The first successful use of a drilling rig on a well drilled especially to produce oil was made in 1859. One estimate suggests that since then, 3.5 million oil and gas wells have been drilled in North America. Because many wells were drilled before well permit regulations were introduced, this number may be even higher, reaching estimates of 4 million.

Ideally, when a well reaches the end of its life cycle, it is properly plugged to prevent leaks and pollution, and then considered inactive. However, over the years, many wells were plugged with nothing more than wooden logs, not plugged to today’s standards, or even left uncapped and abandoned by irresponsible owners. Numerous studies have been done and articles written about abandoned wells that pollute groundwater supplies, emit methane gas, and cause potential explosion and contamination hazards to residential areas and farm land. No one knows for certain how many abandoned wells exist in the U.S., but again, estimates place the number at around 2 million. Many of these wells are referred to as orphan wells because they cannot be traced back to their owner or the company responsible for the well has gone out of business.

The Ohio Orphan Well Program was established in 1977, and is one of the organizations in the U.S. that was put in place to plug improperly abandoned oil and natural gas wells. Funded by a portion of the state severance tax on oil and gas production, Ohio’s program has plugged more than a thousand wells. The Orphan Well Program is charged with plugging idle and orphan wells, restoring land surfaces, and correcting conditions that cause imminent health or safety risks.

Since well drilling and plugging began, technology has advanced significantly, using cement and mechanical barriers to ensure wells are completely isolated from groundwater and the surface.

The Ohio Orphan Well Program in Action

In April of 2015, an Inspector from the Ohio Department of Natural Resources (ODNR) responded to a call from Columbia Gas noting natural gas inside a Cuyahoga County (Cleveland, Ohio) residence. After approximately five (5) days, the gas readings in the home had dissipated substantially and the home was deemed safe for the residents.

A follow up investigation, conducted in June of 2015, revealed the existence of an old oil and gas well in the front yard of the property that was drilled long before the land became a housing development.

Records obtained by the ODNR Division of Oil and Gas Resources Management indicated that the well was drilled in 1936 to a depth of 2743 feet, and plugged as a “dry hole” immediately after drilling was completed. When the hole was originally plugged, most of the casing was removed. Gravel was placed in the well from 2743 feet to 2580 feet and a wooden dry hole plug was then installed on top of the gravel. Additional gravel was placed on top of this wooden plug, and a cast-iron ball was installed on top of the gravel at 2557 feet. Even with plugging in place, a leak was detected, and the hole had to be re-plugged.

Properly plugging the well is intricate work, and for this project, the scope included notification and protection of local residents, consideration of existing utilities, coordination with the Orphan Well Inspector and local authorities as well as the Ohio Utility Protection...
Case Study

Service and the Ohio Oil & Gas Producers Underground Protection Service. An emergency response plan had to be put into place. Every step of one of these well plugging projects follows a preset scope of work with detailed specifications.

This particular project known as Cuyahoga #2, and set out for bid by the Ohio Orphan Well Program, was won and carried out by GonzOil (Canton, Ohio). GonzOil is one of the largest oil and gas well plugging contractors in Ohio specializing in difficult well-plugging situations.

Requirement for Uncomplicated and Reliable Gas Monitoring

Within the scope of work, specifications were set for air monitoring: “The Contractor will set up a wireless monitoring system (up to 8 channels) to monitor for the following factors Methane (CH₄), Lower Explosive Limit (LEL), Oxygen Saturation (O₂), Carbon Monoxide (CO), and Hydrogen Sulfide (H₂S). These factors shall be monitored around the plugging operation and the exterior perimeter and the interior basement corners of the residence.

During the Project, the Contractor will provide wireless air monitoring on a 24-hour basis to ensure resident, worker, and public safety. Results shall be recorded according to location, time, and measurement until the plugs have been set and no gas migration or releases have been detected.”

Douglas Gonzalez, president of GonzOil, contacted Industrial Scientific to determine the best solution for gas monitoring. GonzOil rented eight Radius™ BZ1 Area Monitors with LENS™ Wireless from Industrial Scientific. They were placed around the perimeter of the worksite as well as inside the residence, which was located only 12 feet from the well site. Site safety was the top priority because the homeowners, and their children, decided to remain in their residence during the entire two-week project.

Radius BZ1 Rental Proves to be the Perfect Solution

The Radius BZ1 Area Monitor provides readings for up to seven gases simultaneously. With its fifteen compatible sensors, the instrument is capable of monitoring for oxygen and a variety of toxic gases and combustible gases. The Radius BZ1 is used outdoors and indoors for applications that require a worker or worksite perimeter, fence line, confined space monitoring, or a single unit.

With LENS Wireless, a long-range, power-efficient mesh network from Industrial Scientific, monitors automatically connect and become part of a peer group. The monitors communicate and share data with every other monitor in that group. With one of the largest displays on the market, as well as customizable alarm action messages such as “EVACUATE” or “VENTILATE,” anyone looking at the display can quickly take proper action.

The Radius BZ1 Area Monitor consists of the SafeCore® Module and Radius Base. When installed in the Radius Base, the SafeCore Module serves as the instrument’s central processing unit. It houses the gas sensors, electronics, firmware, data log, settings, wireless radio, clock and clock battery, and the pump for aspirated instruments.

The Radius Base houses the extended run time, rechargeable battery pack that powers the instrument. The Radius Base also serves as the user interface and comprises the instrument’s buttons, display, and visual and audible alarm indicator signals. The Radius BZ1 is the longest running monitor with a typical run time of 7 days (168 hours).

Putting the Radius BZ1 to work is quick and easy. There is no IT setup, licenses, software or infrastructure to deal with. The Radius comes out of the box, ready to connect with any other Radius monitors within its peer group through LENS Wireless.
**Case Study**

**CUYAHOGA #2 WELL PLUGGING PROJECT**

<table>
<thead>
<tr>
<th>AIR MONITORING REQUIREMENTS</th>
<th>RADIUS BZ1</th>
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<tbody>
<tr>
<td>Wireless monitoring system (up to 8 channels)</td>
<td>LENS Wireless provides out of the box instrument-to-instrument communication without IT setup, licenses, software, or infrastructure requirements.</td>
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<tr>
<td>LEL Methane, O(_2), CO, H(_2)S</td>
<td>The Radius BZ1 provides readings for up to 7 gases simultaneously. The rental units are delivered with the required settings.</td>
</tr>
<tr>
<td>Place around the plugging operation, exterior perimeter, interior basement corners of residence</td>
<td>Four monitors were placed around the plugging pad and four more in the corners of the basement of the residence.</td>
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<tr>
<td>24-hour monitoring</td>
<td>A separate Radius Base housing the battery was rented and used in a rotation. As a unit’s battery reached a determined level, the SafeCore Module from that unit was placed in the base with the fully charged battery and the base with the low battery was recharged with the external power supply. Once charged, it was switched out with the next working SafeCore Module. This process ensured 24 hour monitoring for the duration of the project.</td>
</tr>
<tr>
<td>Record all results</td>
<td>The Radius BZ1 takes gas readings every second and records readings-related data at its settable interval. The instrument has capacity for approximately 90 days of data and storage capability for up to 60 alarm events, 30 error events, and 250 manual calibrations and bump tests.</td>
</tr>
<tr>
<td>Temporary monitoring for the duration of the project only</td>
<td>Industrial Scientific provided the option to rent the Radius BZ1 monitors for the 2-week requirement. The monitors are factory-maintained and can ship on the same day the order is received.</td>
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“ODNR’s contract required extraordinary efforts to protect the homeowners, our workers, and the general public. The ease of set-up and operation of the Radius BZ1 allowed us to quickly take our minds off gas detection and concentrate on plugging the orphan well,” said Mr. Gonzalez. “Our expertise is in drilling out, removing obstacles, and plugging these wells. Our crew felt safe doing what we do best.”

Well plugging programs exist across the country. As states determine that abandoned and orphan wells were improperly covered or left completely unplugged, they are prioritized by the possible danger they pose based on location and emissions. Properly plugging a well that is thousands of feet in depth is an intricate process with numerous safety requirements for both workers and surrounding areas.

The Radius BZ1 Area Monitor rental program offers the ideal solution. With out-of-the-box, uncomplicated setup and wireless communication, 7-day battery life, and an extended run time power supply, the Radius is quickly put to work. At the end of the project, the monitor is packed up and returned to Industrial Scientific.

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1. [http://oilandgas.ohiodnr.gov/orphanwellprogram](http://oilandgas.ohiodnr.gov/orphanwellprogram)
2. Scope of Work, Cuyahoga #2 Project, Ohio Department of Natural Resources, Division of Oil & Gas