



REPUBLIC OF NICARAGUA

Central America



AGUA PARA LA VIDA – NICARAGUA

« Potable Water and Rural Sanitation  
in the Community of El Quebracho »

“Basic Proposal”

Community	:	El Quebracho
Municipio	:	Esteli
Departamento	:	Esteli



Río BLANCO, Abril 2012

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## ABBREVIATION LIST

APLV	Agua Para La Vida
C/U	Cada Uno ("Each")
Q	Caudal
cm	Centímetro
cf	Fecal Coliforms
	Comité de Agua Potable y Saneamiento (Potable Water and Sanitation
CAPS	Committee)
HF	Hierro Fundido
HG	Galvanized Iron
km	Kilómetro
LC	Línea de Conducción
l/min	Litros por minuto
l/s	Litros por segundo
m	Metro
m <sup>2</sup>	Metro cuadrado
m <sup>3</sup>	Metro cúbico
ml	Mililitro
MAG	Mini-Acueducto por Gravedad
N/A	No Aplicable
O y M	Operación y Mantenimiento
pH	Potencial Hidrógeno
PVC	Poli Cloruro de Vinilo
RD	Red de distribución
TP	Tanque Propuesto
U/M	Unidad de Medida
NTU	Unidades Nefelométricas de turbidez

## **1 - INTRODUCTION**

This study was undertaken with the objective of constructing a potable water and sanitation system to improve the hygienic/sanitary conditions and the quality of life of the inhabitants of the community of El Quebracho. The technical/feasibility study was done with the support of the community of El Quebracho, The Rotary Club of Longmont Twin Peaks (USA), Namlo International, and Agua Para La Vida.

The project is an integrated Potable Water and Sanitation project, including the community organization (the CAPS Potable Water and Sanitation committee), easements for the pipe, construction of the tank, delimitation of the water source, socioeconomic, technical, and environmental studies, and development of the project with the municipal government of Estelí.

This project is in two phases: Socioeconomic and technical feasibility, and design.

The report reflects the technical feasibility study, considering the current situation of water availability and sanitation, the existing sources of water, availability of funds to guarantee operation and maintenance, analysis and presentation of the available solutions, and the profile of the alternative selected by the Agua Para La Vida team.

## **2 - CURRENT NATIONAL WATER AND SANITATION SITUATION**

### **2.1 The problem expressed in statistics**

Of the 33 Latin American countries, Nicaragua is the second poorest, after Haiti. Based on the consumer index, it has been determined that almost half (47.9%) of the population is poor. The part of the population deemed poor, then, is 2.3 million people, and of those, 830,000 are considered extremely poor.

In 2004, the potable water coverage in Nicaragua was estimated to be 75.8% nationally. In the urban areas, it reached an average of 95.1%, but in the rural areas only 48.5%. In the rural areas, only 26% receive piped water and it is not always of good quality. Another 36% rely on private or public wells, and 24% drink from rivers, springs, and creeks.

Coverage of sanitary systems is 35.1%, with the best coverage being in Managua and the other major cities.

The problem of clean water has a direct effect on the health situation for the population. It is generally estimated that about 80% of the health problems that result in consultations in the public health system are linked to water problems, including diarrhea, conjunctivitis, and skin problems, among others.

The lack of access to water in the home increases the labor requirements on women, who are the ones usually in charge of domestic work, especially in the poorest families and in the more rural areas. This task often requires carrying water for several hours from the water source to the home. In many cases the women are aided by the older boys and girls.

## **2.2 Alternatives for the Rural Areas**

Delivery of water and sanitation services in urban areas is primarily the responsibility of the National Public Service Company (ENACAL).

In the rural areas, there are community organizations scattered throughout the country which are called "Potable Water and Sanitation Committees" (CAPS, or Comités de Agua Potable y Sanamiento, in Spanish).

A CAPS is a group of men and women, elected by the community, who are in charge of organizing the population, coordinating with other entities in the community and/or the municipal government in order to bring water and sanitation to the homes of the population.

It is estimated that between 1.6 and 1.9 million inhabitants have potable water thanks to the 5,000 CPAS in Nicaragua. In 2005, the "Special Law of the CAPS" officially and legally recognized the CAPS committees.

It is in this manner that Agua Para La Vida has always worked in the rural areas of Nicaragua, organizing and then training CAPS committees that then develop and build their own water systems.

## **3 - ABOUT AGUA PARA LA VIDA**

### **3.1 Mission and History**

Agua Para La Vida (APLV) is an international non-profit organization founded in 1987 with the objective of improving the quality of life of the inhabitants of the rural communities of Nicaragua.

APLV has been helping these communities to construct their own potable water systems using an integrated methodology in order to reduce the percentage of people without sustainable access to potable water and basic sanitation.

There are three separate NGOs (non-governmental organizations), APLV USA, APLV France, and APLV Nicaragua. The funds for APLV's work come from various sources including international foundations and individual donors in both the US and France.

APLV has its operational office in Rio Blanco, Nicaragua and has to date executed 72 projects benefiting about 22,000 people in rural communities in the departments of Matagalpa, Jinotega, Nueva Segovia, and RAAS and RAAN.



For each project, APLV develops the following basic activities:

1. Potable water and sanitation: studies, design, and construction of gravity-flow water systems with public and private (household) tapstands, help in construction of latrines, formation and training of CAPS committees.
2. Health and Hygiene: community diagnostics, sanitary and environmental education in the schools and households.
3. Conservation and management of the micro-watershed: Environmental studies of the water source which will supply the community, legal negotiation, establishment of tree nurseries, chats and trainings with workers, families, and schools.

The objectives of the development activities are:

- To improve the quality and increase the quantity of water available for human consumption and household use in the communities.;
- Help the tiny rural communities of Nicaragua to develop and maintain sustainable access to potable water;
- Preserve and protect the watersheds that provide water to the communities;
- Educate these communities concerning health and hygiene in order that they adopt good hygienic practices which contribute to the lessening of water-borne illnesses;
- Organize and train the Potable Water and Sanitation Committee (CAPS) in all aspects of the design, construction, administration, and maintenance of systems of potable water to achieve local autonomy and system sustainability.

## 3.2 APLV Information

Agua Para La Vida – Nicaragua.

[www.aplv.org](http://www.aplv.org)

### 3.2.1 Addresses

#### In the USA

California: 2311 Webster Street, Berkeley, CA 94705

#### In Nicaragua

##### Managua:

Dirección: Barrio Monseñor Lezcano, de donde fue el banco popular, 2c al lago, 1 1/2 arriba.

Telephone/Fax: 2250-1570

##### Rio Blanco:

Dirección: Costado Norte, Colegio Rubén Darío – Río Blanco, Departamento de Matagalpa.

Telephone/Fax: 2778-0009

### 3.2.2 Contacts in the Organization

#### In Nicaragua

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## 4 - CHARACTERIZATION OF THE COMMUNITY

### 4.1 History and Location

This is a semi-dispersed community about 17.5 kilometers northeast of the departmental capital, Estelí. It is accessible by road throughout the year and has public transportation (leaving from Estelí headed toward Yali and La Concordia). Some points within the community have mobile telephone coverage with the Claro mobile telephone company.

There are 58 houses in the community, but due to the relative elevation of the water system and 17 of the houses, **only 41 household tapstands will be constructed** (including one school and two churches).

Age and sex distribution:

0-5		6 a 15		16-25		26-35		Over age 36	
<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>
9	3	13	16	18	20	14	8	21	12

### 4.2 Access

To arrive at the community from Rio Blanco it is necessary to follow this route:

Rio Blanco – Matagalpa – Estelí – Quebracho. This is about 7 hours of travel in a private vehicle, paved to Estelí and then dirt road from Estelí to the community.

The rainy season is not a limiting factor for access because there is a year-around road.

There are 37 families in the community. 11 of them have 23 beasts of burden among them (donkeys, burros, horses).

There are 53 men and 40 women between 16 and 35 years of age that have the capacity to work on the water and sanitation project.

### 4.3 Economic Activities

The population is composed of 53 men and 40 women. Of this active population only two men work outside the community the remainder work at these activities.

- 63 % work in agriculture (farming)
- 7 % raising cattle (and milk)
- 13 % workmen work on nearby farms
- 17 % other (business, evangelical pastor).



In addition most work in subsistence agriculture, harvesting corn and beans. These items are sometimes used in trade as well.

#### 4.3.1 Monthly income:

The mean income is C\$3715 (about US\$162) but six families have significantly higher income (over C\$6000, about US\$260), leaving a majority of families with a mean income of only C\$1977 (about US\$86)

Monthly economic income of families.		
	Quantity	%
100 a 1200	5	17
1500 a 2500	14	46
2800 a 4400	5	17
6000	4	13
20000	2	7
Total	30	100

#### 4.3.2 Property:

84% of the families own their own farms, 14% are borrowed/rented from landlords who live in Estelí, and 3% rent their farms.

22 % of the farms are good; 54% are average, and 24% are in poor condition.

#### 4.3.3 Economic Level

El Quebracho is a community with low economic income, linked to small parcels of land where every family has its own house.

Infrastrutture and Services:

Education	<p>There is one school, Quebracho #1, constructed in 2007-2008 by Namlo International. It currently has 32 students and two teachers (Jacqueline and Glendy Cruz). They teach multigrade primary and preschool. The school has a solar panel for electricity and two latrines in poor condition.</p> <p>To continue to secondary or higher education children must travel to Estelí, about 17 kilometers (a little over 10 miles) away.</p> <p>Of the 30 parents surveyed, 5 are illiterate, 3 have basic alphabet skills, 15 more completed part of primary school, 3 completed primary school, and 4 completed the first year of secondary school.</p>
Electrical Energy	<p>There is no electrical service, although 9 homes have a solar panel for electricity, as does the school.</p>

Health Services	There is no health service provided in the community. Some go to La Concordia, 13 kilometers away, costing C\$30 (about US\$1.25) on the bus round trip. Others go to Las Quebradas, which is only 6 kilometers away; the round-trip fare is C\$20, just under US\$1.00. Alternately, they can walk to Las Quebradas, about 1.5 hours on foot, but they may walk that distance and not find the health official on duty. Others, of course, travel to Estelí, according to their economic situation, where there are specialists and a hospital. The round-trip fare is C\$40 (about US\$1.70).
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#### **4.4 Organizational Level, Initiatives, and Project Experiences**

This community has a school board and a committee for development of projects, which activates whenever there is a project to develop.

As mentioned earlier, the community, with the support of Namlo International, organized for the construction of a school and organized work groups in order to distribute the work fairly.

The community has organized to work with entities of the central government, being beneficiaries of a productive grant and roofing plan that gives to each beneficiary family:

1. One cow
2. 9 hens
3. 1 rooster

5 families have been beneficiaries of this program.

The roofing plan provides to each family:

1. 10 12-foot sheets of zinc roofing
2. 2 pounds of roofing nails..

52 families have been beneficiaries of this program.

The community organized to develop the request for a water project. It formulated a written initial request as is required by APLV, it found a water source, and followed through with the measurements of water flow at the source.

Based on contact with the community, APLV considers that the organizational level of El Quebracho is very good.

### **5 - WATER, SANITATION, AND HYGIENE SITUATION**

#### **5.1 Potable Water:**

20% of the families get their water from Estelí, demonstrating their significant financial means. They pay milk trucks or bus drivers to bring water ever 2, 4, or 8 days as needed. By vehicle the round trip to Estelí is 80 minutes; the bus charges C\$20 (just under US\$1.00) to bring 40 to 60 liters (10-15 gallons) of water. The milk truck may charge the same, or may accept payment in kind, for example firewood or grain.

5 families, or 17%, get water from other sources. One mother received from the government a rain-harvesting tank with a filter; the tank fills in the rainy season and is used up in the dry season. In this case there are just a few members of the household and this technique works. Three families have hand-dug wells that do not dry up in the dry season (but which do not produce enough to share). And one family gets its water from the lake and filters it with a home-made filter.

For household tasks, personal cleanliness, and agriculture, water must also be provided. As a result they have made little artificial lakes which, if the rainy season is adequate, fill up with water that lasts a while in the dry season. But in general, according to the villagers, they usually just have puddles and mud.



The average daily time invested in carrying water is:

In the dry season: 120 minutes

In the rainy season: 25 minutes

100% of the families get water from hand-dug wells.

Water carrying activities:

50% of water carrying is done by the women and children; 37% of the men participate, and the remaining 13% is done by others such as milk truck drivers or public transport.

Water quality checks were done at two water sources that the families use, with the following results:

Site	Date	Quantity sampled	pH	Turbidity	Coliform Bacteria
Hand-dug well at Finca Chilamatillo	Noviembre 2011	100 ml	7.0	<10	<50
Hand-dug well: Finca Roger Rodríguez	Noviembre 2011	100 ml	7.5	<10	<50

The water quality of the chosen water source is better than that of the well. However, there is a road near the source which many people use. We think that fencing the water source and making sure people understand the importance of protecting it will improve the quality over the long term.

## 5.2 Sanitation

In this community 68% of the homes lack latrines. 32% have latrines, but of those 92% are in bad condition.

The soil where they are constructed is generally of sand and clay. For this reason the 41 latrines proposed for this community are of type Elevated VIP.



### 5.3 Health and Hygiene

According to the health and hygiene survey in the community:

- 67% of the families store drinking water in open containers, which increases the risk of contamination before drinking.
- 100% of the families make proper use of gray water after household use, for cleaning patio or watering plants; 27% have drainage facilities. They are used to dealing with the scarce water resource.
- 47% of families throw trash wherever it may land in the patio;
- 80% of the families have hens; in 100% of these cases the animals roam freely, contaminating the area with fecal material.
- Only two families have pigs; one of these keeps the animals enclosed in a stone corral; the other keeps the pigs tied up.
- In 10% of the families there were cases of diarrhea or parasites in the two months leading up to the survey; 3% had kidney infection or skin diseases and 6% had malaria or dengue fever.

As in many communities, the health and hygiene situation is foremost in people's minds and must be developed. To have the most significant impact on water-borne diseases, it is necessary to develop in parallel a potable water and sanitation program and a preventive health education program. This particular community is already quite careful to avoid standing water and gray-water puddles; it probably helps that the terrain is quite gravelly and sandy, which helps prevent these.

## 6 - ALTERNATIVE PROPOSAL FOR WATER PROVISION

### 6.1 Proposed System: Gravity-flow Mini-aqueduct

In order to provide water for El Quebracho a gravity-flow mini-aqueduct will be built and will benefit 41 of the 59 households of the community. ***The other 18 households are at elevations higher than the tank elevation and so cannot be provided with this design.***

**In order to be able to provide water to the 18 remaining families, another alternative would have to be sought, such as an electric pump system, which would require its own complete study. APLV is limiting its study at this point to the gravity-flow system.**

### 6.2 Community Demand for Water

#### 6.2.1 Projected Population

We are designing a project with an expected lifespan of 20 years. The estimated annual growth of the community should be 3%. (The INAA, the national regulator of water development, recommends estimating a rate of growth between 2.5% and 5%.)

The projected or designed population is:

$$P_p = P_{\text{current}} \times (1 + 0.03)^{20}$$

$P_{\text{current}}$  is the current population in the year of the project

$P_p$	is the population projected in 20 years.
0.03	is the projected population growth rate
20	the designed life-span of the project (years)

The current population of the community is 134 persons.

So:

$$P_p = 134 \times (1 + 0.03)^{20}$$

$$P_p = 242 \text{ persons}$$

### 6.2.2 Per-person water usage

This is a project of private water tapstands. In our norms this implies a daily usage of 70 liters per person (about 18 gallons). In addition we estimate system water loss on the order of 10%.

### 6.2.3 Total average daily water consumption

We calculate the the Average Daily Total Consumption (ADTC):

$$ADTC = 242 \times 70 / 0.90$$

70 is the usage per person per day in private tapstands

0.90 corresponds to usable water (less the 10% system loss)

So we have:

$$ADTC = 18,822 \text{ liters/day (about 5000 gallons/day)}$$

The community of El Quebracho needs a **minimum flow of 18,822 liters per day**.

## 6.3 Description of the water source and the micro-watershed

### 6.4 Quantity and Quality of Water

We propose building a gravity-flow water system proving the population with water from a water source found in the upper section of the community.

The source is located 6500 meters from the community in a micro-watershed 9 manzanas (6.3 hectares) in area.

The micro-watershed has a good mountainous relief, with a maximum altitude of 1420 meters above sea level, and with the water source at 1350 meters. It is composed of these zones:

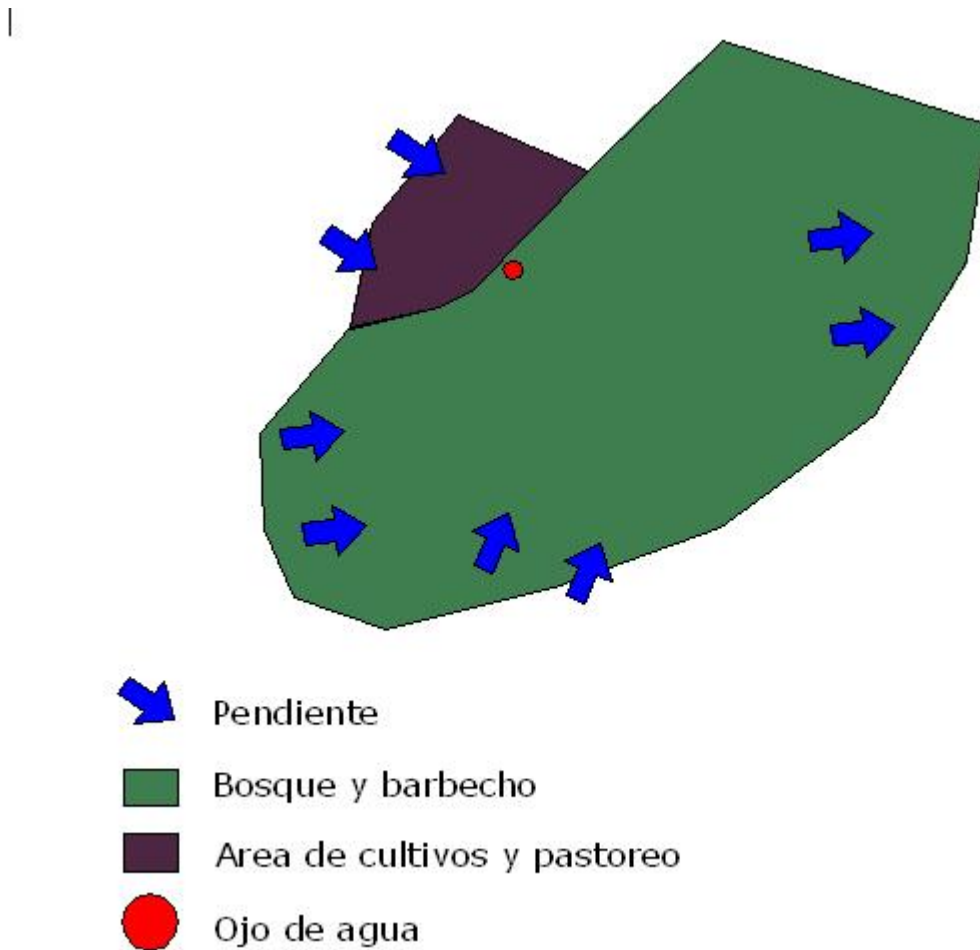


Figure 1 - arrows indicate direction of water flow; green is forest; purple is cultivated or pasture; red dot is water source

#### Zone in the vicinity of the water source

This is a zone of about 9 manzanas, including 8 manzanas of forest and fallow land and 1 manzana of pasture.

- The fallow zone has few trees.
- The pasture zone is used for grazing cattle and has few trees.

#### Risk Analysis

- Tree coverage in the recharge zone is good. The water source has good flows but in order to preserve this source it is necessary to reforest one manzana that is in the area above the source and in the long term augment the coverage and conservation of the micro-watershed.

Currently there is no chemical contamination, only animal contamination, as a result of the area not currently being fenced.

## Quantity

In order to determine whether the flow is adequate, it must be measured at the end of the dry season, when the reserves are at their lowest level. If the quantity is adequate at this time, it will be adequate throughout the year.

The ADTC (Average Daily Total Consumption) is **60%** of the water quantity provided by the water source.

## Water Quality

Two tests of the water were done, both in the rainy season, with these results:

<i>Place</i>	<i>Date</i>	<i>Turbidity</i>	<i>pH</i>	<i>Fecal Coliforms per (100 ml of sampled water)</i>
<i>Fuente N° 1 Tobías Galeano</i>	<i>November 2011</i>	<i>&lt; 5</i>	<i>6.5</i>	<i>0</i>

These results show:

- Water of low turbidity (the recommended value is below 5 NTU, as this sample indicates);
- A relatively neutral pH (about 6.5), which is inside the margin of 6.5-8.5 recommended for drinking water set by the World Health Organization.;

## 6.5 Agreements Executed

### Water source and surrounding Fuente y entornos

An agreement was reached with Sr. Tobías Flores Galiano for one manzana of terrain. For this donation the community promises to develop a grant of one cow, one pig, and 10 hens and fencing material for the three types of animal. APLV will also provide him a latrine if the project is approved.

### Tank and Easements

An agreement was reached with Sr. Marcial Blandón. He has donated a 10x10 meter area for the tank without requesting anything in return; When the project is approved this will be formally recorded.

Note that the tank donation was worked out by the members of the CAPS water committee.

Agreements were signed with the owners of 8 farms through which the conduction line will pass. The agreements were reached easily as everyone is in agreement that the project should be built. The names of the owners granting easements are:

- 1- José María Molina Rodríguez.
- 2- Antonio Matute.
- 3- José A. Rodríguez González.
- 4- Edgar Iván Castillo.
- 5- José Cerapio Castilblanco.
- 6- Carlos Ramón Castilblanco Rivera.



- 7- Arsenio Aguilar Blandón.
- 8- Fátima Moreno Flores

## **7 - PROPOSED PROJECT**

### **7.1 Objectives**

#### **General Objective:**

- Improve the quality of life of the inhabitants of the community

#### **Specific Objectives:**

- Improve the quality and increase the quantity of drinking water and domestic use for all members of the community of El Quebracho
- Decrease the number of cases of diarrhea, kidney infection, and other water-borne diseases.
- Train the CAPS committee (Potable Water and Sanitation committee) in the community in maintenance of the infrastructure and administration of the project in a self-sustainable manner.
- Preserve and protect the watersheds that provide water to the community.
- Educate the community about health and hygiene so that they get full benefit of their new drinking water supply.

### **7.2 Number of beneficiaries of the water project**

The proposed project will include **41 tapstands**:

- 37 families
- 1 school
- 1 Community Center
- 1 Catholic church
- 1 Evangelical Church

The 37 beneficiary families represent a total of 134 direct beneficiaries at the beginning of the execution of the water project.

Nevertheless, this system is designed for 20 years, with the capacity to provide water to 242 beneficiaries at the end of the designed-for period.

### **7.3 Protection of the water source and the micro-watershed**

#### **7.3.1 Objective and areas of work**

The objective of the environmental program is to maintain the sustainability of the micro-watershed's production so it can provide water for community of El Quebracho for the foreseeable future.

This objective will be achieved with the following axes of work defined according to the necessities outlined in 6.2:

- Protection of the source against fecal contamination by physical or natural sources;
- Improve the forest coverage of the source's recharge region in order to maintain the soil by means of shade and root systems;
- Improve the management of the micro-watershed by means of improved forest coverage and development of sustainable agro-forestal practices and by educating the community and especially the owner of the regions above the water source.

### 7.3.2 Development Activities

- Fence the 1-manzana area of the catchment itself to prevent fecal contamination from cattle;
- Develop a tree nursery to prepare trees for planting;
- Plant rapid-growth trees in the area of the catchment that will purify and preserve the the water (examples are Areno, Black Guanacaste, and Acacia trees);
- Proposal and negotiation for implementation of sustainable agroforestral systems with the owner of the areas above the water source, promoting water conservation and at the same time taking into account agricultural and grazing usages with the proposition of:
  - Displacement of the grazing region;
  - Planting Cacao seeds mixed with seeds of the Tamarindo Guaba.
  - Planting trees which provide forage as a source of feed for cattle (like black madero, Leucaena, Genízaro), parceling these áreas in a rotation.
  - Training of beneficiary families in these subjects
- Training of beneficiary families in these subjects:
  - Protection, conservation, and restoration of natural resources;
  - Importance of the forest and the environment in the production of water;
  - Management of micro-watersheds
- Development of four training events for the children of the school in these subjects:
  - Conservation of the forest;
  - Importance of water for living beings;
  - Participation in the development of the community tree nursery;
  - Planting some trees near the school;



## 7.4 Development of local capacity

### 7.4.1 Empowering local capacities

In every APLV development project social promotion/development is a key part of the success of the project and its future sustainability.

Constructing a functioning water system is not sufficient. APLV works with the community so that it knows how to administer the system in the future both in the technical and in the administrative and financial areas.

### 7.4.2 Preliminary Phase

#### Health and Hygiene Area

For this preliminary phase the following activities have already been developed:

The community has demonstrated significant interest in the project and the 37 families have approved the following:

- First contacts with the community en coordination with the leaders;
- Reception of the request letter from the community;
- Presentation of the policies of APLV
- Definition of the tasks and responsibilities of the members of the CAPS committee;
- Election of a CAPS committee
- Census and socioeconomic survey

Preparation of the conditions for formalization and legal acceptance of the water source, easements for the trench/pipe, and location of the tank.

- Contribute C\$1000 (about US\$44.00) for the right to have a home tapstand;
- Give C\$35 (about US\$1.50) as a monthly payment for the future maintenance of the system;
- Work during the entire execution of the project;
- Construct the family's own latrine;

### 7.4.3 Development activities during the project

- Constitution of the work groups
- Consolidate the function and capacities of the CAPS;



- Promote and motivate an egalitarian approach to work and responsibilities in the community
- Guarantee the involvement of the entire community;
- Arrange continuing evaluation meetings with members of the committee and those responsible from the work groups;
- Prepare conditions for good administration of the system with technical, administrative, and financial trainings;
- Support the committee in the elaboration of its internal rules and regulations
- Control of tools
- Control of fulfillment of work obligations
- Support the committee in the inauguration of the project

## **7.5 Water System**

This water system is Gravity-flow Mini-Aqueduct (Mini-Acueducto por Gravedad, or MAG in Spanish) which will supply 37 families, 1 school and 3 other institutions. The hydraulic analysis and construction drawings of the principal works are presented in the technical appendices.

The MAG will be composed in the physical components detailed in the following table:

## Project Components

Item	Description	Characteristics
1	Spring catchment/capture	1
2	Conduction line from spring to tank	7,575
3	Burying the conduction line	7,575
4	Storage tank	1
5	Trenching the distribution network	8,396
6	Burying the distribution network piping	8,396
7	Construction of tapstands	41
8	Installation of meters	41
9	Technical training	5

The execution of the project is directed by the responsible technician and the qualified masons of APLV. All the beneficiaries, constituting the unskilled labor force, are involved directly in the various activities as they develop: Construction of the catchment, trenching, hauling materials, construction of the tank, etc.

### 7.5.1 Catchment

The catchment (spring capture) will be constructed of reinforced concrete and masonry

- Constituted of a filter of larger rocks, gravel, and sand;
- The filter will be covered with concrete so that rainwater and other superficial runoff will not infiltrate or contaminate the spring.

### 7.5.2 Conduction line.

APLV uses the computer program "Water in Pipes" to design the conduction line.

In this project it will be necessary to construct a line of conduction from the spring to the tank. According to the norms of APLV, we design the conduction line to take two times the ADTC (Average Daily Total Capacity), in order to provide sufficient water quantity during times of maximum demand. Thus the conduction line is designed to take **0.69 liters/sec**.

Line of Conduction 1 will be composed of the following elements:

- 1 collection box,
- 7575 m of pipe from the spring to the tank,
- 13 automatic air-removing valves,
- 5 subterranean crossings.

➤  
The volume of the tank is designed according to the following norms of APLV:

- The tank should permit the consumption of half the ADTC (in liters/day) in two hours (this is because the consumption peak is normally two hours in the morning)
- If the flow of the water source is greater two times the ADTC then the volume of the tank should be 1/3 of the ADTC.
- If the flow of the water source is less than two times the ADTC then the volume of the tank should be one half the ADTC.

Since we have a flow of the spring that is more than two times the ADTC:

Tank Volume = ADTC/3 = 6,078 litros

ADTC= 75,600/3

### **Tank Volume = 6 m<sup>3</sup>**

The tank will have a square shape.

Considering that it will hold a water height of 1.6 meters, the dimensions of the tank will be:

Water Height = 1.6 m

Interior space = 2 m x 2 m

The tank will be constructed of reinforced concrete (re-bar is used to reinforce the construction).

### **Fence around the tank**

To guarantee the security and protection of the area around the tank this area will be enclosed with a barbed-wire fence.

### **7.5.3 Distribution Network**

The design of the distribution network has been done with the program NeatWork 3.28, a tool used by APLV to calculate open distribution networks. Using this program it is possible to exactly specify and calculate the flow of every faucet in the system.

The distribution network has a total length of 8,396 meters of pipe of various diameters.

### **7.5.4 Tapstands**

**41 tapstands** will be installed in the community, with an average flow at each of **0.12 liters/second**.

Each tapstand will have a drainage to avoid problems with gray-water puddles.

### **7.5.5 Sustainability of the Water System**

The CAPS committee will be trained throughout the execution of the project with technical trainings, general management trainings, and finance management trainings.

This training regimen will permit the CAPS to have the capacity to administer the system over the long term.

In addition, the policy of APLV is to install water meters at every tapstand. With the defined basic payment, each family can consume 13 cubic meters per month, which corresponds to a bit more than 70 liters per person per day. If a family exceeds this volume, they should pay 5 cordobas extra per cubic meter consumed.

The meters allow each family to use what they need, but also reinforce the habit of taking care of the water resource.

## **7.6 Rural Sanitation**

The masons of APLV will construct a model latrine and train the beneficiaries at the same time how to build their own latrines.

During the survey, 41 latrines were identified which will be constructed with the technical help and materials provided by the Rotary Club.

The latrines are distributed in this manner:

- 37 families are beneficiaries of a tapstand, plus 4 institutions, adding up to 41 proposed latrines.

### **Program of Health and Preventive Hygiene**

The objective of the program of health and preventive hygiene is to influence attitudes and practices in the community with relation to hygiene and the usage of potable water and sanitation in order to reduce water-borne illnesses.

#### **7.6.1 First Stage: Activities already undertaken**

- Diagnostics of existing latrines
- Diagnostic of area hygiene in the community

#### **7.6.2 Activities yet to be developed**

The specific objectives of the program of health and preventive hygiene during the execution phase are:

##### **With the children:**

- Inculcate in the children good hygiene and sanitation practices;
- Fortify the understanding of the teachers so that they can promote good practices at the school and in their own homes.
- Teach the children the importance of responsible and sustainable water consumption.

##### **With the families:**

- Teach the families good practices of hygiene and sanitation in their homes.
- Drive home the importance of potable water for family health.
- Promote via family understanding the sustainability of the potable water system.

### With the CAPS committee health promoters:

- Develop health promoters in the community who will follow up on maintenance of good practices of family and environmental hygiene.
- Establish a plan of health work for the community.
- Train the CAPS committee and in particular the health promoters of the CAPS

For everyone, the trainings are developed around four themes\:

- ❖ Theme 1 – Use and maintenance of latrines
- ❖ Theme 2 – Importance of Water
- ❖ Theme 3 – Management of Trash
- ❖ Theme 4 – Personal hygiene

In addition, the CAPS health promoters will be trained in four other subjects: leadership, water-borne illnesses, household cleanliness and sanitation, and sanitary vigilance for the entire system.

### 7.6.3 Evaluation of program impact and follow-up

At the end of the project, an evaluation will be done of the impact of the health and preventive hygiene program. In accordance with this evaluation, a follow-up plan will be determined for the community. In reality, the practical changes related to hygiene are long-term processes. For this reason, at the end of every APLV project, the health and preventive hygiene portions are carried out approximately an additional 6 months to consolidate good practices.

## 8 - PLANNING AND EXTERNAL FACTORS

### 8.1 Schedule of physical execution

The project should have a duration of **10 months**.

Activities	month1	month2	month3	month4	month5	month6	month7	month8	month9	month10
Catchment/Capture of Spring										
Line of conduction from spring to tank										
Bury line of conduction from spring to tank										
Storage tank construction										
Trenching of distribution network										
Burying distribution network										
Construction of tapstands										
Installation of water meters										
Technical training										

#### 8.1.1 External Factors

These factors can have a negative influence on the schedule.



- **Rain and powerful storms:** if the roads are in poor condition it can be difficult to transport materials, and this can delay the overall schedule.
- **Availability of Construction Materials:** It can sometimes be difficult to obtain all the materials required for the project in Nicaragua (for example, cables and other hardware for suspension bridges, and high-pressure pipe). For this reason, we ask our providers to look for materials in the other countries of Central America. These conditions can delay the schedule as well.

## **9 - EXPECTED RESULTS**

### **9.1 Quantitative Results**

- ✓ **41 tapstands constructed**
- ✓ **41 latrines constructed**
- ✓ **1 manzana of land reforested near the water source**
- ✓ **A minimum of 1 manzana with agro-forestal conditions surrounding the water source.**

### **9.2 Qualitative Results**

- ✓ **Less time invested in carrying water and less work for children.**
- ✓ **More water used for personal hygiene, including hand washing and bathing children.**
- ✓ **Less fecal contamination in the community.**
- ✓ **Healthier living environment with less accumulated trash in the living area and less puddles and drainage problems.**
- ✓ **Good functioning of the CAPS in developing and managing the entire system, including maintenance, administration, and financial management, and the ability to solve simple and common problems without outside help.**
- ✓ **Full understanding in the community of the importance of sustainable management of the environment.**
- ✓ **Acceptance and motivation of the owner of the water source to follow up on the plan established for sustainable management of the micro-watershed.**
- ✓ **Improved management of the micro-watershed in a sustainable fashion in order to protect the water supply.**

## 10 - BUDGET FOR THE WATER PORTION OF THE PROJECT ONLY

Item	Amount (C\$)	Subtotal (C\$)	Amount (\$)	Subtotal (\$)
<b>Catchment</b>				
Construction Materials	36,836C\$		\$1,584	
PVC Pipe	784C\$		\$34	
PVC Accessories	2,420C\$		\$104	
Forms lumber	5,400C\$		\$232	
<b>Total Catchment</b>		<b>45,440C\$</b>		<b>\$1,954</b>
<b>Conduction Line</b>				
PVC Pipe	425,597C\$		\$18,305	
PVC Accessories	7,285C\$		\$313	
<b>Total Conduction Line</b>		<b>432,882C\$</b>		<b>\$18,619</b>
<b>Creek crossings, etc.</b>				
Construction Materials	26,800C\$		\$1,153	
<b>Total Creek Crossings</b>		<b>26,800C\$</b>		<b>\$1,153</b>
<b>Cleansing Valve Enclosures</b>				
Construction Materials	3,695C\$		\$159	
PVC Accessories	1,552C\$		\$67	
<b>Total Cleansing Valve Enclosures</b>		<b>5,247C\$</b>		<b>\$226</b>
<b>Storage Tank</b>				
Construction Materials	59,783C\$		\$2,571	
Form construction lumber	47,400C\$		\$2,039	
PVC Pipe	1,056C\$		\$45	
PVC Accessories	670C\$		\$29	
<b>Total Storage Tank</b>		<b>108,910C\$</b>		<b>\$4,684</b>
<b>Distribution Network</b>				
PVC Pipe	169,093C\$		\$7,273	
PVC Accessories	7,447C\$		\$320	
<b>Total Distribution Network</b>		<b>176,540C\$</b>		<b>\$7,593</b>
<b>Control Valve Enclosure</b>				
Construction Materials	1,912C\$		\$82	
<b>Total Control Valve Enclosure</b>		<b>1,912C\$</b>		<b>\$82</b>
<b>Water Meters</b>				
PVC Accessories and Meters	51,350C\$		\$2,209	
<b>Total Water Meters</b>		<b>51,350C\$</b>		<b>\$2,209</b>
<b>Household Tapstands</b>				
Construction Materials	20,352C\$		\$875	
PVC Pipe	4,974C\$		\$214	
PVC Accessories	8,681C\$		\$373	
<b>Total Household Tapstands</b>		<b>34,008C\$</b>		<b>\$1,463</b>
<b>Tapstand Drainage</b>				
PVC Pipe	13,138C\$		\$565	
PVC Accessories	344C\$		\$15	
<b>Total Tapstand Drainage</b>		<b>13,482C\$</b>		<b>\$580</b>
<b>Additional</b>				
Skilled Labor (partial)	231,607C\$		\$9,962	
Materials Transport	72,000C\$		\$3,097	
Project Administration	39,500C\$		\$1,699	
<b>Total Additional</b>		<b>343,107C\$</b>		<b>\$14,757</b>
<b>Water Project Grand Total</b>		<b>1,239,678C\$</b>		<b>\$53,319</b>

Note that there are other contributions in this project. Community members will provide food for APLV personnel in charge of project execution and for the unskilled community labor, and by paying 50% of the material costs of each family's tapstand.

## 11 - CONCLUSIONS

- ❖ The problem of water is identified and recognized by both the community and by APLV;
- ❖ Sanitation coverage is currently quite low, prejudicing the health of the community;
- ❖ Although the community is quite dispersed, the water source is located quite near the community center, so that will aid the execution of the project;
- ❖ The availability of water resources, even in the dry season, is more than double the projected demand in 20 years;
- ❖ Organization conditions in the community are favorable to permit successful project execution;
- ❖ The people manifest a clear disposition to support the manual labor required, to pay the fee required for a right to a tapstand, and to pay the monthly water bill for maintenance of the system;
- ❖ The entire community seems to agree that providing manual labor for the latrine project is a valuable investment for the common good;