WATER-USE IN JUIGALPA

Analysis of drinking water-use and -distribution
and proposals for efficiency improvement of
Juigalpa, Nicaragua.

Study Assignment
Catchword: Water Use, Urban,
Central America

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Juigalpa, August 1994

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ANNEX 1 NICARAGUA - GENERAL PROFILE

Area	129,494	sq km
Population 1989	3,503,000	
Population Growth	2.9	%
Population Density	27	/sq km
Pop'n Doubling Time	24	years
Urbanization	56.6	%
Capital City	MANAGUA	
GNP 1989 (millions)	$2,464	
GNP per Capita	$703	
Balance of Trade	-$693,000,000	(1986)
GNP for Education	6.6	%
Literacy Rate	74	%

Climate: Tropical. Rainy season May-Oct.

NICARAGUA - HEALTH STATISTICS

Life Expectancy (M)	61	years
Life Expectancy (F	63	years
Crude Birth Rate	39	/1000
Crude Death Rate	8	/1000
Infant Mortality	65	/1000
Hospitals	67	

NICARAGUA - GOVERNMENT

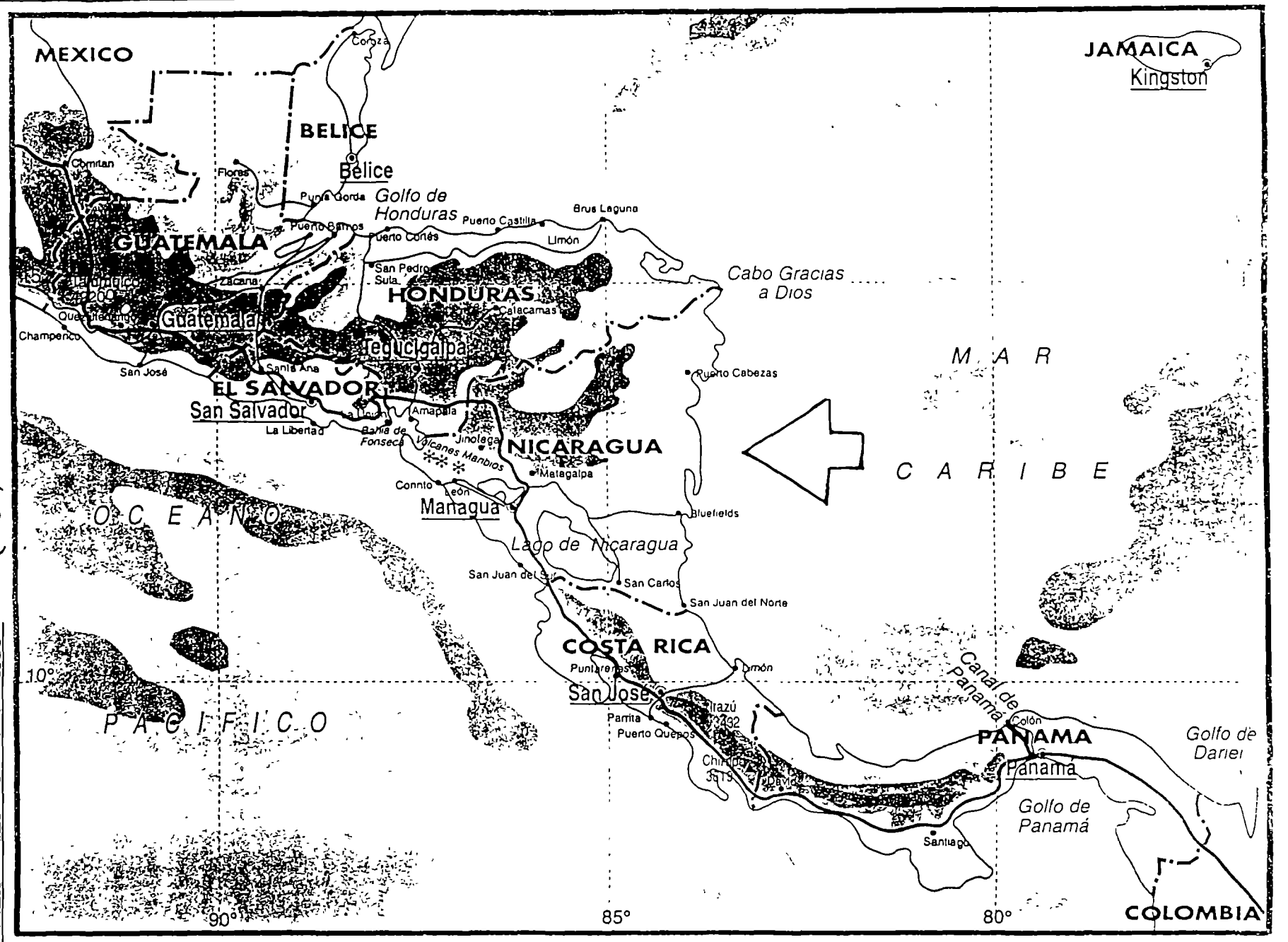
Type of Government	Republic
Government Leaders	President Violeta Barrios de Chamorro (1990)
	Vice president Virgilio Godoy (1990)
Major Parties	UNO
	Sandinista National Liberation Front
	Conservative Party
	Social Christian Party

LANGUAGES, ETHNIC GROUPS & RELIGIONS

Languages	Spanish	95	%
	Miskito	4	%
	Creole English	1	%
Ethnic Groups	Mestizo	68	%
	White	14	%
	Black	8	%
	Zambo	5	%
	Amerind	4	%
	Other	1	%
Religion	Roman Catholic	88	%
	Other	12	%

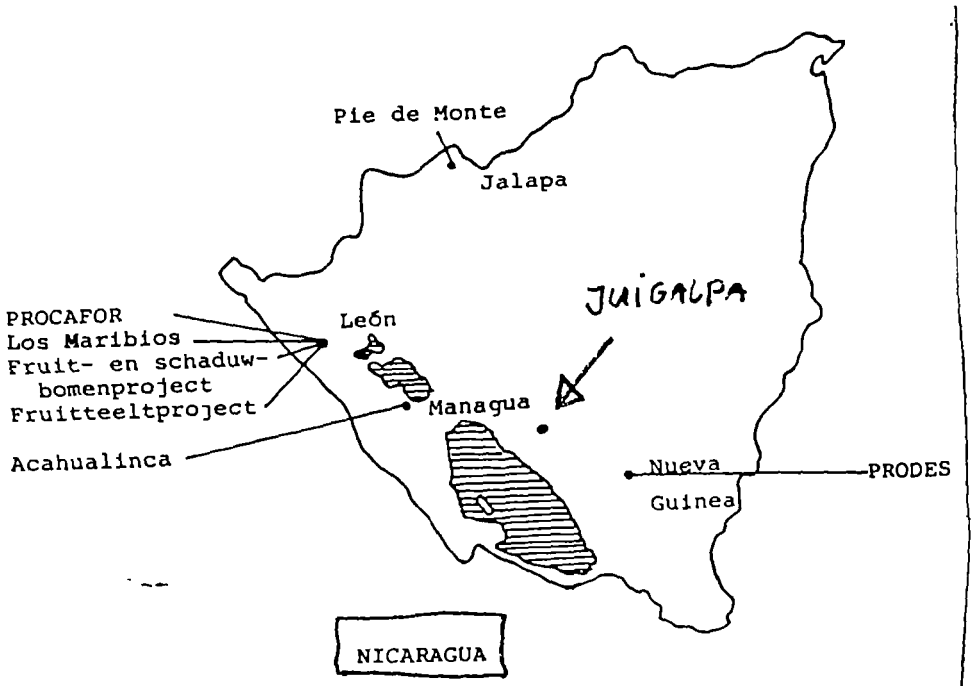
Source: PcGlobe 1990

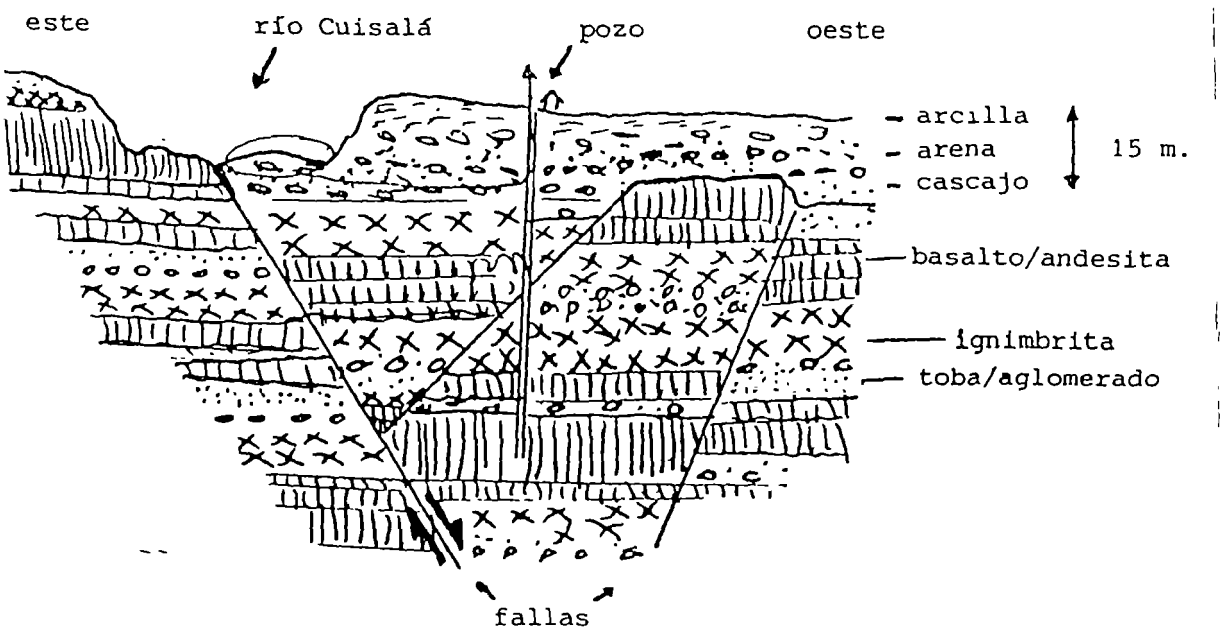
ANNEX 2 MAP OF NICARAGUA (2A)



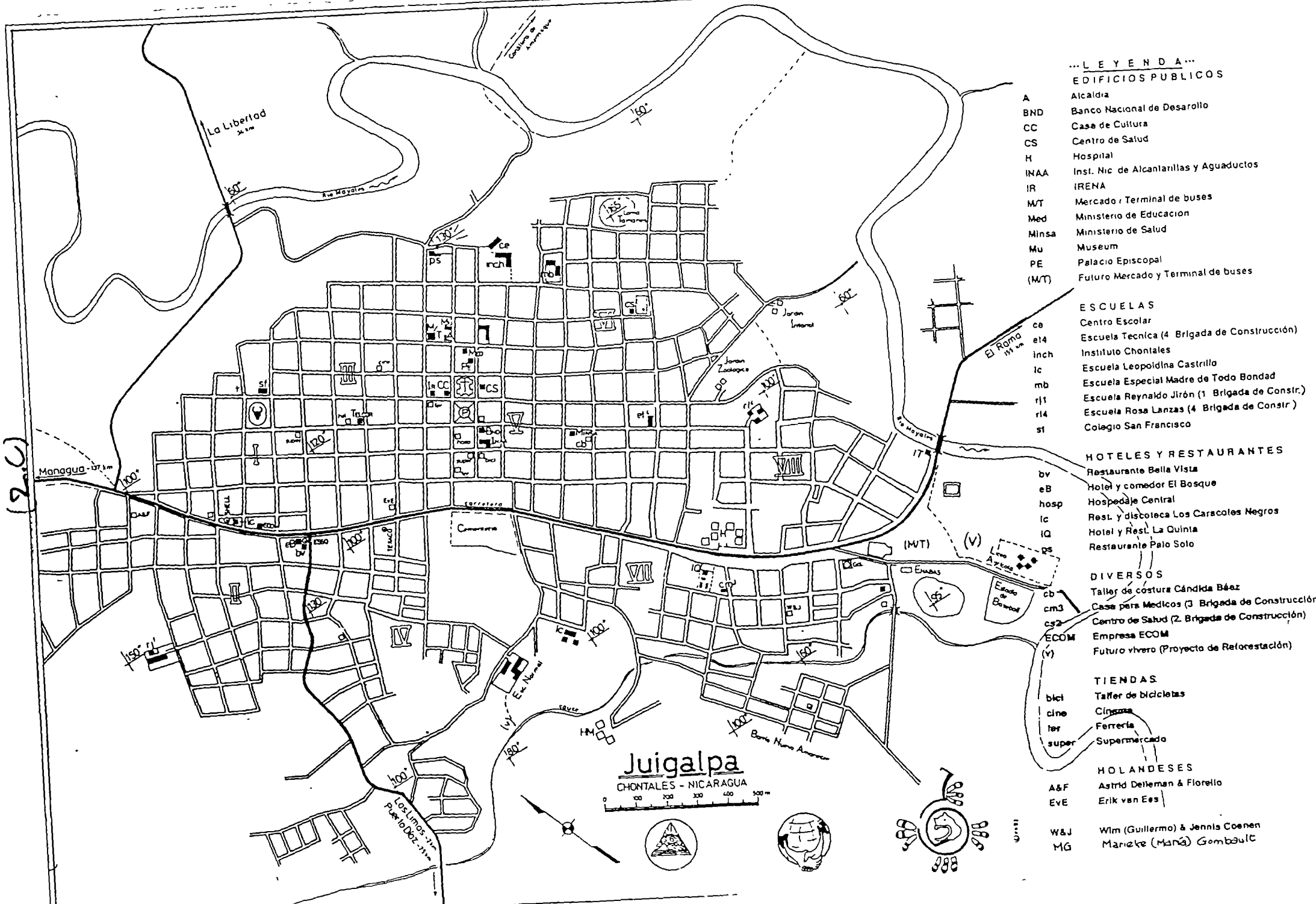
MIDDLE AMERICA

(2.B)





Cuadro 4.1.16. Corte transversal esquemático del campo de pozos cerca de la hacienda Las Limas


...L E Y E N D A...
EDIFICIOS PUBLICOS
A Alcaldía
BND Banco Nacional de Desarollo
CC Casa de Cultura
CS Centro de Salud
H Hospital
INAA Inst. Nic de Alcantarillas y Aguaductos
IR IRENA
M/T Mercado r Terminal de buses
Med Ministerio de Educacion
Minsa Ministerio de Salud
Mu Museum
PE Palacio Episcopal
(M/T) Futuro Mercado y Terminal de buses
ESCUELAS
ce Centro Escolar
et4 Escuela Tecnica (4 Brigada de Construcción)
inch Instituto Chontales
lc Escuela Leopoldina Castrillo
mb Escuela Especial Madre de Todo Bondad
rl1 Escuela Reynaldo Jirón (1 Brigada de Constr.)
rl4 Escuela Rosa Lanzas (4 Brigada de Constr.)
sf Colegio San Francisco
HOTELES Y RESTAURANTES
bv Restaurante Bella Vista
eB Hotel y comedor El Bosque
hosp Hospedaje Central
lc Rest. y discoteca Los Caracoles Negros
lQ Hotel y Rest. La Quinta
ps Restaurante Palo Solo
DIVERSOS
cb Taller de costura Cándida Báez
cm3 Casa para Medicos (3 Brigada de Construcción)
cs2 Centro de Salud (2. Brigada de Construcción)
ECOM Empresa ECOM
(v) Futuro vivero (Proyecto de Reforestación)
TIENDAS
bici Taller de bicicletas
cine Cinema
fer Ferreria
super Supermercado
HOLANDESES
A&F Astrid Delleman & Florello
EvE Erik van Ees
W&J Wim (Guillermo) & Jennis Coenen
MG Mariette (Mamá) Gombault
Juigalpa
CHONTALES - NICARAGUA
La Libertad
Managua
Carretera
Río Mayales
Los Limos
Puerto Díaz
Barrio Nuevo Amanecer
El Ramo
(M/T)
(V)
(2.C)

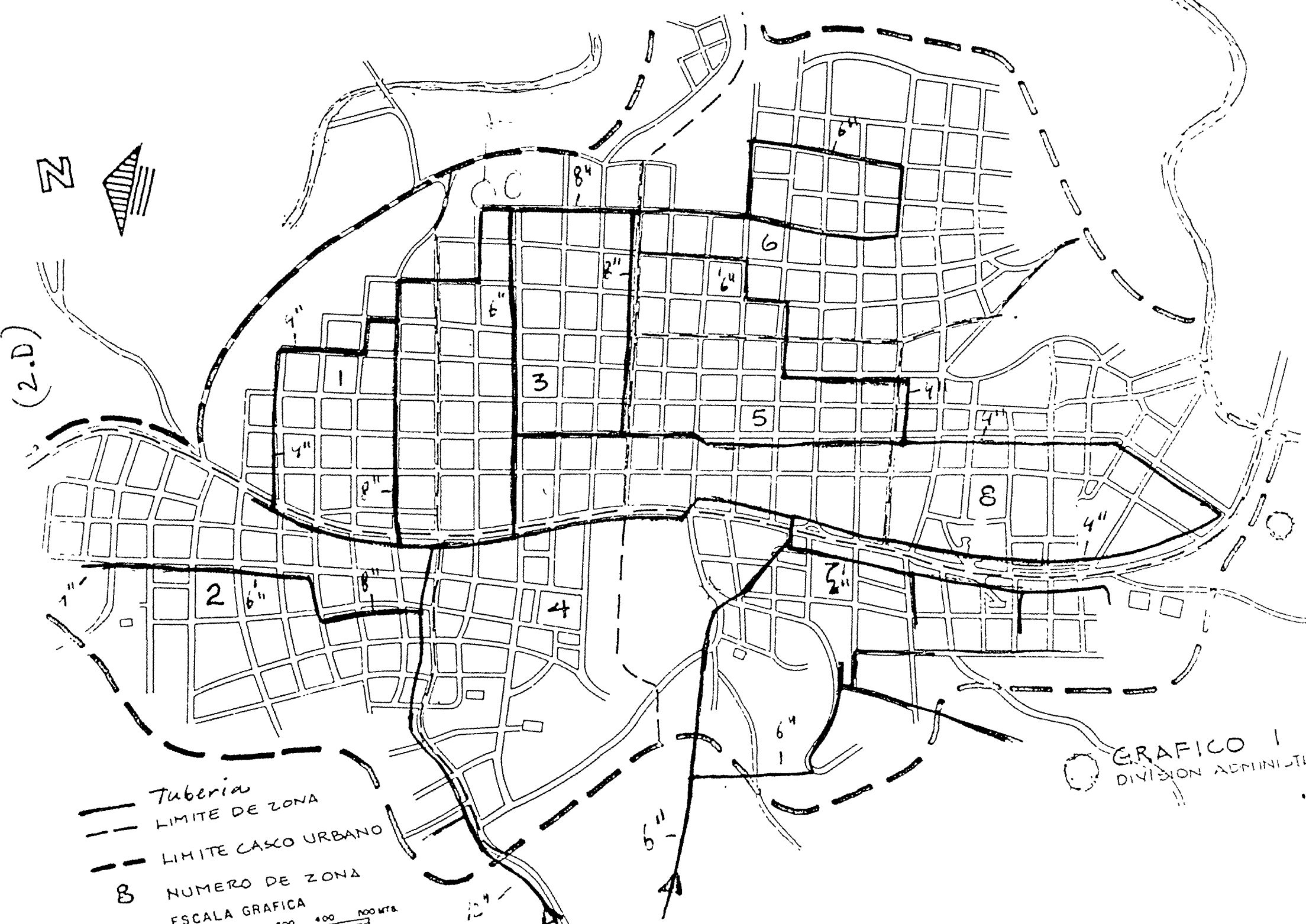
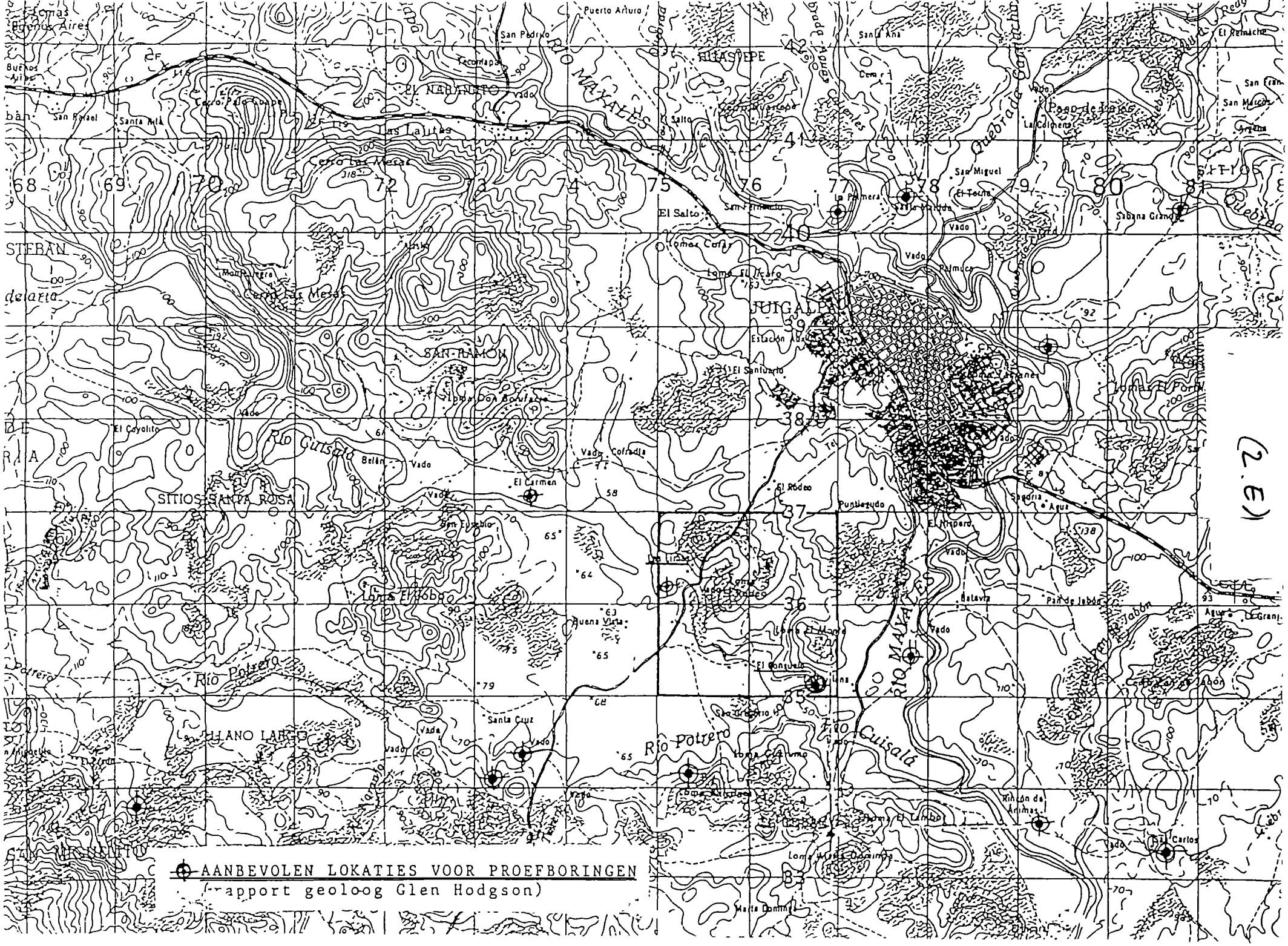


GRAFICO 1
DIVISION ADMINISTR


AANBEVOLEN LOKATIES VOOR PROEFBORINGEN
(rapport geoloog Glen Hodgson)
(2.E)

ANNEX 3 PHYSICAL DESCRIPTION OF NICARAGUA AND JUIGALPA

§ 3.1 Geological situation

Because obtaining water from the underground has very much to do with the origin of the soils, we will give a brief description of the geological situation.

Nicaragua can be divided into four physiographic provinces.
1. Atlantic coastal plain
2. Interior highland
3. Nicaragua depression
4. Pacific coastal plain

The province of Chontales covers the southern part of the interior highland. The terrain is characterized by low hills and dissected plains.
The province is underlain by two volcanic series, both of tertiary age, separated by an angular unconformity. Together they are named the Coyol group. The structure of this group is of hard, massive, ignimbrites that are white, pink or grey. In association with these are tuffaceous sediments, laharic breccias, basalt, dacite and rhyolite.
Around the city of Juigalpa, 6 different geological units can be distinguished that are all of the volcanic origin that was mentioned above. The sediments, laid down by the rivers, consist of sands, gravels and, in the depressions, clay.

§ 3.2 Hydrological characteristics.

The volcanic rocks are only slightly permeable, but the ones of younger age have horizontal cracks through there different layers. Also the granular structured volcanic ashes, that are very permeable from origin, will loose their water supplying capacity because of precipitation of calcareous material, that will form barriers for the water

However, near to the rivers that deposit gravel and sand, there are places with a huge groundwater production The ground water table is strongly influenced by the river water level.

§ 3.2.1 Geo-hydrological characteristics of the pumping fields 'Las Limas' and 'El Consuelo'

The pumping fields are found 3.5 km southwest of the city of Juigalpa, along the Quisala river. Although the wells are relatively close together, they show a great variety in underground, caused by many faults in the (rock)layers.
As far as known, they all have one or more permeable, water containing layers which are old river sediments.

§ 3.2.2 Expectations for other water winning places

According to the 4th technical mission report[1], there are several more places where productive groundwater sources can be made in the surroundings of the city. Mainly situated along the rivers Quisala and Mayales (see annex 2.E ;Recommended Locations for Test Drillings).

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[1] SIS, (1989) Third technical mission The Hague, The Netherlands

ANNEX 4 POPULATION

§ 4.1 Introduction

Obviously, knowing the exact (or even the approximate) number of people that need to be provided with potable water is one of the most essential figures concerning this investigation. One would therefore expect that this is was a clear case. Surprisingly however this was hardly the fact, on the contrary, it took quite some time to find out what most likely the correct figure is.

§ 4.2 First findings

The municipality uses a figure of 80.000 in relation to the number of people that live within greater Juigalpa and 65.000 for the inhabitants of the city. Figures of 60,000 and 50,000 are used by INAA. When asked, it was stated that these figures arose from different institutions. However, the person responsible for public relations of the capital of Chontales could not present a document concerning this issue.
During the first few weeks it was observed that the above stated numbers were likely to be to high. Departing from a number of 65.000 people would mean for example that only about 41 % of the houses would have a water connection (taking into account 6.1 persons per house and 4.407 connections (INAA, February, 1994)). Nevertheless it seemed that a much higher percentage of households were connected to the pipes of the water system.

§ 4.3 Other sources

To get information from other sources, we first asked INE (Nicaraguan Electricity Company). They stated to have 5,579 connections in may 1994 with a coverage percentage of 92 of the number of houses in the city. This meant a total number of houses of approximately 6,064. Multiplied with a figure of 6 persons/house, which at that time seemed appropriate, gave a number of roughly 36,000 persons living in the city of Juigalpa
Other organizations could tell how big the city was, but could not present records or say how the data were obtained and where therefore less appropriate sources.

§ 4.4 Possible causes of differences

During a number of field visits however the authors came across different investigators of the Ministry of health. They frequently (on a yearly basis since 1992) survey the number of people that suffer from e.g. malaria or chronicle diseases. Confronted with the big difference of inhabitants of Juigalpa they gave two explanations. The first one that data given by others are often extrapolated out of old data for example from figures obtained during the seventies. Another major cause for the differences is that many persons who supposedly live in the city, actually do not. They either study or work in Managua or in other places and visit there family's houses only a few times a month But because they are part of the family and lived (and at different occasions still do) in Juigalpa, at times people say when interviewed, that more persons live in the house than at that time is the case Instead of giving the actual number of persons that live under the same roof at that specific time, they state how big their family is when everyone of its members is home including those who work, live or study somewhere else periodically.

When taking this aspect into account, naturally a lower number of persons/household (5.1 instead of another figure often used of 6.5) is found in its turn resulting in a lower number of inhabitants of the city of Juigalpa.

Although convinced for a long time that the Minsa figure corresponded most to reality, the authors finally believed that, as so often, the truth lay somewhere in the middle.
The outcome of the questionnaires gave a figure of 7.0 persons per house. Though maybe on the high side, the difference with 5.1 p/h was thought to be too high to blame completely on people not living home for a longer period. Therefore a compromise was found in taking the average of 5.1 and 7.0, thus giving 6.1 persons per house in the city of Juigalpa.
For the number of houses the figure of Minsa was used.

In the authors opinion these figures best guarantee an accountable number of houses and inhabitants of Juigalpa (6,788 houses and 41,407), but with the above kept in mind. Also because of the fact that more independent sources stated that the figures are likely to be more correct.[2] (See table 2A and 2B.)

It is strongly recommended that all parties who need correct data concerning the population join together and agree upon what figure is used or which method should be used to investigate this very important aspect.

§ 4.5 Population growth

To give a prognosis of the increase of the population of Juigalpa, a growth factor of 3.5% per year is used.
This percentage was obtained at the MINSA-statistics board, were calculations for population growth are made.
A prognosis up to the year 2000 is considered to be most reliable, because the exact number of inhabitants is not known yet, and many factors are influencing the population growth. Ten years is already a long time, and has to be considered as an indication only!

YEAR	POPULATION	# HOUSEHOLDS
1994	41.407	6,788
1995	42.856	7,026
1996	44,356	7,271
1997	45,909	7,526
1998	47,515	7,789
1999	49,179	8,062
2000	50,990	8,344

[2] Sources Dr Bart Bruins working for MINSA via DGIS and Ir Niek Bosma, former employee of INAA, Juigalpa

Remarks:
- For the year 2000, an approximate number of 51,000 inhabitants is found.
- It is expected that the # capita/household will not change the coming 6 years and stay at 6.1 c/hh.

§ 4.6 Water-use prognosis for the period 1994-2000

§ 4.6.1 Increase of # of connections

Growth figures of connections in Juigalpa were derived from the collected data of the # of connections in the INAA books.

YEAR*	# CONNECTIONS	# NEW
1992	2943	
1993	2285	312
1994	4140	855

* figures are given for the month of June

It is possible to construct 855 new connections per year, assuming that there are enough requests for new connections which is likely to be the case. The following increase in connections can be expected.

Coverage of connections for the coming years

YEAR	# CONNECTIONS
1994	4140
1995	4995
1996	5850
1997	6705
1998	7560
1999	8062*
2000	8344*

* The coverage of households is 100% by the year 1999.
From there, there # of connections will be the same as thenumber of households.

§ 4.6.2. Increase of water consumption.

Due to the expected increase of the standard of living and the improvement of the water system (which is already taking place), it is expected that the people will increase their water consumption.
More taps per household; more water closets and more showers are likely to be the result of this development and in their turn, increasing the water consumption per capita per day!

- Making water-use prognosis, the following should be taken into account:
  1 Number of inhabitants and the expected growth of # inhabitants;
  2 Water-use per 'users category' and expected growth of these categories;
  3 Water-use per users group (house connections, governmental con., industrial con. and commercial con.) and the expected growth of each group;
  4 Available water for the coming years;
  5 The policy of INAA concerning the construction of new connections.

Since most of these factors are not known exactly, only averaged figures can be given for the water-use (in l/c/d). Parting from this, an indication of the increase of water-use can be given:

* Water-use prognoses for the year 2000
  Water-use per capita per day for household connections: 90 l
  Total consumption of the city: 158,815 m^3/month
  This means an increase of 27%.

These calculations are based upon the following data:

* Household connections
  - water-use per capita per day 76 l/c/d (1994).

* Other connections
  - water-use per connection per day 3,85 m^3/connection/d (1994)

* Assumptions:
  - Water-use per capita per day for household connections will rise to 90 l/c/d (14 l/c/d increase → high estimation!) in the year 2000 due to changes in the system (more connections) and changes in the water-use of the people;
  - The increase of water production is sufficient to supply this amount of water in the system. This is possible, but at the same time this is likely to be the strongest limiting factor.
    In this case the water-use will be restricted by the water production and the system efficiency (system losses are estimated to stay at the same 27%).
  - The water-use of connections other than household connections will increase with 15% and the number of these connections grows with 3.5%/year.
  - The population will show a growth as displayed in § 4.6 of this annex (3.5% per year).
  - The policy of the INAA will be aimed at improvement of the system.

To supply this consumption the production of water needs to be 217,555 m^3/month (27% system losses), which is the equivalent to a production of 1260 GPM

ANNEX 5 RESEARCH PROPOSAL

WATER-USE IN JUIGALPA

Analysis and proposals for efficiency improvement of drinking-water distribution in Juigalpa, Nicaragua.

RESEARCH PROPOSAL

Mark van Dijk
Jochem Bauhuis

International Agricultural
College Larenstein
H4 ILWM
Velp, April 1994

By order of the municipality of Juigalpa, Nicaragua

§ 5.1 INTRODUCTION

The Hague (The Netherlands and Juigalpa (Nicaragua) are sister-cities since 1984. SIS (sister-ship coordinating organisation) is responsible for the organizational part of implementing several activities. One of the objectives is a structural improvement in the position of the weakest groups in the community of Juigalpa. This was realized amongst other thing by improving the drinking water situation of this 80.000 souls big town. One of the most important components after realisation of the drinking water project forms the education campaign. This is campaign is going to be performed by the municipality in collaboration with the SIS. Foregoing this campaign, a number of essential questions are still unanswered.

With technical assistance from The Hague among others during the operation and maintenance phase, the available amount of drinking water for the inhabitants was doubled. This doubling however sank into nothingness by a tripling of the number of citizens, namely through a move from the countryside to the city. It can be noted that the capacity of the present sources is being used to the fullest.

Financially-technically it proves to be impossible for the city of The Hague to increase the capacity of the distribution system within a short term. Therefore it is sought for non-technical solutions. The educative campaign is set up to try to make the people aware of the reasons of the problems related to water and to try and create a change in behaviour. To make this campaign successful, it is necessary first to obtain a good view of the ins and outs of the water-use. The investigation therefore aims at finding answers at these questions.

§ 5.2 JUSTIFICATION

During deliberation between the authors and the contact-person of the SIS the research received a final form. The campaign can only be successful if it is known what is meant with water-use. The investigation therefore must aim at collecting data concerning the distribution of the water-use related to the different sources of origin (tap, river, public tap point etc.)

§ 5.3 THE RESEARCH

The research will consist of two parts:

1) Investigating the water-use distribution in quantitative sense within the different sections of the distribution systems.

2) Giving recommendations for the improvement of the availability of water, based on the outcome of the investigation.

These recommendations are divided in three different discretion parts:
   a. Institutional
   b. Financial
   c. Technical

Aims

- Establishing a clear picture of the drinking water-use in the city of Juigalpa.
- Giving concrete recommendations to distribute the available water over the citizens in a more efficient manner.

Target group

The target group consists of all the inhabitants of the city of Juigalpa.

Research methods

The applicable investigation methods will consist of:
- Studying the available data
- Observation
- Participatory investigation
- Interviewing with those involved

§ 5.4 Implementation

The implementation will take four months and begin on the 18th of April 1994. The investigation will be guided by the SIS and the municipality of Juigalpa. Furthermore will the tropical section of the IAHL take care of guidance.
The results of the research will be made available to all interested parties in the form of report which will be written in English. In September 1994 the research will be defended during a public presentation.

Ad 1:
To obtain a real image of the water-use distribution (in quantitative sense) within the different sections of the distribution system, the following research activities will be unfolded. (For a good view table 1 is added.)

1) Desk study
First of all the design technical aspects of the system will be looked upon.
This is necessary to obtain a good image of the functioning of the system, real water-use data and the reliability of the available data/information.
Selecting representative parts of the system.

2) Field observation
The next step will be observing the water-use within the selected parts of town.
Through observation an impression can be formed of the distribution of the water-use without this being influenced by subjective information of the users themselves.

3) Interviews
Taking interviews will be the next step.
Information of the users themselves now can be compared with the "hard" objective observations so that eventual "extremities" can be explained en thus it is prevented that unreal data are mis-interpreted.

4) Participatory investigation
The participatory investigation is being coordinated by the municipality and the SIS.
This investigation will be held after showing the educational movie 'Fuente the Amor', with which the beginning of the enlightenment campaign is being heralded.
The data which will be collected through this investigation will be compared with the data obtained from the observation(s) and interview(s) to come to a correct image.

5) Verification/Conclusions
Technical data (1) and through observation (2), interviewing (3) en participatory investigation (4) collected data are going to be compared, and where necessary gaps are filled.
Now a real image of the water-use distribution is established in the city of Juigalpa. Conclusions are drawn on the basis of this image.

6) Recommendations
On the basis of these conclusions now recommendations can be given in respect to the improvement of the distribution of potable water.
- Flattening peak-needs
- Preventing water-spill
- Small scale technical recommendations

PERIOD	NAME OF ACTIVITY	ACTIVITIES	BY WHOM?	RESULTS
02/05 - 08/05/94 1st period 1 week	-Desk study	-Familiarization with project in Juigalpa -Billeting in Juigalpa -Meeting Inaa personnel -Orientation on town water system -Literature & Map study	Jochem & Mark	-Good contact between authors and people of Juigalpa especially with Juan Sanchez and the INAA -Access to data and literature of the water system
08/05 - 22/05/94 2nd period 2 weeks 18/05/94	-Field study -Reporting	-Arrival of Ms. Verheijen -Analysing system capacity -Establishing objective parameters for the selection of representative areas -Selecting representative water sections -Take stock of public tap points, private connections -Checking possible leaks in the system -Writing a monthly report to inform SIS and Mr. v.d. Wall Bake about progress and to ask for comment	Jochem, Mark & Lisette	-Good view of the drinking water system in Juigalpa -Knowledge of restrictions and difficulties of the system -Selected areas and tap points for research and observation
23/05 - 05/06/94 3rd period 2 weeks	-Field observation	-Observing water-use at tap stands and at selected households -Processing of data	Jochem, Mark & Lisette	-Knowledge of the actual situation through which the problems become clear

06/06 - 19/06/94 4th period 2 weeks 18/06/94	-Interviewing -Reporting -Analysing the sanitation situation	-Developing of questionnaires and interview lists including translation -Testing of questionnaires -Developing final forms -Control by municipality -Analyze existing differences between data from observation, desk study and interviews -Reporting to SIS and Mr. v.d. Wall Bake about progress and to ask for comment -Writing a chapter about the relationship between water-use in the city of Juigalpa and the situation concerning sanitation	Jochem & Mark Lisette	-Knowledge about the pro blems that users engage concerning the use of water -Drawing conclusions about the differences between our own observations and what people regard as being their problem -Separate research subject, supplement of the report
20/06 - 26/06/94 5th period 1 week	-Participatory investigation	-This is initiated by the city of Juigalpa coordination between authors and Juan Sanchez	Jochem & Mark	-Good knowledge about the existing problem concerning water-use/distribution in Juigalpa
27/06 - 24/07/94 6 th period 4 weeks 18/07/94	-Writing the report -Reporting to SIS and Mr. v.d. Wall Bake	-Writing the "Water-use in Juigalpa" report, including conclusions and recommendations	Jochem & Mark & Lisette	-Processed information/data in the shape of a report

25/07 -07/08/94 7th period 2 weeks	-Workshop -Recommendations	-Workshop to inform the town of Juigalpa about the outcome of our investigations and to present the report -Presentation of recommendations	Jochem & Mark & Lisette	-Recommendations for further project development in Juigalpa
08/08/1994 8th period	-Leave	-Packing luggage and turning in the house key	Jochem, Mark & Lisette	-Arrival on the 11th of August at Schiphol airport in The Netherlands

ANNEX 6 ADJUSTMENTS

The literature and map study programmed for the first week didn't result in much reading. Due to the fact that we needed to acclimatize longer than expected and also because only a few documents were presented by the INAA. Many more documents were read in the course of the investigation whenever felt necessary or possible.
During the 2nd period we fell one week behind the initial schedule. The designing, (and printing + distribution + collecting) of the questionnaire, planned for the 4th period, was already done now to make it possible to obtain information of the dry season as well as testing the questionnaire.
We needed three full weeks to observe around 60 houses in Juigalpa, this were 30 less then expected. We also didn't have time to analyze the data collected during these two weeks. This analyses was mostly done during fifth period. Unfortunately we did not find the time to also observe the 30 missing households.
Because of illness of two members of the team in the week of 06/06 - 12/06/'94 we lost another week. The interviewing- (or better questioning) part therefore started on June the 27th.
This was rounded up at the tenth of July.
The participatory investigation planned for the 5th period was cancelled as a whole since the municipality had not yet started the educational campaign actively.
The analyses of the collected data which was planned after using each of the different instruments was hardly possible in practice due to lack of time, although most of the dBASE data was analyzed. The rest however was done during the last month together with writing the report. This was combined with a necessary (renewing our visa) vacation of about a week. Instead of the proposed two weeks to prepare and have the workshop, we only used half a week.
As a whole it can be said that during the course of the investigation 3 weeks were lost due to illnesses and other delays. This eventually meant that we had only 3 weeks to write the report and organize the workshop instead of the planned six.
To get a clearer image, the final working schedule is given below.

ANNEX 7 ADJUSTED WORKING SCHEDULE

PERIOD	NAME OF ACTIVITY	ACTIVITIES	BY WHOM?	RESULTS
02/05 - 08/05/94 1st period 1 week	-Desk study	-Familiarization with project in Juigalpa -Billeting in Juigalpa -Meeting Inaa personnel -Orientation on town water system -Literature & Map study	Jochem & Mark	-Good contact between au thors and people of Juigalpa especially with Juan Sanchez and the INAA -Access to data and literature of the water system
09/05 - 29/05/94 2nd period 3 weeks	-Field study	-Arrival of Ms. Verheijen -Analysing system capacity -Establishing objective parameters for the selection of representative areas -Selecting representative water sections -Take stock of public tap points, private connections	Jochem, Mark & Lisette	-Good view of the drinking water system in Juigalpa Knowledge of restrictions and difficulties of the system -Selected areas and tap points for research and observation -Knowledge about the problems that users engage concerning the use of water
	-Questionnaires (first time)	-Developing of questionnaires -Testing of questionnaires -Control by the municipality -Distributing and collecting the first 120 pieces.	Jochem & Mark	
	-Reporting	-Writing a monthly report to inform SIS and Mr. v.d. Wall Bake about progress and to ask for comment		

30/05 - 26/06/94 3rd period 4 weeks 22/05/94 20/06 - 03/08/94	-Field observation -Reporting -Analysing the sanitation situation	-Developing of 'formats' -Observing water-use at tap stands and at selected households -Informing SIS and Mr. v.d. Wall Bake about progress -Writing a chapter about the relationship between water-use in the city of Juigalpa and the situation concerning sanitation	Jochem, Mark & Lisette Jochem & Mark Lisette	-Knowledge of the actual situation through which the problems become clear -Separate research subject, supplement of the report
27/06 - 10/07/94 4th period 2 weeks	-Questionnaires (second time)	-Improving of questionnaires -Distributing and collecting 850 pcs.	Jochem, Mark & Lisette	-Drawing conclusions about the differences between our own observations and what people regard as being their problem
11/07 - 03/08/94 6 th period 3½ weeks 15/07 - 24/07/94 25/07/94	-Analysing data -Writing the report -Renewal of visa and vacations in Honduras -Reporting	-Analyze existing differences between data from observation, desk study and interviews -Writing the "Water-use in Juigalpa" report, including conclusions and recommendations -Obtaining new visa and enjoying a well deserved vacation -Reporting to SIS and Mr. v.d. Wall Bake	Jochem, Mark & Lisette Jochem, Mark Jochem , Mark & Lisette Jochem & Mark	-Processed information/data in the shape of a report -Obtained ability and motivation to finish the investigation

04/07 - 07/08/94 7th period ½ week	-Workshop -Recommendations	-Workshop to inform the town of Juigalpa about the outcome of our investigations and to present the report -Presentation of recommendations	Jochem, Mark & Lisette	-Recommendations for further project development in Juigalpa
08/08/1994 8th period	-Leave	-Packing luggage and turning in the house key	Jochem, Mark & Lisette	-Arrival on the 11th of August at Schiphol airport in The Netherlands

ANNEX 8 DESCRIPTION OF THE ORGANIZATIONAL STRUCTURE OF INAA

§ 8.1 Introduction

The National Institute for Drinking water systems and sanitation, is, as its name explains, an organization at National level. INAA is organized in a top-down approach with a central office in the capital of Nicaragua.
Each region of the country has a regional INAA-office, which in its turn ccoverers several local offices in the cities and towns (see figures 1 and 2).

§ 8.2 Water tariffs

The water tariffs are set by the cental office in Managua, and used in all the local offices. The processing of all the water bills also takes place in Managua with the help of the computer. Bills are printed in the order of connection number, which means that they have to be sorted out at the local offices. Here they are sorted by route number for the meter readers.

§ 8.3 Stock

INAA-central also manages the stock of special materials. Rarely used pipe sizes, big-size water meters and other not current materials are only available in INAA-headquarters. The regional offices have to hand in requests if they need particular materials which are not current.

§ 8.4 Advantages

A top-down organization has the advantage that it forms a controllable organization and a unity in used systems and prices.

§ 8.5 Disadvantages

The local offices have less access to materials, knowledge, money and personal. Their influence in decision making with e.g. tariff setting is relatively small. Interactions on a frequent basis between local offices and headquarters are not really practice. Therefore the local organizations cannot adjust so well to actual differences in local situations and are therefore not as flexible as they should be.
Since the existence of an office is not directly related to the amount of money it makes, the need to provide a high service level often isn't very high Once a direct relation exists between the provided service level and the income of a INAA-branch the users will benefit from an improved service and INAA from an increased autonomy.

FIGURE 1 ORGANOGRAM INAA CENTRAL

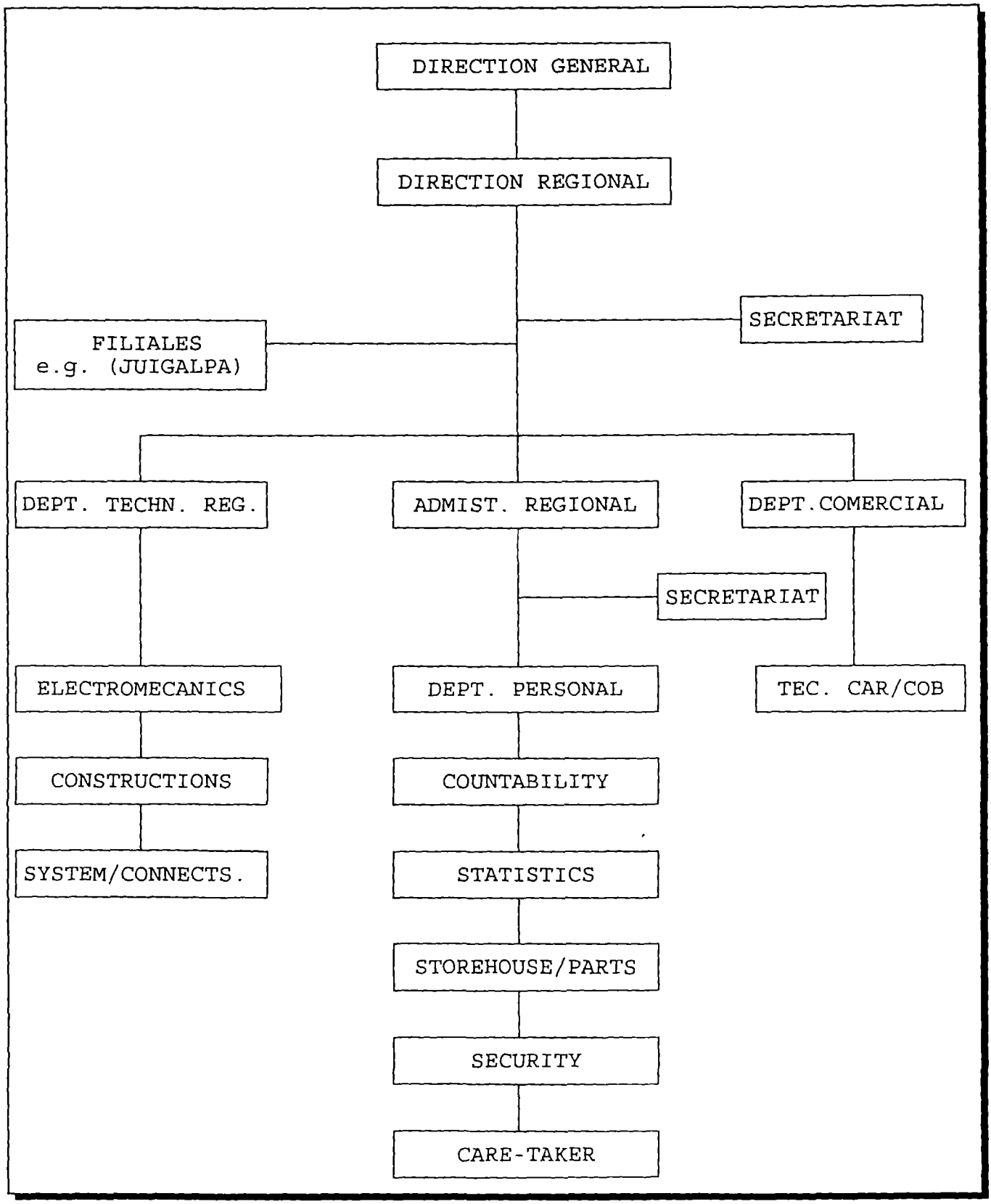
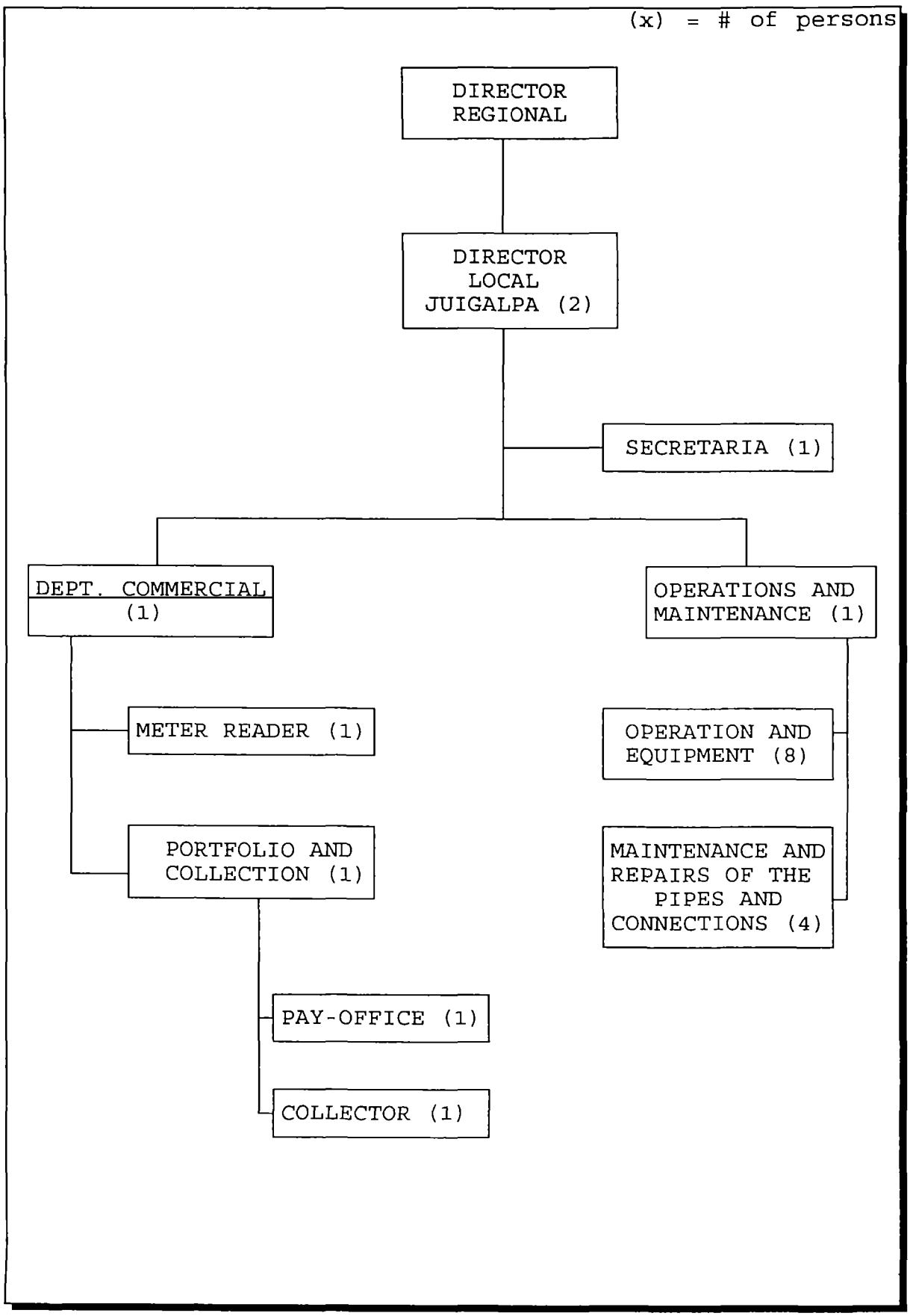


FIGURE 2 ORGANOGRAM INAA JUIGALPA



ANNEX 9 DETAILED DESCRIPTION OF CHOSEN PARAMETERS

§ 9.1 Introduction

Below is described into more detail, on what grounds the different parameters, as shown in paragraph 3.7.2, were selected.

§ 9.2 Parameters

Geographical situation;

* Position in the water system: high - low
  During the literature study, it was found that between the (in general) higher and lower parts of town which were connected respectively to the 12" and the 6" tube, a big difference in pressure existed. Lower parts of town would have pressures of about 70 meters above street level, while higher parts sometimes would receive water with pressure of only 2 or 3 meters. This would in its turn lead to differences in water-use.

* Distance to the river: near by - far away
  Because piped potable water does not come every day and many families are not able to pay for all the water they need, they search for other alternative sources. The city is surrounded by a river which is used by a lot of families for washing cloths. (In a lesser way for bathing and washing cars).
  By distinction of the water-users in a group that lives near enough the river and a group that lives further away, it was believed possible to find out quickly how much water is used for washing cloths. Parting from the assumption that the other uses would be the same.

Physical situation;

* Frequency in receiving water: daily - once every 4 days
  Most people receive water once every 4 days during the rainy season, a minority however receives water daily. Due mostly to the fact that they live close to the 'mot-herline'. It was expected that the use between the two would differ greatly with the latter group using water more efficiently.

* Type of connection: private tap-point - communal tap-point
  Certain quarters of Juigalpa which are relatively new, where established with the help of donations in labour and money from several European countries. Typically these donated '*barrios*' all received communal water connections. But in the course of time some of the families bought private connections
  This made it fairly easy to observe differences in water-use which were practically only caused by a difference in type of connection Since all the other physical or geographical differences did not exist. It was expected that answers could be found to the following questions:
  - Do families with a private connection use less water than families who obtain water from a communal tap point?
  - Are private connection more efficient in use?

* Age of system: new piped system - old piped system
  Because of the proceeding of technology it could be possible that new quarters are constructed in a better way, with regard to water- (electricity-) distribution. This would then lead to a more efficient way of handling water by the system. Above all this, the system can function better because of its clearer, better design en makes it easier to manage. Leakages will occur less frequently, although this also is related to its age.
  The following questions would need to be answered:
  - Does the design of a quarter influence the efficiency?
  - Does the efficiency influence the water-use?

§ 9.3 Distinction in income classes

After the first two weeks, it became clear that these criteria were too rough. With the parameters it was possible to distinct the different *barrios*, but not the different families in the quarters. The water-use of different families also depended largely on how much money they could spent.
Therefore it was decided that it was also necessary to distinct the families in different income classes. This was done during the observations and interviewing.

Through means of the above mentioned parameters, 9 different parts in town were chosen, 5 in the 'high-pressure' part of town and 4 in the 'low-pressure' part. By looking at the map of Juigalpa and talking to different persons, sub-quarters were selected which all had one or two distinct conditions.
In these selected sections could then the water-use be observed, and the results could afterwards be compared with the results from a section with the opposite condition. For example the results of water-use in an old part of town with those of a new(er) part. These comparisons should ultimately result in the ability to state what the influence of each different criteria would be on the water-use.

This however is very difficult since it is impossible to neglect the influence of family specific behaviour. But to minimize these family specific influences, the observed families where divided into 5 different classes of income. This would not take into account the social structure, but it would at least restrict the influence of the family income.

ANNEX 10 SMALL INQUIRY

Somos estudiantes de Holanda y estamos muy interesado a del modo vida de las familias nicagargüenses.
¿Podemos preguntarle un poco?

Un ejemplo para llenar en un modo correcto :
¿Tiene un aeroplano? [] No [] Si

1. ¿Cuantos años tiene?.....

2. ¿En qué barrio dónde vive?.....

3. ¿Cuantos años tiene de vivir aqui?.....

4. ¿Tiene carro? [] No [] Si
   una television? [] No [] Si
   una refrigerador? [] No [] Si

5. ¿Su casa es de madera?.....

6. ¿Hasta donde usted drenage su agua negras? .....

7. ¿Tiene trabajo? [] No
   [] Si, ¿qué trabajo?

8. ¿Tiene Hijos? [] Si, ¿cuantos hijos?.....
   y cuantos hijas?..... ....

9. ¿Que tipo de servicios higiénico tiene?.....

10. ¿Hay un abastecimiento de agua?
    [] No
    [] Si, ¿En que la almanacena? Balde []
    Pila []
    Tanque []
    Cántaros []
    Barriles []
    Otros:que?.....

11. ¿Hay arboles de fruta? [] No
    [] Si, ¿dar un coseha abundante?.....

12. ¿En que dias (su mujer) lava la ropa, y a dónde?..... .....

13. ¿ A que horas hace la comida?Desayuna.....pm
    Almuerzo.....pm/am
    Cena.....am

14. ¿Cuantas personas viven en la casa de usted?.....

15. ¿Cuanto paga por comer al dia, por todos las personas?.....

16. ¿Cuanto paga al mes por electicidad?.....
por agua potable?.....
por madera/tropigaz?.....

17. ¿Con cuantas personas comparte el abastecimiento de agua?
.....

18. ¿Lava la ropa en el rio? [] No [] Si

19. ¿Van sus hijos a la escuela? [] No [] Si

20. ¿Puede no trabajar un dia porqué esta enfermo? [] No [] Si

21. ¿Como usted drenage su agua negras? Con: [] Tubo de desagüe
[] Abierto tubo de desagüe
[] Por el jardin
[] Otros ... .
.....

22. ¿A quien alquilar la casa?.....

23. ¿A dónde vivío en el pasado o ha vivído siempre en la ciudad de Juigalpa? .....
.. ..

23a. ¿Porqué se mudó a Juigalpa?..... .....

24. ¿Qué cosas quisiera cambiar/transformar en la ciudad de Juigalpa?
....

25. ¿Qué compraría de primero, si usted recibe mucho dinero?
....

26. ¿En que orden prefereria las sequientas, puede uso los numeros 1 a 3 ambos inclusive?
[] Televisión
[] Mas hijos
[] Menos hijos
[] Agua potable todos los dias
[] Alcantarillado subsuelo
[] Carro

Fin de encuestra, gracias por su colaboración

ANNEX 11 FORMAT

I GENERAL INFORMATION

1. Observer :_____
2. Date :________
3. Zone :_____ Barrio:_____
4. Location :_____
5. Type of connection: Private [] Public [] None []
6. Meternumber:_____
7. Meteruse :_____m^3
8. Age and sex of intervieuwee:___years Male [] Female []
9. Name of intervieuwee:_____

Ia Family & Housing

1. No. of family members:_____
2. Age of female head of family, responsible for wateruse:____
2a. How many of the children are under 3 three years?_____Remarks:_____
3. Area of compound._____m^2
4a. The walls of the house are made of:
Brick [] Wood [] Combination [] Others []
4b. The roof of the house is made of:
Corrugated sheets [] Tiles [] Thatch [] Others []
5a. Estimate area of the house:_____m^2
5b. How many rooms does the house have?:_____5c.
Seperated by: Bricks [] Wood [] Cloths [] Others []
6. Estimate age of the house:_____
7. General impression: Tidy [] Untidy []
8. What type of floor: Tilefloor [] Concrete [] Mud []
9. List the number of the following assets

Radio_____	Motorcycle_____	Poultry_____
Fridge_____	Car_____	Tropigaz []
T.V._____	Tractor_____	Electricity []
Bycicle_____	Large livestock___	or Fire Wood []
Telephone___		

Remarks:

Ib Acces

1. Is it possible to reach the house by car? yes [] no []
2. Are roads or tracks paved? yes [] no []

Remarks:_____

II WATER

1. Where does the family get their water from?
1a Private connection [] Indoor taps [] How many?_____
1b. Public connection [] Distance?_____meter
1c. How often do they get water? Every_____ days.
1d. Well [] 1e. River []
1f. Spring [] 1g. Rainwater [] Gutters? yes [] no [],
Length of gutters:_____m In what condition?_____

IIa Private tappoint

1. No. of taps:____
2. Type of tap :_____
3. Type of pipe and diameter: P.V.C.__" G.I.__"
4. Standpost support:_____
5. Location :_____
6. Is there any kind of 'valve system'?:
7. General impression: Tidy [] Untidy []

*Remarks:*_____

IIb Public tappoint

1. No. of taps :_____
2. Type of tap :_____
3. Type of pipe and diameter: P.V.C.__" G.I.__"
4. Standpost support:_____
5. Location :_____
6. Is there any kind of 'valve system'?:_____
7. General impression: Tidy [] Untidy []

*Remarks:*_____

IIc Other sources

1. How is the water collected from the source?

Tackle block and attached rope: []
Rope and bucket: []
Ropepump []
Plungerpump []

2. How many buckets are present?_____
3. What do they look like?_____ Clean [] Dirty []

*Remarks:*_____

IId Water transport and treatment

1. Who transports the water from the tappoint or well?:_____
3. By what means is the water transported?._____
4. What kind of container is used to transport the water from the source to the storage:?

_____

2. Are containers used for transport, cleaned first?· no [] yes []
5. Is water spilled?: no [] yes [] How much?_____
6. At what time is the water collected?:_____
7. How is the water treated?: chlorined [] filtrated []
   boiled [] others [], which:?

_____

*remarks:*_____

IId Waterstorage

1. How is the water stored (in what kind of container)?

CONTAINER	NO.	CON-TENTS (liters)	USE	KIND OF COVER
Buckets				
Sink/Wash basin				
Tank				
Pots				
Oil drums				
Others, which?_____				

2. What's the general impression of the container?
Clean [] Dirty []
3. Is the 'old' water removed first before fresh water is filled? no [] yes []
4. Are there any significant leaks? no [] yes []
*Remarks:*_____

IId Wateruse

USES	QUANTITY liters/day	HOURS of mayor use	SOURCE
Cooking			
Drinking water			
Dish washing			
Cleaning the house			
Washing clothes			
Washing hands			
Bathing			
Latrine/Toilet			
Garden			
Car washing			
Animals			
Others, which?_____			

IIf Washing

1. Do the people wash their cloths at home? Yes [] No []
2. What is the distance from the washing place to the nearest water container?_____m
3. Is the washing place muddy? Yes [] No []

*Remarks:*_____

IIg Drainage

1. How is the water drained?	Septictank []	Piped []
	Gutter []	Nothing []
2. Where does the drain end?	Septictank []	Stream []
	Garden []	Fence []
	Street []	No drain []

*Remarks:*_____

III SANITATION

1. Laterine type: Bucket latrine [] Borehole latrine [] V.I.P. []
Pour flush [] Indoor w.c. []
2. Clean [] Dirty [] Many flies Yes [] No []
3. Distance to water container and/of well_____m

*Remarks:*_____

IV HEALTH

1. How many people suffered from diarrhoea in the past half year?_____

*Remarks.*_____

END OF FORMAT

Water-use in Juigalpa

ANNEX 12 WATER-USE FORM

Día	Números de galones usados	Que Uso										Otros usos ¿Que?	Hora de uso
		COCINAR	TOMAR	LAVAR LOS PLATOS	LIMPIAR CASA	LAVAR LAS ROPAS	LAVAR LAS MANOS	BAÑARSE	SERVICIOS HIGIEN	JARDINES	LAVAR VEHICULOS	ANIMALES	

BALDE = 20 Litros.
OLLA = Litros

PILA = Litros
BARRIL= 200 Litros

GALON = 4 Litros

ANNEX 13 1ST QUESTIONNAIRE

INVESTIGACIÓN SOBRE USO DE AGUA POTABLE EN VERANO
EN LA CIUDAD DE JUIGALPA
ALCALDIA DE JUIGALPA EN COLABORACIÓN CON IAHL

Fecha:_____
Promotor(a):_____

Presentación: A la Alcaldía de Juigalpa le interesa hacer una encuesta para mejor como tratar la situación del agua en la ciudad. Todo esto es importante para la comunidad y su familia en especial. Necesitamos apuntar sus respuestas para no olvidarlas. Sólo la Alcaldía usa estos datos en confianza. Usted desea colaborar con nosotros?
Llena con su mama. Leela completo antes de llena!

I. **Datos generales:**
- Nombres y apellidos:_____
- Zona/Barrio:_____
- Número de miembros de la familia:_____ Adultos:_____ Niño:_____
- Ocupación del encuestado:_____
- Nivel académico. Primaria: [] Secundaria: []
  Universidad: [] Ninguna: []

II. Aspectos de investigación:
2.1- Mencionar las fuentes de donde obtiene agua:
Tuberías: públicas []
privado []
Pozo(s):_____ publicas []
privado []
Ojos de agua: []
Lluvia: []
Quebrada/río: []

2.2- ¿Cuánto consume de agua al día (en litros) y de que fuente?.

FUENTE	CONSUMO (litros por dia)
Tuberías públicas	
Tuberías privados	
Pozo público	
Pozo privado	
Ojos de agua	
Lluvia	
Quebrada/río	
Puestos públicos	
Otros, ¿que?_____	

2.3- ¿Como es el suministro de agua en invierno y verano?

FUENTE	TIENE AGUA SI O NO	
	INVIERNO	VERANO
Tuberías públicas		
Tuberías Privadas		
Pozos privados		
Pozos públicos		
Ojos de agua		
Lluvia		
Quebrada/río		
Puestos públicos		
Otros, ¿que?_____		

2.4- ¿Mencione los usos que da al agua, fuente y hora?

USOS	CANTIDAD (litros/dia)	HORA DE MAYOR USO	FUENTE
Para tomar		am pm	
Cocinar		am pm	
Bañarse		am pm	
Limpiar la casa		am pm	
Limpiar la ropa		am pm	
Lavado su vehículo		am pm	
Jardine		am pm	
Animales		am pm	
Otros usos; ¿qué?_____		am pm	

2.5- ¿Cuantos metros cubicos de agua potable usa según el INAA?

_____

2.6- ¿En que almacena usted el agua?

EN QUE	CUANTROS LITROS	USOS
Balde []		
Pila []		
Tanque []		
Cántaros []		
Barriles []		
Otros, ¿que?_____		

2.7- ¿Que opina usted sobre la calidad del agua según la fuente?

Tuberías:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

Pozo público:

[] sabroso [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

Pozo privado:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

Ojo de agua:

[] sabroso [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

Lluvia:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

Quebrada\río:

[] sabroso [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

Puestos públicos

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

Otros, ¿que?_____

[] sabroso [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] oscura [] clara

2.8- Le da algún tratamiento al agua que consume. ¿Con qué? (Cloro, hervir, filtro, otros).

FUENTE	TRATAMIENTO	USO
Tuberías: públicas		
Tuberías: privadas		
Pozo público		
Pozo privado		
Ojos de agua		
Lluvia		
Quebrada/río		
Puestos públicos		
Otros, ¿que?_____		

2.9- ¿A donde se trata? En casa [] En pozo []

2.10.a- ¿Cada cuántos días llega el agua a su casa/barrio y por cuanto tiempo (horas)?

TIEMPO	HORAS	CONEXIÓN	
		PUBLICA	PRIVADA
Diario			
Cada 2 días			
Cada 3 días			
Cada 4 días			
Cada 5 días			
Mas de 5 días			

2.10.b- ¿En cuantos días se agotan sus reservas de agua?

1 día []
2 días []
3 " []
4 " []
5 " []
Mas de 5 días []

2.10.c- ¿De donde obtiene agua cuando se agotan sus reservas? ¿Paga por esto y cuanto?

FUENTE	CUÁNTO PAGA C$	DE DONDE OBTIENE
Tuberías públicas []		
Tuberías privadas []		
Pozos públicas []		
Pozos privadas []		
Ojos de agua []		
Lluvia []		
Quebrada/río []		
Puestos públicos []		
Vecinos []		
Otros, ¿que?_____		

2.10.d- ¿A que distancia se encuentran sus fuentes de agua (yardas o varas)?

FUENTE	DISTANCIA
Tuberías públicas	
Tuberías privadas	
Pozos públicos	
Pozos privados	
Ojos de agua	
Lluvia	
Quebrada/río	
Puestos públicos	
Otros, ¿que?_____	

2.10.e- ¿Como, en que y quién transporta el agua cuando se obtiene fuera de la casa?

FUENTE	COMO (Medio de transporte)	EN QUE	QUIEN (niños, adultos, abuelos)
Tuberías públicos			
Tuberías privados			
Pozos públicos			
Pozos privados			
Ojos de agua			
Lluvia			
Quebrada/río			
Puestos públicos			
Otros, ¿que?_____			

2.10.f- ¿Cuántas veces a la semana realiza la actividad de acarreo de agua?
1 vez: []
2 veces: []
3 " []
mas de 3: []

¿Cuantas horas tiene una vez? .....hora(s)

2.10.g- Está satisfecho con el servicio de agua potable:
Si: [] ¿Por qué?:_____

No: [] ¿Por qué?:_____

2.10.h- ¿Que desearía que se mejore en el servicio de agua? Mencione sólo lo mas importante.

_____

_____

III. Aspectos financieros:

3.1- ¿Cuánto paga de agua al mes por las fuentes que utiliza?

FUENTE	CANTIDAD DE DINERO	CANTIDAD DE AGUA USADA
Tuberías públicas		
Tuberías privadas		
Pozo(s) público		
Pozo(s) privado		
Ojos de agua		
Lluvia		
Quebrada/río		
Puestos públicos		
Otros, ¿que?_____		

3.2- ¿Preferiría pagar mas porque halla agua todos los días o paga la misma que hoy día y seguir en la misma situación?

_____

3.3- ¿Cuánto mas estaría dispuesto a pagar. Por qué?

_____

_____

3.4- ¿Cuantos son los engresos mensual de su familia?

_____

3.5- ¿Si no tiene conexión privada a la tuberia, comparia un por $US 83,-?
Si [] porgué?_____
No [] porqué?_____

¿Quisiera opinar algo mas sobre este asunto del agua potable?

_____

_____

_____

_____

GRACIAS POR SU COLABORACIÓN!

ANNEX 14 2ND QUESTIONNAIRE

INVESTIGACIÓN SOBRE USO DE AGUA POTABLE EN LA CIUDAD DE JUIGALPA ALCALDÍA DE JUIGALPA EN COLABORACIÓN CON IAHL

Presentación: A la Alcaldía de Juigalpa le interesa hacer una encuesta para mejor tratar la situación del agua en la ciudad. Todo esto es importante para la comunidad y su familia en especial. Necesitamos apuntar sus respuestas para no olvidarlas. Sólo la Alcaldía usa estos datos en confianza. Usted desea colaborar con nosotros?
Llena con su mama. Leela completo antes de llena!

I. **Datos generales:**
- Fecha:_____
- Nombres y apellidos:_____
- Barrio:_____ Zona:_____
- Número de miembros de la familia _____ Adultos._____ Niños _____
- Ocupación del encuestado._____
- Nivel académico: Primaria: [] Secundaria: [] Universidad:[] Ninguna: []

II. **Aspectos de investigación:**
2.1- Mencionar las fuentes de donde obtiene agua:

Tuberías:	privado	[]
	públicas	[]
Pozo(s):	privado	[]
	públicas	[]
Ojos de agua:		[]
Lluvia:		[]
Quebrada/río:		[]
Otras:		[] ¿Quáles?_____

2.2- ¿Cuánto agua usa al día por todas las gentes de su familia (en litros por día) y de que fuente?

FUENTE	USO TOTAL (litros por día)
Tuberías privadas []	
Tuberías públicas []	
Pozo privado []	
Pozo público []	
Ojos de agua []	
Lluvia []	
Quebrada/río []	
Puestos públicos []	
Otros, ¿que?_____	

2.3- ¿Como es el suministro de agua a su familia en invierno y verano?

FUENTE	OBTIENE AGUA	
	INVIERNO	VERANO
Tuberías privadas	[]	[]
Tuberías públicas	[]	[]
Pozos privados	[]	[]
Pozos públicos	[]	[]
Ojos de agua	[]	[]
Lluvia	[]	[]
Quebrada/río	[]	[]
Puestos públicos	[]	[]
Otros, ¿que?:_____	[]	[]

2.4- Mencione los usos que da al agua, la cantidad en litros por día, hora de mayor uso y fuente en que se obtiene el agua.

USOS	CANTIDAD (litros/día)	HORA DE MAYOR USO	FUENTE
Para cocinar []			
-Tomar []			
-Lavar los platos []			
-Limpiar la casa []			
-Lavar las ropas []			
-Lavar las manos []			
-Bañarse []			
-Servicios higiénicos []			
-Jardines []			
-Lavar vehículos []			
-Animales []			
-Otros usos, ¿que?·_____			

2.5- ¿Cuántos metros cúbicos de agua usa según el recibo del INAA, (Consumo actual)?

_____

2.6- En qúe almacena usted el agua, cuántos litros almacena y que uso da a este agua?

EN QUE ALMACENA	CUANTOS LITROS	USOS DE AGUA
Balde []		
Pila []		
Tanque []		
Cántaros []		
Barriles []		
Otros, que?:_____		

2.7- Que opina usted sobre el agua según las siguientes fuentes?

Tuberías:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

Pozo privado:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

Pozo público:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

Ojo de agua:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

Lluvia:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

Quebrada\río:

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

Puestos públicos

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

Otros, ¿que?_____

[] sabrosa [] fea
[] fresca [] tibia
[] no pesada [] pesada
[] no causa enfermedades [] causa enfermedades
[] clara [] oscura

2.8.- El agua de tubería esta tratado con cloro. Usted trata el agua por los siguientes usos, a su casa lo mismo también?_____

- Tomar: si [] no []
- Cocinar: si [] no []
- Lavar los platos: si [] no []
- Bañarse: si [] no []

2.9.a- Cada cuántos días llega el agua a su casa y por cuántas horas?

CADA CUANTAS DÍAS	CUANTAS HORAS	TIENE CONEXIÓN	
		PRIVADA	PUBLICA
Diario []		[]	[]
Cada 2 días []		[]	[]
Cada 3 días []		[]	[]
Cada 4 días []		[]	[]
Cada 5 días []		[]	[]
Mas de 5 días []		[]	[]

2.9.b- ¿Por cuántas días sus reservas de agua sirve?

1 día []
2 días []
3 " []
4 " []
5 " []
Mas de 5 días []

2.9.c- ¿De qué fuente hala agua cuando se agotan sus reservas y agua no viene desde tubería; cuántos litros hala y cuanto paga por esto?

FUENTE	CUÁNTO PAGA (C$)	CUANTOS LITROS HALA
Tuberías privadas []		
Tuberías públicas []		
Pozos privados []		
Pozos públicos []		
Ojos de agua []		
Lluvia []		
Quebrada/río []		
Puestos públicos []		
Otros, ¿que?:_____		

2.9.d- A que distancia (en yardas) se encuentran sus fuentes de agua?

FUENTE	DISTANCIA
Tuberías privadas []	
Tuberías públicas []	
Pozos privados []	
Pozos públicos []	
Ojos de agua []	
Lluvia []	
Quebrada/río []	
Puestos públicos []	
Otros, ¿que?_____	

2.9.e- ¿De que fuente, como, en que y quién transporta el agua cuando se obtiene fuera de su casa?

FUENTE	COMO (Medio de transporte)	EN QUE	QUIEN (niños,adultos, abuelos)
Tuberías privadas []			
Tuberías públicas []			
Pozos privados []			
Pozos públicos []			
Ojos de agua []			
Lluvia []			
Quebrada/río []			
Puestos públicos []			
Otros, ¿que?:_____			

2.9.f- ¿Cuántas veces a la semana realiza la actividad de halar agua?

0 veces []
1 vez: []
2 veces: []
3 " []
mas de 3. []

2.9.g- ¿Cuantas horas necesita para halar agua?_____

2.9.h- ¿Está satisfecho con el servicio de agua potable?
Si: [] ¿Por qué?:_____

No: [] ¿Por qué?:_____

2.9.i- ¿Que desearía que se mejore en el servicio de agua? Mencione sólo los dos mas importante cosas.

1. _____
2. _____

III. Aspectos financieros:

3.1- ¿Cuánto paga de agua al mes por las fuentes que utiliza?

FUENTE	CANTIDAD DE DINERO (en cordobas)
Tuberías privadas []	
Tuberías públicas []	
Pozo privados []	
Pozo públicos []	
Ojos de agua []	
Lluvia []	
Quebrada/río []	
Puestos públicos []	
Otros, ¿que?:_____	

3.2- ¿Que Preferiría?:
[] pagar mas para tener agua todos los días
[] pagar la misma que hoy día y seguir en la misma situación?

3.3- ¿Cuánto mas quiere a pagar cada mes?

_____

3.4- ¿Que opinia usted sobre el precio de agua?

_____

_____

3.4- ¿Cuantos son los egresos mensual de su familia?

_____

3.5- ¿Si no tiene conexión privada a la tubería, compraría un por 550,- cordobas?
Si [] no []

IV. Aspectos de sanitacion

4.1- ¿Que tipo de servicio higiénico tiene?

[] Letrina con submidera [] Letrina con balde
[] Inodoro [] Otros, ¿que?:_____

4.2.a- ¿Tiene su familia problemas con drenaje de agua de lluvia?
[] No [] Si, ¿que problemas?:_____

4.2.b- ¿Tiene su familia problemas con drenaje de agua doméstico como lavar los platos y lavar las ropas?

[] No [] Si, ¿que problemas?:_____

4.3.a- ¿Hasta donde usted drenaje su agua sucio?

[] La calle [] El río [] El jardín
[] Fosa séptica [] Otros, ¿que?:_____

4.3.b- ¿Como usted drenaje su agua sucio?

[] Con tubo de desagüe [] Con cuneta [] Por el jardín
[] Otros, ¿que?:_____

4 4- ¿Después o antes que actividades usted lava las manos?

[] Antes cocinar [] Después cambiar el bebé
[] Antes la comida [] Después el uso de servicios higiénicos

4.5- ¿Cuantas personas de su familia tuvieron las siguiente enfermedades en el año pasado?

[] Gripe, ¿cuantas?_____ [] Diarrea, ¿cuantas?_____
[] Malaria, ¿cuantas?_____ [] Cólera, ¿cuantas?_____

Quisiera opinar algo mas sobre este asunto del agua potable?

_____
_____
_____
_____
_____

FIN DE ENCUESTA, GRACIAS POR SU COLABORACIÓN!

ANNEX 15 WATER-SUPPLY SYSTEM

§ 15.1 Water production

The system is supplied with water by 7 wells and pumps, divided in 3 groups: El Consuelo, Las Limas and Cuisala.
With these pumps a monthly flow of 159,260 m^3 (= 922 GPM, May 94) is produced (See Annex 19 table 4). -Before the start of the rehabilitation project, the production of the pumping fields mounted up to a total of 440 GPM.-
In the summer the production is somewhat lower than in the wet season because the rains and the river table influence the water availability of the wells.
At the end of 1990, 35,1% of the population was connected. At the moment 46% of the Juigalpinos has a connection.[3] It is expected that 7000 households can be covered with 1,500 GPM.

§ 15.2 Water treatment and distribution

From the pumping fields the water is transported to the chlorine unit through an asbestos cement pipe of 12" whereafter the water is divided into a pipe of 6" and one of 12", which supply water to the low system (6"), which consist of the zones 4,7,8 and to the high system (12"), which consists of the zones 1,2,3,5,6. The high system consumes 75% of the total supplied water (see figure 3 ;Map of the Piped System).
The 6" line copes with 180 GPM while the 12" line distributes 850 GPM.

The system capacity (2000 GPM) is sufficient for the next 10 years. Departing from a population of 50,000 at the moment.[4] But when we leave from the assumption of 42,000 people living at the moment in Juigalpa, then the capacity will be sufficient for the coming 15 years.

§ 15.3 Possible other water sources

A geological study that was performed in the year 1992, resulted in five new sites to the south of Juigalpa, which offered possibilities for the exploitation of potable water. Although up to now no data are available with respect to possible yields, it can be expected that exploitable potable water can be found in the surroundings of Juigalpa. A production of an extra few hundred GPM even though, seems to lie within reach in the short- to medium long-term.[5]

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3 INAA, (1994) Proyecto Agua Potable Juigalpa, Informe Final. February 1994. Juigalpa, Chontales, Nicaragua page 26

4 Ibid

5 SIS, (1991). Fourth technical mission. July/August 1991, The Hague, The Netherlands

§ 15.4 Water storage

The zones serve for limiting the water by 'rotation'. Every zone gets water every 4 days. In the high system there are 2 storage tanks, with a total capacity of 230,000 gallons. (875 m^3). They hardly store water because they are constructed at the end of the line.

§ 15.5 House connection

A house connection is made at a 0.5" or 1" pipe. the water meter is placed outside the house to make it reachable for the meter readers.

ANNEX 16 NOT ACCOUNTED FOR WATER-USE

§ 16.1 Introduction

One way of increasing the available water in Juigalpa is increasing the production of potable water through more wells and pumps. Another way however is decreasing the losses of potable water. Previous investigations, indicated that 30-40% of the produced water was either lost through leaks in the system or not accounted for due to administrative problems.[6] This paragraph tries to give an insight in the actual situation of water not accounted for. For this the report of the Third Technical Mission (SIS, 1989) was gratefully used as a guideline.

§ 16.2 Water balance

The following balance exists:[7]

PRODUCTION = Ω + accounted quantity of potable water

Ω consists of quantity of water, build up from.

1. system losses
2. meter deviations
3. not functioning water meters
4. illegal connections
5 human mistakes whilst reading water meters
6. human mistakes during the administrative data processing

It is likely that a great part of production can be 'recovered' by increasing insight in Ω. In the following each of the different points 1-6 is commented upon with the findings of the investigation

§ 16.2.1 System losses

The system losses are estimated to lie within the order of 25% at the moment. But it is not exactly known. INAA has no records of the number of leaks that are repaired annually, neither do they know the quantity of water which leaves the system through these leaks.
It still is one of the most important questions to be answered. Since there is no use spending a lot of (foreign) capital on production increase, while in the same time this costly water never reaches the people. Not only from a financial point of view, but also from a environmental point of view.

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6 SIS, 1989 Third technical mission. The Hague, The Netherlands.

7 Ibid

The successive 3rd and 4th technical missions instructed by SIS already indicated a way to establish the system losses through means of a relatively cheap test.
To get a better idea of the system losses, the authors proposed to INAA to install two 2" water meters in two different parts of town (zone 4; *barrio* Madrid and zone 7; *barrio* Hector Ugarte, near Red Cross). (See annex 20 ;Proposal for Meter Installation).
These particular parts are connected to the system only by one pipe. Once the meters were installed, and the system checked, the water meters-readings of the different households (a average number of 150) connected to these systems could than be compared with the reading of the system meters. (This experiment is highlighted into more detail in annex 17 ;System Losses Check).
Unfortunately time proved to be too short and INAA-Managua too occupied to get it fixed.

§ 16.2.2 Meter deviations

The aspect of meter deviations is difficult to improve. Verifying the water meters is seldom done. The importance of an exact, reliable measuring is still underestimated. But it must be said that improving the measuring system only has little influence in decreasing the system losses.

§ 16.2.3 Not functioning water meters

During the research it was observed that quite a number of water meters do not function properly. They either have a not functioning measuring system or the figure can't be read. The latter due to scratches of the meter glass (most meters however have a plastic cap) or meters who have become covered with mud. Problems caused by meters with technical failures, are difficult to avoid However, in the opinion of the investigators, a lot of difficulties related to not properly functioning water meters could be avoided when these were properly installed.

All meters are installed at ground level. This is quite acceptable in placed with a paved street and footpath and a when the meter boxes have a proper lit, although these places still need to be maintained. But most of the streets of Juigalpa are unpaved, often resulting in a muddy street when raining. This in its turn often results in water meters disappearing underneath the soil or meter boxes filled with mud. This not only makes it difficult to read the meters once a month, it also results (in the long(er) run in meters with scratched plastic cover, which makes it impossible to read. Moreover it also makes that people are little concerned taking care of the water meter that cost them so much.
Once it is impossible (or to difficult) for a INAA employee to read a meter he notes down the use which he estimates based upon the previous reading and the number of people that live in the house. In practice this figure often proves to be to low, thus resulting in lower income for INAA (almost 2000 US$ a month, see calculation § 16.2.3.3 ;Calculations).

On the other hand the electricity meters installed by INE proof that it is possible to have a system which enables reading all the meters.
It is strongly suggested to install the meters in a different way or in a different place e.g. inside the house. This will make people to take much more care regarding their water meter. As showed above this will save INAA a lot of money.
Because the installation is a national policy it must be proposed to INAA headquarters in Managua. On a national scale the benefits will be even greater.

§ 16.2.3.1 Not accounted for water balance for the month of May 1994

§ 16.2.3.2 Introduction

In the following, points 3 and 6 of the 'Not Accounted for Water balance' are worked out for the month of May 1994. The information was obtained by looking into the 'route books' and the 'computer books' at INAA Juigalpa.
The influence of both points was calculated by comparing the 'route book' (wherein also the 'not functioning water meters' are noted down in, with the 'computer books, which give the total amount of paid for water.
To estimate the amount of not accounted for water, the difference between the total quantity of used water is calculated.
This was done for the month of may '94, which can be found in the computer books under June. This is because the bills are distributed in this month.
The production of the pumping fields, is given for the month in which the pumps produce the water (May = May).

§ 16.2.3.3 Calculations

The total quantity of factored/accounted water is calculated in the central computer system of Managua. For June, this is 103,839.00 m^3, for which the consumers paid 125,058 90 $C^\$$. This gives an average price of 1,20 $C^\$/m^3$ (1 Córdoba = 0,14 US$).

The total amount of consumed water was computed manually with the lectures of the water meters for the month of June. A total of 89,616.00 m^3 was found, for a number of 3433 connections (=n).
Also 363 not functioning water meters (=r) where discovered; 10,6% of # of connections.
One of these defect meters is the one of the hospital of Juigalpa, where they use 8000 m^3/month, according to INAA.

The mean consumption for these 3433 connections was earlier on computed to be 26,1 m^3 for May 1994. (According to the 20 of the 21 available 'route books'; including all functioning connections except for the hospital (which water meter is not functioning)).
Thus to estimate the consumption:

$$n_{total} = n + r$$

$$n_{total} = 3433 + 363 = 3796$$

According to the computer books there are 4140 connections.
4140 - 3796 = 344 connections are written down in the one book that was not available.
The percentage of 'broken' connections was calculated to be 10.6. This gives a total of 399 meters not functioning (=R). (Including the one of the hospital).

The total water-use can be computed in the following manner:

$$x_{mean} * N + \text{Hospital} = \text{Consumption}$$

$$26.1 * 4139 + 8000 = \underline{116,043}\ m^3 \text{ (May '94)}$$

To visualize this: It equals a water tower with a base of 10 * 10 meters and a height of 116 meters.

When charged, INAA would earn 14,640 córdobas (= 2,065 US$) every month.

This difference can only be caused by failures in copying the figures form the 'route books' to the 'computer books', by a wrong estimation of the connections with a 'broken' or not readable water meters, and by miscomputations in calculating the total water-use, since this was done manually.
If parting from the assumption that copying mistakes both result in too high notations as well as too low notations, thus cancelling one another. **Then the major reason for the difference in 'used water' and 'paid for water' is caused by estimating the water-use of families with a 'broken' meter too low.**

Parting from the assumption that the amount of 'not payed for water' is 12,200 cubic meters, then this means that every connection with a 'broken' meter uses 26,1 + 12,200/398 = **56,8 m^3**. **More then twice as much as the average consumption of functioning water meters.**

§ 16.2.3.4 System losses

With a figure of 116,043.00 cubic meters for the total consumption, which seems for the moment seems to be the most reliable, computation of the system losses will give a loss of 1 - 116,043.00/159,260.00(produced) = **27 %**. This is significantly less then the 35% that was computed by the INAA for this month of May 1994. (See table 6 ;Production versus Consumption). This difference is caused because of the fact that INAA uses the computer books for the calculation, while the percentage of 27 was calculated with the 20 of the 21 available route books. As said before, the figures in the route books correspond closer to the truth.

§ 16.2.4 Illegal connections

The research resulted in the assumption that little or no families have an illegal connection. What does happen, is that multi-family connections sell water to a greater number of family's than initially applied for. This point however will have only little effect on Ω.

§ 16.2.5 Human mistakes whilst reading water meters

A part of this problematic nature was already discussed under ad 3. Humans make mistakes, and this has to be accepted. But the number of mistakes that happen strongly depend on the quality of the water meters.
As mentioned about 10% of the meters are impossible to read, an other 5-10% are difficult to read because of scratches or condense.[8]
Also still some meters indicate gallons instead of cubic meters.
A simple solution is use only water meters with glass caps instead of plastic ones, since they cannot damage so easily. Another solution would be only to use 'wet running water meters' since these do not condense so easily. But special attention must then be paid to a proper installation.
With the money that is gained by a higher 'paid' consumption because of well functioning water meters, the broken or improperly functioning ones can simply be exchanged.

§ 16.2.6 Human mistakes during the administrative data processing

INAA Juigalpa has two bookkeepings to administer the reading of the water meters. The 'route books' are used to note down the readings of the meters once every month. As mentioned above, when the meter can't be read, the figure is estimated. The other books, the so called 'computer books' list the figures that the users actually pay for. The consumptions from the 'route books' are copied into the 'computer books' and send to the capital of Managua, where they are put into the computer. Here the bills are printed which in there turn are send to Juigalpa to be distributed. This is not only a time consuming process, more than this it increases the chance administrative mistakes.
A comparison between the 'route books' and the 'computer books' gave a difference of 14,354 m^3 for the month of June 1994. An equivalent of 12% of total consumption of that same month!
This therefore strongly asks for a different method of processing data. In both interests, it would be better to let this part be handled totally be INAA Juigalpa instead of INAA central, Managua. Increasing the responsibility for the departments in general will lead to greater efficiency and a better service in water. And that's in the interest of all people.

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[8] Information obtained during the 'Field Observation'.

ANNEX 17 SYSTEM LOSSES CHECK

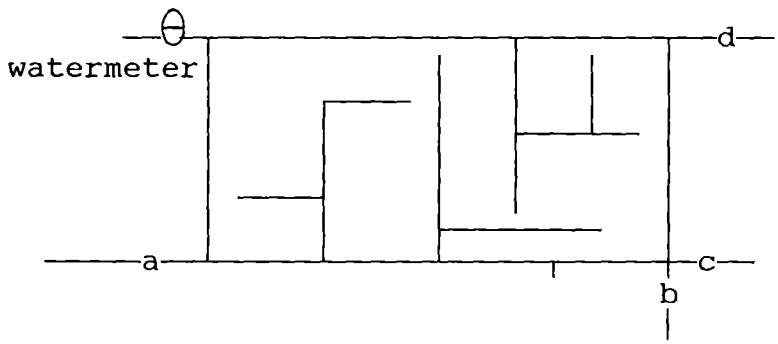
§ 17.1 Introduction

As said in annex 16 ;Not Accounted for Water-use, it was proposed to perform a system losses check in two different parts of Juigalpa. With the help of this test it is possible to establish the amount of water that is lost in the main supply pipes of the system up to the level of a water-meter connection.

§ 17.2 Short description of the test

Isolate a part of the system -with approximately 100 connections- completely. Provide this section with one supply pipe, in which a well functioning, verified water meter is being installed. The diameter has to be fairly big, but not to big, because then the meter will be unreliable when the water flow is low, since the water meter is installed in the initial part of the pipe.

FIGURE 2 Test plot



Make sure that the stopcocks (a, b, c and d) shut well. Then take stock of the following data:

1. Total length of pipe in the test plot.
2. Number of persons in the test plot.
3. Number of connections in the test plot, divided into households, industries, public tappoints and government buildings.
4. Number of metered connections.
5. Number of not metered connections.

Observe for two months de water meter in the supplying pipe in the actual situation of the test plot. Let the meter be read by two different persons to decreases the role of human errors. Check the two readings immediately after surveying.
Also check the metered connections during those two months. Control this labour as well, again to reduce the factor of human errors.

Once this 'zero-situation' is established clearly, the test can start.

Once this 'zero-situation' is established clearly, the test can start.
It means that one different improving measure is performed at a time in the test plot and that afterwards is concluded what the results are. Examples of these measures are:

AChecking the plot for humid places, small leaks and big leaks.
B. Having the 'inside' installations of the connection inspected within the test plot.
C. Letting one 'meter route' being executed by two persons working independently.
D. Controlling the water meters for functioning.
E. Installing water meters at connections which are not metered.
F. Replacing old meters by new ones.
G. Making changes in the administrative processing of the gained data.

If every step is performed successively and every time the use is surveyed by two independently working persons, then a insight is created in the effects of the different measures.
This way insight is obtained in how big Ω is at the start and at the end. Next to it knowledge is obtained concerning the water-use per head of the population. Also it is possible to create a improving plan for the distribution system of the city because of this gained knowledge.
At last some distinct figures can be computed, like:

- Number of leaks per meter pipe.
- Number of people per connection.
- Water-use at not metered connections.
- Water-use at metered connections.
- etc.

ANNEX 18 WATER QUALITY

§ 18.1 Introduction

Water brings many things to life, but water of bad quality can also take lives. This annex deals about the quality of the piped potable water in Juigalpa.

§ 18.2 Water quality control by INAA

Since 1990, INAA executes a programme named 'PRONCAGUA', part of a national programme to control and increase the quality of potable water.
In July of the following year bacteriological analysis were made in there new established laboratory. During the same month 2 chlorination injectors were installed, one for the 6" line and one for the 12" line. In the beginning these were operated manually and because of the availability of only one operator for no longer than 8 hours each day.[9]
The system however, functions completely automatically, for the last two years, and thus chlorinates 100% of the water 24 hours daily

The potable water, distributed by INAA is analyzed daily at the injection point in the system. These analysis show that in 100% of the cases the level of residual chlorine is lower then 1,5 mg/l. Furthermore, water monsters from the distribution system show that the minimum level of residual chlorine stays above 0,5 mg/l. The latter tests are performed a few times per month. Once every month the *agua* in the system tanks are analyzed for their bacteriological quality. In 1993, 88% of the tests were negative, which indicates that the standards were met.[10]

§ 18.3 Negative impact of no-daily supply

Nevertheless, it goes without saying that it is not beneficiary for the quality of the potable water when it stays int the system for 3 or 4 days or even longer.
- After closing the valve of a certain part of town to distribute the water in another part of the city, it is unavoidable that a certain amount of water stays behind in the pipes. The amount of chlorine cannot keep the quality at an acceptable level for 4 days or longer. Therefore a certain amount of water not fit for human consumption will exit the system and enter at household level once it is again there turn to receive water.
Another aspect is that because of the many leaks, contaminated water will enter the pipes during low pressures and influence the water quality of potable water in a negative way.

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9 INAA, (1994) Proyecto de Agua Potable Juigalpa. Informe final. February 1994, Juigalpa, Chontales, Nicaragua.

10 Ibid

§ 18.4 Street opinion

Though INAA states that the quality of the system water cannot be questioned, many of the direct water users have an other view. The authors talked about the quality with several citizens who seriously had doubts about the water they needed for eating and drinking. During a certain period there was a rumour going around that the potable water caused many people to suffer from diarrhoea.
A quick few into the results of the questionnaires that were handed out, revealed that 9 out of 102 families (=9%) stated in the questionnaires that they believed that piped potable water was causing diseases!

ANNEX 19 TABLES AND GRAPHICS

TABLE 1 MEAN ANNUAL RAINFALL IN JUIGALPA

MONTH	05	06	07	08	09	10	11	12	01	02	03	04	YEAR-LY
RAINFALL millimetre	104	215	150	190	280	240	69	33	26	8	8	10	1333

Source: TH Delft, (1984). Sin agua no hay vida.

TABLE 2A POPULATION FIGURES DERIVED FROM DIFFERENT SOURCES

SOURCE	POPULATION	HOUSEHOLDS	PERSONS/HOUSE
Municipality	80,000	10,000	8
INAA	60,000	-	-
INAA	50,000	7,700	6.5
INE	-	6,064	-
MINSA	34,755	6,788	5.1
Research		-	7 0
USED FIGURES	41,407	6,788	6.1

TABLE 2B POPULATION OF THE CITY OF JUIGALPA IN 1994

	MEDIATED FIGURES[11]		MINSA FIGURES	
ZONE	# HOUSES	#INHABITANTS	# HOUSES	#INHABITANTS
1	597	3,642	597	3125
2	1097	6,692	1097	5503
3	854	5,209	854	4152
4	876	5,344	876	4823
5	671	4,093	671	3479
6	943	5,752	943	5032
7	960	5,856	960	4671
8	790	4,819	790	3970
TOTAL	**6,788**	**41,407**	**6,788**	**34,755**

Source: MINSA, investigation concerning the number of malaria cases, July 1994.

TABLE 3 # OF CONNECTIONS PER ZONE IN RELATION WITH NUMBER OF PEOPLE

ZONE	# OF HOUSES	# OF INHABITANTS	# OF CONNECT.[12]	CONNECT./ HOUSE	CONNECTION/ INHABITANT
1	597	3125	455	0 77	0.146
2	1097	5503	310	0 20	0.056
3	854	4152	810	0.95	0.20
4	876	4823	328	0.37	0.068
5	671	3479	583	0.87	0.168
6	943	5032	257	0 27	0.051
7	960	4671	412	0.43	0.088
8	790	3970	387	0.49	0.097
TOTAL	6,788	34,755	3,542	0.521	0.102

Source: MINSA and INAA, July 1994.

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[3] The figures given are mediated according to the manner described in annex 4.

[12] The following numbers were extrapolated from 1984 numbers (TH Delft, Sin agua no hay vida), since no more recent data were available. Therefore they should be used simply as an indication, more than 'hard' information

TABLE 4 MONTHLY PRODUCTION OF POTALBLE WATER IN JUIGALPA IN 1993, (x1000) m^3.

MONTH	LIMAS 1	LIMAS 2	LIMAS 3	LIMAS 4	CONSUELO 1	CONSUELO 2	CONSUELO 5	CUI-SALA	TOTAL M^3	TOTAL GPM
JANUARY	24 3	4.7	18 0	8 0	4 3	28 0	12.8	25.7	125 8	744
FEBRUARY	20 6	6 2	5 8	9 0	21 7	24 3	11 2	23.3	122.1	722
MARCH	22 0	15 0	-	11 3	22 6	21 1	11 2	23.9	127.1	752
APRIL	19 9	14 9	20 6	10 6	15 8	4 7	7.1	22.9	116 5	689
MAY	21 0	11 1	1 2	10 0	16 2	8 4	7.4	23.6	98 9	585
JUNE	22 6	19 2	17 3	7 4	20.9	19 3	9.8	24 1	135 6	829
JULY	23 3	15 9	18 6	5 3	22.3	22.8	10.9	24 4	143 5	849
AUGUST	23 7	15 8	19 3	4 1	23 1	24 4	11 0	24 2	145.6	861
SEPTEMBER	23.4	15 6	11.2	-	22.5	26 4	11 6	23.0	133 7	817
OCTOBER	24 6	16 5	12 6	BROKEN	24 5	29 3	12.4	23 5	143.4	876
NOVEMBER	22 3	15 7	12 1	1 5	22.7	28 4	11 4	21 3	135.4	828
DECEMBER	23 5	17 1	1 8	BROKEN	24 0	31 2	12 2	20.8	130 6	798

Source: INAA, (1994). Proyecto agua potable Juigalpa Informe Final. February 1994, Juigalpa, Chontales, Nicaragua.

TABLE 5 MONTHLY PRODUCTION OF POTABLE WATER IN JUIGALPA IN 1994, (x1000) m^3.

MONTHS	LIMAS NO 1	LIMAS NO 2	LIMAS NO 3	CONSUELO NO. 1	CONSUELO NO. 4	CONSUELO NO 5	CUISALA NO 1	PRODUCTION TOTAL
JANUARY	23,18	16,26	9,93	17,71	31,22	11,78	20,37	130,453.0
FEBRUARY	22,21	14,35	14,11	18,22	32,55	7,77	16,91	126,117.0
MARCH	29,92	17,34	19,70	25,34	36,25	15,41	8,34	152,286.0
APRIL	28,29	13,69	17,28	21,84	26,85	13,03	18,06	139,036 0
MAY	28,89	12,58	28,21	24,94	27,04	15,64	21,97	159,260.0
Own observation	28,08 04-05	11,91 06-'94	27,21	22,98	26,28	15,63	N.O	132,090.0
JUNE	29,12	12,15	26,11	25,58	29,85	15,55	21,31	159,660 0
Own observation	28,26 02-06	12,36 07-'94	25,71	22,98	28,68	15,10	19,95	153,040 0
JULY								
AUGUST								
SEPTEMBER								
OCTOBER								
NOVEMBER								
DECEMBER								
TOTALS	161,60	86,359	115,326	133,631	183,749	79,183	106,960	866,812.0

Source: INAA, July 1994

TABLE 6 PRODUCTION VERSUS CONSUMPTION INAA JUIGALPA

MONTHS	PRODUCTION M^3	PRIVATE CONSUMPTION	MUNICIPALITY CONSUMPTION	TOTAL CONSUMPTION	LOSSES[13] M^3	LOSSES %	PUMPING HOURS
JANUARY	130,453 0	86,681 0	12,667 0	99,348 00	31,105.00	24	4,593.0
FEBRUARY	126,117 0	80,157 0	12,517 0	92,674 00	33,443.00	27	3,760.0
MARCH	152,286.0	85,157.0	11,703 0	96,860.00	55,426.00	36	4,672.0
APRIL	139,036 0	88,312 0	10,949.0	99,261.00	39,775 00	29	4,413 0
MAY	159,260 0	91,727 0	12,112 0	103,839 00	55,421.00	35	5,135 0
JUNE	159,660 0	94,486 0	12,068 0	106,554.00	53,106.00	33	4,936.0
JULY			12,504.0				
AUGUST							
SEPTEMBER							
OCTOBER							
TOTALS	866,812 00	526,520 00	72,016 00	598,536.00	268,276 00	31	27,509 0

Year· 1994 Source: INAA, 1994

[13] These are the quantyties not accounted for Either because of technical problems like leaks or unproperly functioning watermeters, or because of administrative problems like incorrect reading of the meters or incorrect processing of data

TABLE 7 NUMBER OF PEOPLE PER HOUSEHOLD

Group	Rich	Middle	Poor	Private con.	Public con.	Total
Number	116	25	79	34	34	220
χ[14]	6.9	7.2	7.2	7.0	6.9	7.0

Source: Questionnaires

TABEL 8 DIVISION IN PRIVATE AND PUBLIC CONNECTIONS

Group	Rich %	Middle %	Poor %	Private con. %	Public con. %	Total %
Private con.	74	87	77	100	0	77
Public con.	26	13	23	0	100	23

Source: Questionnaires

TABLE 9 TOTALS OF WATER-USE

Group	Rich	Middle	Poor	Private con	Public con.	Total
n	88	18	52	29	31	158
χ liters	67 4	57.5	67.0	68 1	72.3	66.1

Source: Questionnaires
n: Number of returned questionnaires for that specific group

[14] The meaning of χ is 'mean x'

Totals of Water-use

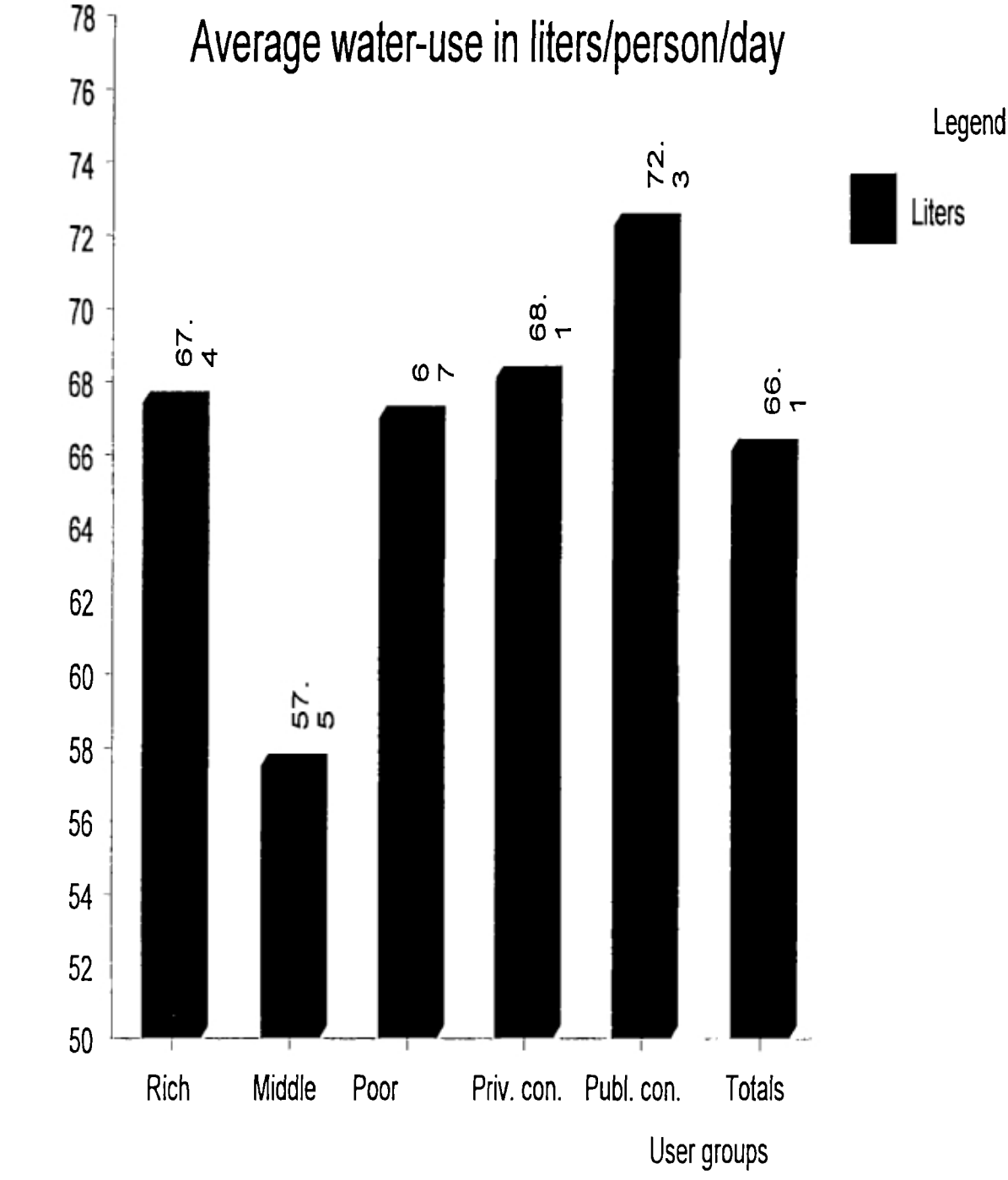


TABLE 10 PAYMENT PER M^3, WHEN OBTAINED AT OTHER THAN NORMAL SOURCES (IN C_s)

Group	Rich	Middle	Poor	Private con.	Public con.	Total
Private con.	22.8	26.0	28.4	29.6	17.5	25.0
Public con.	28.3	13.8	26.6	17.9	41.3	26.8
Private well	18.3	27.9	18.1	22.5	14.0	20.4
Public well	26.0	25.8	9.0	-	27.0	18.7
Spring	-	-	-	-	-	-
Rain	-	-	-	-	-	-
River	4.55!	-	-	-	-	!
Water vending	31.1	18.8	17.2	25.0	22.1	27.5

Source: Questionnaires

TABLE 11 WILLINGNESS TO PAY

Group	Rich		Middle		Poor		Privat con		Public con.		Total	
	I	II										
Pay %	75	9.8	53	12	68	12	90	14	79	14.3	69	10.8
No %	25	-	47	-	32	-	10	-	21	-	31	-

-Source Questionnaires

Pay = Pay more for receiving water every day.

No = Pay the same and remain in the same situation of water service (once every four days)

I Indicates the percentage in a certain category that choose that specific answer.

II Indicates the amount of money that they would like to spent extra (in C_s).

TABLE 12 SATISFACTION

Group	Rich	Media	Poor	Private con.	Public con.	Total
Yes(%)	33	71	46	52	27	42
No(%)	67	29	64	48	73	58

Source: Questionnaires

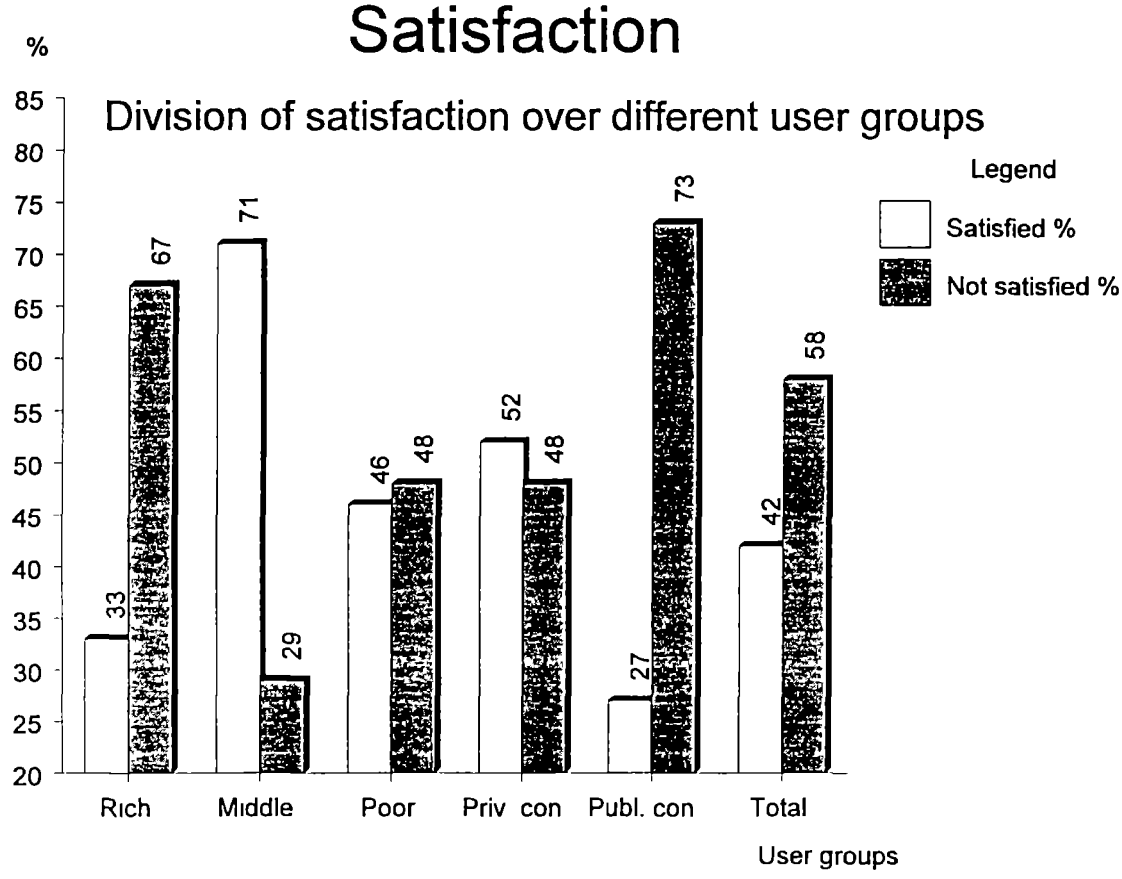


TABLE 13 PRICE OF CONNECTION

Group	Rich	Media	Poor	Private con.	Public con.	Total
Price % too high	61	61	64	71	32	38
Price is good %	39	31	36	29	68	62

Source· Questionnaires

TABLE 14 DIVISION IN PLACES WHERE WATER IS OBTAINED

Group	Total %
Private connection	65
Public connection	20
Private well	6
Public well	3
Spring	2
Rain	3
River	0
Other	1

Source: Questionnaires

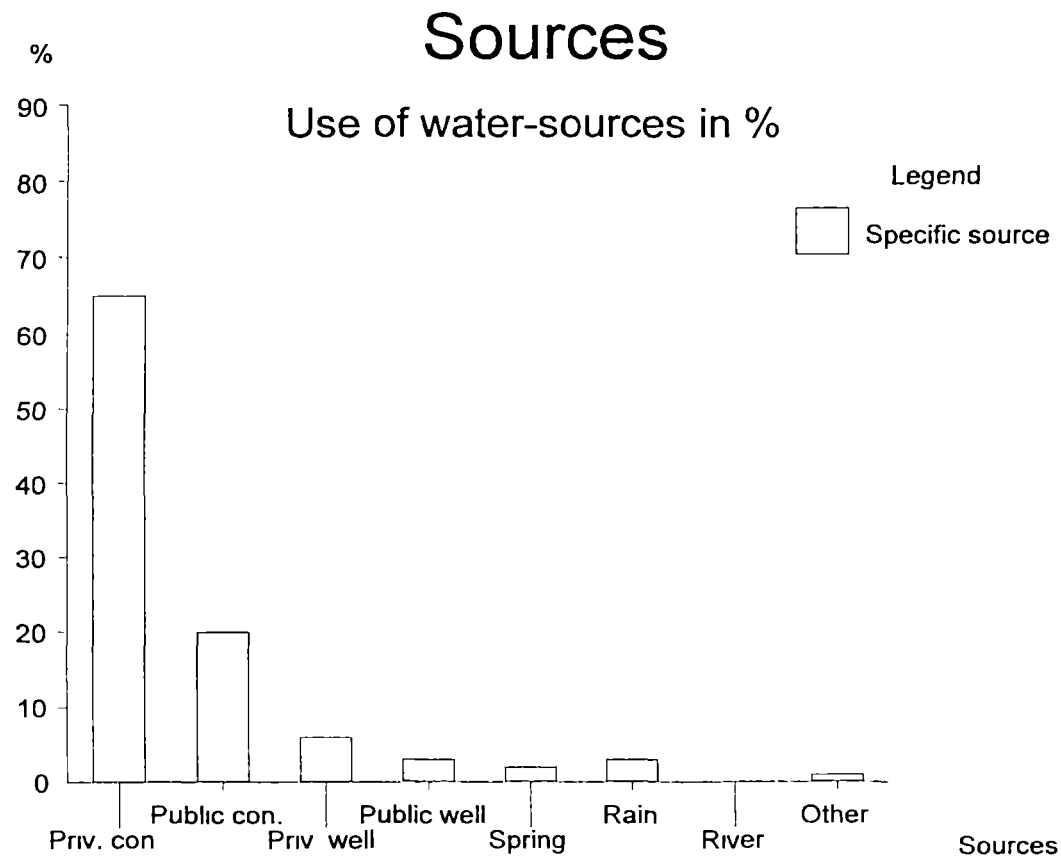
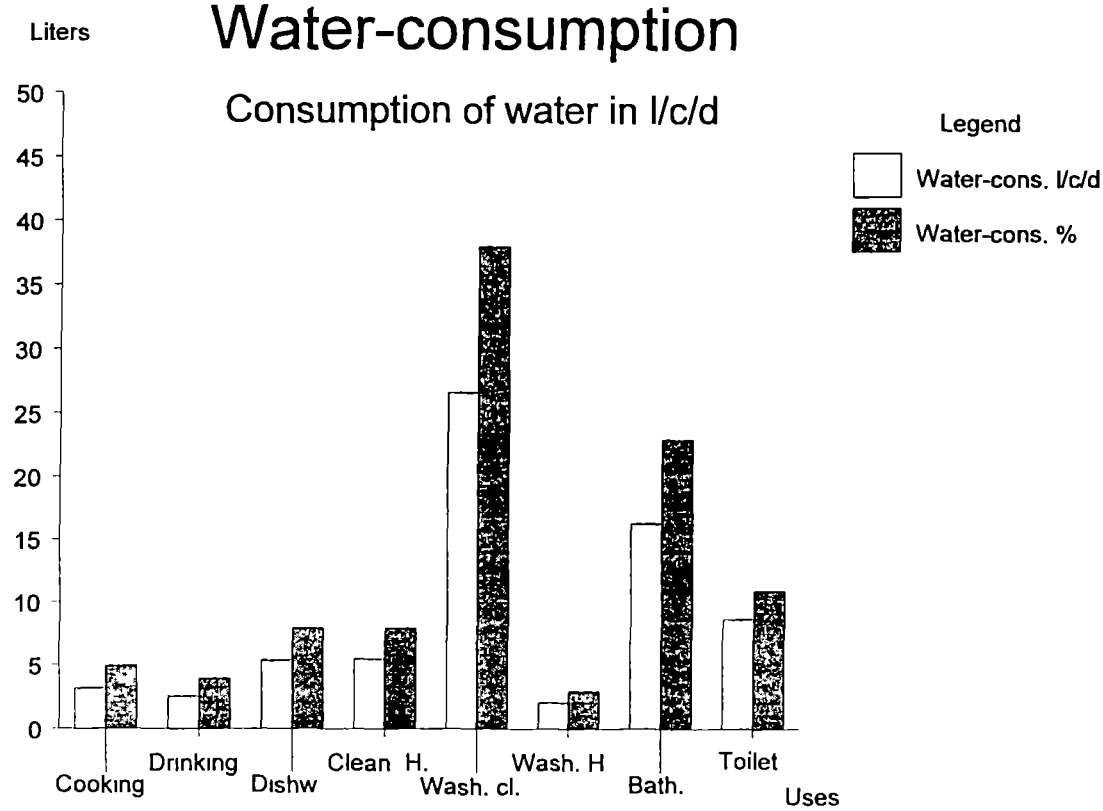


TABLE 15 DISTRIBUTION OF WATER-USE 1

Group	Rich			Middle			Poor			Private con.			Public con.			Total		
	n	χ	%	n	χ	%	n	χ	%	n	χ	%	n	χ	%	n	χ	%
Cooking	83	2 7	4	14	4 7	7	47	3 5	6	28	2.8	4	27	4.8	7	144	3.2	5
Drinking	82	2 4	4	14	2 5	4	48	3 0	5	25	3 0	4	28	2.3	3	144	2.6	4
Dish washing	82	5 3	8	13	4 6	7	47	5 9	10	23	6 9	10	28	4 9	7	142	5.4	8
Cleaning house	75	5 5	9	12	7 5	12	44	5 0	9	25	7.4	11	27	5.0	8	131	5 5	8
Washing cloths	75	28.1	44	13	28	45	45	23.7	40	23	30 9	46	25	30.7	46	133	26 6	38
Washing hands	78	2 1	3	13	1 5	2	42	2 2	4	24	2 1	3	27	1 9	3	133	2 1	3
Bathing	81	17.2	28	13	1 4	23	45	15 3	26	24	14.5	22	27	17.1	26	139	16.3	23
Water closet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	8.7	11

Source Questionnaires

Water-consumption



Water-storage

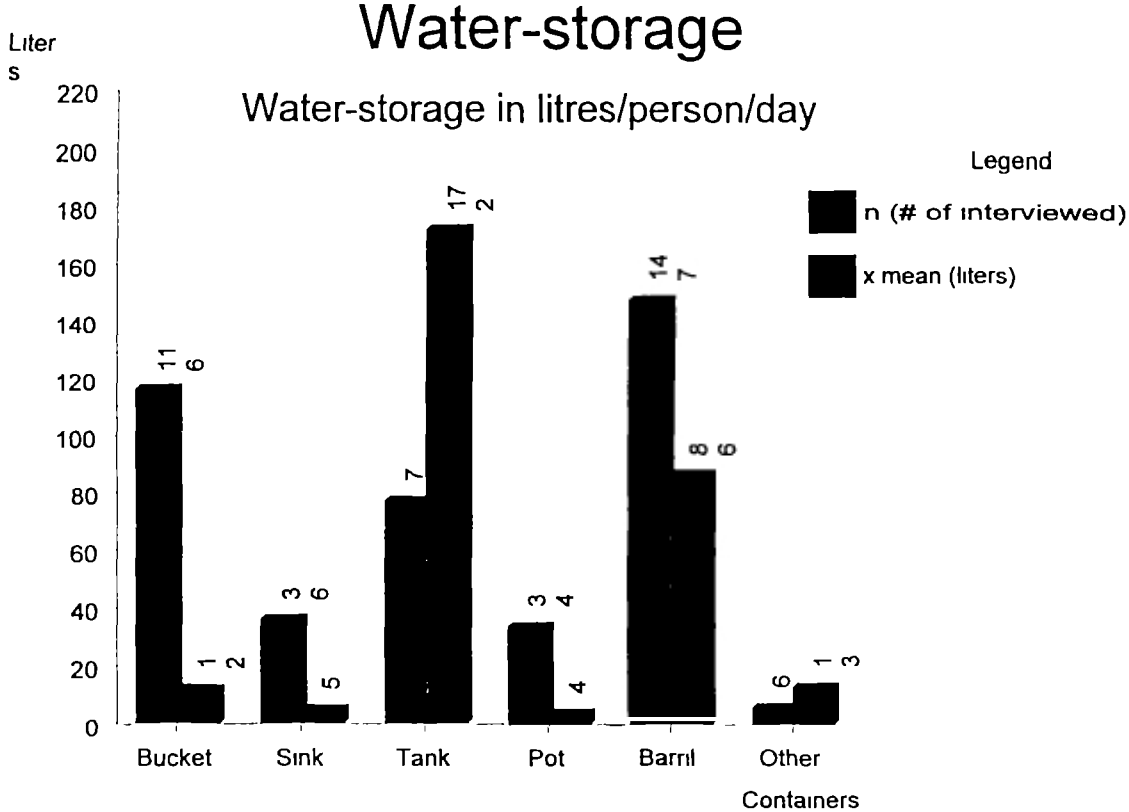


TABLE 16 DISTRIBUTION OF WATER-USE 2

Group	Rich			Middle			Poor			Private con.			Public con.			Total		
	n	χ	%	n	χ	%	n	χ	%	n	χ	%	n	χ	%	n	χ	%
Water closet	45	9 5	31	3	8	61	16	6 5	13	11	7 6	29	13	8 8	37	64	8 7	11
Garden	22	7 3	24	3	3	23	20	8.1	17	9	8 8	33	8	4 6	19	45	7.4	37
Carwash	10	4 6	15	-	-	-	2	31 5	64	1	6	23	2	3.5	15	12	5.6	27
Animals	15	4 9	16	1	2	16	11	3.1	3	7	4 1	15	3	1 7	7	27	4 1	20
Other	1	4 0	10	-	-	-	2	3	3	-	-	-	1	-	22	3	3.3	16

Source· Questionnaires

TABLE 17 WATER-STORAGE

Group	Rich		Middle		Poor		Private con.		Public con.		Total	
	n	χ	n	χ	n	χ	n	χ	n	χ	n	χ
Bucket	57	13	13	15	46	9	20	14	28	14	116	12
Sink	25	4	2	12	9	4	11	3	4	3	36	5
Tank	48	200	9	111	20	123	10	206	16	135	77	172
Pots	12	5	6	5	16	4	4	4	8	3	34	4
Drum	77	96	17	75	53	75	25	82	26	86	147	86
Other	5	15	-	-	1	5	2	14	1	12	6	13

Source: Questionnaires

ANNEX 20 PROPOSAL FOR METER INSTALLATION

Juigalpa, 23 June 1994

Dear Ing. Flores,

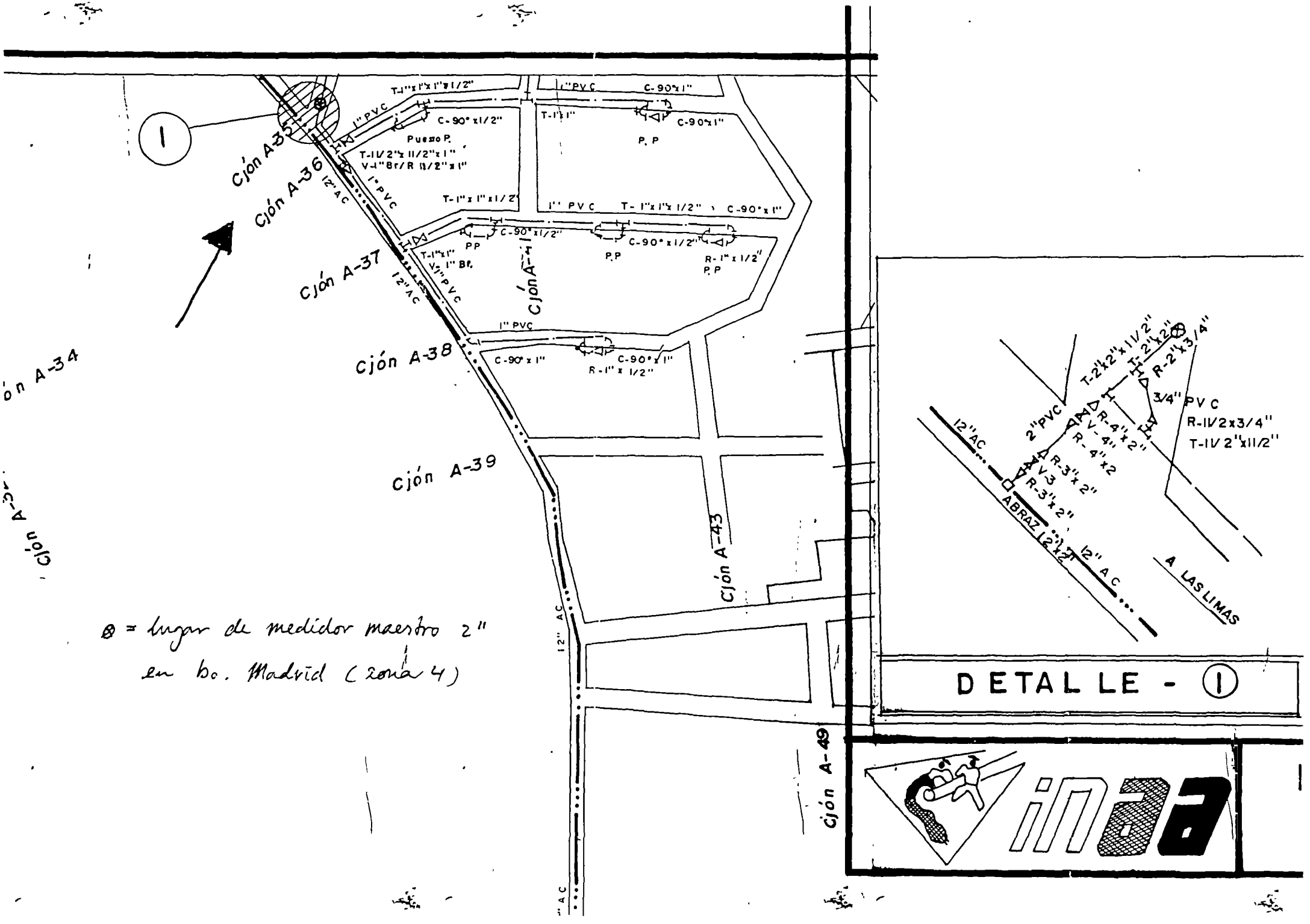
We are two students from Holland, investigating the use of drinking water in de city of Juigalpa. For this investigation, it is very important to know exactly what the water-use is per person in a representative part of town. We investigate this by visiting a great number of families and observing the different ways in which the water is used. To compare the use with the quantity of available water, it is neccessary to know exactly how much water enters the system.
Therefore we would like to propose to you, to install two master meters in two different barrios, so that it is possible to read the use every week. This was also proposod by the 3e and 4th mission of Dutch engineers in 1987 and 1991.

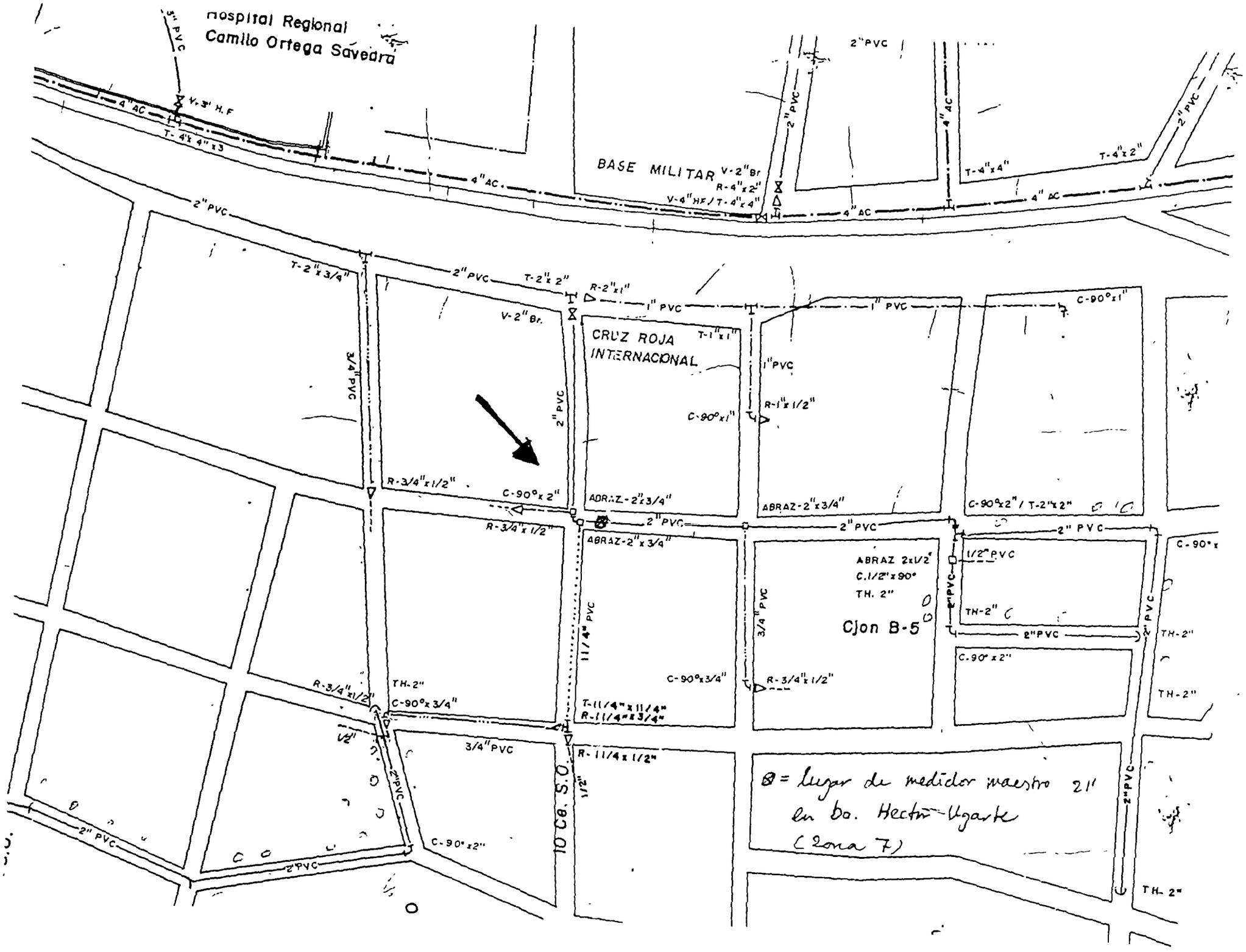
In our opinion, one meter should be installed in barrio Madrid in Zone 4 another one in barrio Hector Ugarte in Zone 7. We selected these, because we expect that the water-use in both barrios will differ greatly. In both barrios only two 2" master meters need to be installed. For exact details, see map.
Also for INAA these master meters can be of great assistance, since they can be used to check the individual connections in this zone. Through this it is possible to find out if there are any leaks or perhaps illegal connections.
To obtain as much information as possible, we need to start as soon as possible with the reading of the meters. Therefore we hope that it is possible to have the meters installed as soon as possible.

We hope that you understand the importance of installing the master meters, and therefore hope to hear from you soon.

Con un saludo atento,

Jochem Bauhuis
Mark van Dijk


Cjón A-35
Cjón A-36
Cjón A-37
Cjón A-38
Cjón A-39
Cjón A-41
Cjón A-43
Cjón A-49
Cjón A-34
12" AC
1" PVC
C-90° x 1/2"
Puesto P.
T-1 1/2" x 1 1/2" x 1"
V-1" Br/R 1 1/2" x 1"
T-1" x 1" x 1/2"
P.P
T-1" x 1" x 1"
C-90° x 1"
R-1" x 1/2"
R-1" x 1/2" P.P
V-1" Br.
⊗ = lugar de medidor maestro 2"
en bo. Madrid (zona 4)
DETALLE - (1)
T-2x2"x1 1/2"
R-2"x3/4"
3/4" PVC
R-1 1/2x3/4"
T-1 1/2"x1 1/2"
2" PVC
R-4"x2"
V-4"
R-4"
R-4"x2
R-3"x2"
V-3
R-3"x2"
ABRAZ 12"x2"
A LAS LIMAS


Hospital Regional
Camilo Ortega Saveedra
BASE MILITAR
CRUZ ROJA
INTERNACIONAL
Cjon B-5
⊗ = lugar de medidor maestro 21"
en bo. Hector Ugarte
(zona 7)
10 Cb. S.O.
4" AC
2" PVC
3/4" PVC
1" PVC
V-2" Br.
V-3" H.F
V-4" HF / T-4" x 4"
T-4" x 3
T-4" x 4"
T-4" x 2"
T-2" x 3/4"
T-2" x 2"
T-1" x 1"
R-2" x 1"
R-1" x 1/2"
R-3/4" x 1/2"
R-1 1/4 x 1/2"
R-1 1/4" x 3/4"
T-1 1/4" x 1 1/4"
C-90° x 2"
C-90° x 1"
C-90° x 3/4"
C-90° x 2" / T-2" x 2"
ABRAZ-2" x 3/4"
ABRAZ 2x1/2"
C.1/2" x 90°
TH. 2"
TH-2"
1/2" PVC
1 1/4" PVC

ANNEX 21 NEW WATER TARIFF

§ 21.1 Introduction

The idea for a new progressive water tariff for household connections originated from the high maximum consumption and the scarcity of water. The thought was to lower the minimum consumption border (now being 18 m^3/month) to encourage users to decrease their mmonthly use. This will lead to lower water consumption per capita, also it will increase the income of INAA, this money should be used for the improvement of the system.

§ 21.2 Facts and assumptions

* Actual minimum consumption: 18 m^3/month
* Actual minimum price : 22,40 C_s/month
* Actual household tariff : see table

Table: Tariff for households

RANGE (M^3)	VALUE/M^3 (C_s)	TOTAL VALUE (C_s)
00 - 10	1.20	12.00
11 - 20	1 30	25.00
21 - 30	1.40	39.00
31 - 40	1.60	55.00
41 - 50	2.20	77.00
51 - 60	3.20	109.00
61 - 70	4.70	156.00
71 - 100	7.00	366.00
101 - MORE	10.10	

* Percentage of connection with a use ≤ 18 m^3/month: 53%
* Proportionally division of water consumption of households with a consumption ≤ 18 m^3/month. see table

Consumption m^3	1	2	3	4	5	6	7	8	9	10
Percentage of users	1	2	2	3	6	5	7	6	7	8

11	12	13	14	15	16	17	18
7	6	7	8	10	4	5	6

Average consumption of households using ≤ 18 m^3/month: 11 m^3/month. Assumption· When the new tariff will be applied, the system supplies water on a daily basis to the whole city, and 69% of the people are prepared to pay 10.80 C_s/month more

§ 21.3 New tariff

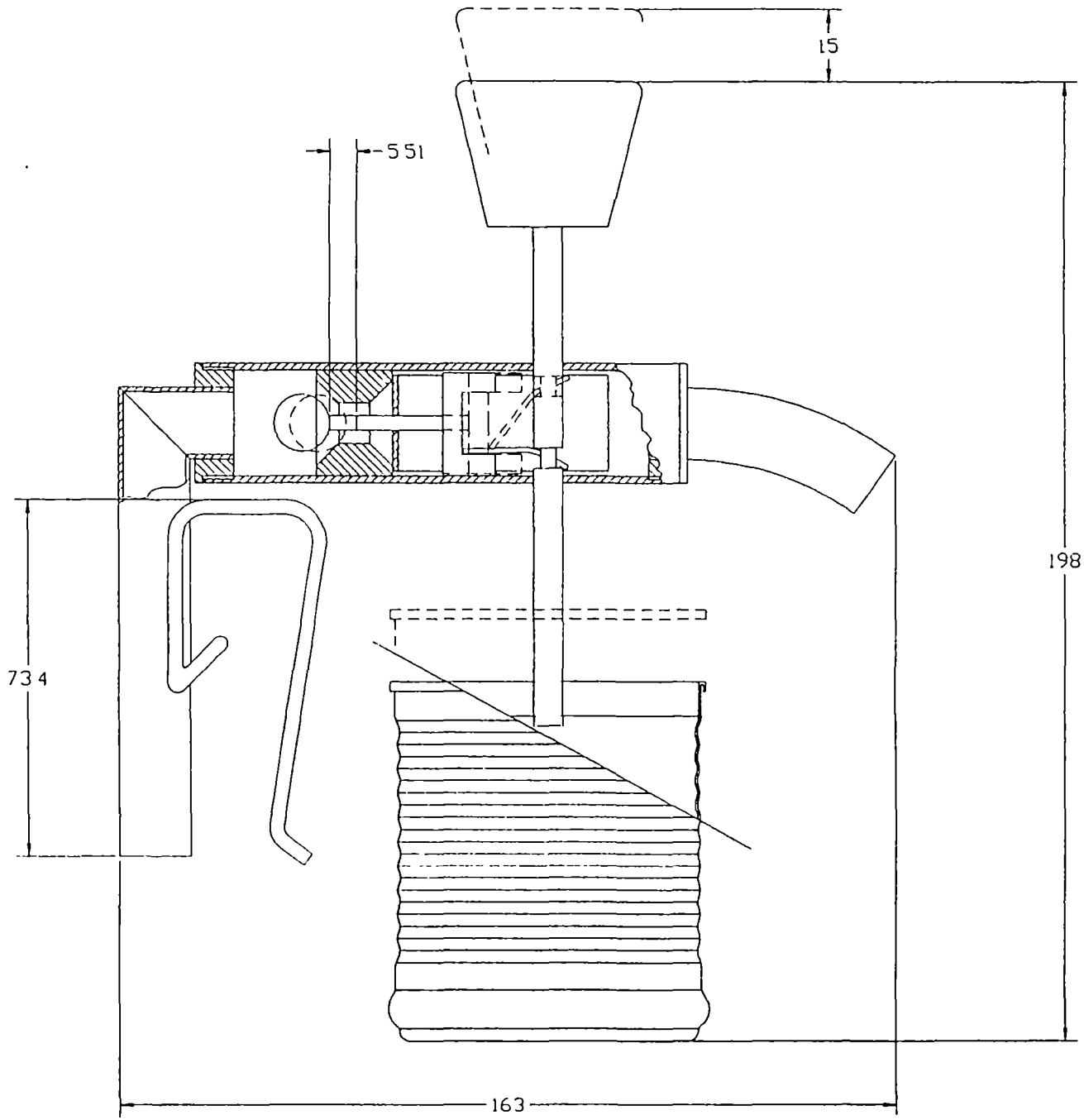
New minimum consumption : 11 m^3/month
New minimum tariff : 15 $C_\$$/month

Motivation: To encourage the people to lower their consumption, an extra low minimum is set.
It will stimulate people to buy there own connection, in relation to lower water meter costs.

RANGE (M^3)	VALUE/M^3 ($C_\$$)	TOTAL VALUE ($C_\$$)
0 - 10		15
11 - 15	2.00	25
16 - 20	1.90	34.5
21 - 25	1.80	43.5
26 - 30	2 00	53.5
31 - 35	3.00	68.5
35 -> ∞	4.00	∞

* At 28 m^3 consumption, the tariff is 30.7 $C_\$$; 8.3 higher then the minimum
* At a consumption of 13.4 m^3/month the tariff is 23 córdoba per month It is here where the increase begins.

* **The above is solely meant as a guide, explicitly not as the answer!**


15
55.1
198
73.4
163

ANNEX 23 OBSERVATION OF PUBLIC TAP POINTS

Introduction

During three occasions, students from the college of school-masters observed under our guidance the use of water at tap stands. The authors were interested in the public tap stands because it was unclear what their role in the whole system was.
The students observed the way the water was fetched, who fetched it, at what hours etc. Below the results are given.

Tap stand 1 (Santuaria)
20 Families use this point, there average family size is 5.8 persons. The average water-use is 123 others/hh.
Man as well as woman come to fetch water.
The tap stand was installed 2 months ago. Already now the water-meter was covered with a thick layer of clay because it was located directly underneath the tap.

Tap stand 2 (Nuevo Amanacer)
6 Families use this point, their average family size is 5.5 persons. The average water-use is 287 l/hh.
The fetched water is used for all kinds of uses.
Each family pays 0.25 córdoba per bucket of about 20 litres. This is far more, on a monthly basis, than families with a private connection have to pay.

Tap stand 3 (zone 7)
Four families use this Tap stand. The average consumption nor the average family size can be given.

Although these three points, as well as all the other public tap points, are officially meant to serve many persons in providing water, none of the tap point have special arrangements for this purpose. Like with most of the tap points in Juigalpa the tap is either attached to the side of the house with a piece of wire and a nail or simply to a wooden pole. Often the taps face problems of leakage.
The responsibility of INAA ends with the installation of the water meter. Therefore the responsibility of installing a proper tap stand lies with the users. And they are not familiar with the benefits of a proper tap stand. It is recommended that INAA takes up a greater role in the installation of public tap stands, namely to increase the service and to reduce health risks related to malfunctioning tap stands.

ANNEX 24 TERMS OF REFERENCE FOR ESTABLISHING THE SANITARY SITUATION

SANITATION IN JUIGALPA

Analysis of sanitary situation and the relation between sanitation and drinking water in the city of Juigalpa.

-Terms of Reference for investigating the sanitary situation and establishing the relation between sanitation and drinking water in general and more specific in the city of Juigalpa, Chontales, Nicaragua.-

INTRODUCTION:
Within the framework of her second 3rd year practical term, Ms. Lisette Verheijen applied to collaborate with the investigation 'Water-use in Juigalpa'. This investigation is carried out by Mr. Jochem Bauhuis and Mr. Mark van Dijk is the period of 29-04-94 / 10-08-1994 in the city of Juigalpa, Nicaragua.

Justification:
In this respect it was decided to give her a separate assignment witch will serve as a complementary part of the investigation.

The assignment will consist of:
- analysing the sanitary situation
- establishing the relation between sanitation and drinking water

The assignment will be carried out under the supervision of Mr. J. Bauhuis and Mr. Mark van Dijk in the period of 01-06-1994 / 18-07-1994. The results will be embodied in a written (English) report, that will function as a complementary chapter of the report 'Water-use in Juigalpa'.

Terms of Reference:
The outcome of the investigation 'Sanitation in Juigalpa' has to meet the following criteria:
A. Written English report with:

1. Definition of sanitation
2. 'Theoretic' relation between drinking water and sanitation with respect to the following:
   I. hygiene and health
   II. awareness building (importance of sanitation)
   III. education (how to reach the appropriate groups)
3. Analysis of existing situation concerning sanitation in the city of Juigalpa.
4. Establishing relation between water-use and sanitation in the city of Juigalpa.
5. Conclusions
6. Recommendations for eventual future project development in the city of Juigalpa concerning sanitation.

B. Oral and visual presentation

1. Presenting theory, findings, conclusions and recommendations of the investigation "sanitation in Juigalpa"
   time: before 08-08-94
   place: Juigalpa, Nicaragua
   for whom: Local government of Juigalpa and other interested people.

JUDGEMENT AND EVALUATION

The work will be evaluated and criticized by M. v. Dijk and J. Bauhuis before 10-08-94. This evaluation will function to hear from others what here qualities are and which aspects can have more attention and thus the evaluation will be a guide to Lisette in other, later missions.
For the supervisors the evaluation will be used to gain experience in judging other peoples in a working atmosphere in the correct way.