LOCATING ORPHANED WELLS WITH TOP OF CASING CUT DEEP BELOW GROUND SURFACE

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Background/Objectives:

Unplugged orphaned oil and gas wells have been identified as a source of greenhouse gas leakage into the environment, contributing to climate change and contaminating groundwater and soil with residual hydrocarbons. While some orphaned wells have surface features revealing their position, others are difficult to find. Locating orphaned wells where the casing has been cut a hundred or more feet below ground surface has been a challenge. Factors such as surface debris, a lack of measurable gas emissions, and vegetative regrowth over decades since the last human activity at these sites have made detecting these problematic orphaned wells particularly difficult, even with the use of ground-based magnetometers.

For the past two decades, Parsons has been working in mid-Michigan to identify and remediate these more elusive deep cut orphaned wells. Our use of advanced magnetometry techniques using processing algorithms adapted from unexploded ordnance detection methods paired with an airborne magnetometer have allowed for the consistent identification of orphaned wells located 200 to 300 feet below the ground surface, allowing us to find these wells and cap them to mitigate further environmental impact.

Approach/Activities:

The approach to locating hard to find orphaned wells builds on Parsons' best practices previously developed for our munitions response projects. Proven effective across numerous sites in Michigan and Arizona, this methodology integrates drone-based magnetic data collection, processing, and reporting into a GIS platform. Combining these results with other remote sensing data, such as LiDAR point clouds, has helped the team accurately predict the location of orphaned wells with an error margin of just a few meters. This precision streamlines field efforts, reducing the need for scientists to trudge through thick underbrush and minimizing the scope of excavation required to locate the orphaned well.

Results/Lessons Learned:

Lessons learned from orphaned well locating efforts can be categorized into two main areas: data collection and data processing.

The data collection process begins with historical records research to identify the terrain, last known details about the wellbore and to develop a tailored data collection plan for the field crew. This plan includes considerations such as flight altitude, flight directions, perpendicular tie lines, diurnal corrections, and other niche parameters that must be carefully understood, collected, and applied correctly.

Data collection also includes the drone component, ensuring that the payload is stable and flight height is consistent; low enough to collect high resolution data, but high enough to avoid vegetation, terrain, and magnetic anomalies caused by unrelated surface features. Additionally, flight speed is optimized to allow for effective filtering to maximize the signal to noise ratio. Operational considerations, including flights both within and beyond visual line of sight, are also factored in.

For data processing, the team employs a multi-step approach involving magnetic data band pass

filtering optimized for specific site conditions to identify a precise center point for the well location. The data are then integrated with photogrammetry and LiDAR-derived digital terrain models and analyzed to rule out magnetic anomalies with characteristics inconsistent with orphaned wells.

Once the data analysis is complete, the field team verifies the well location by excavating to locate the surface casing, or in cases where casings have been pulled, finding the mudded well bore. Only after verification are the sites marked as confirmed in the system. Parsons maintains comprehensive tracking of each site from start to finish, enabling consistent feedback on the effectiveness of data collection and processing techniques. This feedback loop helps the team refine methodologies and address challenges encountered during the process, ultimately improving outcomes for future investigations.

About The Author

Ron has a BS in Mechanical Engineering and 20 years of experience with Parsons including plugging & abandonment operations of early-era wells, risk analysis, bioremediation, geophysical and hydrogeological investigations, remediation systems, permitting, and contractor/HES management.