

Bolivia Water Well Drilling Follow-Up Training

May 6 – May 11, 2013

By Jason Gehrig

Suma Jayma Team Members:

Jaime Rosa (lead driller), Braulio Rojas, Jorge Rosa, Hernán (mechanic)

WEFTA-sponsored volunteers:

Dale White, North Texas well driller and former owner of the drill rig shipped to Bolivia and donated to the non-governmental organization Suma Jayma; Jason Gehrig, WEFTA volunteer (both employees of Tarrant Regional Water District). It was Dale's first trip to Bolivia.

A Few Dale White Comments along the Way...

When told about the three Andean "Commandments" – Don't lie. Don't steal. Don't be lazy. -- Dale observed, reflecting upon the tremendous work ethic of both the members of the Suma Jayma team as well as the community members themselves who supported the drilling effort (and with pick axe and shovel in hand), "I don't know the people well enough to say about the lying or stealing part, but I certainly know they live up to the don't be lazy part! There wasn't a day during my time there that we didn't head out at dawn and get back to the house from the countryside after nightfall."



Suma Jayma's water well drilling rig



Dale White, North Texas driller, enjoys Aymara hospitality

*The food left a lasting impression on Dale. It included potatoes to cumin-coated beef, home-made cheese, the giant-kernelled white corn known as *choclo*, and the Andean freeze-dried potato *chuño* and *t'unta*. "There wasn't a thing put before me that I didn't eat; and for that matter, not a thing that I tried that I didn't like."

Every night upon our return from the field, Braulio's wife Basilia would have a different traditional Bolivian soup and entrée awaiting us after our hot showers under an electric heater-coil shower head. The hospitality and gratitude of the community members was overwhelming, as was the quantity of food!

Other lasting images for Dale included the harvesting by hand of the barley fields, the "crazy" driving in the urban thoroughfares where a two-lane road would quickly become filled with three to four lanes of traffic, and the thrill of looking down on the capital city of La Paz 1500' below from the

canyon rim where the city of El Alto lies. The poverty he encountered affected Dale as well, and yet the happiness and sense of humor of the community members themselves made it evident that despite hardship and suffering, the people were resilient and hopeful.

At the conclusion of the slideshow he gave about his trip to colleagues at Tarrant Regional Water District on May 23rd, Dale recalled how happy he was to get on the plane after a successful week of accompanying the Suma Jayma water well drillers. "I was tired!" Of course, before he could catch up on rest back home, he would become even more tired from getting up at 3:45 am that final morning and to start the trip back to his home outside of Forestburg, Texas, where he arrived at 11 pm!

Monday, May 6th

We picked up Dale White, the drilling trainer and former owner of the drill rig WEFTA donated to Suma Jayma, at the El Alto Bolivia airport and settled in at the Suma Jayma center where Braulio's family lives. After a welcome breakfast, we made our way to Suma Jayma's metal shop, where Dale was introduced to Suma Jayma's building skills and processes for constructing hand pumps from scratch. Following that, we made the hour and a half long drive out to the village of Collagua to become familiar with the site and set up the drill rig. We attempted to perform a 1D resistivity test to confirm the earlier geophysics study prepared by a government agency, but a short in the wire caused the unit to not read correctly (we thought it was lack of soil moisture but figured out the problem the following day). After reviewing the site, we selected a site to drill fairly close to an open well which would facilitate a supply of water for the drilling mud. As Dale admired the work ethic of the community members in digging out the drilling mud pit, I told him of the three Andean commandments: Don't lie. Don't steal. Don't be lazy. He found the latter to be particularly appropriate for the Aymara people he would meet that day and throughout the week, where benefiting families and their community leaders actively participated in supporting the drilling operations. Late that afternoon, the first 20 feet of drilling was completed, with the lower half going through a water-bearing porous material. Only later that night did Dale finally get to rest on his first day in the altitude at 13,000 feet above sea level.

Tuesday, May 7th

Today the experienced driller and the drillers-in-training would learn the limits of what Suma Jayma's drill rig – affectionately nicknamed "Little Red" (now "Pequeño Rojo") by Dale years earlier – could do in this particular subsurface geology found in the Collagua area... and what it couldn't. At about 40' of depth, the drillers struck a layer of sharp-edged, 4" to 8" cobblestone-like rock (evident in cuttings in nearby stream banks as well) that impeded any further progress into the substrata. Following various failed attempts to proceed deeper, we decided to set up a cased, shallow well (above the cobblestone layer was plenty of saturated sandy gravels). We set the shallow 4" screen and casing, gravel packed, and explained to the community we would only be able to provide a manual hand pump for that location.



Community members all pitched in to get the drilling started



Jaime Rosa bentonite to make drilling mud



Loading up the rig after the first well

Hopes were dashed for a deeper, better producing community water well for the 45 families in Collagua. We packed up the rig with all the drill pipe, casing and accessories and made the long trip back to El Alto. This was particularly difficult for Suma Jayma as well since the hoped-for funding from the municipal government of Viacha for the community well would not be forthcoming given the inability to drill in that area resulting in the project requirements not being met. Substantial drilling start-up expenses were being required of Suma Jayma (PVC casing pipe, gravel for packing, water tanks, diesel, etc). Yet, the Suma Jayma team realized there would be both a learning curve involved in acquiring the skills to successfully drill water wells, as well as a required upfront investment of significant time and expenses before they could start working toward being more self-sustaining through meeting the water well drilling need of rural communities in the Bolivian Altiplano. With over 12 years of experience as a non-governmental entity, the Suma Jayma team had faced their fair share of challenges in the past, which has helped hone their resilient nature.

Earlier in the day, we took the geophysics resistivity one-dimensional meter out and successfully read various subsurface resistivity readings, including areas with known groundwater. Jason will provide a summary of the user's manual for the Suma Jayma team in Spanish for future use in characterizing approximate subsurface conditions into the future.

Wednesday, May 8th

Realizing we wanted to take full advantage of Dale's presence that week, Braulio quickly called a meeting with Viacha municipal officials to identify other potential wells to be drilled. Meanwhile we spent most of Wednesday with Dale, showing Jaime and Suma Jayma's contracted mechanic Hernán the ins and outs of the drilling rig Dale once owned: adjusting motor operations to better perform at 13,000 feet; replacing-reconnecting both diesel fuel filters; cleaning out the tank and changing the motor oil; and getting under the rig to show the Suma Jayma team how to replace the clutch plates for the mud pump and turntable when the time comes to do so. By that afternoon, with a good *Plato Paceño* (fava beans, choclo, a cut of beef with cumin and a slab of local white cheese) under our belts,

our spirits were picking up and we headed out to the rural community lying just outside of the town of Viacha, just to the northeast of one of Bolivia's largest cement plants. The municipality of Viacha had identified this community of Palcoso as one in need of a safe water supply.

There we spoke with the community leaders who showed us the poor water quality they were enduring since their system was built several years earlier. It appeared yellowish in nature and considered by the local people not even fit for their animals, and certainly not for themselves. They likened it to *chicha* - a corn-based alcohol drunk by folks in the valleys of Bolivia - in texture and appearance anyway, certainly not in taste! After conversing with the community leaders, we identified a well site within a couple hundred yards of the existing, successful well supplying the cement plant (itself located on the villagers' property). We called for the drill rig to be brought out to the 60-family community of Palcoso so that an early start the following day could be undertaken.



Buying motor oil and fuel filters in El Alto

Thursday, May 9th

Such quick movement on the part of Suma Jayma and the town of Viacha officials had taken some of the Palcoso community members by surprise. A fairly lengthy discussion was underway by the time we arrived that morning, which is typical of the Aymara communitarian decision-making process. We allowed them time to air their concerns and consider alternative proposals, and within half an hour reach a consensus that had the community fully on board with drilling the well in a particular location that straddled the property line of two adjacent property owners in the community. The community had contracted a backhoe to excavate the drill mud pits, about 2 x 2 x 2 meters each, as well as to excavate the small trench leading from the borehole to the mud pit. Drilling mud was prepared, perhaps not quickly enough, though, as we immediately drilled into a pea gravel layer after about 15 feet of clay. Alternating between the full 20' joint of drill pipe and the 10' joint of drill pipe which Dale instructed the Suma Jayma guys to make, we made our way



Equipment needed for air developing a water well - 1" PVC with air insert - to draw out fines

through the ongoing pea gravel layers intermittent with thin layers of clay. The drilling mud was thickening up and we were able to bring significant amounts of cuttings up to the surface; yet it appeared some of the larger diameter pea gravel was not coming up. There was no doubt as to the presence of groundwater. We proceeded to about 70' of depth, circulated the hole, and pulled pipe for the night. Throughout the day, the Suma Jayma team picked up drilling tips from Dale, especially Jaime, who will be Suma Jayma's lead driller in the future. The Suma Jayma team also learned how to measure the viscosity and density of the drilling mud to help them achieve optimum drilling conditions.

Friday, May 10th



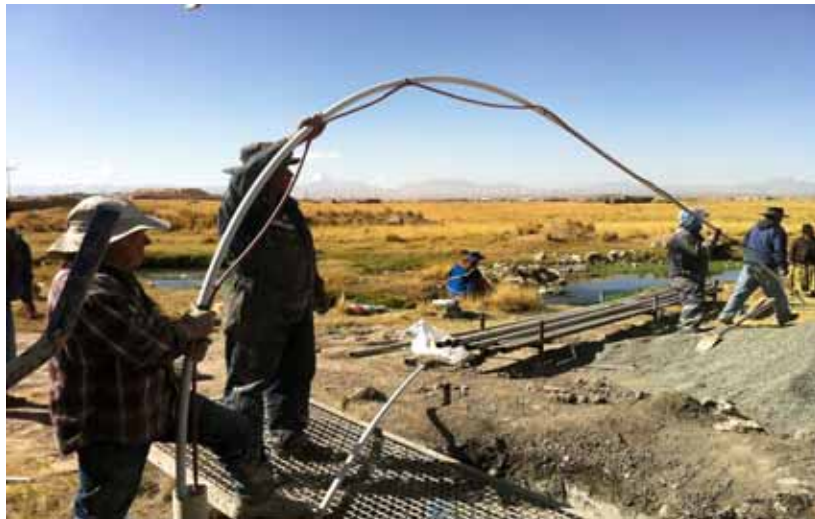
Dale initiates second well as hopeful community member looks on



Jaime and Hernan of Suma Jayma take the reins on the water well drilling

Friday, Dale had Jaime of the Suma Jayma team lead the drilling operations, giving him tips along the way. Drilling continued throughout the morning, reaching a depth of 90' (the lower 75' of which being primarily pea gravel). We found the drilling mud unable to maintain the borehole wall in the lower 20', and unable to circulate up the larger diameter gravel. The bentonite in Bolivia runs about \$25 per 50 kg (110 pound) bag, about three times what we had paid a year earlier in North Texas during the two training wells drilled by the Suma Jayma team during their visit there. Being a poorer quality bentonite, it also took many more bags to reach an adequate drill mud. pH strips will be shipped to the Suma Jayma team in the near future so that they can make sure they're working with mud in neutral to basic condition ($\text{pH} > 7$) for better drill mud preparation. Knowing that we were hitting significant groundwater, we decided to set 20 feet of screen made by the Suma Jayma team out of 4" schedule 40 PVC at a depth of 70', and then bring the 4" PVC casing up to the surface.

The well was then gravel packed to within about 15 feet of the surface, then sealed with concrete mixed by the community members to avoid any undesirable near-surface and above-surface waters from contaminating the aquifer being tapped below. Finally, using Suma Jayma's air compressor and tank, we rigged up with an air hose feeding into a 1" PVC pipe dropped to the bottom of the casing. The well was developed using air to draw up the fines and drilling mud out of the well. This was a great lesson for the Suma Jayma team on how to perform this important phase, especially when no electricity is nearby to run a submersible pump for developing the well. This air development of the well, taught to the Suma Jayma team by Dale, was truly a technique they wouldn't understand without this first-hand kind of training opportunity. Flows of around 8 to 10 gallons per minute coming out of the well were estimated for over an hour before the air compressor tank had run low, with the water level in the well at about 15 feet of depth and never dropping. It was certainly a producing well, with increased water clarity evident even in that short run of time air developing the well. The water tasted "sweet." To me, it still had a strong taste of bentonite to it, but I took Dale's word that it had all the signs of a great water producing well for this community of approximately 60 families. A concrete storage tank already existed on the hill about a quarter of a mile away; from that tank there was already a piped, PVC gravity distribution system to the various homes in the dispersed



Inserting 1" PVC and air hose into gravel-packed, cased water well to later "air develop" the well, a process used to clear up the water coming out of the well

community. The Suma Jayma team will perform the hydraulic calculations to determine the approximate pumping head required, taking into account both the difference in water levels between the tank and the well, as well as the friction losses in the piping up to the tank . These are calculations they've performed for years on their multiple community water systems designed and installed since 2001. Based on that and the desired flowrate, they will help size the electric submersible pump to be installed by the municipal government in the near future. The Suma Jayma team returned to continue developing the well the following Monday, describing the water as plentiful and crystalline. Water quality analysis will be carried out by the public university lab, UMSA.

With the sun setting over the altiplano, the community leaders expressed their immense gratitude toward Dale, myself and the Suma Jayma team through the traditional *cha'lla* (blessing) and words of appreciation. Woven coca bags and scarves that were being worn by the community leaders were then placed on Dale and Jason. Everyone expressed surprise at the swiftness of the well drilling and the quantity of water coming out of the well that was calculated to easily meet the water demands of the community, and plenty more to help support their local, small-scale dairy operations. We headed back to the house that evening with spirits high, knowing that Suma Jayma was ready to continue forward on their own in meeting water supply needs of communities throughout the Bolivian altiplano for years to come.



Saturday, May 11th

Alarm set at 3:30 am, we got Dale to the El Alto airport for his return home. I would head out the following morning. That day we had a chance to review the week's water well drilling challenges and accomplishments, discuss Jaime's progress toward a civil engineering degree he's pursuing with support from a key WEFTA donor, and look forward to future community water-supply projects to be implemented by Suma Jayma and funded by WEFTA with substantial local support. A great trip!



And, of course, some time at the end to celebrate among new friends!