Waterlines Trip Report: Panama 2011

Trip Overview

The 2011 Waterlines trip visited numerous water projects in western Panama from January 4 to January 19. This year's visitors included Father Robert Cumberland from Arteaga, Coahuila, Mexico; John Vavruska, Waterlines volunteer from Santa Fe, New Mexico; Brent Adams and Anne Englert, from Souder, Miller and Associates out of Cortez, Colorado. This was Father Robert's 21st trip to Panama for Waterlines, the second trip for John and the first for Brent and Anne.

TimWellman (Peace Corps APCD for Environmental Health Project) accompanied the team for visits to the joint Peace Corps/Waterlines projects, including one in Bocas del Toro province on the Caribbean side of the Cordillera at the beginning of the trip. Two third-year Peace Corps volunteers, Meredith Butterton and David Caley, also accompanied the Waterlines group for several community visits including in the Llano Ñopo area. Meredith and David are "circuit riders" sponsored by Waterlines to visit Waterlines-funded projects to gather project status information. Non-Peace Corps related Waterlines projects were also visited during the middle and latter portions of the trip in Coclé and Chiriquí provinces in western Panama.

Approximately 20 communities were visited again this year. Like last year, the condition of the various water systems ranged from needing improvements to working smoothly. Several studies were assigned to Nicolas Arcia for potential future water projects. The Peace Corps continues to be a great and valuable partner in the implementation of Panama water projects and now more than ever with the "circuit rider" program in place. Based on the trip, a few observations and recommendations are provided at the end of this report.

2011 Waterlines Trip Activities

Monday, January 3, 2011

Father Robert Cumberland, John Vavruska, Brent Adams and Anne Englert all arrived in Panama City around 7:30 p.m. and were met by Tim Wellman, Peace Corps APCD for the Environmental Health Project. The team stayed at the Hotel California in Panama City. Ironically there was no water available at the hotel for the Waterlines team, due to municipal water treatment issues related to turbidity from recent rains prior to the team's arrival.

Tuesday, January 4, 2011

The team departed Panama City about 8 a.m., westward along the Pan American Highway in a Peace Corps vehicle driven by Tim Wellman.

Pedregoza (Coclé): The team met Peace Corps Volunteer (PCV) Aaron Winston in Pedregoza (1,170 ft elev.[1]), who has been in the village for just over a year. We had visited Aaron in Pedregoza last year as well. The first toma (more than 2 km above the village), the tank, and distribution system had been completed previously by PCV Andrew Hable. The existing toma apparently supplies 25 gpm during the wet season, but only 2.5 gpm during the dry season. We visited the site of a future additional toma (1,780 ft elev.), intended to augment the water supply from the existing toma. The flow from the future toma is estimated at a reliable 3.5 to 4.0 gpm. Aaron said that a type of grass called vetiver will be planted around the toma site. This grass produces a mat to stabilize the soil around the toma. Several trees in the immediate vicinity of the future toma will be cut to eliminate root intrusion. The source area of the future toma is protected from development, with 2 hectares fenced off and planted with coffee, bananas, and other agricultural trees.

Aaron Winston is currently organizing water system training for PCVs in Pedregoza, which will be funded by Waterlines.

Limon (Coclé): The community of Limon, approximately 250 residents, is just west of Pedregoza. PCV Kathryn Peebles, who has been living in Limon, met us on the trail during our visit to the future Pedregoza toma site. From here, we walked to the Limon toma (1,410 ft elev.), which has three old toma boxes. Nicolas had visited this toma 2 weeks previously to check out the situation for a future re-build of the toma. We made a rough measurement of the total flow from the Limon toma as 15 gpm (5 gpm dry season and 11 to 15 gpm wet season). Protection of the toma site has not been established with the property owner. From the toma, we walked to the community of Limon and its 25-year old water tank (non-Waterlines). This tank will be replaced. The tank featured a tablet chlorinator, although proper dosing is difficult, and re-supply of the chlorine tablets is inconsistent. After the 6-mile loop hike, we returned to Pedregoza.

Examining piping at Limon toma

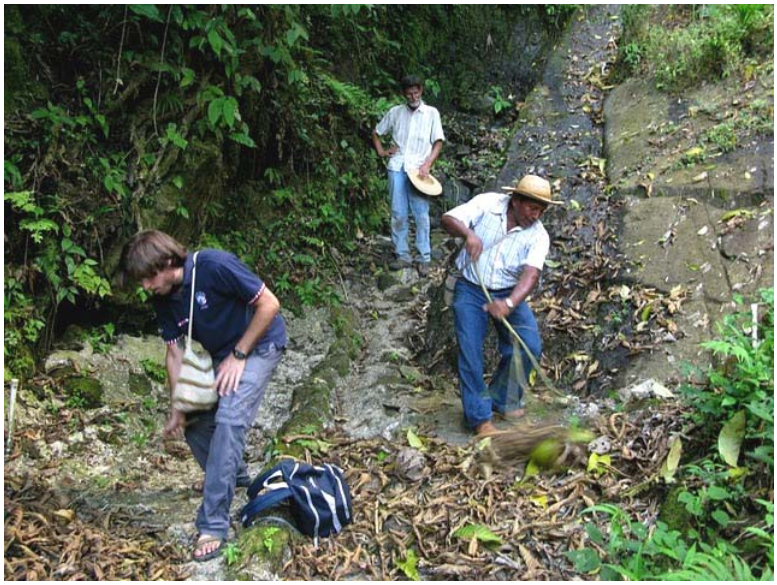
The team stayed at the Pyramid Hotel in Santiago.

[1] Elevations were measured using an altimeter watch and a GPS, both of which measure altitude based on atmospheric pressure. Unfortunately, the GPS was inadvertently set to periodically recalibrate the elevation using satellite signals and sometimes resulted in inconsistent elevation data, which might explain some of the discrepancies observed between the altimeter watch and the GPS over the course of the trip.

Wednesday January 5, 2011

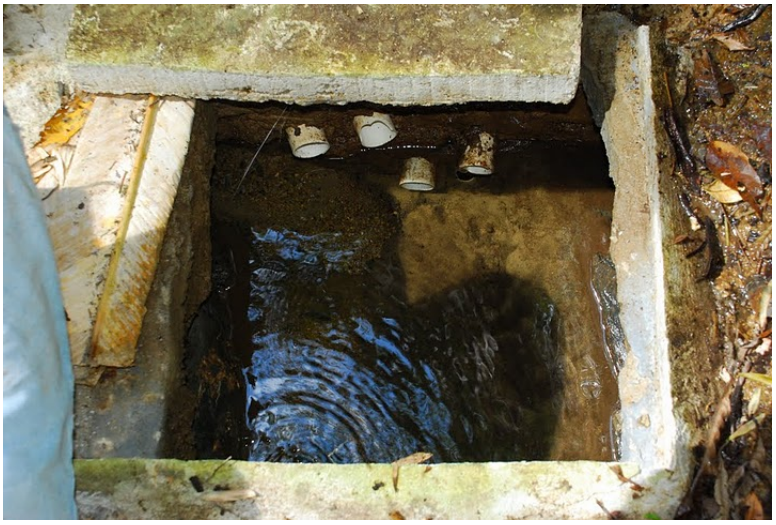
From Santiago, the Waterlines team drove to Tolé to pick up Nicolas Arcia, who traveled with the team for the remainder of the trip. The two circuit riders, third-year PCVs Meredith Butterton and David Caley, joined us for today's site visit to Bajo Cacicon.

Bajo Cacicon (Chiriquí): The water system at Bajo Cacicon, also called Quebrada Plata, was completed in 2010 from funds raised by citizens of Los Alamos, New Mexico, with oversight by PCV David Caley, who is currently a Waterlines "circuit rider". We visited the toma (1,540 ft elev.), built by Nicolas, which includes two breather tubes, two overflow pipes, and one 1 ½" outlet supply pipe. We measured a flow rate at the toma of 6.3 gpm. The tank (1,460 ft elev.) has a capacity of about 2,200 gallons. Further down the ridge there is a break pressure tank (1,210 ft elev.) with a float valve. The float valve does not shut off tightly in the closed position. There was discussion that the rubber seals on float valves are prone to wear over time, causing leakage of water through the valve. Nicolas evidently does not use float valves and break pressure tanks because of the valve leakage problems. Instead, he uses a throttling valve to reduce pressure, although doing so also reduces the available flow. The Bajo Cacicon system has 28 taps, for a population of 160 people. Flow orifice plates were installed at each tap to limit flow, with larger orifice plates installed on taps close to the main line (with less elevation head) and smaller orifice plates installed on taps further from the main line (with greater elevation head). A meeting of the water committee and villagers was held with introductions of the Waterlines and Peace Corps team.



Cleaning the Bajo Cacicon toma

The majority of the pipe in the system has been buried, but there are several areas where the pipe is exposed and should be buried to avoid breakage.



Bajo Cacicon toma outlet box

The team drove on to the city of David and stayed at the Hotel Tolédo.

Bajo Cacicon tank

Float valve in break-pressure tank, Bajo Cacicon

Thursday January 6, 2011

The team met PCV Lee Espey for breakfast at the Hotel Tolédo at 7:00 a.m. and drove in the Peace Corps vehicle over the Cordillera to Bocas del Toro for the visit to the community of Cerro Brujo.

Cerro Brujo (): The visit to Lee's site, Cerro Brujo, involved a one-hour boat ride across the Laguna de Chiriquí**.** PCV Harold Whitaker met us for the boat ride to Cerro Brujo; Harold's site is the community of Shark Hole nearby. Cerro Brujo is at sea level and the old tank, built in the 1980s, is at an elevation of about 60 ft. above sea level. We measured a flow rate into the tank of 4 gpm. A new tank will be built from poured concrete at about 80 ft above sea level and will have a capacity of 18 m^3 (4,755 gal). A suspension pipe bridge will have to be built to distribute water from the tank across boggy bottom land to several houses in the community. Two future toma sites have been identified by PCV Harold; toma site #1 is at 110 ft. elevation and has been measured at 5 gpm after two weeks without rain. This toma site is in a solid rock gully that Harold is considering damming. Toma site #2 is in the next drainage to the north at 220 ft. elevation and the safe flow was estimated at 3 gpm. The water at each toma site is turbid likely due to a combination of suspended solids and organic matter. Tim Wellman suggested a screen at the toma site to remove some of the suspended silt that flow down the gully from above, although the fine nature of the turbidity at the time of the site visit suggests that it would be resistant to screening or even settling without chemical treatment. Due to the apparent surface water influence and resulting turbidity, these water sources appeared to be the lowest quality water sources of all the sources observed on the 2011 trip. In addition, one home was recently relocated to an area at some distance from, but above, the two tomas. Approximately 3,300 ft of pipe will be required from toma site #2 to the future new tank.

Some homes cannot be served by the planned system, so rainwater catchment systems will be installed. In addition, two public taps will be installed at the dock for homeowners with rainwater catchment systems to use during the dry season. Homes on the system are assessed a monthly fee of $1.00, and homes with catchment systems will be assessed $0.25 per month. The team had a tasty supper of lentils with vegetables from Lee's garden over rice with boiled yuca and spent the night at Lee Espey's house.

Friday January 7, 2011

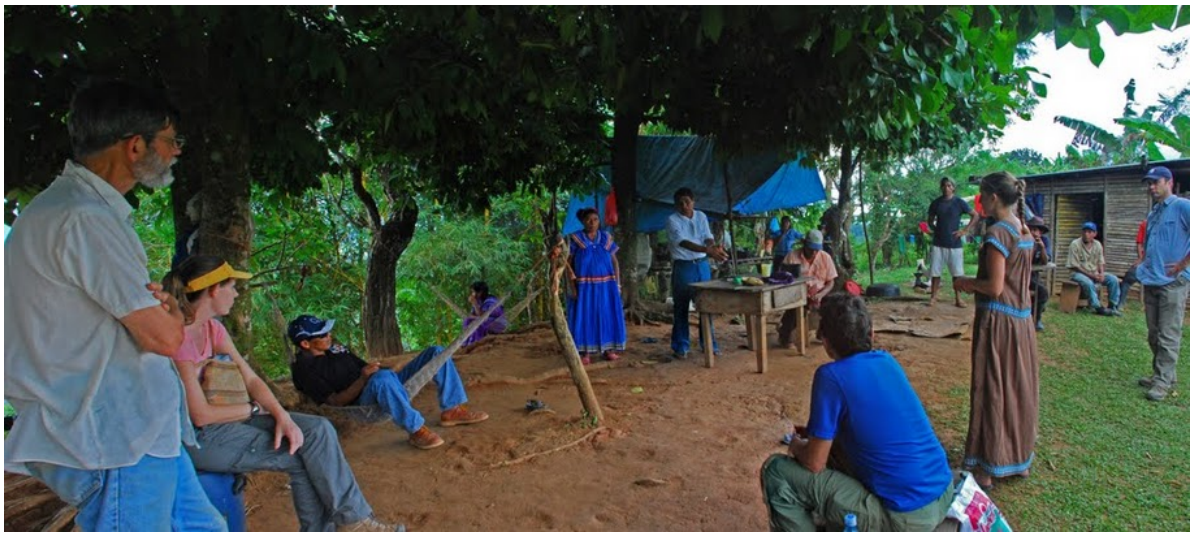
The team awoke in Cerro Brujo to a great breakfast prepared by PCVs Lee and Harold of scrambled eggs, cold yuca, granola, yogurt, coffee, and homemade cacao from the village. At 10:00 a.m., the team said their goodbyes to Lee and Harold, thanking them for their hospitality, and boarded the boat for the ride back across the bay to the PC vehicle. The team had lunch at the Black Pearl restaurant in Chiriquí Grande, then drove back across the Cordillera to the city of David. The Waterlines team rented a 4WD Toyota Land Cruiser Prado (aka the Golden Chariot) at the David airport and spent the night at the Hotel Tolédo.

Saturday January 8, 2011

The two circuit riders, third-year PCVs Meredith Butterton and David Caley, joined us for breakfast at the Hotel Tolédo and accompanied the Waterlines team through noon on January 11.

The team drove to Cerro Ceniza where they met Peace Corps Volunteer Aleah Sommers.

Cerro Ceniza () and Alto Cañaza (): For reference, the elevation at Aleah's house is 1,230 ft. A European NGO had built the upper aqueduct which now needs rehabilitation. Aleah provided an excellent overview of two current projects including diagrams of the aqueduct systems: Cerro Ceniza/Alto Cañaza and Cerro Ceniza Abajo. Aleah has run computer simulations on these projects using the software "Neatworks".



Community meeting at Cerro Ceniza

The Cerro Ceniza/Alto Cañaza project will involve:

1) Reconstruction of the existing toma built about 15 years ago (5 gpm safe flow, 1,620 ft elev.). Aleah stated that the water from this toma tested positive for coliform, presumably due to contamination from two houses and a small tienda near the spring that do not have latrines. The entire area around the toma needs to be excavated to determine how best to re-build the toma. Also, a down live tree above the existing toma needs to be removed.
2) Build a new additional toma in another drainage at 1,450 ft. elevation in a steep-sided ravine; unfortunately wastage from the sides of this ravine and the seasonally variable location of the surfacing of the spring will make construction and maintenance of the toma challenging.
3) Build a 5,000 gal tank with two outlet transmission lines, one to Cerro Ceniza and one to Alto Cañaza, (the existing tank is at 1,340 ft elev and has outside dimensions of 2.75 m x 2.75 m x1.5 m high), and
4) Build a break-pressure tank for the line to Alto Cañaza (pipe needs to be > ½" diam. here).

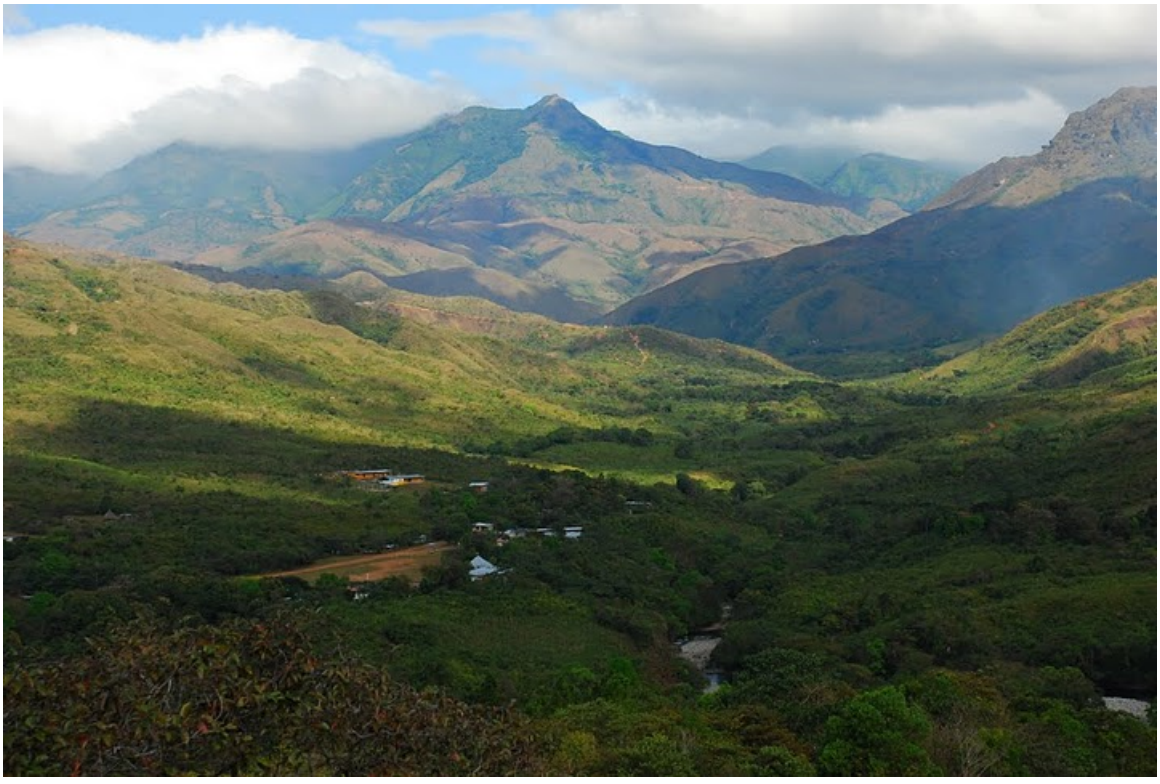
It is planned that there will be 32 taps providing water to 250 to 300 people and a school with 300 students. Nicolas Arcia would design and build the tomas and tank and the villagers would install the pipe.

Cerro Ceniza Abajo (): This project is below Cerro Ceniza proper and will consist of a completely new system serving 37 houses (37 taps) and 200 people. The upper toma flow is estimated at 2.5 gpm and the elevation of this site is 1,730 ft. A lower toma site with reliable flow has also been identified, although there is a home close by and above the toma. There will be one tank with two outlet transmission lines to branch #1 and branch #2. There is a 150 m drop over 2 km distance from the toma site to the tank site. From the tank site to the lowest house on branch #1, there is a 180 m drop and for branch #2, 140 m drop over 1.3 km of distance. A break pressure tank will be installed on each branch.

Tim Wellman departed for Panama City and the remainder of the team drove back to Tolé where a fine supper was served at Nicolas' house by his wife, Colombia, and daughters. Except for Padre Roberto, who stayed at the Arcia house, the rest of the team (John, Brent, Anne, Meredith, and David) stayed the night in the dormitory at the Centro Misional Jesus Obrero in Tolé.

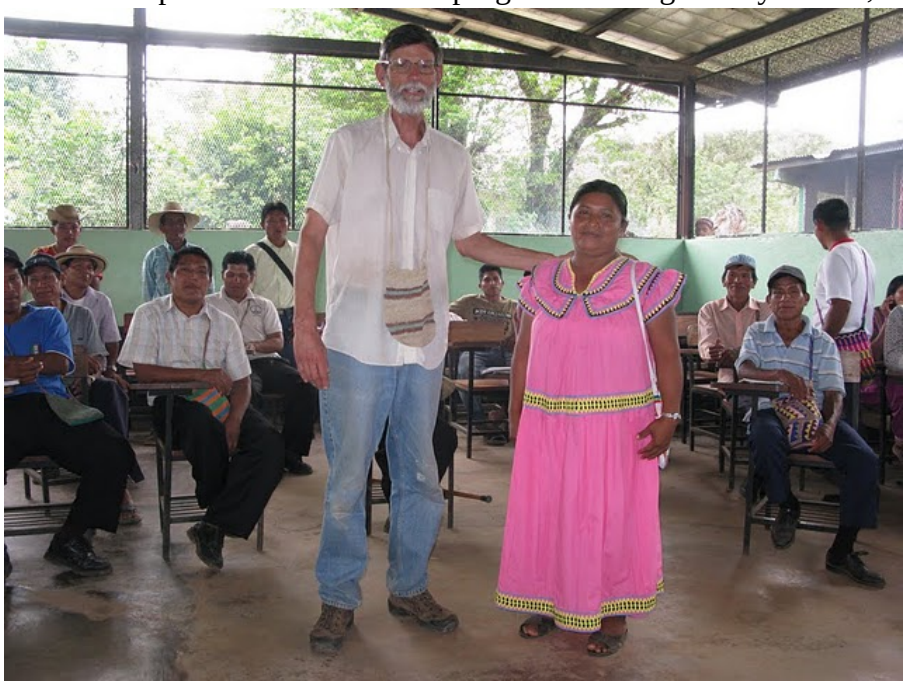
Sunday January 9, 2011

The team (Padre Roberto, Nicolas, John, Brent, Anne, Meredith, and David) headed off in the rental vehicle to Llano Ñopo, arriving at 11:30 a.m. A meeting of several water committees from the surrounding communities began around 1:30 p.m. After introductions of everyone at the meeting, including the Waterlines team, a representative from each water committee gave a report of the status of their water systems. Following are notes taken during the meeting.



Llano Ñopo

Llano Ñopo (26): During the summer, the system provides less water. The population continues to fluctuate and internal problems have slowed progress. During the dry season, they vary water distribution by shutting off water to houses for various durations. The committee charges 50 cents/mo per tap (30 cents goes to maintenance and 20 cents to the operator). Their community water fund currently has $1,580. The sisters charge $25 to run a water line from the linea madre (main line) to a house.



Meeting of water committees, Llano Ñopo

Llano Rey (46): This is an 11-year old system that is working well after some repairs in 2009. The toma was damaged by tree roots, but presumably, the trees have now been cut back. The committee charged users 25 cents/mo until 2009, then raised the fee to 50 cents/mo and are considering raising the fee to $1/mo in 2012. Their community water fund currently has $90.

Buena Vista (135): The villagers are very grateful for their new water system and presented Padre Roberto with a handmade chácara (shoulder bag). By the end of summer (April), the flow rate of water is low and some of the houses have little or no water. Since completion of the project, the committee has waited one year to start charging users; they will now start charging 25 cents/mo for upkeep of the system.

Alto Arena (98) [also referred to as "Bajo Quebrada Arena" in the Waterlines report form]: A representative for the president of the committee stated that generally, the system is working well and they are content, though they have had some bursting of pipe connections at the lower end of the system, possibly due to high pressure. A new toma was annexed two years ago. They have been sponsoring various activities to raise money for upkeep of the water system. A user fee of 25 cents/mo is charged but most users do not pay the fee.

Cerro Javilla (136): This system has been operating since 1985. A fee of 25 cents/mo is charged for upkeep but many people do not pay. There are 60 houses in the community but only 19 houses have taps on this system. The toma, tank, and distribution piping all need work and, though the pressure is "good" it may have caused some damage to the system. (Note: it is not clear what the pressure problem really is.) They feel the tank is now too

small and would like to be considered for a new larger tank. They are requesting a study by Nicolas.

Quebrada Macho (): This community consists of 53 houses, has a water committee, and has a solicitation for upgrades. The president of the committee gave the presentation. MINSA (the gov't) built a system but the toma dries up in the dry season, possibly due to deforestation around the toma. Currently the system provides no water. An alternative toma site, which is government registered, has been identified and the government is planning to develop it.

Cerro Grande (133): This is a 1 ½ year old system that the president of the committee says is working well with no problems. The president presented a sombrero to Padre Roberto as a gift of appreciation. The community now has plenty of water. The committee charges 30 cents/mo per user, but some users are not paying the fee. Another man from the community agreed that the system is working well but expressed that the water committee needs training and an orientation on the system.

Cerro Aguacate (): This is a neighboring community to Cerro Javilla. There is a water system but it is not working well and there is insufficient water for the growing population. The system provides water to only 8 taps but there are 20 houses. There are two other potential toma sites and the community would like to annex at least one more toma to the system since the flow from the existing developed toma is inadequate and dries up in the summer. The tank is in good shape. The committee is no longer charging users a fee for upkeep of the system.

Llano Majagua (37): The community has a reworked system and there is enough water, but there are problems with failure of the older tubing at the lower end of the system due to excessive pressure. The people whose taps come off the ruptured tubing are complaining. A user fee of 25 cents/mo is charged and the people are paying the fee. It was stated that it is the responsibility of Waterlines to fix the system. Nicolas was mentioned as someone who could fix the system.

Llano Bonito (47): The committee was present. The system has been working well for 11 years and the toma has never gone dry. They have a very united community with an excess of water. Padre Roberto was presented with a Panamanian hat as a gift of appreciation. The committee charges users a 30 cent/mo fee and the people are paying the fee. They paid for the new tubing to some new houses.

Cerro Concha (): The system is 10 years old but the toma lasted only 1 year; the toma is in bad shape. However, the tank is doing fine. With the reconstruction, Waterlines provided some families with taps while others did not receive taps, which created some problems within the community; not all those who worked on the system received a tap.

Quebrada Cama (143): After the meeting in the afternoon, the team walked the short distance to the system constructed and overseen by Nicolas, completed in March 2009, and visited by the

Waterlines team in January 2010. This community is part of the Llano Ñopo water committee. The source consists of two infiltration ditches, each covered in gravel and capped with concrete. The two ditches join each other to form a common water source for the supply pipe. There is a clean-out at the bottom of each infiltration ditch. The entire toma area is fenced off with barbed wire, and the community plans to plant 100 caoba trees, a hardwood tree used for lumber, within the fenced area. Overall, the source structure, tank, and piping continue to look good. They plan to add another toma in the future.

Monday January 10, 2011 (The Long Walk)

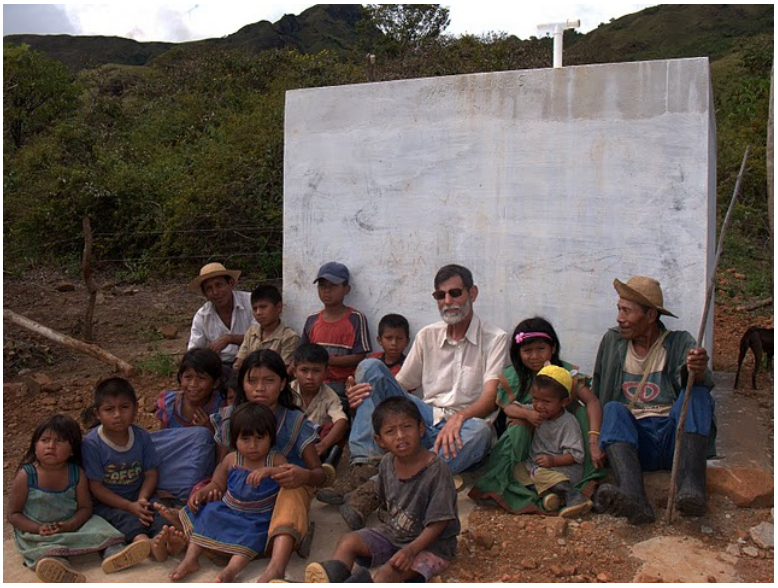
Today, the Waterlines team planned to visit three remote villages deeper into the Cordillera and roughly a 5-hour walk one-way, northeast from Llano Ñopo. After breakfast at the Sisters' place, the team (Padre Roberto, Nicolas, John, Brent, Anne, David, and Meredith) left Llano Ñopo (1,100 ft elev.) on foot at 6:22 a.m.

Children at pluma, Bajo Nube

Bajo Nube (116): Five hours of hiking up and over the eastern shoulder of Cerro Banco brought the team to the community of Bajo Nube at an elevation of 2,580 ft. The team first visited the toma for a mini-aqueducto that serves 10 homes. The pipe from the toma was recently trenched and buried, as evidenced by the lack of vegetative growth on the trench backfill. The main Bajo Nube system was constructed and overseen by Nicolas this past year. A meeting with the community was held with introductions of the Waterlines team and community members. They expressed great appreciation for the water system and for our making the effort to trek to their remote village. One village elder stated that "no one like us" had ever been to their community. Numerous photos of people at the operating pluma (tap) were made, then quick visits to the toma and tank (with a "Waterlines" inscription on it) and the team departed for the community of Guayabal to the north.

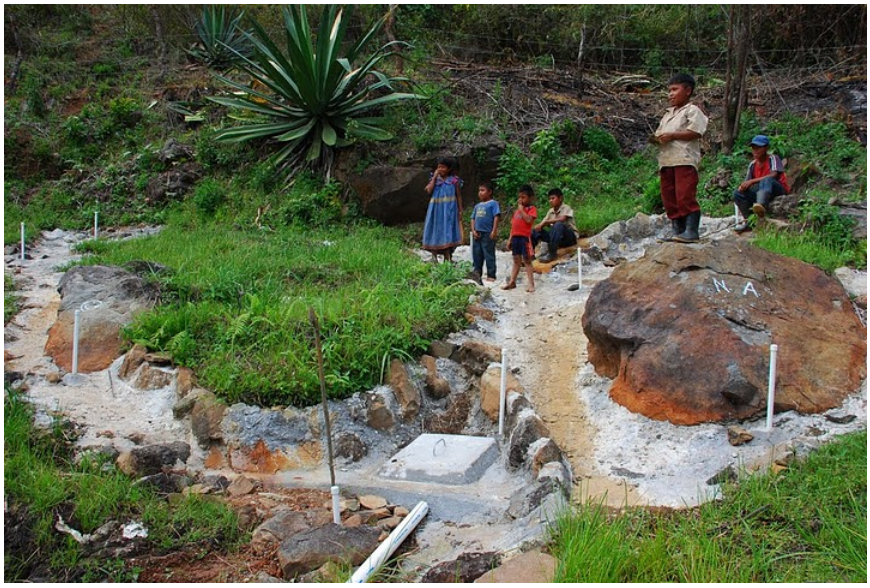
Bajo Guayabal (139): The Bajo Guayabal toma (3,640 ft. elev.) was visited and the flow rate was measured at 4.5 gpm, serving 12 houses. The community was laying out tubing along the alignment from the toma to the tank site during the team's visit. The team then hiked up toward the crest of the ridge that extends northward from Cerro Banco to visit a community at an elevation of 4,500 ft. (let's call it Alto Guayabal). This is a remote village and the highest we have visited. While the team was in the village, a baby was baptized. Each member of the team was asked to breathe out over incense above a bowl of water. The baby was washed with the water, and dried by being fanned with the team members' hats that had been collected by a

young woman. The team was shown a potential site for a toma in a marshy area amongst banana trees.

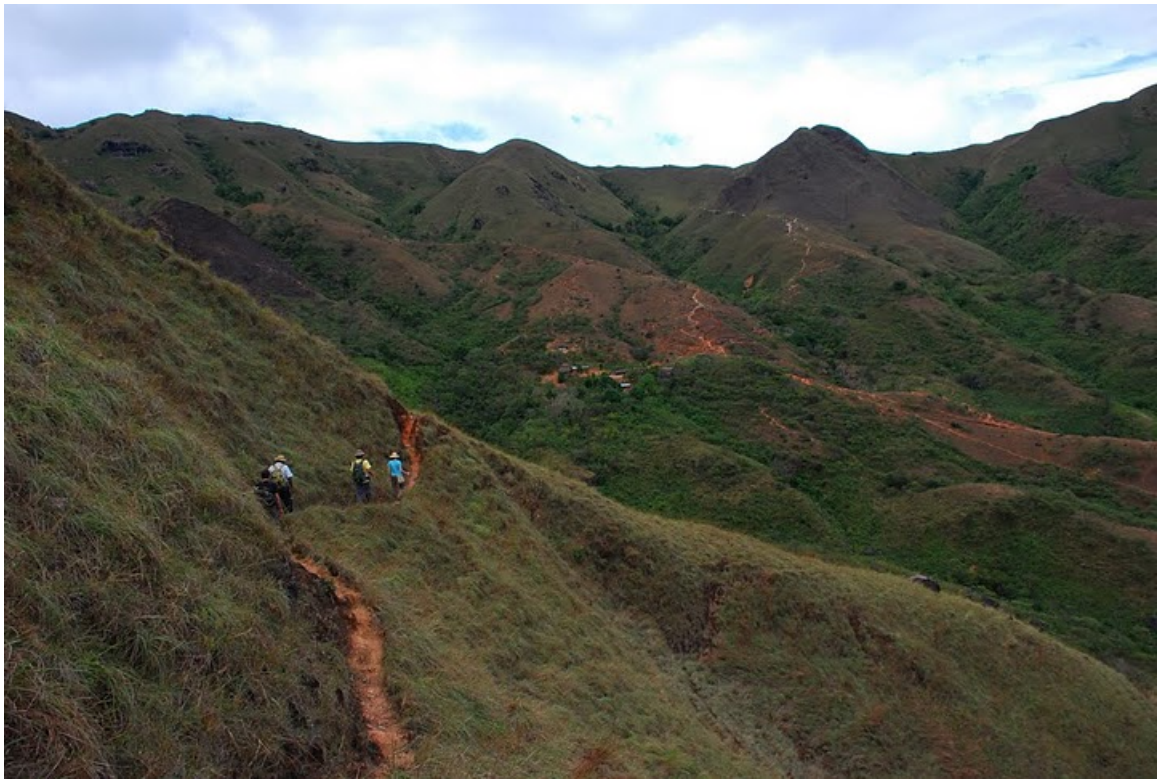


Bajo Nube tank

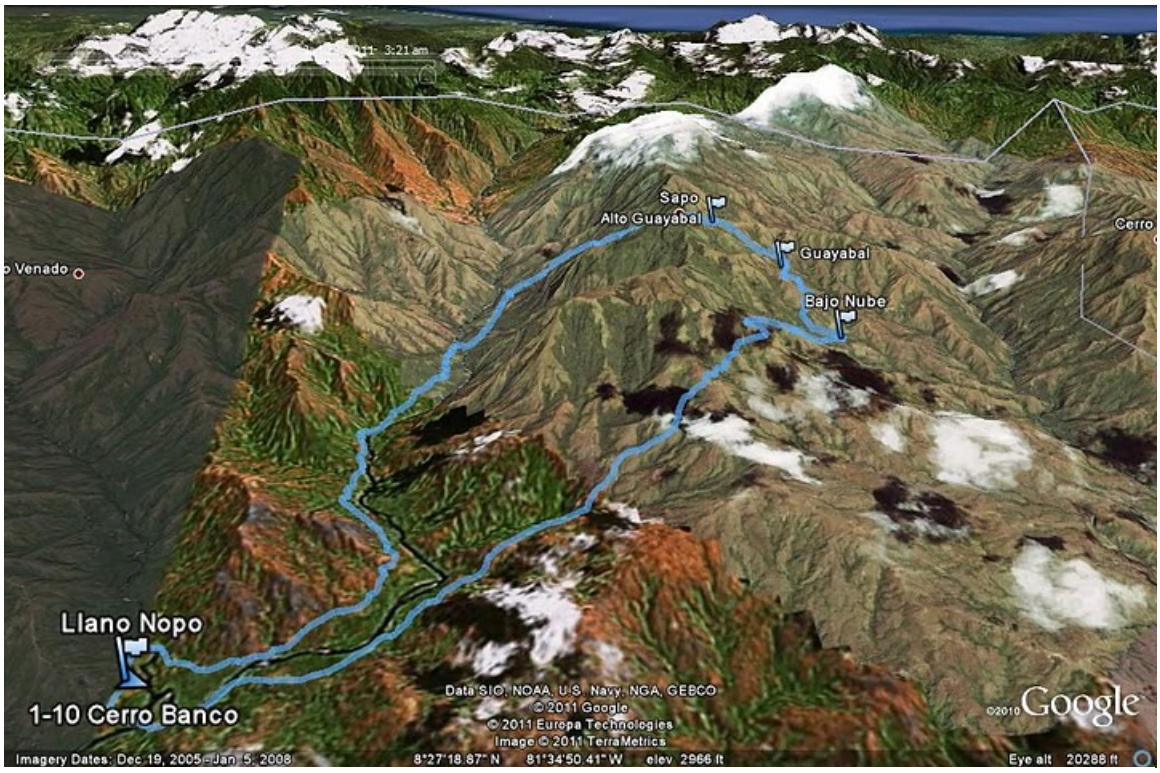
It was then decided that, rather than return to Llano Nopo by the same route we had taken in the morning, we would circumambulate Cerro Banco (counterclockwise) to see some new terrain with the one hour of daylight remaining. At about 5:45pm, the team topped out at 4,740 ft. elevation on the ridge north of Cerro Banco directly above Alto Guayabal and began the long descent to the Rio Tabasará for the return to Llano Ñopo. While this may not have been a circumambulation of Tibet's sacred Mt. Kailas while prostrating, which takes many days to complete, ours was a very respectable effort for a single day! The hiking stats according to Brent's GPS were: 20.8 miles, 7,000 ft of vertical elevation gain, and the day's journey took 16 hours and 15 minutes, only the final three and a half hours of which were by headlamp.



Bajo Nube toma



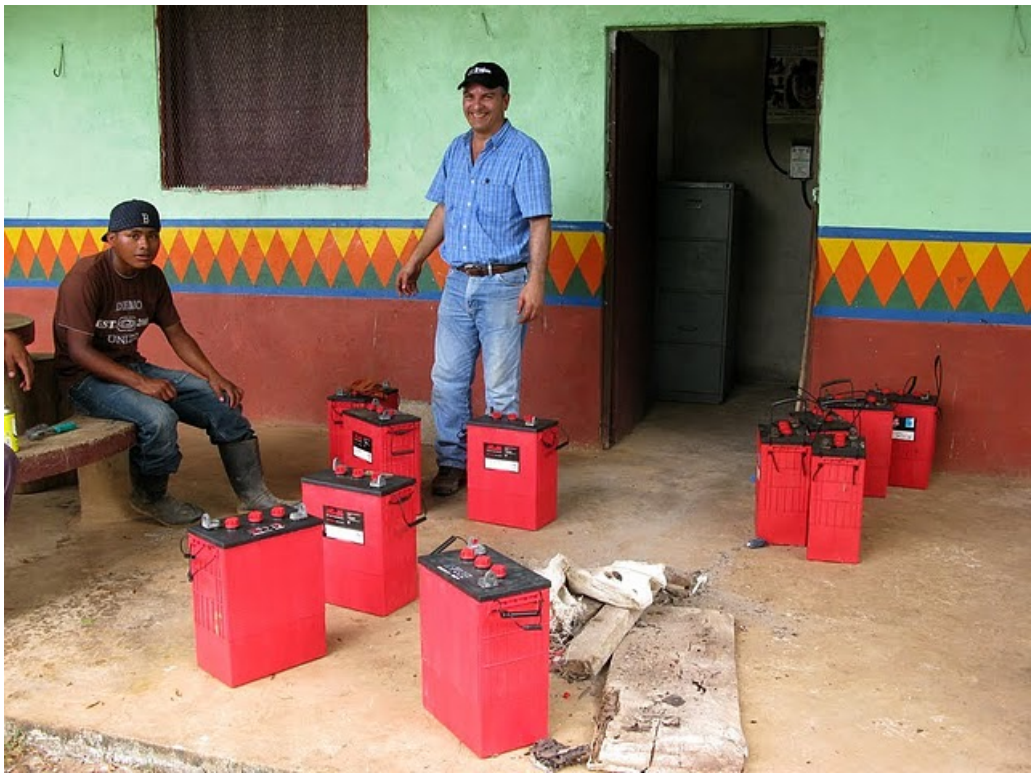
Route to Guayabal



Tuesday January 11, 2011

Today was a day of rest and clothes washing for all the team except Padre Roberto and Nicolas, who visited Alto Cienega and a few other systems above Llano Ñopo. The systems they visited are summarized in Roberto's trip report. The Peace Corps "circuit riders" David and Meredith departed Llano Ñopo at 1:00 p.m. on a chiva (truck with a covered bed) for the city of David, where they live. The rest of the Waterlines team spent the night in Llano Ñopo.

Llano Ñopo clinic – solar electric system (35): The solar photovoltaic collectors, batteries, and controls on the clinic were all inspected by Victor Saldañas who originally installed the system. The collectors and controls were found to be in good condition, and Victor replaced all of the batteries (8 total) for the Hogar and the Woman`s Center.[2]



Victor and assistant changing out batteries for the photovoltaic system, Llano Ñopo

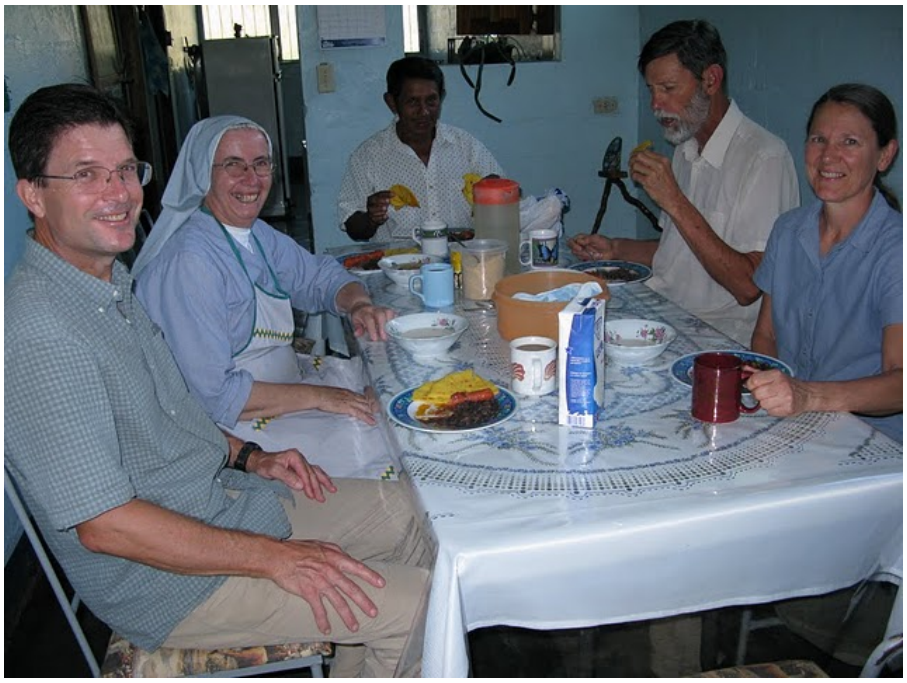
Wednesday January 12, 2011

The team departed Llano Ñopo after lunch and briefly stopped at Alto Algarrobo, along the road on a ridge top.

[2] The 8 solar collectors that had been installed and then stored for many years at Marcial Mendosa's house at Cerro Venado were removed by the Waterlines team on January 14 and taken to the Centro Misional Jesus Obrero in Tolé for storage in an office until they can be installed by Victor Saldaña in Llano Ñopo to augment the existing array.

Alto Algarrobo (132): The community still has not organized a water committee. Padre Roberto thinks that, with the new chapel nearby and the help of the Llano Ñopo sisters, the community may be able to organize a committee and submit a solicitation for a water system. The young woman who has leukemia here was doing better this year than in 2010.

Guabino(138) (also referred to as Cana Blanca): In the early evening, the team drove 45 minutes from Tolé to the system called Guabino, south of the Pan American Highway, on a ridge just a few miles from the Pacific Ocean. The system has two tomas; toma #1 was built by the Panamanian government about 2 years ago and is fenced off. Toma #2 was recently built by Nicolas (Waterlines) and it has no protective fence. There was evidence of cattle being at the toma and portions of the pipe were unburied and susceptible to damage by the livestock. The summer flow of toma #2 is about 3 gpm. The tomas (1,640 ft elevation) are within 100 ft of each other and their outlet lines connect to each other for transmission to the Guabino community. The community is not pleased with the numerous problems on the government portion of the system.



Breakfast at the nuns' home, Llano Ñopo

PVC tubing supply, Llano Ñopo

The team returned to Tolé after dark for a tasty

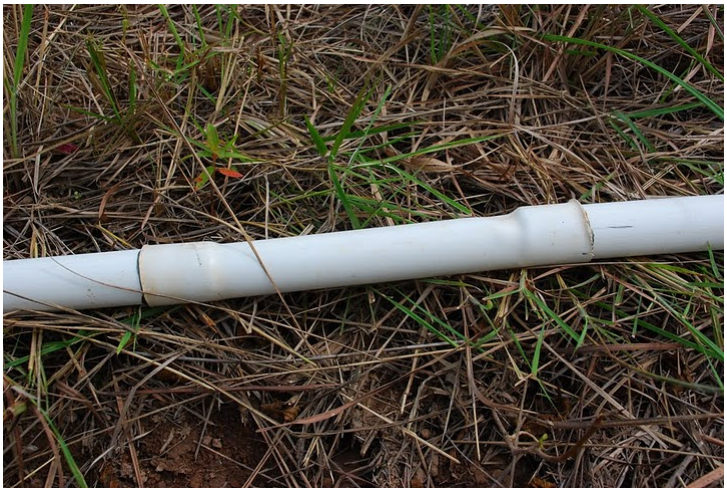
dinner of chicken, rice, and guandu (pigeon peas) at Nicolas' house and spent the night in Tolé.

Thursday January 13, 2011

The team picked up Marcial Mendosa at his house and drove to visit the systems that he oversaw in Llano Macano and Changoso. Nicolas did not accompany the team on the visits this morning.

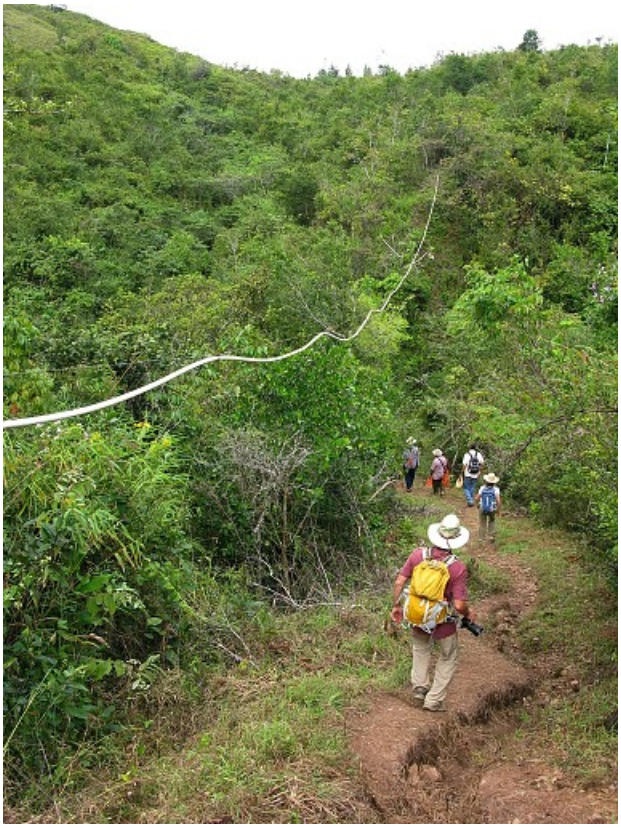
Llano Macano (33): This community consists of 25 houses and a school (K through 6) with 6 teachers and more than 150 students. Children from nearby Changoso come to this school. We first visited at the home of the water committee chairman Sebero Perez (1,030 ft elev.) who explained the status of the system and the on-going political problems. A water system was built about 12 years ago, but was never finished. The village is in the Comarca but the toma is outside the Comarca. The man who owned the land on which the toma is located sold the land and the new owner is threatening to shut off the toma. Marcial says the law is on the side of the villagers. During the first month of school in April, the school typically has little or no water. The pipe apparently burst on the 2-mile length of pipeline between the toma and the tank but it has been repaired. As reported in last year's trip report, the cause of the breakage is unknown but exposure to the sun could be a factor along with residual head exceeding the pressure rating of the pipe. The tank is in good shape and has had no problems. Downstream of the tank, the pipe is not buried and is exposed to the sun. It may be necessary to work through MINSA (the government) to intervene to protect the toma for this system.

Changoso (91): This community has a system that was built five years ago, but here too, the PVC pipe was not buried and damage by exposure to the sun was likely. This past year, the villagers took it upon themselves to re-build their system. They found a suitable site for a toma in May 2010 in a ravine (1,130 ft elev.) and we visited this site on this trip. The flow rate from this toma was guesstimated at 2.5 gpm. They built a make-shift toma out of rock to capture the spring water coming out of the clay soil bank and also laid salvaged PVC pipeline on the ground from this temporary toma to 21 houses on two branch lines. The pipe was joined using short sections of salvaged pipe as pipe couplers, fabricated by delicately heating the ends of the coupler to form socket end sections. They were in the process of trenching and burying the pipe during the team's visit. Currently there is no tank but a suitable location for a tank upstream of the bifurcation was also identified at an elevation of 1,060 ft. The elevation of the bifurcation is 940 ft. The western branch supplies 6 houses and the eastern branch supplies 15 houses. Both branches are currently 1-inch pipe which may be inadequate for the eastern branch with more houses. There is a shutoff valve on each branch right at the bifurcation and they have to open and close these valves to direct flow to one branch



Pipe coupler formed from salvaged tubing

at a time. There are 3 or 4 additional houses that could ultimately be hooked up on the western branch that currently do not have water. During our visit, we measured the elevation of the highest of these houses at 1,030 ft. So, if a tank is installed at the location identified, there would be about 30 ft of head available from the potential tank site to this highest house that currently has no water. An even higher location for the tank should be considered. A suspension pipe crossing, supported by a single strand of barbed wire and approximately 400 feet in length, was built across a ravine on the western branch upstream of the houses on this branch. The community is requesting a proper toma and tank at a minimum. It is recommended that new properly-sized pipe and a proper suspension crossing also be included in any new construction.



Suspension pipe crossing, Changoso

Cerro Ñame (): In the late afternoon, the team (including Nicolas) visited Cerro Ñame on the road to Bajo Cacicon. The visit involved steep humid hiking up through jungle to the locations for two potential tomas. Toma site #1 at 2,180 ft elevation is registered with the government. We guesstimated a flow rate of 4 gpm from this toma. Toma site #2 is back down the trail in the jungle and a short distance up a side drainage at 1,990 ft elevation. There is an existing tank of about 1,500 gallon capacity on a ridge at 1,760 ft elevation. The community plans to use this existing tank and wants to develop the toma sites. The elevation in the part of the community on the road is 1,640 ft. A one-hour meeting of the Waterlines team was held with the villagers after dark.

The team returned to Tolé for a late dinner at Nicolas' house and spent the night again in Tolé.

<u>Friday January 14, 2011</u>

Piedra Pintada (67): In the morning, **t**he team picked up Marcial and visited the toma (1,300 ft elev.) built by the government in a ravine in a pasture, a five minute walk from the road. This toma was originally intended to supply water to an agricultural co-operative nearby. A considerable amount of water is seeping out of the bank, and is not being captured by the toma box. Also, the toma is unprotected from livestock grazing in the area. When the team visited the site, the lid was not on the toma box; the landowner may have left the lid off after accessing the water supply at the toma. The area around the toma should be fenced, with a tap installed at a convenient location for the landowners use so that the toma is not compromised. We understand that the lower concrete toma that we visited is connected downstream by the supply from a crude

make-shift toma higher up. After this short visit to the concrete toma, the team toured the agricultural co-op where yuca, orange trees, guandu (pigeon peas), and other crops are being grown. The team also visited the existing tank at 1,260 ft elevation. No water was entering this tank, but the tap at the co-op had water pressure. We speculate that the line from the toma to the tank has been tapped by other users, preventing flow from reaching the tank when the users are drawing water. The water committee has been unresponsive to past Waterlines recommendations. Consequently, Padre Roberto does not recommend that any actions be taken on this system other than fencing off the toma to protect it from further contamination by livestock.

Cerro Venado (21): Marcial and Estévan Mendosa live here. We visited the tank and pump system. A submersible pump has been installed by the government in the bottom of the tank since the January 2010 Waterlines visit. Also, repairs to the serious leaks on the tank have been made since last year such that the tank is leaking only slightly now. The elevation of the tank was measured as 930 ft. We were told the pump is manually turned on for one hour in the morning and one hour in the evening to pump water through the 2-inch line to the high tank on the hill above Cerro Venado.

The Waterlines team removed the 8 photovoltaic solar panels from their frames. These panels had been stored at Marcial's house at Cerro Venado for approximately 20 years. The panels appear to be in working condition. They were taken to the Centro Misional Jesus Obrero in Tolé for storage until they can be installed by Victor Saldaña in Llano Ñopo, to augment their existing array and growing demand for electric power.

For future reference, Marcial Mendosa has the following contact information:

Phone: 6138-6328

e-mail (neighbor): dominga.85@hotmail.com

It rained very hard for a half hour or so this afternoon. Supper was served at Nicolas' house and the team once again spent the night in Tolé.

Saturday January 15, 2011

At 5:30am, the team headed off up the newly cut road toward the spectacular Peña Blanca as far as possible to drop off Padre Roberto and Nicolas at 7:30 a.m. for their long trek to Trinchera, across the Cordillera. John, Brent and Anne then headed to the town of David, but first visited Boquete and the eastern flank of Volcan Barú for a couple of hours of sightseeing. They then drove on to David and stayed again at the Hotel Tolédo.

Sunday January 16, 2011

The rental vehicle (aka the Golden Chariot) that had several perplexing features or lack thereof, was returned with relief to National Car Rental at the David airport. From David, John, Brent,

and Anne flew to Panama City in the morning and, with all three suffering from coughing and congestion, decided to attempt to reschedule their flight home, originally on the 18th to the 16th. They were successful and flew out of Panama City on an afternoon flight to Houston and points beyond.

Project and Studies for 2011

The following are transcribed from Padre Roberto's notes from the 2011 Waterlines trip.

a) Studies and estimates:
   1. Cerro Ñame – study completed; now need an estimate for improvements
   2. Trinchera – study and estimate
   3. Llano Horcon – study and estimate
   4. Algarrobo – study and estimate
   5. Llano Bonito – study and estimate

b) Requests:
   1. Cerro Plata (Cerro Banco)
   2. Cerro Plata (Chichica)
   3. Quebrada Macho

c) Pending Projects:
   1. Bajo Guayabal (finish by end of February 2011)
   2. Quebrada Macho (begin March 2011) and Alto Cienega (visit and study)
   3. Cerro Ñame (Alto Caballero) – 26 families
   4. Trinchera (March 2012)
   5. Cerro Plata (Chichica) – needs a study
   6. Llano Horcon (Cerro Banco) – 25 families
   7. Cerro Algarrobo (Cerro Banco) – 20 families
   8. Llano Bonito (Cerro Banco) – 10 families
   9. Cerro Plata (Cerro Banco) - ? families; an improvement project, but lacks study
   10. Aguacate (Rio Tabasará – Javilla) - ? families, no study as yet
   11. Calabacito (Chicica) - ? families; an improvement project, but lacks study
   12. Cerro Concha (Rio Tabasará) - ? families, not study as yet
   13. Javilla (Rio Tabasará) – an improvement project

Observations and Recommendations

Following are a few observations from the trip along with recommendations for consideration.

- Waterlines continues to rely heavily on Nicolas Arcia to study and execute water projects. Without Nicolas, water project construction would be significantly impacted. He is now 55 years old and says he can keep going for several more years. Nonetheless, Waterlines should consider training additional people to be water supply technicians in Panama. Maybe Nicolas could recommend one or more apprentices that he could "take under his wing".

- We saw several examples of poor workmanship and incomplete construction associated with projects conducted by Marcial and Estévan. In some cases, reconstruction will be required. As from last year's report, it is recommended that Waterlines limit their involvement on projects.

- It is not clear how the non-Peace Corps systems are being designed from a hydraulic standpoint. If not currently being done, systems should be designed from survey data and using hydraulic calculations. Reports of pipes bursting or insufficient water delivery indicate that a system may have been improperly designed from a hydraulic standpoint. If location and elevation data could be gathered by the Waterlines Panamanian representative completing system studies and designs, the design could be verified by engineers prior to ordering the materials and completing the work.

  The difficulty in verifying proper design is obtaining accurate design data. Traditional means of gathering survey data, such as Abney levels or water levels and chains, are time consuming but tried and true. Use of a consumer-grade barometer-equipped gps, available for $300 or less, might provide design data accurate enough for designing water systems where precise elevations are not required (typical of most of the systems visited on this trip), but would require training and access to a computer to download and e-mail data. Waterlines volunteers could provide this function on the annual trip, but it would require more time spent in fewer communities to gather the gps data. Use of a consumer-grade non-barometer equipped gps is not recommended because of the imprecision of determining elevation using satellite signals.

- Again this year, we observed PVC pipe unburied, i.e. lying on the ground or in unfilled trenches. The pipe should be buried to protect it from sun exposure, animals, and erosion. The white PVC pipe degrades and loses its pressure rating over time with cumulative sun exposure. Also, in areas where sun exposure cannot be avoided the pipe should be painted, or in the case of suspension crossings, inserted inside another pipe for UV protection as has been done on some of the projects.

- Given the number of Waterlines projects in Panama, it is difficult to oversee and monitor past and current projects using volunteer labor alone. Waterlines should consider options for how the organization can respond to the increased number of projects and maintain a constant connection with the communities. The possibility should be explored of having someone in Panama who would visit communities, perform minor repairs, recommend major work, work with water committees, report to Waterlines, and collaborate with Peace Corps. The Peace Corps circuit riders are able to fulfill this function to some extent, but a full-time "circuit rider" approach should also be explored. This may also be a way to address concerns about the design of non-Peace Corps projects.