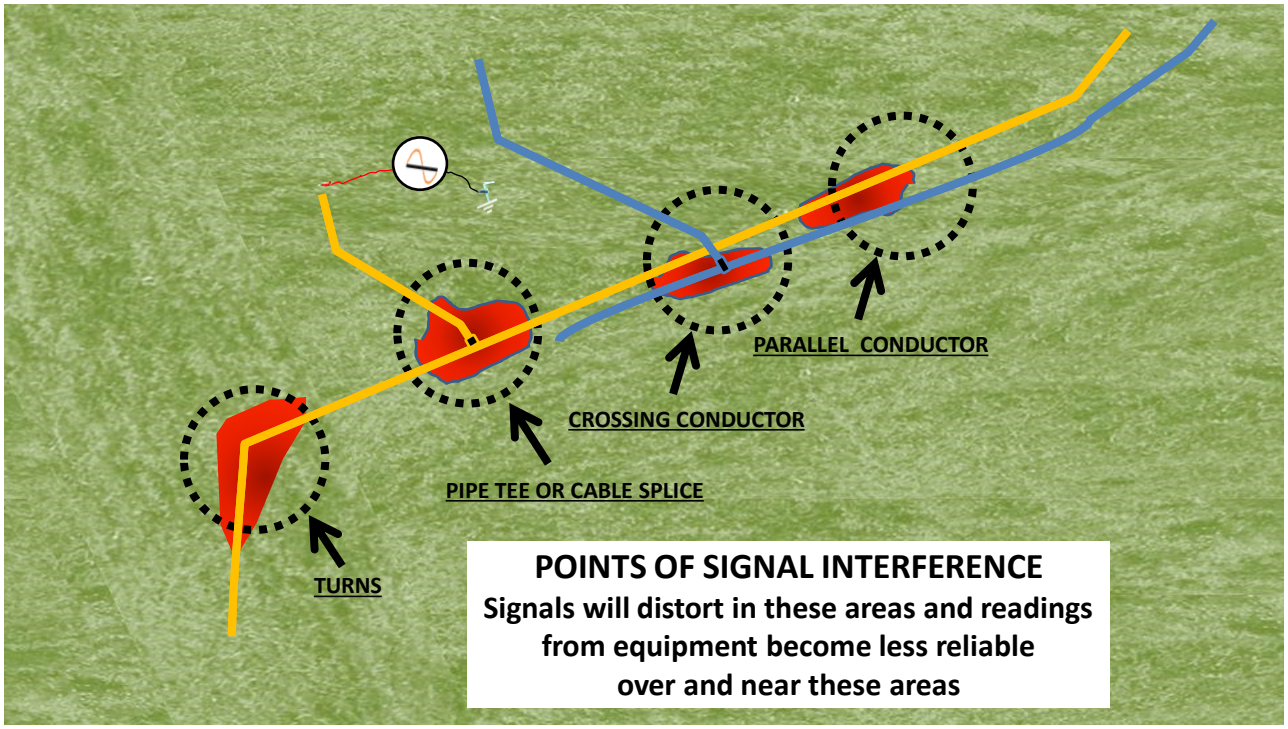


55

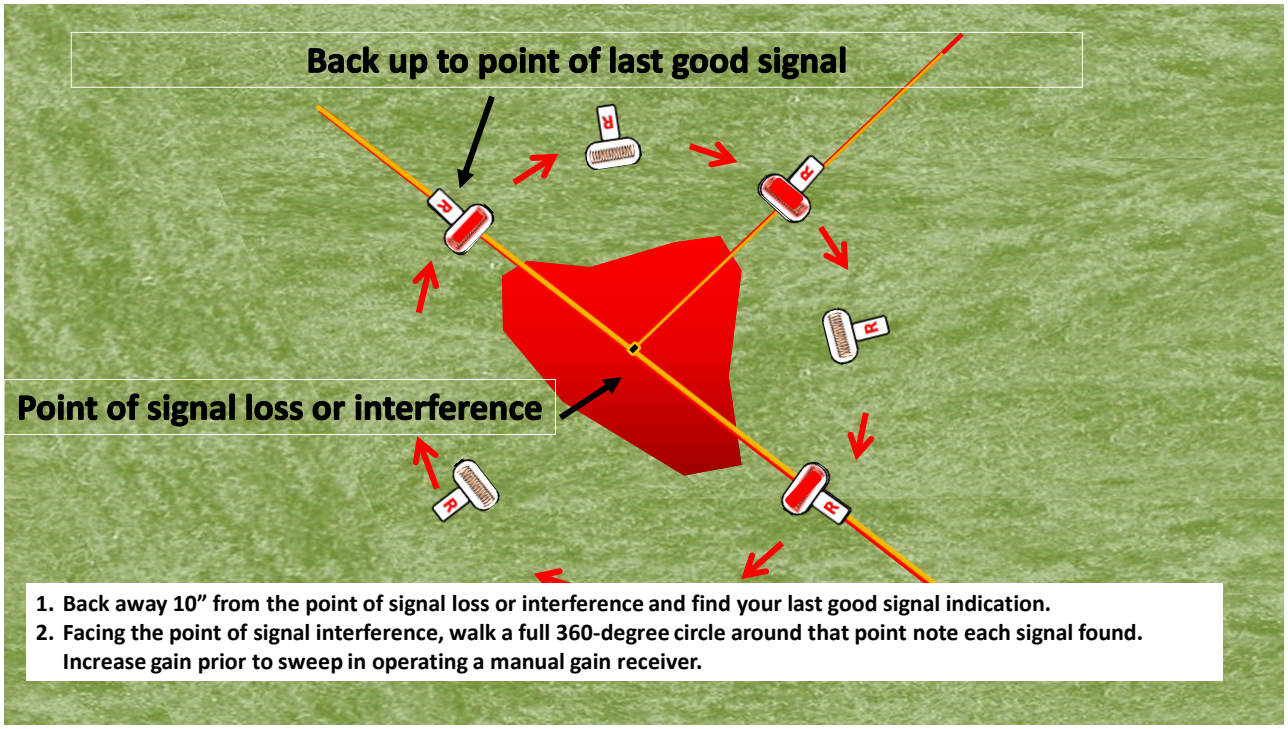
Performing a Signal Search



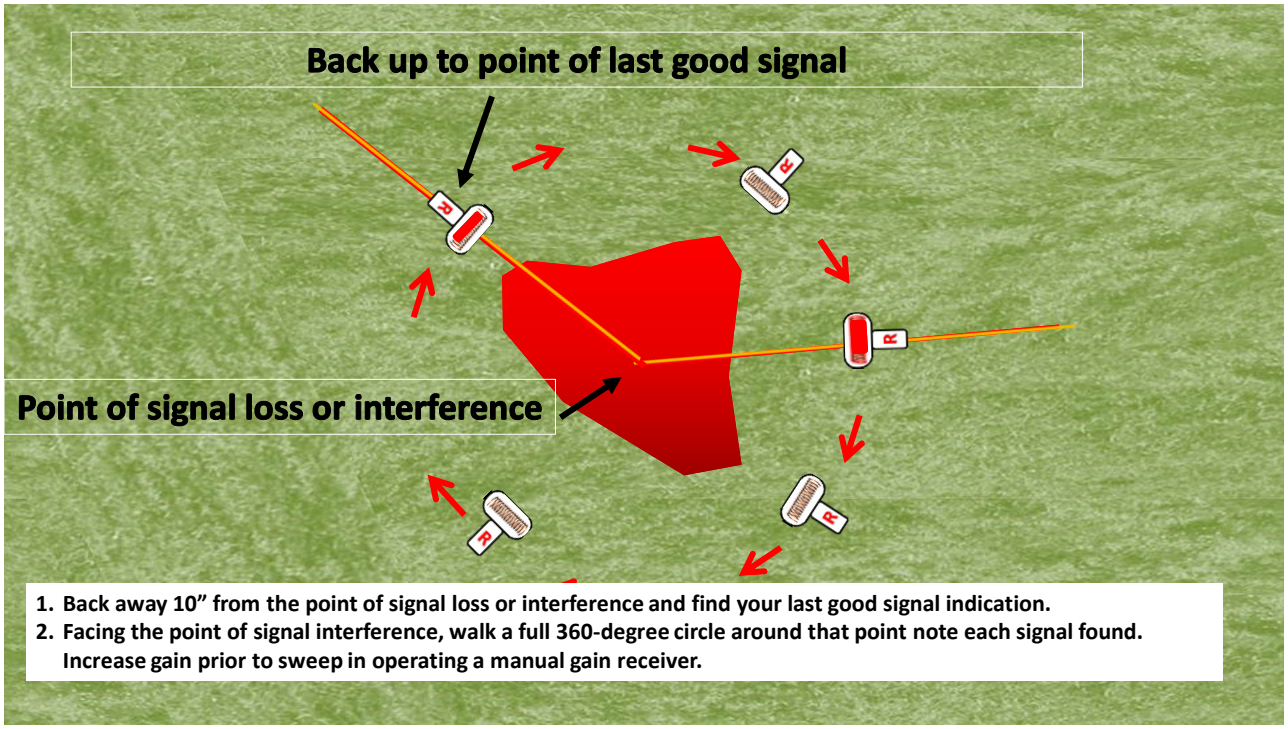
56


PARALLEL CONDUCTOR
CROSSING CONDUCTOR
PIPE TEE OR CABLE SPLICE
TURNS
POINTS OF SIGNAL INTERFERENCE
Signals will distort in these areas and readings from equipment become less reliable over and near these areas

57


Back up to point of last good signal
Point of signal loss or interference
1. Back away 10" from the point of signal loss or interference and find your last good signal indication.
2. Facing the point of signal interference, walk a full 360-degree circle around that point note each signal found. Increase gain prior to sweep in operating a manual gain receiver.

58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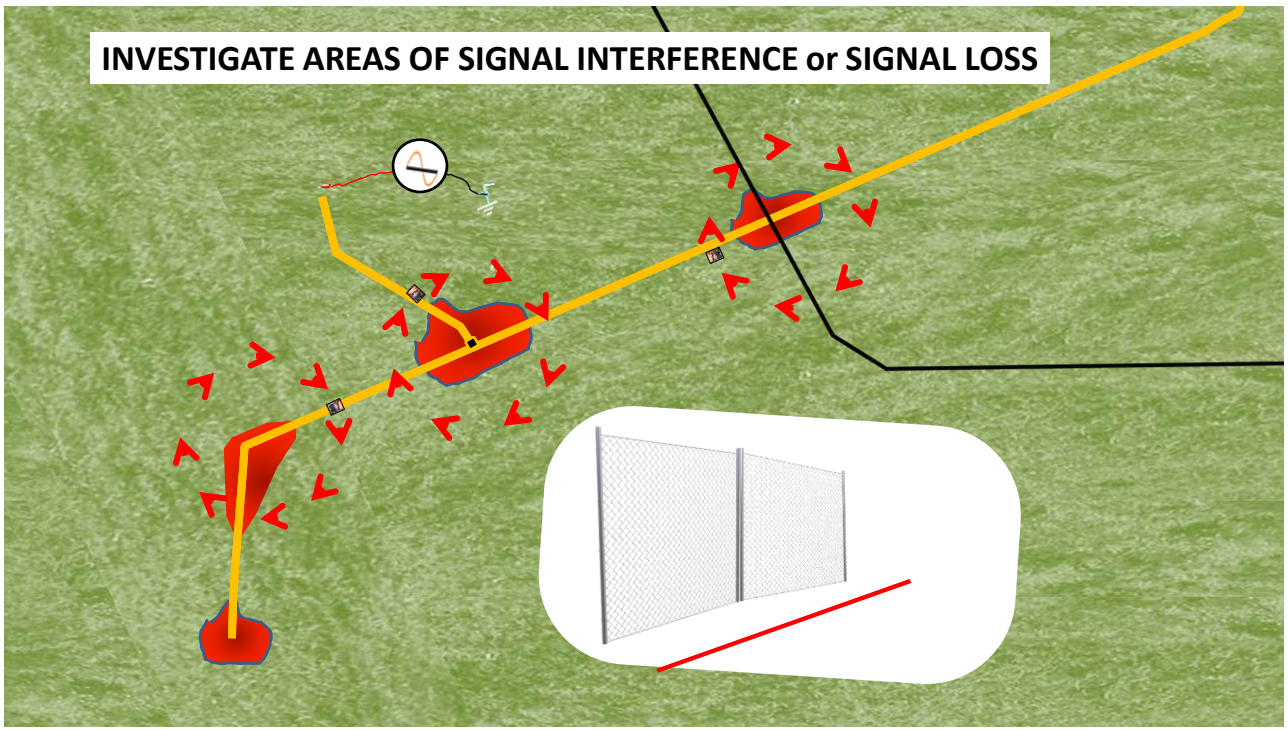
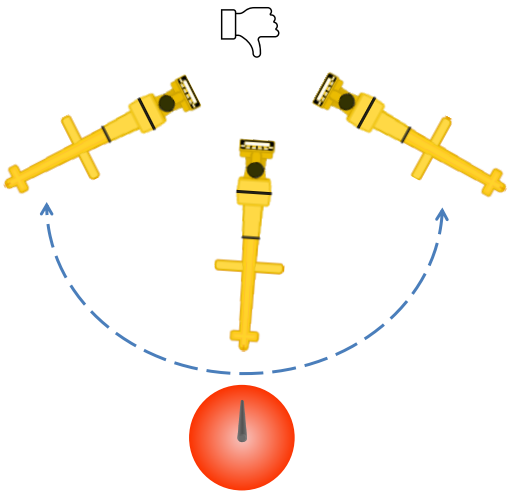
59


INVESTIGATE AREAS OF SIGNAL INTERFERENCE or SIGNAL LOSS

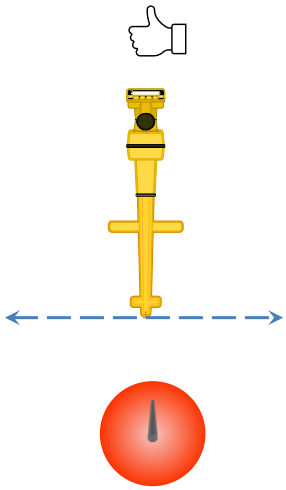
60

Keep Receiver Level

Avoid swinging your receiver



Move it evenly through the signal field



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