Orphan Wells Project #77

Orphan Wells

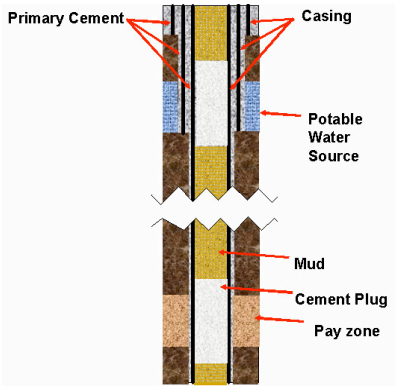
If you google the term the results page may lead with the question *"did you mean Orson Welles?".* Near the bottom you'll see a reference to an alternative rock band called Orphan Wells. Sandwiched in between you'll find assorted references by state and country. If you look through these, what emerges is a dismal story befitting the moniker, orphan.

Orphan wells are the implacable detritus of the historical progression of oil and natural gas exploration and development. Orphan wells are the silent testimonials to the bust cycles. They reflect the history of exploration and development technology. Orphan wells are the forgotten remains of oil and natural gas exploration and development activity. Owned by no one. Attended to by no one. A silent hazard causing unanticipated harm generations beyond their productive life.

Consider that oil has been produced from wells as early as 347 A.D. in China, using bits attached to bamboo poles. Seep oil, oil naturally rising to the surface in a river or pond, or through a mine, has been collected in every country of the globe since the Middle Ages. In fact, one method involved damming rivers and creeks with oil seeps located nearby to create a pond where oil could be skimmed from the surface. In the early 1800's in the U.S., water wells or brine wells were known to produce the "unwanted" byproducts of natural gas and oil. California was among the first to harness this waste to light the Stockton Courthouse. Early drilling technology didn't vary much from the Chinese method. Iron poles replaced bamboo and were powered by a steam engine to pound holes into the ground, a process known as cable tool drilling. By the 1920's, cable tool drilling was being replaced by rotary drilling, enabling petroleum prospectors to go deeper in search of oil and natural gas reserves.

Since the first recorded wells in the U.S. were drilled in 1859 in Titusville, Pennsylvania, there have been an estimated total of 3.5 million oil and natural gas wells drilled in the U.S. to date. There are approximately 900,000 wells are currently in production. That leaves 2.6 million wells scattered across the 36 oil and natural gas producing states that are not in production. The majority of these wells are idle, that is a well that is not producing, but has state approval to remain idle. Idle wells represent future potential production as either technology or market prices support the cost of putting wells back into production. However, every well drilled eventually will reach the end of its productive life. Such wells may be plugged and abandoned, with liability of leakage remaining with the owner. In some cases, wells have no current owner or parent company. these are orphan wells.

Abandoned wells can be subdivided into three categories. The first is wells that are not plugged. During the earliest years of petroleum production, wells were literally abandoned. The wooden superstructure might be salvaged for other uses or left to the ravages of weather and time. As metal replaced wood, the casings might be pulled for use in other wells, or for salvage value, especially during the two World Wars when steel was in short supply. Category two includes wells plugged before 1952. Cement was introduced to the petroleum drilling process in California as early as 1903 to isolate a water zone. Typically cement was used to bolster the production of hydrocarbons by preventing the flow of water into a well, but was seldom used for plugging purposes. California made plugging with cement mandatory in 1915. By then, about 30,000 wells had been drilled in the state. Other states lagged behind, with some not regulating the process until the 1950's. Even with the establishment of state regulatory bodies during the 30's and 40's, effective cement plugs were often not installed, as early cement compounds lacked the chemical components to withstand down-hole temperature and pressure and so failed to harden properly. Prior to regulations mandating the use of cement, operators may have plugged wells with tree stumps, logs, animal carcasses or mud. The third category would include wells plugged after 1952, the year American Petroleum Institute published standards for plugging procedure and cement composition, Finally, with the creation of the Environmental Protection Agency, national laws protecting drinking water developed national standards and mandates. Since this time abandoned wells are plugged using cement to close the well as it passes through formations. The well itself is generally filled with a mud fluid with sufficient weight to offset the hydrostatic pressures surrounding the well. This stabilizes the well and prevents the migration of petroleum products or water or salts from one strata to another via the well.



Of the abandoned wells in the country, about 16% are orphan wells. These are wells that are inactive and unowned. And, if they are wells pre-dating 1952, they are likely improperly plugged. Wells lacking a cement plug are most likely to be shallow wells, generally drilled prior to the 1930's. However, many deeper wells were also left unplugged after the 1986 oil bust as many companies became insolvent. In fact, bust cycles are likely the most common cause of improperly abandoned or orphan wells. Without an owner, monitoring and plugging abandoned wells falls to the state. The average

cost to properly drill out and plug an orphan well is about $5,400. States often levy fees or taxes on current oil and gas production to fund these costs. As funds may still fall short of the need, most states stretch their funds by prioritizing the hazardous conditions of the wells. A survey conducted in 2000 revealed six producing states with waiting lists of 1,000 or more wells approved for plugging with state funds. Kentucky tops the list at 12,000 orphan wells waiting to be plugged.
The other major issues involving orphan wells are, of course, finding them and subsequently, monitoring their condition. Location and other data pertaining to wells drilled in the first 20 years of petroleum exploration is incomplete at best. Likewise, data concerning wells abandoned by companies who themselves have vanished is also incomplete. In any event, without an owner, these wells are also not monitored to ascertain whether they pose a specific hazard. Orphan wells can pose both physical and environmental hazards. Hydrocarbons, salts and ground water migrate. An unplugged well creates a conduit allowing these materials to mingle, either contaminating precious below ground aquifers and water wells or seeping to the surface to contaminate fields and ponds or rivers and streams. Beyond the contamination, surface seeps can accelerate the hazards and ferocity of wild fires. As unplugged wells deteriorate over time, they can cave in on themselves, while appearing intact on the surface, posing a danger to animals and humans that may tread unwarily.

Today's petroleum prices provide yet another incentive to identify and address orphan wells. As noted earlier, wells may be abandoned because the costs of production at a particular point in time were unsupported by the prices for petroleum product in the market. Wells from earlier periods also may have produced less than their actual capability due to the inferior technology of those early years. In any event, even as hydrocarbons can migrate and pollute water resources, water and salt may similarly migrate and pollute petroleum reservoirs.

However, the mere process of finding orphan wells is, itself, daunting. Since the turn of the century land ownership patterns have changed. Some producing states have huge tracts of land under some form of governmental ownership, often federal, but states also own significant tracts. The federal government currently owns some 5 million acres in vacant land, or land not used for federal facilities, highways or other purposes. These holdings include national park systems, ecosystem preserves and other similarly protected natural resources. The first national park, Yellowstone, was created in 1872, the first wildlife refuge in 1903. By 1916, when Congress authorized the creation of the National Park Service, the federal government had 40 parks and nature preserves. In 1933, 63 national monuments and military sites were added. Over 54% of the federal government's land holdings are in western states. Additionally, over the course of the history of petroleum exploration and development, the population of the U.S. has grown, and with it the proliferation of private land ownership in previously open territories.

The process of searching for orphan wells is significantly affected by land ownership. Beyond the complexity of gaining access to private property, for example, there is also the issue of liability. This includes liability for damage or injury occurring to persons,

equipment or land, specifically crops. On the other hand, public lands offer an unprecedented opportunity for collaboration.

In any case, most efforts towards locating, assessing and monitoring orphan wells barely crawl out of the concept stage due to a lack of personnel to undertake the challenge.

A Case Study

Pennsylvania has produced oil and natural gas since 1859. In fact, Pennsylvania was responsible for nearly half of the world's production of oil until the east Texas oil boom of 1901. Most of that production occurred around Titusville, in an area now known as Oil Creek Park. Without the benefit of geologic science, Pennsylvania oilfields were discovered by physical evidence. Oil seeps at the surface and near various creeks identified the potential for oil production. Wells were drilled at random and often very close together. A famous tintype from 1871 shows a location known as Triumph Hill with a veritable forest of wooden derricks. It would only be much later that petroleum engineers would understand that drilling too many wells, too closely together actually reduces production capability, as well as increasing environmental damage. At the time, all anyone worried about was fire. Drake's first well lasted only a couple of months before being consumed.

With its long history of petroleum production, Pennsylvania was particularly concerned with orphan wells. Oil Creek State Park falls under the jurisdiction of the Venango County Conservation District. To augment his small staff, Director Mark Richert recruited summer interns to help canvas the District in search of orphan wells. The results were lackluster. Then, in 2000 Richert and Curt Pieper, Pennsylvania Office of Mineral Resources Management, attended a convention hosted by PaSEC, Pennsylvania Senior Environment Corps. Launched in 1997 by by a partnership between the Environmental Alliance for Senior Involvement (EASI) and two state agencies, the Department of Environmental Protection and the Department Aging, PaSEC is a statewide network of older citizens who monitor Pennsylvania's water resources.

Similarly, EASI is a national nonprofit coalition of environmental, aging and volunteer organizations. It was founded in 1991 following an agreement between the U.S. Environmental Protection Agency and the American Association of Retired Persons. EASI typically partners with national, state and local public and private organizations to provide opportunities for older adults to play an active, visible role in improving the environment in their communities.

It didn't take long for Richert and Pieper to realize that the group's mission to protect the state's water resources blended beautifully with their need to locate and remediate orphan wells which could be polluting those resources. When approached, EASI and PaSEC were enthusiastic about the idea. By 2002, PaSEC, EASI, the Venango County

Conservation District, the Pennsylvania Department of Environmental Protection (DEP) and the Department of Conservation and Natural Resources (DCNR) were ready to launch their pilot project in Oil Creek State Park. According to Pieper, the area was selected because it had a ready combination of key ingredients: state land ownership providing access, a large probability of orphan wells resulting from historical activity, and an active PaSEC volunteer cadre ready to go. DEP provided the money, $40,000 to start, and the pilot was up and running.

EASI has existing training programs for its members for its water monitoring projects. This includes safety, site location and recording methodology. DEP and DCNR added training in operating hand-held GPS devices, mapping coordinates and downloading data for transmission to state databases. Additionally, the volunteers would have the support, as needed, of the Venango Conservation District while in the field. The funding provided hand-held GPS units, walkie-talkies and radios, first aid kits, topographical maps and compasses, briar-proof pants, orange safety vest and hats, computer software, markers, flags and tags and digital cameras. By late spring the PaSEC volunteers were ready to hit the bush, all 10,000 acres of it.

Long-time PaSEC volunteer John Kolojejchick recalled those experiences during the summer of 2003:

> We always go out in teams, no less than three and I'd say six is about the most you'd want. We get in a spaced line, set a bearing and head for it and with the way the terrain dips and rises, its hard to keep the line and keep everybody in sight. That's important for safety and to be sure we're covering the area properly.
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> We take photos, enter a description of the site on a log sheet and record the latitude and longitude. That report goes to the Venango Conservation District and the DEP. They (DEP) verify the data and add the sites to the official list.
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> But its not always that cut and dried. First thing we learned was that we needed better topo maps and gps units. Next we learned that what we actually would see in the field might not be what we though we were going to see when we were doing the training. Sometimes a well site is just a depression in a field. They can be pretty large, maybe three or more feet across. We test the surface to see if it's an open shaft. And, we figured out pretty quickly we needed to work around the various hunting seasons.

According to Richert, the volunteers set their own schedules, doing most of the work in the late spring to early fall. Teams notify the District when they are headed out and the area they'll be canvassing. They can maintain contact with park officials while they are in the field. As of October 2003, the PaSEC volunteers had identified 57 potential orphan wells. Richert and Pieper admit to surprise on the first round, compared to the re-

sults of previous efforts. The training, dedication and focus of the volunteers were the key ingredients, they noted.

With the pilot program proving so successful, the project alliance moved forward to launch a second phase, with additional funding of $20,000. Four new areas were added to the project to include some game lands and forestry preserves. To date, some four years since inception, the project has found 340 wells, logged 880 volunteer hours and cost a total of $60,000.