

# Tech Brief

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## Locating Distribution Lines

By **Zane Satterfield, P. E.**, NESC Engineering Scientist

Photos by **Chris Metzgar**, courtesy of Morgantown Utility Board

### Summary

Finding water distribution lines can be a daunting task. Fortunately, there are several techniques for finding your pipes. This Tech Brief examines as-built drawings, locating devices, geophones, and tapping the expertise of previous employees as useful methods for locating distribution lines.

### Don't Lose Them in the First Place

The best way to find your distribution lines is not to lose them in the first place, and the best way to ensure this is to have an accurate set of as-built drawings. These are drawings (computer or hard copy) of the distribution system as it was constructed, not necessarily as it was designed. "As-built" refers to the fact that things change from the design stage to the construction stage, not necessarily because of bad design but because unforeseen events always pop-up. The as-built drawings need to reflect these changes—all of them.

The design engineer will usually add an additional charge if the water system asks for as-built drawings, but this is money well spent. Don't take the revised drawings at face value. Always check the drawings, and if you find mistakes, make the engineer fix them. Having someone familiar with the system present during construction can help the accuracy of the drawings. (See the Tech Brief titled "Quality Control in Construction Projects" in the summer 2005 *On Tap*.)

After all construction is done, make sure you have at least two copies of the as-built drawings: one in a safe place, in case of fire or other disaster, and the other at the system office. It's also not a bad idea to have a set at the treatment plant. Anytime a section of line is replaced or modified, all copies of the as-built drawings should be updated.

### Tracer Wire and Magnetic Tape

Over the last 20 years or so, many systems have opted to put tracer wire or magnetic location tape on the pipes themselves. When used in conjunction with an electronic pipe finder, the job of locating distribution lines becomes much easier. In fact, some of these electronic locators will work on metallic pipe without tracer wire or magnetic tape. Electronic locators are discussed in more detail below.



Photo of a spool of tracer wire courtesy of [Pollardwater.com](http://Pollardwater.com).

Tracer wire and magnetic tape are not fool-proof, though. Not all pipes are metallic or the line may be too big to induce enough electromagnetic field for the locator to pick up. If this is the situation, you may be able to first find the smaller branch lines and narrow the location of the main trunk line down from there. Tracer wire and magnetic tape occasionally get ripped during back-fill. When this happens, the signal on a locator will stop at the cut and you have to connect on down the line and backtrack and hope that is the only break. If the signal stops before you get back to other end, you probably have another break.



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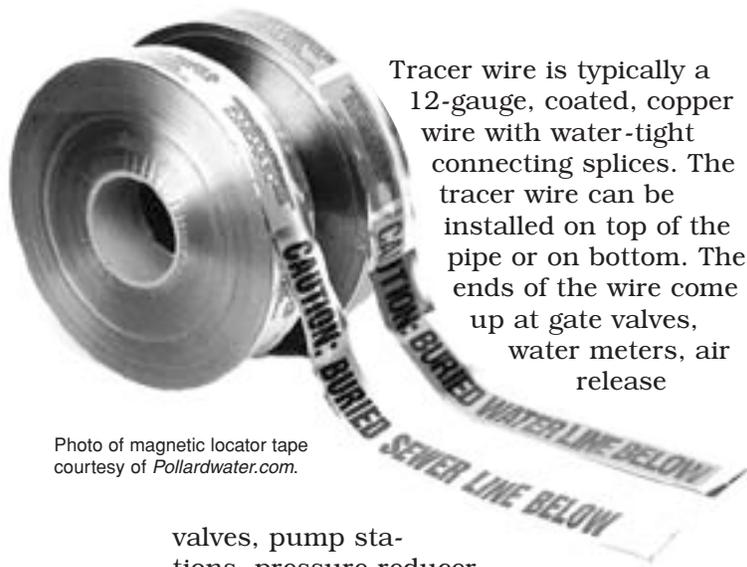


Photo of magnetic locator tape courtesy of Pollardwater.com.

Tracer wire is typically a 12-gauge, coated, copper wire with water-tight connecting splices. The tracer wire can be installed on top of the pipe or on bottom. The ends of the wire come up at gate valves, water meters, air release

valves, pump stations, pressure reducer stations, or test stations, where you can have a box just for the tracer wire. When running the tracer wire ends up to the gate valves, put them on the outside of the curb box. This way, when turning the valve with a gate valve tool, the tracer wire doesn't get wrapped around the tool and become damaged or broken.

"Tracer wire is a good thing when it works but usually it only lasts about a year in the ground because electrolysis eats it up," says Chris McAfee, a circuit rider who works with small systems for the Maryland Rural Water Association. "The biggest problem with using a locator on metal pipe is getting a good ground. That is the biggest flaw we see. Many things can be used as a ground such as a street sign or even a fence. Wetting the soil around the ground stake can help in completing the circuit. When you use a locator, you send an electronic signal through the pipe and it comes back through the ground. Make sure you have a good connection to the pipe and a good ground."

### No clue? No problem

As-built drawings and tracer wire are, of course, an ideal. However, many systems have neither. How can you locate your distribution lines when this is the case? Three useful methods are: (1) probing, (2) listening with geophones, and (3) talking to former employees.

Probing uses a 1/2" or 5/8" diameter, smooth, stainless steel rod approximately three to four-and-a-half feet long (rounded not pointed on one end). Insulated probes are available through most water utility

distributors and provide some protection when working around buried electric lines (some up to 50,000 volts). Probing takes a little practice because you have to learn what it sounds like when you come in contact with different pipe materials. Remember not to drive the probe too hard when you are close to the line because you could pierce a light plastic pipe. A handle can be welded near the top to help turn the probe back out. To make probing more efficient, locate as many water meters, gate valves, air release valves, or any other thing to narrow down the distribution line search area.

Geophones are listening devices similar to your doctor's stethoscope but are used for listening to things in the ground. Open the nearest fire hydrant and use a set of geophones. The sound will be louder near the fire hydrant but you should be able to follow the line out a little way from it. Keep in mind when you open a fire hydrant that you could possibly stir up the water resulting in customer complaints.

This technique might be best done at night when usage is low, allowing some time for the water to settle. Also don't forget to account for the water in the water loss report. The water used from the fire hydrant would be for maintenance purposes, the same as if you were flushing you system. If there is no fire hydrant, a water meter, flushing hydrant, or any valved outlet might work.

"Old timers," or other people who have worked for the water system in the past can be a valuable information source. Get in touch with retired or other former workers and pick their brains. Personnel who actually installed the distribution lines may have a surprisingly good memory about where the lines are located.

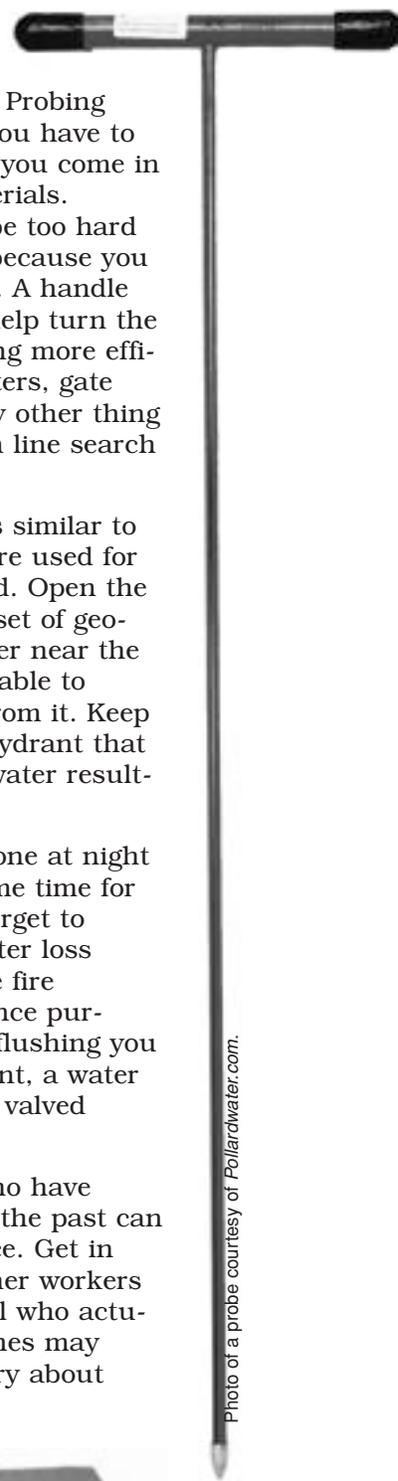


Photo of a probe courtesy of Pollardwater.com.



Photo of electronic pipe and cable locators courtesy Metrotech Corp.



Photo of electronic pipe and cable locators courtesy Metrotech Corp.

There are specific kits available to help find different kinds of water lines. Illustration courtesy of *Pollardwater.com*.

### Electronic Locators

There are many electronic locators available. They work best when the system has tracer wire or magnetic locating tape, but some will work without the tracer wire or magnetic locator tape. Before you buy, shop around. Have the prospective company send a representative to demonstrate on a hard-to-find line in your distribution system, as well as on several types and sizes of line. Use lines that are at a known location and depth to see how accurate the instrument performs.

Electronic locators have two pieces: one to send a signal of some sort and the other (usually a handheld device) to pick up the signal. Electronic locating instruments or electronic pipe finders consist of a portable radio-direction-finder receiver. The transmitter induces an electromagnetic field into any buried metallic object within its range. As the receiver is carried over and across a pipe location, the induced electromagnetic field is detected and produces an audible tone. On some models, both the location and depth of the buried pipe can be determined.

Electronic plastic pipe locators are also available as shown in the illustration at the top of the page. These are expensive, ranging from \$1,000 to \$2,000, without attachments for fire hydrants, water meters, or sprinklers. These locators use a low-fre-

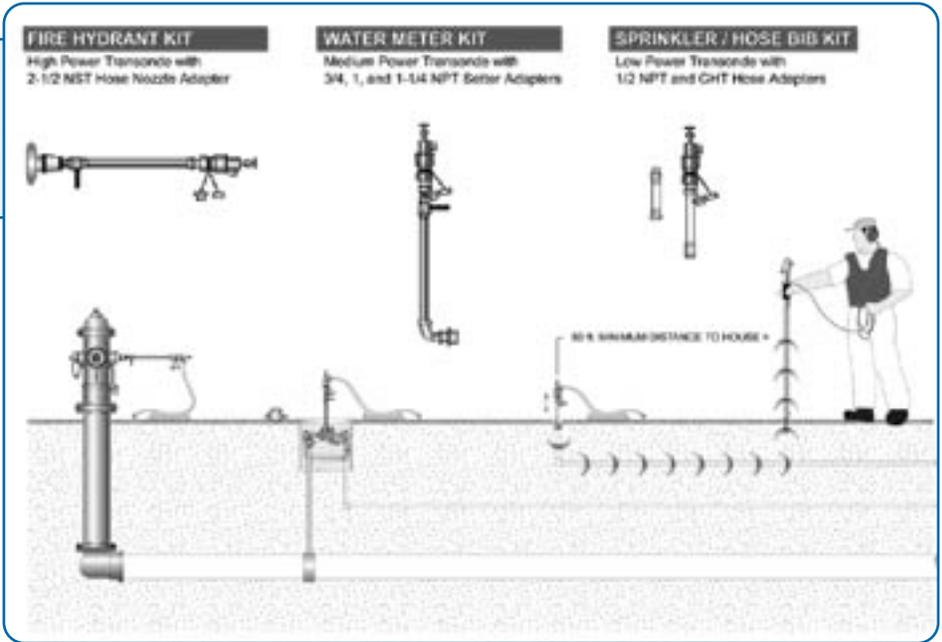


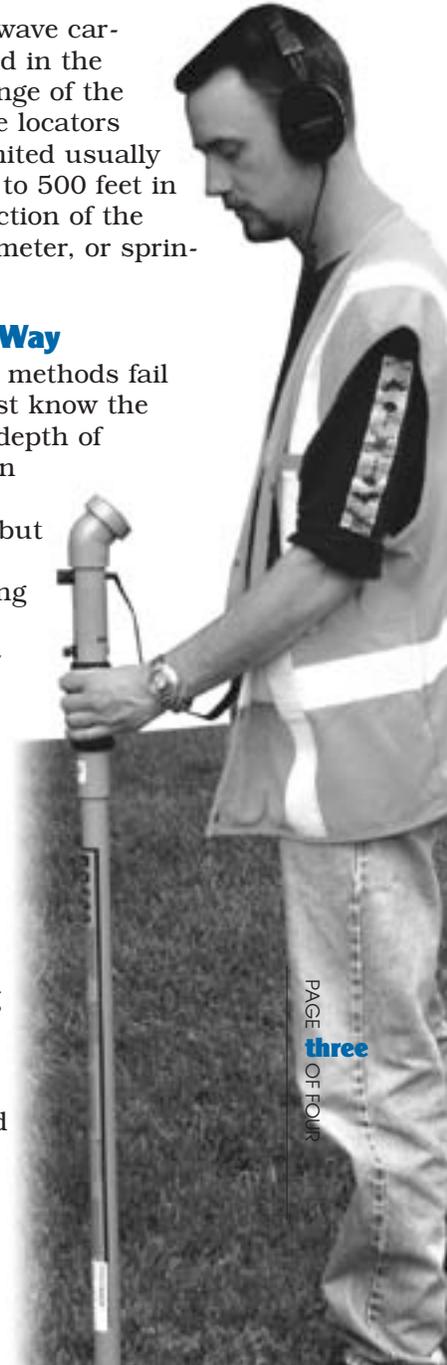
Photo of plastic pipe receiver (above and at right) courtesy of *Pollardwater.com*.

quency, pressure wave carried by the fluid in the pipe. The range of the plastic pipe locators can be limited usually from 250 to 500 feet in each direction of the hydrant, meter, or sprinkler.

### The Hard Way

When other methods fail and you must know the location and depth of the distribution line, you may have no choice but to dig. You can often start digging with a backhoe, but to avoid hitting the line or other utilities, you will need to shovel to finish the job.

Use the probing technique discussed above as you dig to help avoid line punctures. If your local area or state has a call-before-you-dig program, use it. Keep in mind that many of these require a three-day notice before you dig and that it's the law in many places.



Once you uncover the distribution line, document its location and depth for future reference. Don't lose it twice. To do this, measure from the uncovered line to at least two objects that are relatively permanent, such as a fire hydrant or utility pole. Make reference to the power pole numbers or any other details that will help find its location in the future. These measurements are called "tie downs" and you need at least two measurements to tie an object down, preferably at 90 degrees from the uncovered water line. The third measurement is an insurance measure if one of the objects has been removed or is missing when you come back in the future. If you want, you can take more measurements for extra insurance. Write these measurements down in a surveyor's field book or on the water distribution system's plans. When you come back in the future, locate at least two of the designated objects. Measure out based on your notes and make an arc (like using a giant compass). Then, do the same from one of the other permanent objects. Where the two arcs intersect is the location of the previously uncovered water line.

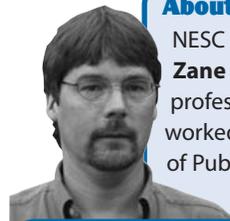
### An Unconventional Way

When locating undocumented lines, you might at least consider divining (also known as witching, doodlebugging, or dowsing). Divining supposedly works with the magnetic field given off by buried metal objects or the water itself. Keep in mind this technique takes practice before you can be proficient at it. Many water products catalogs even sell magnetomatic pipe locators. These are hand-held

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#### About the Author



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Photo of a magnetomatic pipe locator courtesy of [Pollardwater.com](http://Pollardwater.com).

devices that have a collapsible antenna 90 degrees from the handle. To make your own, cut two coat hangers or brazing rods to form an "L," one leg measuring 18 to 24 inches and the other six to eight inches. Held at chest level while slowly walking, the rods should cross when passing over a buried object. These techniques will not determine depth of the buried object, only the location.



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