



**Water Engineers for the Americas**

**BOLIVIA**

**April, 2010**

**To:** Water Engineers for the Americas  
and to Past, Future or Potential Donors

**Subject:** Bolivia, Department of El Alto – La Paz  
Funding Needs and Project Descriptions  
Following Site Visits to Current and Future Water Projects  
Conducted with Suma Jayma: Braulio Rojas, Director; Jaime Rosa,  
Technician; Edgar Vargas, Assistant.

**Date:** April, 2010

**From:** Kari Juanita Edenfield, P.E.,  
Water Engineers for the Americas (WEFTA)

## **Machacamarca**

The Machacamarca regional water system project began in 2003 with Suma Jayma (under the direction of Braulio Rojas) in collaboration with the Maryknoll Missionaries (represented by Jason Gehrig) and the Municipal Government and Centro de Salud Palcoco. Two communities in the Andean Province, first section, in the area called Canton Hayna Potosi Palcoco, in the Department of La Paz, Pucarini, Bolivia, 1) the communities of Palcoco and Machacamarca are in need of a water system to deliver water service to each of 250 and 200 homes, respectively, each of an average size of 6 people. The system will serve approximately 2,700 people.

An engineering report for the project was completed in December of 2003. Since that time, Suma Jayma has worked tirelessly in the communities to secure agreements from all parties involved, including from each of the homeowners. This effort has been tremendous and is now beginning to come to fruition. First, a Water and Sanitation Committee was initiated with representation from the communities and the overseeing Municipal Government. The members of the Water and Sanitation Committee are responsible for convening meetings and assemblies of all water users a minimum of twice per year to deal with operation and maintenance matters, enforce monthly dues, authorize or suspend services in accordance with the committee statutes and to balance the budget as well as to conduct the actual operation and maintenance of the system. The President, Francisco Hildalgo Condori; Vice President, Claudio Aruquipa Quispe; and Secretary, Teresa Quispe Chuyma, all signed the Engineering Report for the project, which also defines all their roles and duties for the Water and Sanitation Committee.

Suma Jayma also met with each family to execute an agreement to receive potable water service, consisting of an outdoor pedestal and spigot, contributing 150 Bs and agreeing to a monthly service fee of 2 Bs to contribute to ongoing operation, maintenance and administration of the system. The agreed-upon monthly service fees will go to the Committee in order to cover the costs of tools, replacement parts and repairs and future maintenance. The design intent of the system is focused on minimal maintenance for a long-lived self-sustaining system, capable of lasting a minimum of 20 years without modifications. These new water services would improve

the circumstances of each family in the area, who have been hauling water for long distances (often miles) from either surface sources or open “wells” – essentially shallow holes in the ground, surrounded by livestock. These unsanitary sources of water have long been a concern and a threat to health and safety in the area.



*Typical Shallow “Well” Used to Date for Water Supply in Machacamarca*

Most profoundly, the Municipality agreed to contribute a large percentage of the project cost (a sum of 407,167 Bs, dedicated in correspondence to Suma Jayma dated February 27, 2010) and through that contribution, at present, a water tank with 100 cubic meters capacity to capture surface waters has been constructed along with over 15 miles of small diameter pipeline (3” diameter and smaller) comprising the entire distribution network for the system. This work was completed with the in-kind contribution of the community (in effect 241,000 Bs, or 34% of the total project cost). The community volunteers comprised over 200 individuals who came together to construct the tank and distribution system and completed all this construction in less than one month.



*Portion of New Community Water Source- Partially Diverted  
for Tank Construction  
(Glacial Runoff from Condor Mountain)*



*President-Coordinator of the Potable Water Committee Pointing Out the Location of One of the Network Crosses Interconnecting the Three Main System Laterals (All Piping is 3" – 1 ½ inches in diameter)*



*Palcoco Water Storage Tank, April 12, 2010 (Approximately S16d18m43s; W68d23m28s, elev. 3965m)*

System components which remain to be completed and are in need of immediate funding include a settlement basin (prior to the tank) in which the turbidity of the surface water can be reduced, installation of protective screen at the water tank and connection of the entry and exit pipes to the tank, installation of valves, including pressure reducing valves, and valve vaults (valves have already been purchased) and installation of the distribution laterals and services themselves. In meeting with the representatives of the Committee, elected officials, Suma Jayma and WEFTA

today and reviewing the project, it is believed that the entire project could be completed within 5 months of receiving the needed funds.



*Representatives of Machacamarca Water and Sanitation Committee, Officials of the Municipal Government of Pucarani, Suma Jayma and WEFTA Representatives  
Machacamarca, Department of La Paz, Boliva, S.A., April 12, 2010*

Representatives of Suma Jayma, Braulio Rojas and Jaime Rosa, and representatives of WEFTA, Kari and Tom Edenfield, III, traveled from El Alto to Pucarani to view the current progress of the project and to speak with the representatives there. A total of 15 representatives of Machacamarca and Palcoco met with WEFTA and Suma Jayma to express their sincere and emotional thanks for helping the community in their dire circumstances. They also confirmed that the local government had contributed 100% of their commitment to the project funding. Those who spoke emphasized and repeated that without WEFTA the projects would fail. They would like to do many things to improve their community and it all begins with water for health and well being at the most basic level, the community simply lacks monetary resources. The projects they are desperate for are in no way elaborate, they consist of the most simple and minimalistic components. Water delivery is not even plumbed into the homes, it is simply delivered to a tap stand in the yard, at which time the community will be ecstatic to have water available so conveniently and cleanly.

There is a third community, Viruyo, located just northeast of Machacamarca, which is also now included in the project. Viruyo has an established water delivery network, but relied upon an elevated water storage tank. When their water pump failed, the community was unable to replace it and the system ran dry. With a few hundred meters of pipe, a connection to their existing distribution system was made by the community of Machacamarca installing the pipe.

During the April 12, 2010 site visit, WEFTA representative, Kari Edenfield, spoke to the community members and Suma Jayma with recommendations that for future consideration, the elevated tank be left in tact and plans to replace the pump be taken into consideration so that in

the future, all communities connected to the new water system might take advantage of the overhead storage tank in the event of a line break or regular maintenance and repairs to the system between the storage tank and distribution networks.



*Suma Jayma Representatives, WEFTA Representative, and President-Coordinator of the Potable Water Committee, Francisco Hildago Condori, Reviewing the Design Plans for Water Distribution in the Region, Machacamarca, Canton Huyna, Potosi Palcoco, April 12, 2010*

A new hospital in Machacamarca is also located within easy reach of the new water system and will benefit from the project with its own service pedestal/tap stand.



*Machacamarca Hospital*

An updated cost estimate was prepared by Suma Jayma on February 22, 2010. Approximately 6,500 Bs is needed for the sedimentation tank, 4,000 Bs for chlorination/disinfection equipment, 12,400 Bs for the water tank screening, 5,400 Bs for the pressure reducing valve vaults, 2,150 Bs for isolation valve vaults, 3,000 Bs for transport of materials, 18,000 for technical supervision

and monitoring, 1,500 for tools, 74,700 Bs for individual services, 53,400 Bs for intermediary piping and appurtenances between the water mains and services, and 1,200 Bs for education and training in health and hygiene for the water system users. The total projected cost or funding need for the project is 182,250 Bs, or approximately \$25,800.



*Machacamarca (Children Walking Home from School)*

At this time, the residents and authorities are ready to install the laterals to each home from the main distribution network and to construct the water service pedestals and taps at each home. Each homeowner is responsible for preparation of the area in which their pedestal will be installed, including leveling and compacting the subgrade and constructing a trench around the area to divert any runoff and a ring of protection around the service. They are willing to contribute all that they have, time and effort, and need only the means to purchase the materials to complete the construction.

The community is extremely dedicated to completing the project and grateful for the assistance they have received. They are a kind and generous group of people with great concern for the health and well being of their community and especially their children.

## Escuela Condoriri

The Condoriri Valley contains a very dispersed community of agrarian Aymará people. The typical dwelling is adobe with thatched roof and surrounding walls of hand-stacked rocks cleared from the fields. Each home is surrounded by a variety of llamas, sheep and cattle. These subsistence farmers are traditional, hard-working and generous people. At the top of the large valley in the foothills of the Condor Mountain in the Andes is a small school house. WEFTA and Suma Jayma met with the Palcoco Authorities and representatives of the school to discuss the need for clean potable water for the school at approximately 1:00 p.m. on April 12, 2010.



*A Typical Home in the Condoriri Valley*

The Condoriri School operated independently for 40-50 years, but eventually became incapable of self-sustaining. It is now a fiscal school and is functioning once more. It is home to approximately 20 students. In meeting with Francisco Hidalgo, President of the Machacamarca Water Association, along with four other municipal representatives, including elected officials, the need to install at least two tap stands at the school was discussed. WEFTA representative, Kari Edenfield, P.E. spoke to the group, relating her appreciation of the situation and explaining that a report would be made to WEFTA officials and sent out in order to express the need for this project and solicit funding. The Machacamarca and Palcoco representatives expressed their utter willingness to donate their time and labor to realization of the project. The school's professor related the current situation, in which there is no potable water available at the school. When the children are thirsty, they drink from the nearest place, a river which runs through the valley and is likely not a safe drinking water source due to the large amounts of grazing sheep, llama and cattle in the area. "There is water around and it is difficult to get to it, there is a lot of livestock around and the water is not very clean or safe for the kids. They don't know any better and they run to the river if they are thirsty and drink it." (Approximate translation of statement by the school master.)



*Escuela Condoriri*



*WEFTA Representative Kari Edenfield, P.E., Speaking with Suma Jayma, Palcoco Authorities and Escuela Condoriri Representatives in the Condoriri School House*

Suma Jayma and WEFTA representatives reviewed the proposed project – to construct a water storage tank at a spring approximately 100 m from the school house. The tank would store spring water which would be piped to the school and to several tap stands around the school grounds with an additional tap stand for the professor who resides on the grounds and also lacks potable water. Filtration and disinfection components would be included as well. With the

assistance of the community in all labor, the group estimated two days to complete the construction once all necessary materials are procured. The total estimated cost for this project is \$3,320.



*WEFTA Representative, Kari Edenfield, Speaking with Escuela Condoriri Students*



*Project Team and Students at the Site of the Spring Water Source  
(Escuela Condoriri in the Background)*



*Escuela Condoriri Students*

The Escuela Condoriri project is very basic, low-cost and extremely important. It is a project with a high benefit to cost ratio and recommended for funding and execution as soon as possible, ideally in June, 2010.

## Batallas

Batallas is located approximately 20 minutes by car west of Machacamamarca. This is a more dense Aymará community of adobe or daub homes with thatched roofs. The community has installed shallow wells at each home and is now in need of covers for the well enclosures and hand-pumps to extract the water from the shallow wells. Suma Jayma and WEFTA representatives met with Barboa Lucio, a local project coordinator. There are two communities in the municipality of Batallas, Culucachi and Titin Jawira. Culucachi has 33 families, each with a shallow well (approximately 3-5 meters maximum depth). Each well is stabilized with a 1-meter diameter concrete pipe (like a manhole) and rocks were installed at the bottom of each well for further filtration and stabilization.

The entire community (see photos below) is very proud to have these new wells. To date, they have relied upon an artesian well installed in the 1970s which dries up every October. People have been hauling water for miles and now have water accessible very near to their homes. They would like to know how soon their project can be completed so that they can finally enjoy the privilege of having water so close to home.

WEFTA Representative, Kari Edenfield, requested that Suma Jayma and/or the local coordinator obtain a written agreement from the water users that all water would be boiled or otherwise disinfected prior to consumption due to concerns regarding the proximity of a variety of livestock to the wells.





*Children in Batallas Proudly Display the Newly Installed Well at their Home (April 12, 2010)*

## **Huanucollo, Comanche**

Huanucollo is a remote traditional Aymará pueblo in the municipality of Comanche. On April 13, 2010, Suma Jayma and WEFTA representatives met with the Alcalde of Comanche and the authority of Huanucollo, Ramiro Condori, as well as the head of the Water Committee, Ancelmo Cortez. The Water Committee's concerns regarding the lack of potable water were expressed. Collaboration for the project planning and design has taken place and the study was concluded last year. The community is very concerned with getting potable water to the families in the disperse community, with special concern for the homes at higher altitudes and additional concerns with potable water service during winter months. In meeting with Suma Jayma, the community has expressed great concern with when the project might be completed. At this point, the community expressed the dire need for the project in that the people of the pueblo do not even have a glass of water and the situation is not good for anyone. The need is to purchase piping to construct water services to homes, some of which are 500 to 600 meters from the main network. The community will be drafted to donate the manual labor to install the lines and they are hoping for a well designed and constructed project to complete domestic installations. There are 21 homes to be reached with the new system. They thanked WEFTA for visiting the project and presented representatives with certificates. They spoke about the need for water for cooking and bathing and their hope that a solution can soon be reached and that the community can soon have water. They were very grateful to WEFTA for visiting despite their being a small community. The community was very welcoming and the Aymará tradition of referring to all as brothers and sisters was quite touching. They would like to reach an actual solution to their desperate need for potable water.



*Meeting with Community Representatives, Authorities, Water Committee, Residents, Suma Jayma and WEFTA at Huanucollo, Comanche, La Paz, Bolivia, April 13, 2010*

Suma Jayma representative, Braulio Rojas spoke to the community, saying we understand their concerns and that we also want to accomplish the improvements. The project design is completed and the mayor has asked for a couple of additions to the project, a protective trench around the tank, for example. We need to bring water to all. That is the goal of the project. He mentioned that WEFTA was here to learn about the community's concerns, to meet the community and to learn about the projects as well as to check the system, the tank, etc.

Another community representative then spoke, welcoming WEFTA representatives to Bolivia and to Comanche, a small community with many needs, all about water. These problems they feel committed to solving themselves as much as possible. He spoke about the community's confidence in Suma Jayma, knowing that Suma Jayma has a successful record of past similar projects in the La Paz Department of Bolivia. He spoke about the morality of work and that the municipality has done much to the extent that it can. Here the project is large, disperse and the municipality cannot do it all. The municipality by law cannot bring individual services to homes so can only complete the tank and the distribution network. He stated that he hoped today the project could begin. Maybe in a month or more we can be working to bring this project to completion. We have problems, we know them and we are on the path to a solution and have the opportunity for improvements. We also have a little project in Comanche Chico, we know this is a little behind the other, but we can do studies.



*The Cooperative Building of Huanucollo*

The meeting with representatives took place at the Cooperative building of the pueblo, located at 4,049 meters of elevation at S16d57m26s W68d26m59s. The group then hiked across an amazing vista of open fields and wild pasture with llamas and sheep and herdsmen towards a sacred mountain called the Grandfather in Aymará from whence flows a clear spring.



*The Disperse Remote Community of Huanucollo*



*Hiking Towards the Water Tank and Sacred Mountain*

This spring has been piped to a water storage tank on the top of a closer mountain, which the group hiked up to inspect. The tank was located at 4,103 meters of elevation at S16d58m12s W68d27m07s.



*The Water Tank at Huanucollo*

More speeches were made and plans were made between the community and Suma Jayma for a mapping session to take place on the following Monday morning. The community agreed to hand-excavate the existing network as installed with the help of the municipality at 100 meter intervals so that Suma Jayma representatives could conduct a survey of the existing system utilizing GPS on Monday to establish a firm map of the existing system to conduct design calculations and verify the project scope and design.



*Existing Valve Vault at Huanucollo*

Suma Jayma will verify line locations and sizes in order to run hydraulic calculations and confirm that each home can be reached with the existing system with sufficient water pressure. We also inspected a vault as a possible location for chlorination/disinfection.



*Project Team Returning from the Water Tank to the Cooperative Building in Huanucollo*

## **Comanche Chico**

Comanche Chico is a future project which has been designed by Suma Jayma following an Engineering Study and Report. Comanche Chico is in the municipality of Comanche in the Department of La Paz with 21-36 family homes. The municipality has completed construction of a water tank and network, but the network may need some repairs and the system is lacking the individual services to homes. The municipality contributed 55,000 Bs for the first phase of the project. The community provided manual labor as well as local materials. All that is lacking are the domestic services. The municipality stated that an additional 131,000 Bs is needed to complete the project (\$34,000 - \$45,000). The community is very concerned and is in need of assistance. The project is very close to being complete and all are waiting desperately for the final stages of the project. They stated that they were very satisfied and happy to have WEFTA and Suma Jayma visiting the project and have hope and confidence in the successful completion of the project.



*WEFTA and Suma Jayma Representatives with the Authorities of Comanche Chico*



*The Children of Comanche Chico*

## Hichuraya

Hichuraya was visited by WEFTA and Suma Jayma representatives on April 14, 2010. A potable water project was completed for this community of 38 families between 2006 and 2007. A tank, filter, percolator, distribution network and pedestal taps were installed along the side of a mountain where the homes are constructed alongside fields and grazing livestock. The homes are distributed at all levels of the steep mountainside down into the valley with the tank at the uppermost elevation. This is a community of agrarian subsistence dwellers with adobe homes and hand-stacked walls constructed from the stones they have painstakingly removed by hand from their fields. This was the first WEFTA project completed in the Municipality of Calamarca. WEFTA representatives Peter Fant and Scott McKittrick were present for the inauguration of the project in 2007.



*The Water Tank (Foreground) and Filter (Background) at Hichuraya, Calamarca, La Paz, Bolivia, April 14, 2010 with WEFTA and Suma Jayma Representatives Onsite*

WEFTA and Suma Jayma representatives visited several of the homes to verify that the system was still working well and that all were satisfied with the resultant outcome of the project. We spoke with one property owner who confirmed that they have water all year and that they are very happy with the water system. He also related that the community undertakes the cleaning of the water tank every three months.



We also met with Seferina Huanoca, who was the Authority for the community during the execution of the water project. She also confirmed that the water system is working well.

At this point, another community member joined the discussion and raised the topic of a potential future project very much in need in Hichuraya. In 2006 when the water project began, the community had also asked about latrines. The problem with wastewater in the community is very severe. At this time, all wastewater is hauled by hand to the bottom of the valley and dumped into the river there, creating an ecological and health/safety hazard for the community and the area. While the water system is a big change and improvement, the community feels very strongly the need to prepare and submit a solicitation for aid with latrines. They have asked the Calamarca mayor and authorities for assistance, but under the new policy of government the Municipality cannot assist the community with this need. The Alcalde was going to start the project in 2008 but under the new government regime, the project was halted. The community is willing to complete all structural construction labor voluntarily to contribute the project. They will construct dry latrines with adobe. They only need assistance for procurement of other materials, such as cement. These dry latrines should be situated at least 200 meters from all water services.

## **Valle Andina**

During the meeting with Machacamarca and Palcoco officials, several additional needed projects were discussed. The Secretary General, Antonio Vargas expressed the need to complete similar projects in other communities within Palcoco, especially Valle Andina. The community of Valle Andina and its school would need a water system of a similar scale to that of Machacamarca.

## **Escuela Litoral**

A solicitation for funding was received for the Escuela Litoral for potable water from the Palcoco community and Secretary of Education, received April 12, 2010 by both WEFTA and Suma Jayma representatives.

## **Other**

Suma Jayma is seeking funds to purchase a well drilling machine – one capable of drilling a well a maximum of 70 or 80 meters in depth. They have a couple of quotes from machines available from Chile. The estimated cost is approximately \$10,000. Another idea, collaborated with Jason Gehrig, would be to work out the purchase and import of a machine in collaboration with the Maryknolls. The Maryknolls are able to import items without exorbitant duties from the Bolivian Government. This option should be further discussed with Jason and Suma Jayma.