"I Bet Nine Lives on GPS"

RTK Surveyor Bob Long Helped Avert Pennsylvania Mine Tragedy

A bad map can get you killed. A good map just might save your life. Ask nine miners who spent 77 hours trapped underground, in cold, black water sometimes over their heads. The GPS-guided drill bit that found them 300 feet below the surface opened the first stage for their return to their families.

Wednesday night. A crew of nine miners working in the Quecreek Mine, Somerset County, southwestern Pennsylvania, were drilling into a coal vein to extract more ore. Relying on a 50-year-old mining map, they thought they were about 300 feet away from an abandoned mine. Instead, they were right on top of it. When the drill broke through the mine wall, 50 million gallons of water from the Saxman pits began gushing into their shaft. They scrambled for survival and, after harrowing episodes in floodwaters that were chest-high and sometimes over their heads, they reached a small cavern with an air pocket where the water level seemed stable — for a time. Then they waited.

Bob Long of Civil Mining Environmental Engineering, Inc.

Meanwhile, topside, 34-year old engineer Bob Long of Civil Mining Environmental Engineering, Inc., had just dropped off to sleep when the phone rang. "We need you and the GPS out at the site," his boss told him. "Fast."

Arriving in darkness and chaos at the mine entry, Long unpacked his equipment from the back of his Chevy Blazer. He had used GPS to complete an as-built survey of the surface site during the mine-permit process a few months earlier and knew the coordinates of his control points. He and the mine's surveyor now had to link the mine's underground maps, based on subsurface surveys that used laser measurement equipment and recorded survey points in North American Datum 27 (NAD27) coordinates, to the surface survey in the World Geodetic System 1984 (WGS84) coordinate frame used by GPS. They then needed to predict where the miners might have sought refuge and pinpoint a spot vertically above it to drill an airhole.

"The mine engineers gave me the point they wanted. That was somewhat of a guess. I had to get a bunch of stuff tied down to their survey. I set up my base, walked around with my handheld [data collector] shooting control points, and staking. All in the dark, for an hour and a half."

Thursday Morning. At about 1:15 a.m., Long drove a stake in the ground — his determination of the spot directly above the guessed-at cavern on the mine map. The crew pulled up a rig and began drilling.

If they missed by only a few feet, they'd have no idea where they were. A miss is as good as a mile in such circumstances. They had to hit the void, the 17-foot wide opening 300 feet underground in which they hoped the nine miners were still alive.

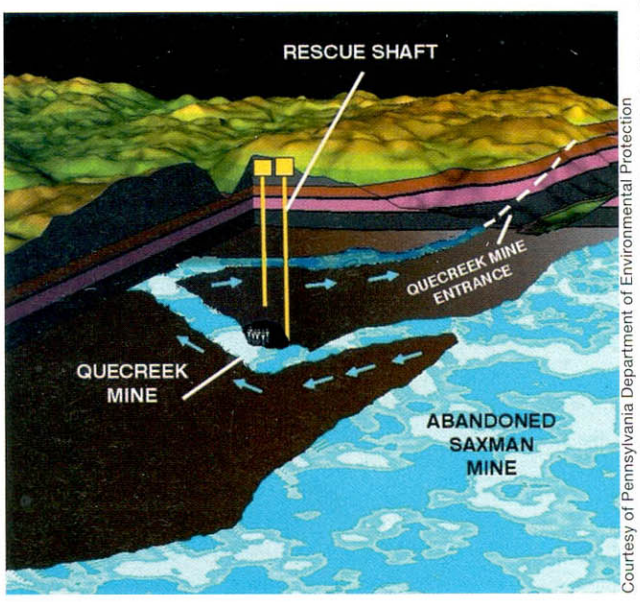
Even if Long's surface survey was dead-on, drilling is not a precise procedure. Drill bits can vary and float, searching for the easiest way through the earth. The deeper the bit goes, the more it can stray from vertical. Long went off to survey other areas for water de-pumping holes.

An hour and a half later, he returned just as the drill broke through the sought-for tunnel ceiling, only 20 feet from the trapped miners. Within minutes, the surface crew heard nine metallic clangs — the miners pounding the drill bit with their hammers to signal they were alive.

"The sweetest sound I ever heard," said Long. "Everyone owes a big thanks to the underground surveyor. He did his job very well."

Sunday. For more than three days thereafter, rescue crews labored over a 36-inch hole, next to the 6-inch exploratory hole, to lift the miners to safety — a hazardous and complex operation in itself. The last miner emerged 77 hours after his ordeal began.

Retrospective. Old mining maps such as the one used by the nine miners are often found to be inaccurate — sometimes because of old survey methods that employed poles, chains, and tape measures, and sometimes because mine owners deliberately underreported the extent of their excavations to reduce the fees they paid. Today's mine surveyors frequently use laser technology below ground and GPS on the surface.



Courtesy of Pennsylvania Department of Environmental Protection

"They [the Quecreek mine] set up a laser site and used a short set of legs," reported Long. "They usually traverse, and always run perimeter and centerline, and

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Mine Rescue

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close back and forth between the two. The miners try to stay on centerline with that [as they dig further] and once or twice a week, the mine surveyor goes in to reset, trying for an estimated misclosure within 1-in-10,000. They do a lot of open-end surveys, and close them out at the end of a week. The surveyor had just closed that [area] out on Tuesday."

"Now he says he's going to close it out every day he goes in."

The surface drilling area named "Rescue One" lay more than a mile from the mine entrance — and the base for the underground survey. Consequently, much precision work both below and above ground, performed by the Quecreek mine surveyor and Bob Long, preceded successful drilling of the exploratory hole.

Long's work was far from over once he heard the clanging of the miners' hammers on the first drill bit. He stayed onsite through Sunday, getting five hours sleep over that time, staking drill hole sites to enable rescuers to pump compressed air into the caverns and extract water, keeping it at bay until the miners could be lifted to safety.

"I bet nine live on GPS," he told *GPS World*. "Just trust the unit. It knows what to do." ⊕

Vicki Rock/Daily American

Rescue workers pump compressed air into the mine (right) while drilling an adjacent rescue shaft (center).

Alan Cameron *is* GPS World's *senior editor.*

Manufacturers

Civil Mining Environmental Engineering, Inc. purchased a **Trimble** *GPS Total Station 4700* 18 months ago. Bob Long used it and a Trimble *Survey Controller (TSC1 v 7.60)* handheld at the Quecreek site.