CHAPTER 4 CURRENT SITUATION AND CHALLENGES OF THE TEGUCIGALPA EXECUTING AGENCY

Chapter 4 Current Situation and Challenges of Tegucigalpa Executing Agency

4-1 Current Status of Executing Agency

4-1-1 Organizational Structure and Human Resources

(1) National Autonomous Service of Aqueducts and Sewerage (SANAA)

The National Autonomous Service of Aqueducts and Sewerage (SANAA), under the Ministry of Public Health, was created in 1961 to standardize, design, build, and supervise the national drinking water and sanitation system. Its main functions include the development of water supply sources, execution of aqueduct and sewerage projects, operation and maintenance of infrastructure, provision of drinking water and sanitation services, negotiation and contracting of financing, financial management, definition and collection of tariffs, appointment of staff, definition of its powers and duties, preparation of the land use plan, watershed conservation, and other duties.

SANAA performs the following functions as the technical directorate of CONASA.

- Definition of drinking water and sanitation sector goals and policies, elaboration of financing and investment strategies, operation and maintenance proposals, etc.;
- Execution of the studies and analyses necessary for PLANASA's planning, and periodic review and evaluation;
- Preparation of urban and rural investment programs and coordination of the investment mechanism;
- Opinion on access and investment opportunities for construction and expansion projects of water and sewerage systems;
- Promoting linkages with the financial and private sectors, and developing financing strategies for public and private investments; and
- Promotion of innovation and technology transfer

SANAA is a financially autonomous agency. SANAA is in charge of developing the study, construction, operation, maintenance and administration of all projects and works of aqueducts and sewers, belonging to the Central District, Municipalities, CONASA or any government agency, and will represent the interests of the State regarding water supply and sewage, in private companies that provide public services. The number of SANAA employees nationwide was 1,260 as of April 2021, of which 1,021 people belonged to the Metropolitan Division that operates the Tegucigalpa aqueduct and sewerage system. The number of water connections at the same date was 123,000 connections, which translates into 8.3 employees per 1,000 connections. Subsequently, after the progress of the transfer of operations to UMAPS, 717 staff members are reported in SANAA in September 2021.

The following are the organizational charts of SANAA and the Metropolitan Division.

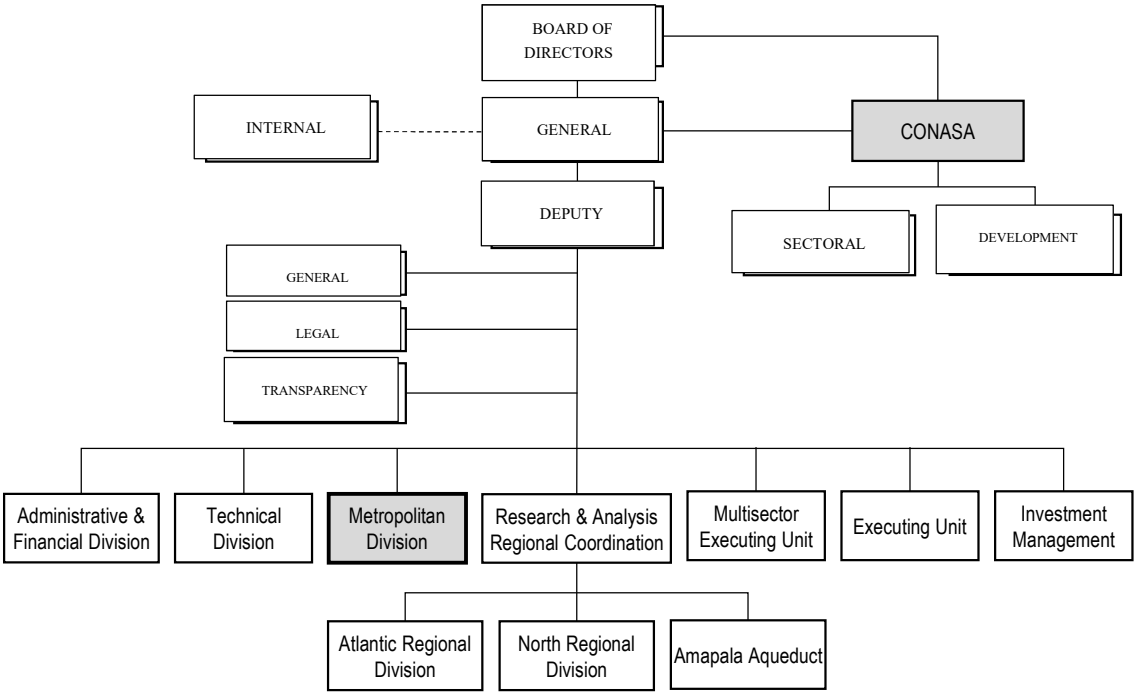


Figure 4-1-1 SANAA Organizational Chart

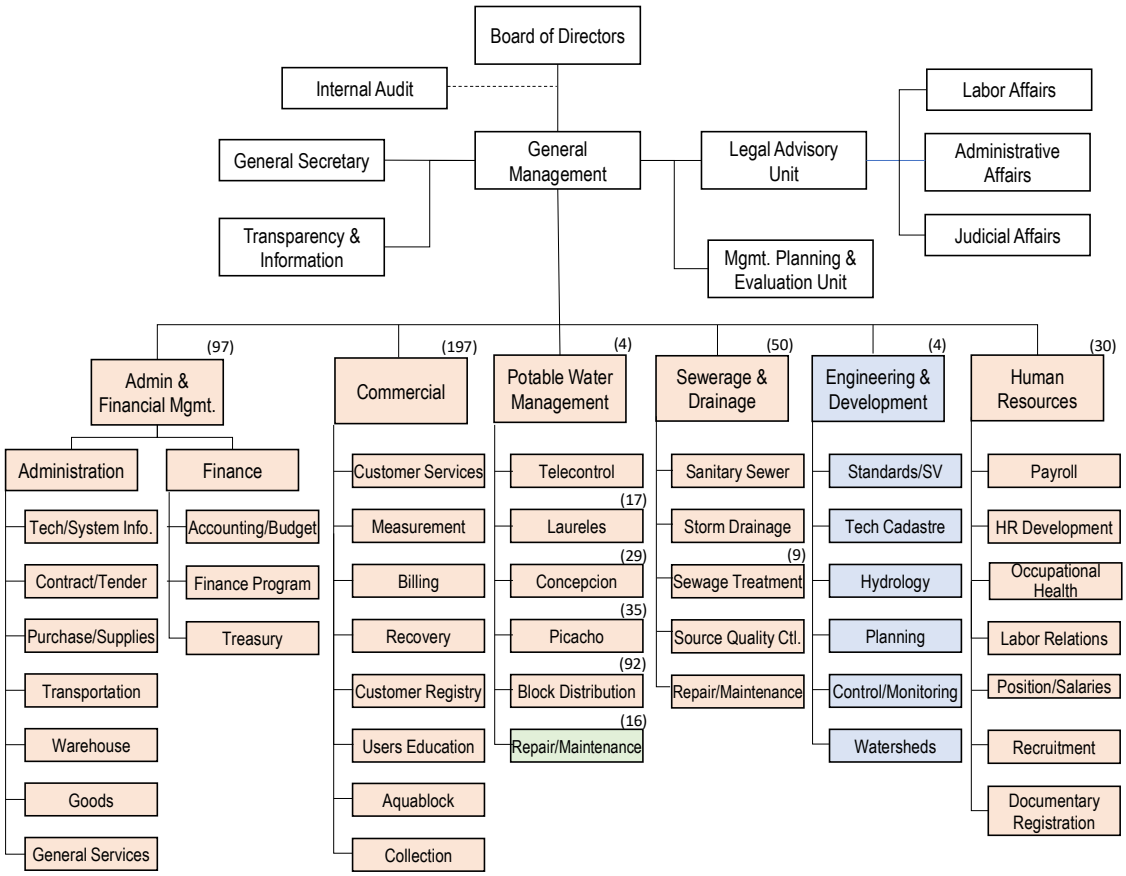


Figure 4-1-2Organizational Chart of Metropolitan Division of SANAA

As of September 2021, the Departments and Divisions colored pale orange in figure above are already transferred to UMAPS and the yellow green ones are currently in the process of being transferred to the Repair and Maintenance unit of the UMAPS Drinking Water Sub-Management. It should be noted that the figures in brackets is the number of staff as of April 2021.

(2) Central District Municipal Mayor's Office (AMDC)

The AMDC is responsible for contributing to the improvement of the population's quality of life and economic development through the development of social infrastructure in the Central District including Tegucigalpa. It assumes the following functions in relation to drinking water and sanitation services.

- ❑ Elaboration and execution of financial and public investment policies
- ❑ Elaboration of the strategic infrastructure development plan and expansion targets
- ❑ Project development and service delivery optimization, assurance of technical and economic efficiency and financial feasibility
- ❑ Promoting technical assistance, education and training
- ❑ Approval of the regulation and tariff system for drinking water and sanitation services.
- ❑ ERSAPS quality of service and tariff compliance and citizen participation
- ❑ Attention to rural areas and the socially vulnerable population, and protection of users' rights.

The AMDC created in 2015 the Municipal Drinking Water and Sanitation Unit (UMAPS) to which SANAA's powers will be transferred, and the Municipal Water and Sanitation Management Unit (UGASAM) in charge of policies. In April 2021, 2,541 employees were reported in the AMDC, of which 360 belonged to UMAPS and 72 to UGASAM; however, in September 2021, with the progress of the transfer, 650 belong to UMAPS and 8 to UGASAM. The organizational chart of the AMDC is presented below.

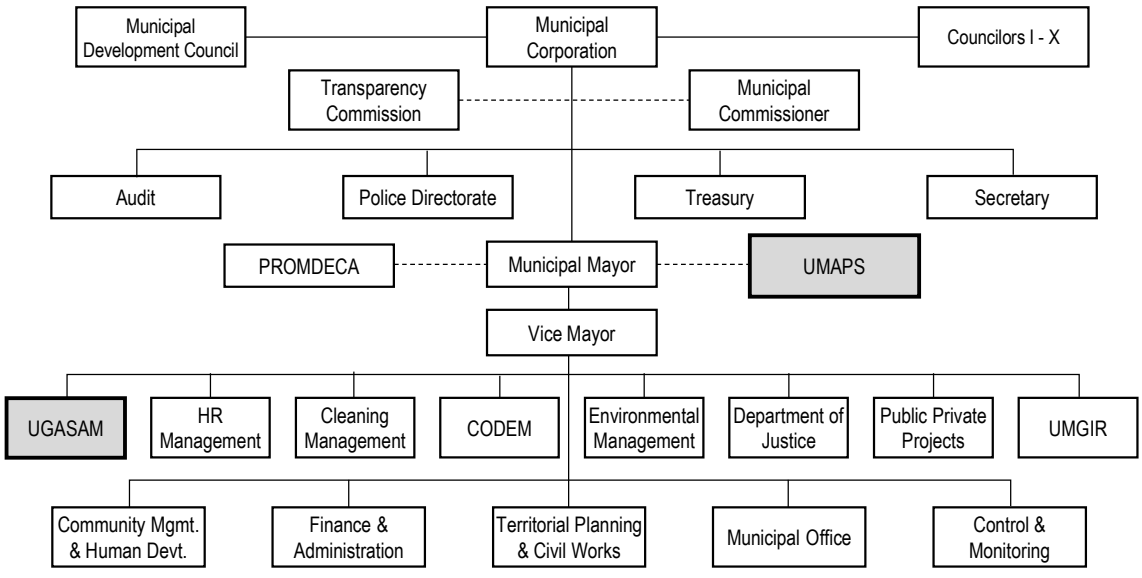


Figure 4-1-3Organizational Chart of AMDC

(3) Municipal Drinking Water and Sanitation Unit: (UMAPS)

UMAPS was created in 2015 as the receiving unit for the potable water and sanitation projects of the Metropolitan Division of SANAA. Due to the delay in the transfer, UMAPS began to operate provisionally from January 2021, and at that time only had the finance and accounting areas that had already completed the transfer. Subsequently, the relocation of operations progressed, and in September 2021, the following areas were gradually moved, with the new name of Administrative and Financial Sub-Management including administration and finance, Commercial Sub-Management responsible for tariff collection and user control; Human Resources Sub-Management responsible for human resources management; Sanitary Sewerage and Stormwater Drainage Sub-Management responsible for sewerage, waste treatment plants and stormwater drainage; and Potable Water Sub-Management including water supply and distribution service and operation and maintenance of the El Picacho, Los Laureles and La Concepción systems. In the future, the operations of the division responsible for ANF reduction and water leakage control, and the division responsible for construction management and hydraulic analysis are expected to be transferred.

The main operations of UMAPS are presented below.

- ❑ Identification of surface and groundwater, protection of aquifer recharge areas;
- ❑ Development of business management and investment plans to improve services;
- ❑ Operation, management and maintenance of drinking water and sanitation infrastructure;
- ❑ Definition of tariffs necessary for the provision of services, operation and maintenance of infrastructure and collection of tariffs;
- ❑ Implementation of alternative water storage and distribution programs for areas not currently covered by potable water services; and
- ❑ Development and execution of awareness-raising activities on environmental conservation, rational use of water, health and sanitation.

Figure 4-4 shows the organizational chart of UMAPS. The number of employees was 360 as of April 2021, however, in September 2021, 650 staff members are reported. In the organizational chart, the Departments and Divisions in pale orange color are those that were transferred from SANAA and those in yellow green color are in the process of being transferred as of September 2021.

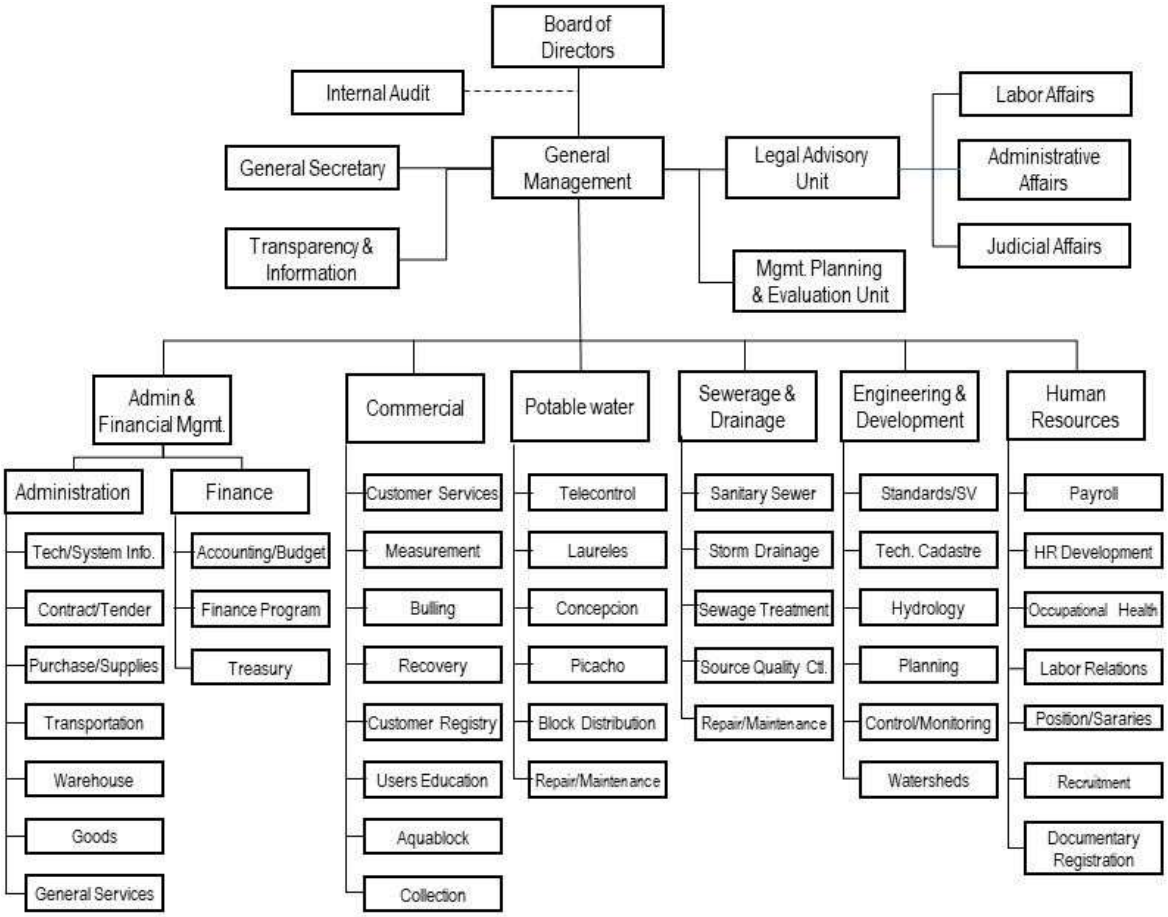
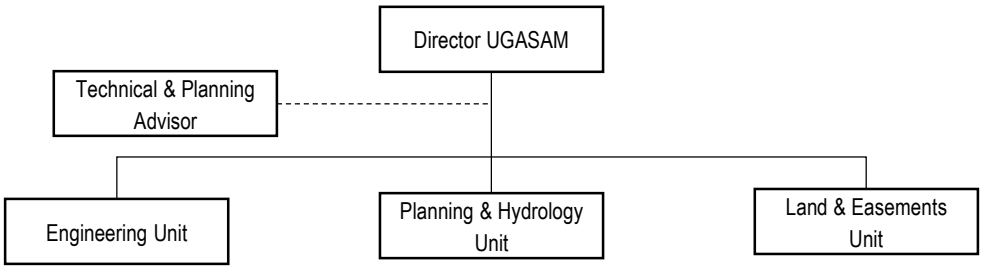


Figure 4-1-4UMAPS Organizational Chart

(4) Municipal Drinking Water and Sanitation Unit: (UGASAM)

UGASAM has been constituted as the municipal administrative unit responsible for the AMDC, and had 72 employees as of April 2021, and 8 in September 2021. UGASAM was inaugurated as a water and sanitation project management unit and functioned as a transfer coordinator during the period of transfer of SANAA operations to UMAPS, for this reason, more staff members were employed than originally assigned. With the transfer of operations, these staff members were assigned to UMAPS. The main functions of UGASAM are as follows.

- ❑ Processing of the transfer of the potable water and sanitation project of Tegucigalpa, currently operated by SANAA;
- ❑ Management of water, sewage and effluent disposal services by contracting a third party;
- ❑ Reception of assets related to SANAAA's water and sewerage and effluent disposal services; and
- ❑ Execution of the studies and activities required for the transfer plan included in the SANAA-AMDC agreement



* The Land and Easements Unit was eliminated; this unit will be called the Legal Advisory Unit.

Figure 4-1-5Organizational Chart of UGASAM

4-1-2 Transfer of SANAA services

(1) Transfer of Responsibilities from SANAA to UMAPS within Framework of Decentralization Policy.

The Government of Honduras has enacted in 2003 the "Ley Marco del Sector Agua Potable y Saneamiento" (Ley Marco) establishing the transfer of water and sewerage services from SANAA to the municipalities, who will contract their respective WSP with financial independence, and the Ente Regulador de los Servicios de Agua Potable y Saneamiento. Once its powers are transferred, SANAA will provide assistance to the municipalities as a technical advisory body. As part of this transfer of responsibilities, the systems of 33 districts have already been transferred to their respective municipalities, but not those of four districts including Tegucigalpa.

(2) Amendments to Institutional Agreement of Municipality

In Tegucigalpa, the UMAPS was created as the unit receiving SANAA services and the UGASAM as the unit in charge of policies, but due to financial constraints, the transfer process has not progressed as planned. Initially, the institutional framework of this unit established by the municipal ordinance had been very similar to that of SANAA, but after it was identified that insufficient and inefficient institutional management was one of the root causes of the deterioration of drinking water and sanitation services, the AMDC decided to correct the institutional and organizational structure of UMAPS. With this correction, the Mayor's Office is expected to defend the WSP from political intervention, and to develop aqueduct and sewerage systems capable of meeting the rapidly growing population's demand in a financially and environmentally sustainable manner. On the other hand, the UMAPS will have to prepare guidelines, manuals and operation and maintenance plans for the efficient provision of drinking water services.

(3) Severance Payment for SANAA Employees

One of the factors hindering the smooth transfer of services to UMAPS is the restructuring of SANAA staff and the payment of labor benefits. To date, SANAA has paid severance payment to some 700 employees because the Metropolitan Division will no longer be needed due to the transfer of potable water services functions and authority to UMAPS. The Honduran Labor Code establishes

that all employees who will be dismissed will receive severance pay. However, the Framework Law establishes that in order to materialize the transfer of services from the State to the municipalities, the system in question must not have any debt. In other words, the completion of the retirement pension payment to Metropolitan Division employees by SANAA constitutes the premise for the completion of the transfer process. It is estimated that SANAA will have to pay the retirement pension to about 1,000 employees before finalizing the transfer, the process of which is currently being assisted by the World Bank. [2]

(4) Gradual Transfer of SANAA Services to UMAPS

Ideally, all functions and assets should be transferred simultaneously, as has been done in other cities. However, the AMDC and SANAA have agreed to move the transfer process forward in a gradual manner, depending on the availability of resources. This mechanism of partially transferring functions and assets when the necessary resources are available, makes the disbursement necessary for UMAPS to start operations more flexible. According to the business plan elaborated in 2018, 900 people will be hired which include the new recruits but also part of the SANAA staff plant that will be laid off due to the transfer. On the other hand, according to the interview with the UMAPS Human Resources Deputy Manager in the September 2021 field survey, 744 people are planned to be hired as UMAPS officers based on the calculation of six people per 1,000 connections. At that time, the number of staff was 650. The transfer is expected to be completed by December 2021.

(5) Progress of Transfer to UMAPS as of September 2021

According to interviews with AMDC and the World Bank progress report, UMAPS began operations in January 2021, and at that time the transfer of the finance, commercial and administrative areas was almost completed. Subsequently, the drinking water supply system areas of El Picacho, Los Laureles, Concepción and sanitation service were gradually transferred in September 2021, where AMDC is in charge of operation and maintenance of the main drinking water and sanitation facilities. At the end of the same month, there were 650 officials in UMAPS (in April, there were 360), of which 44% of the total are former SANAA officials, 44% are new hires, and 12% are former AMDC officials including UGASAM. The number of design officials is 744 according to the calculation of six people per 1,000 connections, so it is planned to hire about 100 more people before December 2021.

The main reason for the delay in the transfer of SANAA operations to UMAPS was the dissatisfaction of many SANAA staff with the settlement and salary at AMDC after the transfer. Above all, senior staff with a lot of seniority tend to choose whether to stay with SANAA or retire, so there is a fear that it will be difficult to pass on technical knowledge to newly hired junior staff.

It should be noted that among the units pending transfer, SANAA's Operational Optimization, which is in charge of ANF reduction and leakage control, will be transferred to UMAPS' Drinking Water Sub-Management, and SANAA's Special Projects Division, which is in charge of construction

[2] World Bank, "*Tegucigalpa: "Project for the Strengthening of the Potable Water Service in Tegucigalpa (P170469)".*

management, and hydraulic analysis, will be transferred to UMAPS' Engineering and Development Sub-Management.

(6) Division of Labor

The following table summarizes the division of labor after the transfer of water business operations to UMAPS. The important work of financial planning and financing will be carried out by AMDC at the inter-agency level and the UMAPS Administrative Sub-Management internally. Also, project bidding, procurement and inventory management work will be carried out by UGASAM for large projects and UMAPS ADM for small projects and procurement.

The Engineering and Development Sub-Management will be in charge of technical planning, design, hydraulic analysis, ANF reduction and leakage control, energy efficiency and energy savings, IT data management, environmental management, etc., which suggests the importance of the active participation of the Engineering and Development Sub-Management for an efficient and sustainable operation of the water service. On the other hand, in September 2021, the Engineering and Development Sub-Management has only four employees, and so it is urgent to ensure and train human resources.

Table 4-1-1 Division of Labor of Drinking Water System

Duties and Activities	Department/Division in Charge	Remarks
Financial planning and financing	At the inter-institutional level: AMDC, At the internal level: UMAPS Administrative Sub-Management	
Bidding, procurement and inventory management	Large projects: UGASAM, Small projects: UMAPS Administrative Sub-management.	
Asset management	Warehouse Division of the Administrative Assistant Manager's Office	The assets belong to the AMDC.
Water accounting and rate setting	Deputy Finance Manager	To establish tariffs, ERSAPS approval is required, followed by AMDC approval.
Billing and recovery of fees and disclosure	Commercial Sub-Management	
Hydraulic design, planning and analysis	Engineering and Development	
Operation and maintenance of systems	Drinking Water Sub-Management	Operation and maintenance is performed by subsystem unit.
ANF reduction and leakage control	Analysis: Engineering and Development Sub-management, Field work: Drinking Water Sub-management.	
Water quality analysis and monitoring	Drinking Water Sub-Management	Subsystem analysis room
Energy efficiency and	Supervision: Engineering and	

energy savings	Development Sub-management, Field work: responsible for electromechanical of the Water Supply Sub-management.	
System monitoring (SCADA)	Drinking Water Sub-Management	Design and planning by the Engineering and Development Sub-Manager
Information and computer data management	Engineering and Development	
Human resources management and training	Human Resources Sub-Management	
Environmental management	Engineering and Development	Small projects: UMAPS, Medium projects: AMDC, Large projects: MIAMBIENTE
Sewerage and drainage system	Sanitary Sewage and Storm Drainage Deputy Manager	

4-1-3 Institutional Capacity

In this Survey, the capacity of the drinking water sector was evaluated, including the legal instruments, as well as the current technical, administrative and financial capacity of the WSPs by applying JICA's "Capacity Assessment Manual for Urban Water Supply and Drinking Water Services Sectors in Developing Countries" in order to assess the capacity and performance of the WSPs. It should be noted that this assessment is based on information obtained through interviews with the Metropolitan Division of SANAA conducted in March and April 2021.

(1) Operational Indicators of Water Service

For this purpose, benchmarking was carried out using the following main operational indicators to understand the challenges and difficulties faced by Tegucigalpa's drinking water service. While it is true that the Web database of the International Benchmarking Network for Water and Sanitation Utilities (IBNET) operated mainly by the World Bank accumulates data from WSPs in different countries, the data corresponding to the Metropolitan Division of SANAA, Tegucigalpa's aqueduct operator, have not been updated since 2014. In this Study it was decided not to use the IBNET data, but rather the updated data were obtained through interviews with SANAA and AMDC. Table 4-1-2 presents the main operational indicators for Tegucigalpa.

Table 4-1-2 Main Operating Indicators of Water Utility Service

Category			Indicator	Target
Requirement	Parameter	Issue		
Improvements that can be achieved through	General	Continuous supply	Supply time (hours/day)	8 hours ×10 times/month (Average: 2.6 hours/day)

investment in infrastructure (FI)	Expansion	Water service coverage	Water supply service coverage (%)	68.6 %
Improvements to be achieved with capacity building (CD)	Technical Aspects	ANF Management	ANF rate (%)	32.9 % (Average 2016-2020)
		Water quality management	Performance rate of residual chlorine tests at supply points (%)	16.7 %
	Non-technical aspects	Financial management	Turnover rate- W& WW (%)	85 %
			Operating profit margin excluding depreciation W&WW (%)	95.2 %
		Operational efficiency	Number of personnel per 1,000 connections (people)	8.3 persons
Improvements that can be achieved through project implementation	Balance between water and sewage systems	Coverage balance	Sewerage service coverage (%)	58.3 %

a) Service Time

Scheduled water supply is according to days and times for specific districts. The average supply time is eight hours/day/time, and ten times per month, which translates into 2.6 hours per day.

b) Drinking Water Service Coverage

The percentage of the population served by aqueduct is 68.6% including bulk water supply.

c) Unbilled Water (ANF)

The ANF rate is 32.9%, with a tendency to improve since it was 38% in 2016. It should be recalled that in this Survey the averages of the five years between 2016 and 2020 were used, by virtue of the fact that in 2019 water production was reduced due to the low water level, and in 2020 consumption was reduced due to the COVID-19 pandemic and the ANF rate was reduced more than the impact of the leakage control measures.

d) Performance Rate of Chlorine Residual Tests at Supply Points

The national drinking water quality standards establish the frequency of residual chlorine tests that must be performed at the water supply points. Due to the size of the population, it should be done six times a week, but in reality it is only done once a week, with an execution rate of 16.7%.

e) Collection Rate

According to SANAA's Financial and Administrative Sub-Management, the collection rate is 85%.

f) Number of Personnel per 1,000 Connections

The number of employees of SANAA's Metropolitan Division as of January 2021 is 1,008 people, and the number of connections is 123,377 connections. This translates to 8.2 employees per thousand connections.

g) Sewerage Service Coverage

Sewerage service coverage is 56.6 % according to 2018 IDB data. Based on these figures, the sewerage service coverage calculated based on the number of potable water connections as of 2020 is 58.3 %. The following table shows the data for the calculation of the operational indicators.

Table 4-1-3 Data for Calculation of Operational Indicators

Category			Indicator	Target
Requirement	Parameter	Issue		
Improvements that can be achieved through investment in infrastructure	General	Continuous supply	Supply time (hours/day)	8 hours ×10 times/month (Average: 2.6 hours/day)
	Expansion	Water service coverage	Population served (thousand inhabitants)	889,000 inhabitants (2020)
			Population of the service area (thousand inhabitants)	1,296,000 inhabitants (2020)
			Water production (millions of m ^{3}/year)	80,000,000 (m^3/year)
Improvements to be achieved through capacity building	Technical Aspects	Water quality management	Required frequency of chlorine residual testing of treated water (times/year)	3120 times/year (10 samples × 1 time/week)
			Tests performed for chlorine residual in treated water (times/year)	520 times/year (10 samples × 1 time/week)
		ANF Management	Invoiced volume (million m ^{3}/year)	53,600,000 (m^3/year)
			Number of connections (thousand connections)	123,000
	Non-technical aspects	Financial management/ Water rate	Total operating profit - W&WWW (LC/year)	996 million (HNL/year)
			Total costs collected - W&WWW (LC/year)	689 million (HNL/year)
			Total operating costs excluding depreciation - W&WW (LC/year)	1,046 million (HNL/year)
		Operational efficiency / training	Total number of employees in charge of water supply (expressed in full time staff)	1008 (January 2021)
Improvements that can be achieved	Balance between water and	Coverage balance	Population served by sewer system (thousand inhabitants)	755,000 inhabitants (2020)

through programs	sewage systems		Population of the sewer service area (thousand inhabitants)	1,296,000 inhabitants (2020)

(2) General Information on Water Sector

The general situation of the drinking water sector is summarized below, following the order of the checklist.

Table 4-1-4 General Situation of Drinking Water Sector

	Indicators, Variables	Numerical Data	Sources
Drinking water supply at the national level			
1-1. Indicators			
1)	Drinking water service coverage	Percentage of household water connection: 96 %. Other water supply services: 88	JMP 2017
2)	Sewerage service coverage rate	Improved sanitation: pit latrines 24 %. Septic tanks 26 %, sewerage 40 %.	JMP 2017
3)	Poverty indicators	GDP per capita: $ 2390 Percentage of population with median income <$1/day: 38.05 %. Poverty gap rate (median income <$1.25/day): 38.7%.	GNI per capita Atlas method INDICATORS COUNTRY FIGURES 2019. INE.gob.hn.
4)	Level of corruption	Corruption Perceptions Index: 26 Ranking: 146/180	Global Corruption Report of Transparency International, 2019.
1-2. Level of drinking water services			
1)	Gap	The level of potable water services varies substantially depending on the size of the population served. This is due to the ease of access to financing in the urban area.	Interview with SANAA
2)	Continuity	Number of cities with continuous potable water service: 4	Interview with SANAA
3)	Chlorination	In general, the WSPs perform drinking water chlorination, with the exception of some rural aqueduct systems.	Interview with SANAA
2. Policies, plans, laws, regulations and guidelines			
2-1. Indicators			
1)	Policies and plans	State policy covers the "user pays" principle, the concept of full cost recovery, and affordability. There are sectoral policies referring to the minimum level of drinking water services, including quality, time and volume of supply, water supply to the poor population, development of water sources, and training of human resources. Meanwhile, there are no policies but only ANF reduction, water economy and leakage management programs.	Interview with SANAA

2)	Laws and regulations	There are guidelines on the definition of water tariffs, water quality standards, approval standards for aqueduct equipment and materials, design, operation and maintenance standards, bulk water supply, WSP governance and management, and environmental impact assessment.	Interview with SANAA
3)	Guides	There is the General Water Law, regulations to promote citizen participation, municipal aqueduct ordinances, laws regulating the use and management of groundwater, etc., but not the system of authorizations and licenses for plumbers to reduce water leaks.	Interview with ERSAPS
4)	Integration	Current policies, plans, laws, regulations and guidelines are integrated and coherent, without generating conflicts or administrative problems in the water sector.	Interview with SANAA
5)	Tariff	Supervising entity of the minimum level of services and water tariffs of the WSP: Municipality (mayor). The "Ley General de Aguas" requires WSPs to comply with the "user pays" principle, full cost recovery concept, autonomy of the accounting system, as well as adequate water tariffs.	General Water Law
6)	Poverty	The central government provides subsidies to reduce poverty in water supply to a more adequate level compared to other sectors.	Interview with SANAA's Operation Unit
7)	Water quality management	Test parameters performed by WSP: routine tests less than 10 National water quality laboratory that can assist in the development and modification of drinking water quality standards, including the selection of appropriate test methods for each indicator: SANAA Metropolitan Water Quality Control Laboratory (Los Laureles Drinking Water Treatment Plant).	Quality of Service Regulations (ERSAPS)
3. Operational balance between sectoral agencies			
3-1. Governance management			
1)	Government	The central government has issued documents on the updated division of responsibilities clarifying the roles and responsibilities of the Ministry, regulator and water service providers.	Interview with SANAA
2)	Regulatory Entity	Entity that oversees compliance and performance of drinking water service providers: ERSAPS The regulatory body is sufficiently autonomous to be able to supervise the drinking water service providers free of personal political influence, budget or tariff definition. The PI to statistically understand the performance of existing drinking water service	Drinking water and sanitation sector law 2018 indicators water and sanitation of Honduras

		providers is used in the evaluation of business management. Water tariffs are defined by the municipalities or the central government.	
3)	Water service providers (WSPs)	As for the human resources management of the HPS, the mayor of the municipality appoints its personnel. The president of the WSP has independent powers in the operation and maintenance of the infrastructure, but is not entirely independent. Regarding the hiring of WSP employees, the central government and municipalities exert strong influence, but powers have been transferred to each WSP. The water tariff has been pressured by political influence and has not been reviewed for several years. WSP salaries and benefits and social security are low compared to private companies, if compared to employees of private companies with the same qualifications (more than 50 % and less than 100 %). WSP do not apply incentives to achieve performance improvement (salary increase and promotion according to individual performance, bonus, etc.).	National Policy Interview with SANAA
3-2. Coordination of financial sources			
1)	Investment	The central government and municipalities' procedures for accessing low-interest funds and subsidies for WSP to improve infrastructure are working relatively well. (Budget allocation is limited because demand is greater than supply). Companies and public entities are required to disclose all information on the transparency portal. Regarding the water sector, the level of accessible and publicly available information is high in order to attract investments from different donors and the private sector. In terms of investment in the urban water sector over the last five years, investments by national and international NGOs have increased in accordance with the National Plan and the Country Vision.	National Policy Law on transparency and access to public information CONASA Report
2)	Subsidies	The central government does not offer a scheme of access to subsidies and low-interest loans to WSPs that meet specific requirements, for capital investment, such as development of supply sources, construction of water treatment plants, expansion of distribution networks, etc. Regarding electricity tariff subsidies for WSPs, there is no inter-ministerial agreement (e.g., subsidy for WSPs from the Ministry of Energy or its attached institutions).	National Policy Interview with SANAA

3)	Private sector	The private sector is not involved in the operation and maintenance of drinking water services. Private intervention in the management of water services consists mainly of investment in the development of new sources of supply, which is expected to increase substantially in the coming years.	Interview with SANAA
4. Capacity building assistance			
1)	Training center	Execution of group training of plumbers by the state agency: INFOP Supply of programs that meet the needs of technicians. Improvements are needed in training space, facilities and equipment, financing, program planning and management capacity, etc.	INFOP (National Vocational Training Institute)
2)	Regulatory Entity	There are several training courses for the regulatory agency, ERSAPS.	Interview with SANAA
3)	Cooperative relationship	Organizations coordinating communication with different interests at the state and regional levels of the drinking water sector: SANAA, ERSAPS, CONASA. Organizations that conduct ongoing research in the water sector: ERSAPS and CONASA. There is no exchange of training courses among the WSPs, nor is there an entity that sends instructors to the WSPs.	Interview with SANAA
	Training of small contractors	Training to small contractors who execute the works of laying service pipes, water meters, distribution pipes, etc. on the quality management of the works.	ERSAPS
5. Other local stakeholders			
1)	Beneficiaries	Reports of socioeconomic studies: Available	ERSAPS
2)	Donors	Individual exchanges and discussions are the only means of coordination between donors and municipalities on the allocation of projects, etc. There is no coordination mechanism between donors.	Interview with SANAA
3)	Small water operators	There is no adequate control of the micro systems or community water supply systems, nor of the water vendors, and their operators do not comply with the established rules.	Interview with SANAA

(3) UMAPS General Information

a) Type of Entity Providing Drinking Water Services

- Name: Municipal Drinking Water and Sanitation Unit (UMAPS)
- Head of Unit: Mr. Nasry Afura, Mayor of Tegucigalpa
- Date of establishment: February 14, 2015
- Fiscal year: Starts in January
- Operations: Aqueduct, sewerage, waste, water quality analysis, storm water evacuation

(programmed for the future)

- Operational modality: Municipal waterworks entity (attached to the Mayor's Office, but with financial and administrative autonomy).

b) Private Sector Participation and Contracting

The participation of the private sector in drinking water services is limited to service contracts for the supply of chemicals for drinking water treatment, and rental of public land (for shopping centers, etc.).

For the appropriation of various operations to the private sector, the WSP must secure the budget. The design and execution of major works are outsourced. Planning, procurement, operation and maintenance, monitoring, etc. are assumed by the WSP itself.

c) Information Sources such as Annual Reports and Pipeline Database

SANAA's Metropolitan Division has published the triennial reports through 2018, which include annual executed budgets, balance sheets, revenue statistics, volume treated, etc. The triennial reports are prepared every three years, and it is expected that SANAA will take over the publication of the next version of the report (2018-2021) in the midst of the process of transferring the operations of the latter to UMAPS.

On the other hand, part of the data has been transferred to UMAPS in this transition stage, but the data on infrastructure and pipelines are being archived by each corresponding unit of SANAA.

Table 4-1-5 SANA Metropolitan Division Data Management

Data Classification	Responsible SANAA Unit	Progress in Ttransfer to UMAPS
Water sources (water catchment, volume of raw water)	Metropolitan Division Planning Unit	Not completed
Potabilization (quality of raw water and treated water)	Metropolitan Division Operation Unit	Not completed
Pumps (flow, pressure)	Metropolitan Division Operation and Maintenance Unit	Not completed
Accounting/financial management	Finance Unit	Some, but not all, of the operations have been transferred to UMAPS.
Billing / customer management	Metropolitan Division Business Unit	Some, but not all, of the operations have been transferred to UMAPS.
Asset and infrastructure maintenance	Finance Unit	Not completed
Monitoring and evaluation (KPIs)	Metropolitan Division Administrative Unit	Not completed
Human resources management	Metropolitan Division Administrative Unit	Not completed

d) Characteristics of Area Served

The area served is characterized as an urban area and its surroundings. The total population of the city of Tegucigalpa amounts to approximately 1.3 million inhabitants, of which the population served (with connection pipes) amounts to about 900 thousand inhabitants.

The number of connections by customer type are: residential 114,589; non-residential (industrial, commercial, institutional, etc.) 8,603; bulk water supply 185, totaling 123,377 connections. Non-residential customers represent 7.1% of the total, with most of the customers being residential. For reference, the average number of family members per household is approximately five people.

e) Financial Management of Fixed Assets Related to Water System

The fixed assets of the WSP include the dam, water treatment plants, pumping stations, distribution stations, wastewater treatment plant, wastewater pumping stations, wells, administration building, materials warehouse, and surveillance center for the protection of the basin. The depreciation of these facilities and infrastructure is included in the financial statement every year.

f) System Automation

Of WSP operations, document management, asset and infrastructure management, billing, customer management, accounting and claims handling have been digitized, as well as water treatment and human resources management are automated. On the other hand, most of the pump operations are carried out manually, with only 5 % being automated.

g) Water Sources and Water Purification System

The main sources of water supply in the city of Tegucigalpa are dams, rivers and deep wells. The drinking water treatment system consists of coagulation, sedimentation, filtration and chlorination.

h) Sectoral Reform

Currently, the transfer of potable water services to the AMDC UMAPS from the Metropolitan Division of SANAA belonging to the central government is in process and is expected to be completed by the end of 2021, according to SANAA's expectations. During this process, SANAA continues to operate the systems. However, the lack of resources due to the delay in the capitalization of the investment is affecting the start-up of new services, as well as the repair of deteriorated distribution networks.

On the other hand, the target year of PLANASA (2014-2022) that constitutes the master plan at the national level is defined in the next year, in addition to the fact that the master plans at the Tegucigalpa level (Master Plan for Improvement 1984-2004 and the JICA Master Plan 2001-2015) have already expired.

(4) Evaluation of WSP using Basic Checklist

Based on the basic information gathered on the HPS, the Study Team quantified and evaluated institutional capacity. This work has been carried out together with the Honduran executing agency,

and consisted of plotting the scores obtained to identify the areas requiring strengthening, which information will serve as a basis for discussing the direction of capacity building assistance.

Table 4-1-6 Basic WSP Checklist

Category(Dimensions, Aspects and Elements)			Questions	Responses	Rating
Improvements that can be achieved through investment in infrastructure (FI)	General		Q1.Medium and long term plan	They exist, but the horizons have past long ago.	2
			Q2. Continuity of water supply	Average 2.6 hours/day	1
	Expansion	Drinking water service coverage	Q3. Overall average drinking water coverage	68.6 %	2
			Q4. Water for the poor stratum	About half of the poor population receives water from the aqueduct.	2
		Water treatment plants	Q5. Reserve capacity of the water treatment plants.	-23.3 %	1
	Repair and replacement	Infrastructure conditions	Q6. Conditions and renovation of civil works	Leaks in civil works are constantly occurring, which can be solved with partial repair.	2
			Q7. Conditions of the main transmission and distribution lines	Use of obsolete asbestos pipes and cast iron pipes: less than 10%.	5
			Q8. Terms and conditions of connection services	Between 60 and 70 % of the connection pipes are more than 25 years old since their installation.	3
			Q9. Mechanical and electrical equipment conditions	Less than 10 % of mechanical and electrical installations are out of service due to serious failures	3
Improvements to be achieved with capacity building (CD)	Technical Aspects	General	Q10. Operation and maintenance of infrastructure	Facility operation and maintenance manuals exist but are not effective.	3
		Distribution network management	Q11. Drawings of piping installations	Almost all are available, and a simple GIS system	3

				has been implemented.	
			Q12. Zoning of the distribution network	There are systematized distribution areas, but there are almost no properly zoned distribution networks within each distribution district.	2
			Q13. Water pressure at supply points	Water pressure at almost a quarter of the supply points is not within the 10-45 m range.	3
		ANF Management	Q14. ANF Rate	32.9 %	3
			Q15. Installation of water meters	Water micro-meters are hardly used because they apply a fixed tariff.	1
			Q16. Bulk water meter installations	The necessary bulk water meters have not been sufficiently installed.	2
		Water quality management	Q17. Water quality tests at the drinking water treatment plant.	Water quality control is performed in accordance with the daily and continuous water quality monitoring plan, using appropriate test methods and properly maintained laboratory equipment.	4
			Q18. Potability of tap water	There are some districts whose tap water does not meet benchmark water quality standards. However, it is potable when boiled.	3
	Non-technical aspects	Financial management	Q19. Level of cost recovery	The operation and maintenance costs of the water systems are only	1

				partially covered by the tariff.	
			Q20. Fee collection rate	85 %	3
		Institutional development	Human resources management and promotion rules Q21.	The labor and basic wage definition rules are not clear.	1
			Q22. Execution of training	Training courses are given on certain topics.	2
		Attention to the community	Q23. Claims handling	The system is in place and the procedures for dealing with complaints are established, but there is a large number of unresolved complaints.	3
			Q24. Awareness-raising activities	Several awareness-raising activities have been carried out to date.	2
Improvements that can be achieved through project implementation.			Q25. Laws and regulations related to the drinking water sector.	The General Water Law establishes the autonomy of the accounting management of drinking water services.	3
			Q26. Sewerage service coverage	58.3%	4

The results of the checklist are presented below.

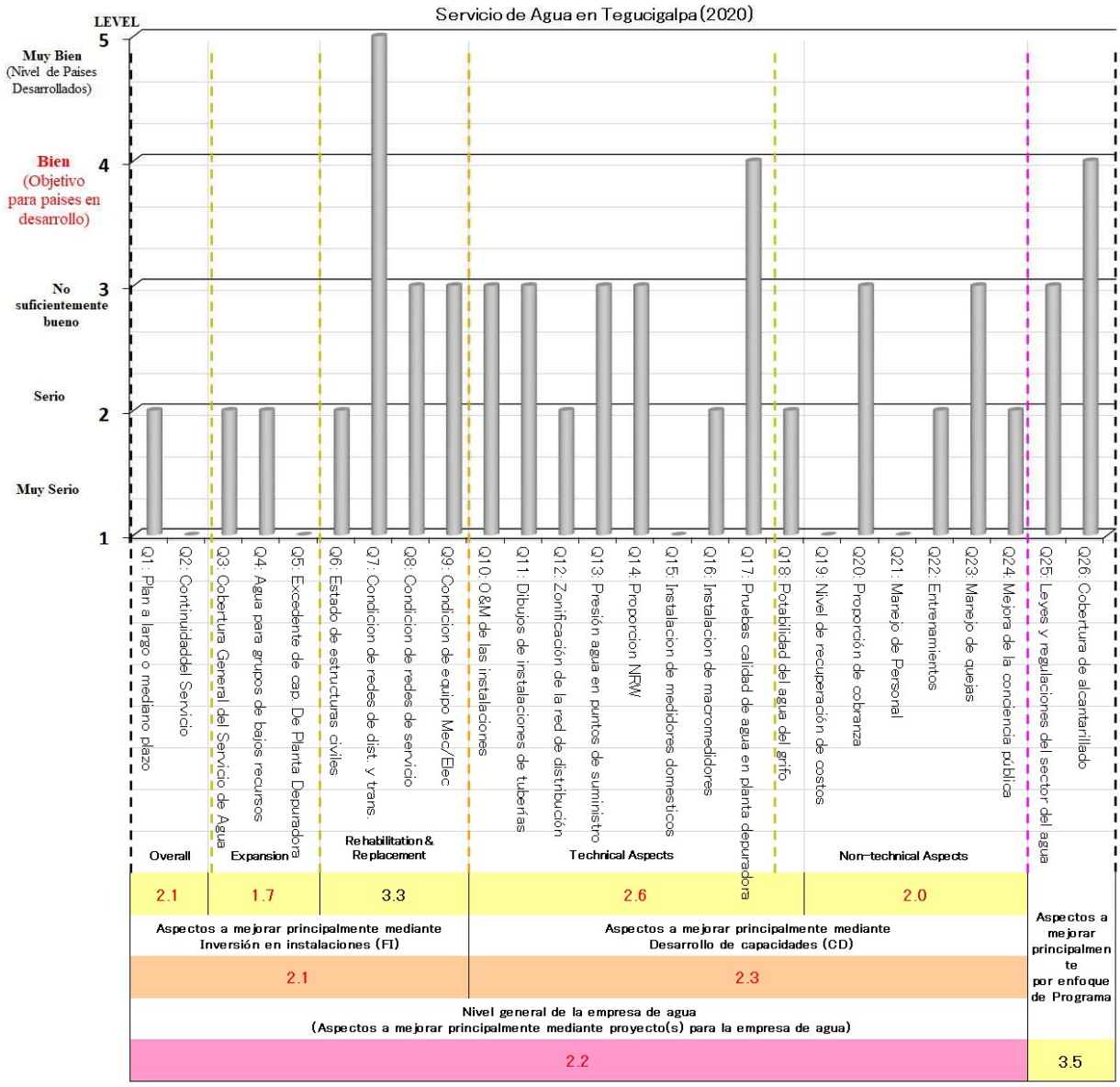


Figure 4-1-6Graph of Institutional Capacity of HPSs

Few variables scored four points, and there are numerous variables with less than three points. The lack of capacity is more accentuated in the financial and managerial aspects, rather than technical, and it is necessary to strengthen these variables as a priority in order to build an organization capable of operating drinking water services in a sustainable and stable manner.

4-1-4 Administrative and Financial Situation

(1) Water Tariff System

Tegucigalpa's water tariffs are basically volume-controlled, with the exception of customers without micro-meters who are charged at a flat rate. Residential users are classified into four categories

according to income level and geographic areas, and as consumption increases, the unit price for water and sewerage gradually increases, as well as the costs of meter management and fixed connection charges. The sewerage tariff is set at 25% of the potable water tariff. The meter management cost is defined at 1.5 HNL, and the fixed connection cost is deferred according to classification. Unmetered customers are charged a fixed tariff resulting from the minimum tariff plus the sewerage tariff, meter management cost and fixed connection cost. The following table presents the potable water tariff system

Table 4-1-7 Water Tariff System

Customer Classification	Consumption (m^3)	Minimum Rate (HNL/month)	Unit Price (HNL/m^3)	Fixed Rate	Calculation Example (HNL) General Residential	
General residential 1 (Poor areas)	0-20	31.8	1.59	Exonerated	(Residential 1) In the case of consumption of 20 m^3/month of water	
	21-30		3.17		20 m^3x L.1.59	31.80
	31-40		5.23		Sewerage cost L.31.80 x 25 %.	7.95
	41-50		9.1		Cost of meter control	1.50
	51-55		12.92		Fixed connection fee (exemption)	0.00
	56 or more		15.11		**Total**	**41.25**
General residential 2	0-20	65.6	3.28	25,00	(Residential 2) In the case of consuming 25 m^3/month of water	
	21-30		4.05		L.65.6 + 5 x L.4.05	85.85
	31-40		6.18		Sewerage cost L. 85.85 x 25 %.	21.46
	41-50		10.54		Cost of meter control	1.50
	51-55		13.12		Fixed connection fee (L.25.00)	25.00
	56 or more		16.79		**Total**	**133.81**
General residential 3	0-20	88.4	4,42	70,00	(Residential 3) In the case of consumption of 35 m^3/month of water	
	21-30		5.23		L.88.4 + 10 x L.5.23 + 5 x L.7.37	177.55
	31-40		7.37		Sewerage cost L. 177.55 x 25%.	44.39
	41-50		11.4		Cost of meter control	1.50
	51-55		14.42		Fixed connection fee (L.70.00)	70.00
	56 or more		18.24		**Total**	**293.44**
General	0-20	141.6	7.08	150.00	(Residential 4) In the case of consumption	

residential 4					of 50 m ^{3}/month of water	
Economically favored area	21-30		8.9		L141.6+10x8+10x10.93+10x13.58	475.70
	31-40		10.93		Sewer cost (679.70 x 25%) 169 .75	169.75
	41-50		13.58		Cost of meter control	1.50
	51-55		16.86		Fixed connection fee (L.150.00)	150.00
	56 or more		19.42		**Total**	746.13
Commercial	0-20	119	5.95	175.00		
	21-30		7.96			
	31-40		12.17			
	41-50		16.03			
	51 or more		22.48			
Industrial	0-20	299.6	14.98	250.00		
	21-40		19.67			
	41 or more		29.12			
Government	0-20	299.6	14.98	150.00		
	21-40		19.57			
	41 or more		29.12			
Water seal	0-40	116	2.9	Exonerated		
	41 or more		2.9			

Meter coverage in Tegucigalpa is reported to be approximately 39%; however, this figure does not include meter failures or inadequacies. As a result of the spread of COVID-19, meter reading activities are more difficult to perform, so all areas, including areas that were charged by consumption, now pay a flat rate. However, in view of the drastic reduction in tariff revenues, the consumption-based tariff regime was resumed as of March 2021.

Although the Commercial and Finance Deputy Managers have been transferred from SANAA to UMAPS, the collection of tariffs continues to be made in the name of SANAA, and invoices and receipts are issued in the name of SANAA. The fee payment windows were at the central SANAA, however, after the spread of COVID-19, the windows were closed, and in September 2021, the fee payment is made only through automatic payment from the bank account or online payment.

On the other hand, the rate of tariff recovery is approximately 50%, with a high percentage of payment in middle and upper class households and the commercial and industrial sectors. Of the defaulters, 20% pay the tariff after the second billing; however, the remaining 30% remain in arrears even after the second billing. Usually, when the water rate is not paid for a month, measures are taken

against the defaulters, which is the suspension of water service; however, as of March 2020, due to the stagnation of economic activities due to the COVID-19 pandemic, the measure of suspension of drinking water service was interrupted. However, due to the reduction in tariff revenues due to the 35% increase in delinquent payments, the water service suspension measure was resumed as of March 2021. The supply will be resumed when the delinquent user has paid the outstanding fee and the reconnection fee at the SANAA payment window.

The population of the areas of Tegucigalpa that are not covered by the aqueduct purchase water from private tanker, and these areas are called "bloques". These companies fill their tanker with SANAA/AQUABLOCK and transport it to the communities. The price is higher than the price paid by volume-controlled users. According to the interview conducted by the Study Team, the price of water from tanker trucks is between 10 and 15 times higher than SANAA's water tariff.

(2) Financial Income and Expenses

The profit and loss balance sheet and the financial balance sheet of the Metropolitan Division of SANAA for the last five years (2016-2020) are presented below. It should be noted that in government institutions in Honduras, as of 2015, the software program called SIAFI (Integrated System of Administration and Finance) of the Ministry of Finance is used, and so in the Metropolitan Division of SANAA, the financial balances are also recorded in the SIAFI format.

Table 4-1-8 SANAA Metropolitan Division Profit and Loss Statement (2016-2020)

Unit: Lempiras

Item	2016	2017	2018	2019	2020
Income					
Tariff revenues	**607,770,675**	**612,786,356**	**603,600,808**	**565,647,069**	**523,008,238**
* Flat rate	103,787,742	88,123,406	60,658,379	61,903,432	60,782,605
Water rate based on meter reading	375,569,899	389,173,278	338,667,886	325,294,877	303,196,584
Water rate not based on meter reading (average)	136,569,532	140,022,813	202,996,965	187,249,707	184,749,422
Regulated water rate billing adjustment	(20,474,256)	(23,799,431)	(22,682,277)	(31,519,223)	(36,776,660)
Other water sales	12,317,758	19,266,291	23,959,856	22,718,275	11,056,287
Other income	**270,833,533**	**297,879,496**	**611,747,897**	**322,697,725**	**868,366,775**
Other income	11,873,974	17,404,813	3,599,116	2,330,206	3,205,572
Water connection fee (operation of aqueducts)	81,335,210	94,213,071	92,948,040	93,877,171	93,926,237
Sewer rate	113,900,685	117,482,953	123,839,178	117,976,702	111,599,747
State subsidies transfers received	-	-	286,530,934	1,233,224	543,294,898
Financial income	63,723,664	68,778,658	104,830,629	107,280,422	116,340,321
Total income	**878,604,209**	**910,665,852**	**1,215,348,706**	**888,344,793**	**1,391,375,013**
Expenses					
Cost of operation and maintenance of aqueducts	**444,366,214**	**452,400,937**	**452,963,586**	**479,637,918**	**372,260,574**
Catchment facilities	46,273,526	44,560,142	45,132,375	46,903,813	40,423,429

Pumping stations	126,582,805	145,459,136	148,006,155	158,863,617	127,421,553
Water treatment plants	88,858,255	87,297,307	94,763,423	102,382,181	41,531,721
Pipelines, distribution and transmission lines	182,651,629	175,084,352	165,061,633	171,488,306	162,883,870
Sewer operation and maintenance	**40,481,749**	**43,153,353**	**42,143,473**	**41,918,466**	**37,230,949**
Wastewater pipeline	40,481,749	43,153,353	42,143,473	41,918,466	37,230,949
Pumping and sewerage stations	-	-	-	-	-
Depreciation	71,690,760	71,607,600	71,607,600	71,607,600	71,607,600
Operating expenses	**441,870,207**	**617,076,483**	**727,795,597**	**445,621,671**	**912,506,574**
Commercial	84,246,327	75,284,623	72,289,729	72,006,278	62,218,573
Administrative	351,457,950	524,919,574	623,589,184	342,647,789	813,451,513
Financial	6,165,929	16,872,286	31,916,683	30,967,604	36,836,488
Total expenses	**998,408,931**	**1,184,238,372**	**1,294,510,256**	**1,038,785,655**	**1,393,605,697**
Surplus (or Deficit)	**(119,804,722)**	**(273,572,520)**	**(79,161,551)**	**(150,440,861)**	**(2,230,684)**

* Data only for the districts of Amapala, El Progreso, La Ceiba adjacent to Tegucigalpa.
Source: Budget and Accounting Unit of SANAA

The costs of infrastructure construction and renovation of major facilities are accounted for in separate accounts from the corresponding projects and are therefore not included in the profit and loss balance sheet. Once the management responsibility for the water and sewerage systems has been transferred from SANAA to UMAPS, both the general accounts and the project accounts including construction and renovation costs will pass under the control of UMAPAS.

According to the profit and loss balance sheet (Table 4-1-8), expenditures exceed revenues in the management of the Metropolitan Division of SANAA over the past five years. In 2020, potable water consumption was reduced due to the stagnation of economic activities because of the COVID-19 pandemic, and therefore, operating and maintenance expenses for facilities and infrastructure were substantially reduced. However, in return, retirement pension payments associated with the transfer of operations increased dramatically. As a result, expenses exceeded revenues this year as well.

Looking at the change in revenues, they increased year over year between 2016 and 2018, but decreased in 2019 to three-quarters compared to the previous year because of the drought. In 2020, tariff revenues were reduced due to reduced consumption for the reason stated above, but the amount of state subsidy for the payment of retirement pensions associated with the operating transfer was so high that higher revenues were recorded in the last five years.

In terms of expenses, the cost of operation and maintenance of infrastructure and facilities did not change between 2016 and 2018, but expenses showed an increasing trend due to the increase in operating expenses. In 2019, expenses experienced a decrease due to the substantial decrease in operating expenses. In 2020, the highest expenses in the last five years were recorded due to the increase in operating expenses, despite a reduction in aqueduct operation and maintenance costs. Of the operation and maintenance expenses for drinking water facilities in 2020, operation and maintenance expenses for water treatment plant operations were reduced to approximately 40% of the

previous year's expenses. This is due to the surplus of chemicals (chlorine gas) purchased in massive quantities in the previous year were used in the following year. In addition, the volume of treated water was reduced due to the COVID-19 pandemic, and for these reasons, the reduction of these expenses are remarkable. The reason for the increase in operating expenses (administrative expenses) in 2020 is due to the increase in the payment of retirement pensions for SANAA employees as a result of the transfer of operations.

Table 4-1-9 Financial Balance of Metropolitan Division of SANAA (2016-2020)

Unit: HNL

Item	2016	2017	2018	2019	2020
Assets					
Fixed assets	**7,612,873,155**	**7,501,545,516**	**6,328,303,491**	**6,156,108,374**	**6,089,586,478**
Assets and facilities in services	4,241,026,025	4,293,073,475	4,561,981,806	4,377,837,457	4,311,315,561
Projects under development	3,371,847,131	3,208,472,042	1,766,321,685	1,778,270,917	1,778,270,917
Deferred assets	**238,647,590**	**113,961,057**	**19,136,511**	**19,090,436**	**19,090,436**
Guarantee Deposits	116,060	116,060	116,060	69,985	69,985
Depreciation costs	20,223,581	19,020,451	19,020,451	19,020,451	19,020,451
Accounts receivable (investments to be distributed)	218,307,949	94,824,546	0	0	0
Accounts receivable project	0	0	0	0	0
Current assets	**1,205,940,705**	**1,261,050,190**	**1,346,473,842**	**1,424,462,742**	**1,841,390,287**
Cash and banks	61,473,431	21,025,576	60,064,918	55,149,891	270,827,366
Accounts receivable net	985,612,257	1,104,749,429	1,157,606,476	1,218,419,422	1,415,361,775
Other accounts receivable	5,434,757	15,451,757	18,877,069	18,192,441	21,828,759
Equipment Inventories	153,420,260	119,823,428	109,925,380	132,700,988	133,372,387
Prepaid expenses	0	0	0	0	0
Other assets	**852,075**	**0**	**0**	**0**	**0**
Total assets	**9,058,313,525**	**8,876,556,763**	**7,693,913,844**	**7,599,661,552**	**7,950,067,202**
Equity and liabilities					
Contributions	**6,140,351,954**	**5,907,594,042**	**5,404,482,503**	**5,421,445,436**	**5,400,922,261**
Contribution for Projects	**3,365,008,791**	**3,348,399,990**	**2,536,657,751**	**2,535,710,398**	**2,535,710,398**
Surplus (Deficit)	**(1,442,247,379)**	**(1,696,691,170)**	**(1,821,647,831)**	**(1,969,941,216)**	**(1,968,319,271)**
Deferred gains and losses of the prior period	(1,322,442,657)	(1,423,118,650)	(1,742,486,280)	(1,819,500,454)	(1,966,088,587)
Profit for the year	(119,804,722)	(273,572,520)	(79,161,551)	(150,440,761)	(2,230,684)
Project-related accounts payable	**0**	**0**	**0**	**0**	**0**
Long-term loans	**20,440,705**	**0**	**0**	**217,896,953**	**217,896,953**
Current liabilities	**974,759,453**	**1,317,253,901**	**1,574,421,420**	**1,394,549,980**	**1,763,856,861**
Short-term loans	22,625,170	236,807,681	272,422,066	27,454,141	43,443,428
Notes and accounts payable	940,800,628	1,072,760,341	1,292,709,871	1,351,714,129	1,705,197,775
Other payables	11,333,655	7,685,880	9,289,483	15,381,710	15,215,658
Total Equity and Liabilities	**9,058,313,525**	**8,876,556,763**	**7,693,913,844**	**7,599,661,552**	**7,950,067,202**

Looking at the balance sheet in Table 4-1-9, while fixed assets show a decreasing trend in recent years, current assets show a trend of relative growth. On the other hand, both assets and liabilities tend to decrease. From the financial indicators calculated by applying these figures (Table 4-1-10), it is observed that the business management tends to decrease slowly between 2018 and 2020, although it has not reached the level of considering as financial difficulties. Therefore, it is considered necessary to improve the situation in the coming years. The stockholders' equity ratio decreases year by year, but remain at a high level of 75.1 %, which translates into stable business management. On the other hand, the debt ratio (the lower the better) is not high at 33.2 % in 2020, but shows an increasing trend in the last five years. The fixed asset ratio exceeds 100 % after 2018, when the ideal ratio is considered to be less than 100 %. Still, the level is considered to be healthy. The ratio of current assets to current liabilities of SANAA remains in the order of 100 % in recent years, when the level of 150 - 200 % is considered to represent that the management is stable. It is said that the Metropolitan Division of SANAA and the Deputy Finance Management of UMAPS do not use their own indicators, and the trend analysis is performed by comparing the parameters with those of the previous year.

Table 4-1-10 Financial Indicators of Metropolitan Division of SANAA (2016-2020)

Unit: HNL

	2016	2017	2018	2019	2020
a. Assets and liabilities	995,200,159	1,317,253,901	1,574,421,420	1,612,446,933	1,981,753,814
b. Shareholders' equity (net assets)	8,063,113,366	7,559,302,862	6,119,492,424	5,987,214,619	5,968,313,388
c. Total assets (a+b)	9,058,313,525	8,876,556,763	7,693,913,844	7,599,661,552	7,950,067,202
d. Equity ratio (b/c)	**89.0 %**	**85.2 %**	**79.5 %**	**78.8 %**	**75.1 %**
e. Liability ratio (a/b)	**12.3 %**	**17.4 %**	**25.7 %**	**26.9 %**	**33.2 %**
f. Fixed assets	7,612,873,155	7,501,545,516	6,328,303,491	6,156,108,374	6,089,586,478
g. Fixed asset ratio (f/b)	**94.4 %**	**99.2 %**	**103.4 %**	**102.8 %**	**102.0 %**
h. Current assets	1,205,940,705	1,261,050,190	1,346,473,842	1,424,462,742	1,841,390,287
i. Current liabilities	974,759,453	1,317,253,901	1,574,421,420	1,394,549,980	1,763,856,861
j. Ratio of current assets to current liabilities (h/i)	**123.7 %**	**95.7 %**	**85.5 %**	**102.1 %**	**104.4 %**

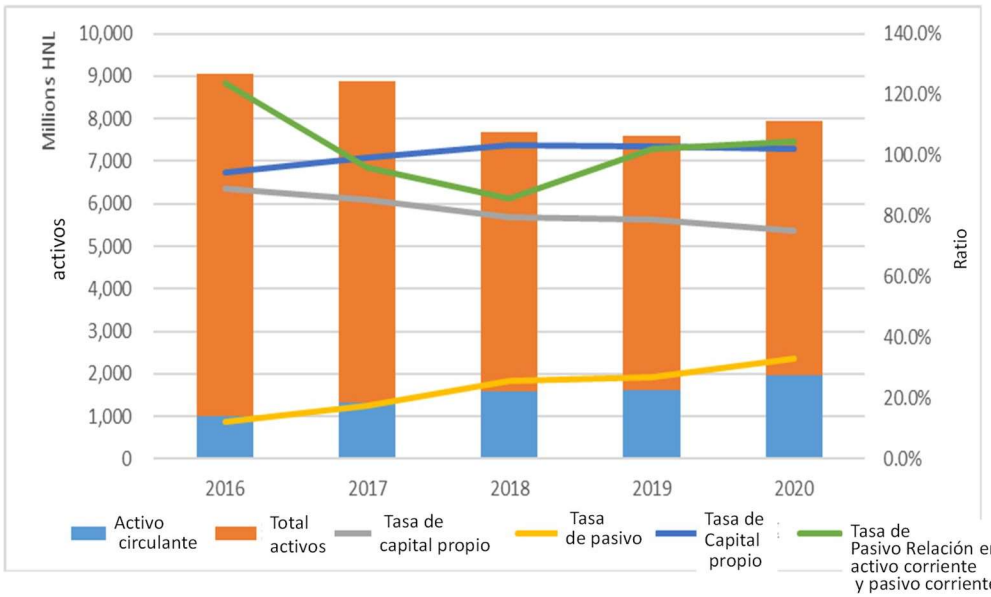


Figure 4-1-7Assets and Financial Indicators of Metropolitan Division of SANAA (2016-2020).

What requires attention in the interviews with the Deputy Finance Manager is the debt owed to the Empresa Nacional de Energía Eléctrica (ENEE). There is talk that SANAA owes ENEE a debt of one billion HNL (about USD42 million). On the other hand, as a result of the COVID-19 pandemic, ENEE started charging interest on the electricity tariff debt, so expenses tend to increase. With respect to the debt, the Framework Law establishes that SANAA cannot transfer its debt to UMAPS, and therefore, we can affirm that if it does not pay this electricity tariff debt, the transfer to UMAPS will not end. In order to reduce the increasing electricity tariff, it is an urgent task to implement energy saving measures and improve energy efficiency.

(3) Customer Service and Claims Handling

Customer service and claims handling is the responsibility of the Commercial Sub-Management. About 2,000 complaints are received monthly, as shown in the following table. Most of the complaints are that the water consumption shown on the bill is excessively higher than the actual consumption. Other complaints are related to this, where there are many claims to check the meter reading results, point out reading errors, and check the tariff regime category/segment. These complaints reflect dissatisfaction with the lack of water volume due to intermittent supply once every 3-5 days.

Table 4-1-11 Content and Number of Claims (March 2021)

Claim	Number of Claims (March 2021)
Excessive water consumption	1,437
Invoicing of uninhabited dwellings	274
Suspension of service to uninhabited dwellings	58
Checking the meter reading results	55
Water quality test	51

Category/segment check	26
Difference in water consumption	25
Meter reading error	21
Suspension of service to inhabited dwellings	13
Meter search	6
Checking the installed meter data	4
Checking the sewerage connection	4
Checking the service connection	2
Others	6
Total	1,980

(4) Impact of COVID-19

Interviews were also conducted on the impact of COVID-19 that spread since March 2020 on the water business. The main impacts are listed below.

- Costs for chemicals, PPE (personal protective equipment), antigen testing, etc. increased.
- Measures were taken to reduce or waive water rates and the suspension of service was interrupted (resumed in March 2021).
- Drinking water service deteriorated due to the curfew that forced employees to stay at home.
- Due to curfew and traffic regulations, procurement plans were forced to change.
- Limitations on the use of public transportation increased transportation costs to and from the office.
- Improved sewer and storm drainage facilities increased costs.
- The distribution of personnel was modified (personnel over 60 years of age were transferred and replaced by younger personnel).
- Income from tariffs was reduced by 35%, especially by 40% in the case of income from households in general.
- Unpaid fees from governmental institutions were paid in one lump sum.
- Electricity tariff debt accrued interest and increased electricity tariff expenses.
- Fare payment windows were closed and fare payment is accepted only through automatic bill pay or online payment.

4-2 Challenges for Executing Agency

(1) Strengthening of UMAPS Service Management Capabilities

Tegucigalpa's aqueduct infrastructures constitute assets of the AMDC, and UMAPS assumes the operation and maintenance of these infrastructures as an economically and financially independent WSP. However, while it is true that UMAPS was created in 2015, the process of transferring SANAA's services as of April 2021, and only the finance and commercial sections, has not yet been completed. The transfer of operations to UMAPS is being gradually driven from section to section with the assistance of the World Bank, with the expectation of completion by the end of 2021. UMAPS has approximately 360 employees as of April 2021. Many of the trained SANAA employees retired and it is not known at this time how many of them were hired by UMAPS. Ideally, along with the infrastructure, all the knowledge, skills and experience accumulated by SANAA in the operation,

operation and maintenance of the services should also be transferred. Most of the information provided to the Study Team on operation, operation and maintenance as of April 2021 was provided by SANAA. In order for UMAPS to function as a healthy WSP, it is necessary to absorb the information, experiences and knowledge accumulated by SANAA, while strengthening capabilities in plan, asset, financial, information and data management, infrastructure operation, operation and maintenance, client management, etc. and building a stable foundation as an WSP. Also, the WBDA, assisted by the World Bank, has developed a UMAPS business plan in 2018 that includes a service efficiency and drinking water system improvement plan, as well as the investment plan. However, despite the fact that three years have elapsed since its preparation, the business plan has not been implemented due to time lag, being necessary to update such plan.

(2) Improving Financial Policies

Despite the fact that the inflation rate in the capital city of Honduras has reached 60 % in the last decade, the water and sewerage tariff as of the month in which the present study was carried out in 2021 remains at the same level established in 2010, making it necessary to review the tariff system. The current water and sewerage tariff does not cover the full cost of running, operating and maintaining the systems, and the average commercial deficit in the last five years exceeds 10%. There is a high percentage of unregistered or misclassified customers, which results in billing deficiency. The ANF rate is estimated at 32.9%, which is mostly due to intermittent water supply. The rate of meter installation is approximately 39% according to AMDC information, and for the rest the fixed tariff is applied based on estimated fixed consumption. The fixed tariff consists of paying a certain amount regardless of the volume of water consumed, and this can lead to excessive consumption or waste of water, hindering balanced financial management. Behind the application of a somewhat outdated tariff system are a number of factors such as the gap between plan and investment, inadequate management of water supply services, low labor productivity, lack of adequate financial planning, etc. To improve drinking water supply services, there is an urgent need to develop a viable infrastructure development and investment plan, improve the management framework, train staff in the management of the plans, and develop appropriate financial policies.

(3) Coordination between Commercial and Technical Sub-management

The problem raised by UMAPS about the organization is that changes in supply volume including new connections and service suspensions are not reflected in the pipe network analysis, and therefore, inconsistencies are observed between the current water service situation at the ends and the hydraulic analysis data for distribution management. Specifically, the hydraulic analysis based on production volume, distribution tank capacity, etc. in the upstream water treatment plants is determinant to allocate the distribution volume and establish the supply volume and supply schedule for each sector. Meanwhile, downstream, at the request of the users, procedures are carried out daily for new connections and suspensions due to new constructions or removals, and the consumption of the users is verified by reading the meters or due to meter failures, etc. In this way, the company providing the

water service is informed of the volume of supply. However, according to the Commercial Deputy Manager responsible for verifying consumption, the most recent user data held by the company is not being used for the analysis of the pipe networks, and therefore, the drinking water supply service is not improving. For this reason, in order to improve the supply service, it would be good to coordinate closely between the Technical Sub-Management responsible for production volume and distribution volume upstream and the Commercial Sub-Management responsible for supply volume and claims handling downstream, in order to exchange information and reflect the most recent user data in the analysis of the pipe networks, so that they can provide a drinking water service that responds exactly to customer needs with a high level of customer satisfaction. Improving the level of customer satisfaction implies obtaining stable tariff revenues, and this is indispensable to achieve the objective of strengthening the management base of the utility, and therefore, coordination between the Commercial and Technical Deputy Managers and the consequent consistency between upstream and downstream is an important task.

CHAPTER 5 RESULTS OF DEMONSTRATION WITH EQUIPMENT AND MATERIALS FROM JAPAN

Chapter 5 Results of Demonstration with Equipment and Materials from Japan

5-1 Background

In this survey, a demonstration will be carried out with equipment and materials acquired in Japan, keeping in mind the expected result proposed by the project, which is the possibility of using Japanese technologies in the ODA loan and technical cooperation project. Among several Japanese technologies mentioned as the most advantageous technologies in Honduras that offer energy efficiency in the previous survey "Data Collection Survey for JICA-IDB Cooperation in the Water and Sanitation Sectors for Latin America", the technology "Measures against water leakage" was selected to be verified in this Survey, because it is a viable technology to implement demonstratively in the short term, the most effective at this time as measures to improve the drinking water supply service in the city of Tegucigalpa.

Table 5-1-1 Feasibility Comparison of Most Advantageous Japanese Technologies

Japanese Technology	Feasibility for Demonstrative Deployment	Selection
Micro hydropower plant system using surplus water pressure	It is necessary to install a micro hydropower generation system and time is required to verify the effect.	△
High capacity energy saving type pump (VFD control)	High energy saving effect can be expected by using high efficiency pump and Variable Frequency Drive (VFD) exciter control, however, it is not suitable for demonstration.	△
Water leakage measures	Leakage measures is a highly effective technology for correcting problems in the potable water supply system in Tegucigalpa, including lack of water volume, inefficient supply, and inadequate pressure control. Compared to other Japanese technologies, the demonstration can be carried out in a short period of time, as no equipment needs to be installed.	◎
High-performance water meter	High-performance water meter equipped with communication function is useful for monitoring water volume, however, considering the procurement and installation works, it is not suitable for demonstration, rather it is for pilot activities.	△
Automatic control (automatic	The introduction of SCADA system and automatic control system when replacing the facilities makes it easy	△

monitoring), and remote control and monitoring of operations (SCADA system)	to know the efficiency of operations in the facilities, however, it takes time for installation and is not suitable for demonstration.	

5-2 Objectives

General detection of water leaks is extremely difficult in the city of Tegucigalpa, since in most areas water is supplied once every five days for about 12 hours. The reasons why it is difficult to detect water leaks during the water rationing period are as follows:

- Short time for water supply makes it difficult to detect surface water leaks.
- Short time available for detection.
- When there is water service supply, most users are using water, and the noise generated by this makes it difficult to hear the sound of water leaks.
- It is not possible to perform the leakage survey if there is no water service being supplied.

The demonstration in this survey had time and budget constraints, and therefore, instead of performing a general leak detection where the pilot area is hydraulically isolated and water is supplied only in that sector for 24 hours, a water leakage survey was performed using Japanese technologies that allow leak detection, even if it is still under conditions of water rationing.

5-3 Background on Equipment and Material Selection

The water leak detection equipment and materials to be used in the demonstration were evaluated and selected based on the analysis parameters in Table 5-3-1. The following Table 5-3-2 shows the results of the evaluation.

Table 5-3-1 Leak Detection Equipment and Materials Analysis Parameters

Parameters	Content
Objects of Survey	Both house connections and distribution pipes are objects of the study. Regarding distribution pipes, it will be evaluated from the point of view of which of the following can be detected: leakage area (surface), leaking pipe (line) and leakage location (point).
Application environment	① Applicability to PVC pipes. Water leak detection is highly dependent on the pipe material and the survey environment. Since PVC pipe is a material that hardly transmits the sound of water leakage, we evaluate the equipment that can realize leak detection even for PVC pipes. ② Applicability to low water pressure

	Leakage noise tends to be reduced in low water pressure environment. Therefore, we evaluated equipment that can be used for leak detection even at low water pressure. ③ Influence of Noise Noise, such as from passing vehicles or wind, often affects the survey. Therefore, equipment that can carry out leak detection even under noisy conditions should be evaluated. ④ Leakage survey in case of intermittent water supply If the water supply time is less than 24 hours (especially if the water supply time is less than 12 hours), it is not possible to detect leaks with equipment that needs continuous water service.
Working Hours	Leak surveys are normally performed at night, when water consumption is low and there is less urban noise. However, due to security issues in Tegucigalpa, it is difficult to perform work at night, and so equipment that can be used during the workday should be evaluated.
Technical Level Required	The technical level required for personnel to learn how to use the equipment should be evaluated as follows: "High: Requires a lot of time," "Medium: Requires some time," and "Low: Can use easily."
Procurement Criteria	Taking into account the above characteristics, the procurement policy in this Survey is indicated. "○: Applicable.", "×: Not Applicable."

Table 5-3-2 Proposed Leak Detection Equipment

Leak Detection Method	Objects of Survey				Application Environment				Working Hours	Technical Level Required	Selection Criteria
	Distribution Pipelines			ouse Connection	24-hour supply			**Service during Limited**			
	Surface	Line	Point		PVC	Low pressure	Noises				
Ultrasonic flowmeter	○	○	×	×	○	○	○	×	At night	Low	×
Acoustic rods (direct listening, electronic)	×	○		○	×	×	×	×	Daytime	Direct listening: High Electronics : Medium	×

Geophone leak locator	×	×	○		×	×	×	×	At night	Low	×
Correlators for leak location (two points)	×	×	○		△	×	×	×	Mainly during nighttime	High	×
Correlators for location of leaks (multipoint)	○	○	○		×	×	×	×	Possible during daytime	High	×
Leak detector by time	×	○	×	○	×	×	×	×	Daytime	Low	×
PVC pipe locator by electromagnetic induction (non-metallic pipe detector)	×	×	○	×	○	○	○	×	Daytime	Low	×
Leak detector by tracer gas	×	×	○	○	○	○	○	○	**Daytime**	**Low**	○

Taking into account the results of the previous selection, in the demonstration of this survey we verified the possibility of applying the tracer gas leak detector, which allows the study of both distribution pipes and house connections, and which is the only leak study equipment adaptable to the situation of water rationing in Tegucigalpa.

5-3-1 Tracer Gas Leak Detector

The water leak detection technology will be introduced, which can reliably detect the leak site under water rationing. The process of this technology is as follows: the tracer gas for field survey (mixed gas of 4% hydrogen and 96% nitrogen) is generated, the gas is introduced to the drinking water pipeline, and the detection of hydrogen gas leaking from the leak site is carried out using the hydrogen gas detector.

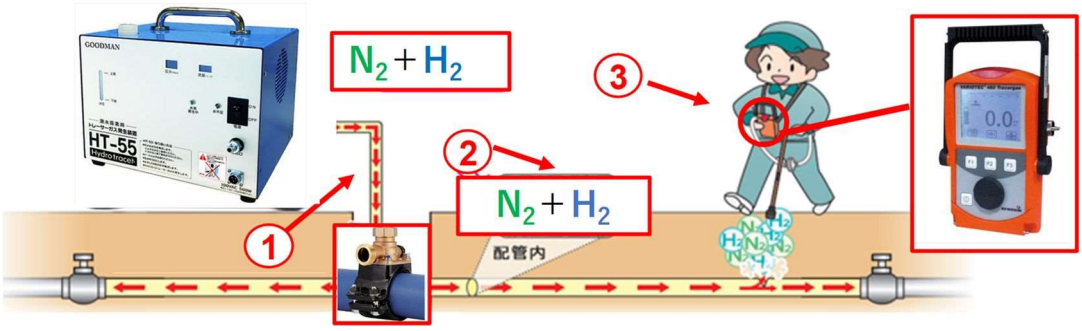
Table 5-3-3 Tracing Gas Leak Detector Features

Advantages	▪ Allows to detect micro leaks in low pressure conditions, which the conventional method with acoustic rods hardly detects. ▪ Allows to detect leaks in sectors under water rationing. ▪ Allows to work during the day in places with high traffic and high noise. ▪ It is not affected by the depth of the buried pipe, or the type of diameter of the pipe. ▪ The gas has little risk of explosion and is safe for the human body, and so there is no problem to introduce it directly into the drinking water pipe.
Disadvantages	▪ When gas is generated, an electric generator is required in the field.

	▪ It is necessary to isolate the survey section by closing the pipeline with a valve, etc. in order to be able to inject the gas and fill the pipeline.

Hydrogen gas leak detection unit (hydrogen-nitrogen gas generator)
(mixed hydrogen and nitrogen gas generator)

Hydrogen gas detector



Valve Diversion Collar Valve

① The mixed hydrogen and nitrogen gas is delivered into the pipeline through an air valve, valve seat, bypass collar, or water meter.

② The pipeline is filled with hydrogen and nitrogen gas.

③ The hydrogen gas is detected with the gas detector and the water leak is located.

Figure 5-3-1 Summary of Tracer Gas Generator and Hydrogen Gas Detector

The tracer gas detection method has many advantages, however, compared with other methods, this method was not widespread due to the high cost of purchasing the gas tank. However, in recent years, tracer gas generation technology was developed in Japan through electrolysis of water to generate hydrogen gas and then mix with nitrogen in the air, and this technology is currently being used in Japan. The cost of generating the gas is just 1/60th of the cost of gas tank. With a small electric generator and distilled water, the mixed gas of hydrogen and nitrogen can be generated, and no special material or technology is required for continuous use.

5-3-2 Equipment and Materials Required for Water Leak Detection

To detect water leaks with tracer gas, the gas is injected through a collar, air valve, or hydrant, however, if the pipeline does not have these fittings, a collar is installed and from there the gas is injected. Before performing the leak detection work, it is necessary to check the location of the buried pipeline. In case there is no pipe drawing or the exact location of the pipe is not known, an electromagnetic induction PVC pipe locator is used to locate the location of the buried pipe.

5-3-3 Proposals for Water Leakage Repair Materials

Both inside and outside Japan, more than 90% of EPS water leaks from distribution pipes and house connections are leaks from house connections, and many leaks are from the connection part of the pipe (thread, joint part). For this reason, it is important to repair water leaks at the connection point of the house connections. In the demonstration, it was proposed to use Japanese technologies also in the repair equipment to quickly repair localized leaks. It was proposed also to use the pipe repair clamp (pressurized thread) to repair the leaks in the distribution pipes, which is the temporary leak repair method, and to use the repair tape (rubber waterproof adhesive tape) to repair the leaks at the connection point of the house connections and at the branch collar.

Replaceable press-fit thread

- Leaks can be repaired without suspending water service.
- Quickly repaired in 5-10 minutes in the event of a sudden leak.
- The connection part with the gasket can be repaired.
- It can be used in the environment with vibrations.
- It can be used in a wide range of temperatures.
- It is economical, reusability is allowed.

Figure 5-3-2 Repairing Leaks with Pressure Clamp

Waterproof rubber adhesive tape
0.6 mm×30 mm×24m

Leakage point

Insulok cable clamp

- Upon tensioning the tape, it is placed over the leakage point of the PVC pipe and rolled up.
- The same tape adheres to each other and stops the leakage.
- Finally, it is fixed with the Insulok cable tie.
- Leakage can be stopped even if it is wet from leakage due to its high adhesiveness.

Figure 5-3-3 Leak Repair Procedure with Rubber Waterproof Adhesive Tape

5-3-4 Equipment Used

Table 5-3-4-1 shows the procurement equipment used for water leak detection and Figure 5-3-4shows photographs of the equipment used.

Table 5-3-4 Equipment and Materials Used in Demonstration

	Name of Equipment	Purpose of Use	Quantity	Origin
1	Locate the location of the buried pipe			
1)	PVC pipe locator by electromagnetic induction	・Confirm the location of the buried pipeline when there is no pipeline drawing or the exact location of the pipeline is not known.	1	Japan
2	Locate the leak site			
1)	Tracer gas generator	・Generate the mixed hydrogen and nitrogen gas in the field.	1	Japan
2)	Hydrogen gas detector	Detect the hydrogen component of the tracer gas emanating from the leak site to the ground surface.	1	Japan
3)	Small electric generator	It is needed as the power source of the tracer gas generator. Power: 1.8 kVA, Voltage: 100V	1	Honduras
3	Repair of the leakage site			
1)	Waterproof rubber adhesive tape	・Used to repair leaks in house connections and distribution pipes.	10	Japan
2)	Pressure clamp	・Used to repair leaks in the connection part and straight line part of distribution pipelines.	10	Japan

PVC pipe locator by electromagnetic induction

Tracer gas generator

	
Hydrogen gas detector	Small electric generator
	
Waterproof rubber adhesive tape	Pressure clamp

Figure 5-3-4 Demonstration Equipment and Materials Photographs

5-4 Selection of Execution Area

In the present demonstration, it was necessary to adequately isolate the pipeline for gas injection. The First Phase of the present survey was performed remotely, so AMDC and UMAPS were asked to select the candidate sites for the demonstration, which were places that always have a drawing of the pipeline network. As a result, Colonia Miraflores, Colonia Jardínes de Miraflores and Colonia Miraflores Sur were selected. Subsequently, while performing the demonstration in Honduras since August 2021, UMAPS requested us to perform a demonstration in Colonia Monteverde where there are many water leaks. Also, after performing the demonstration in Colonia Miraflores and Colonia Monteverde, another demonstration was performed to obtain further verification data in the Buenos Aires Zone where they say there are relatively many water leaks. Table 5-4-1 shows the general description of the zones under demonstration and Figure 5-4-1 shows the map of these zones.

Table 5-4-1 General Description of Colonies Subject to Demonstration

No.	Name of Colony	Features
1	Miraflores	・Receives water distributed by gravity (30-50m elevation difference) from the potable water tank of Miraflores Water Treatment Plant. The drinking water tank and the distribution pipe network were built in 2004 with Japan's Grant Aid. It is sectorized in blocks. Water is distributed by branching the primary pipe (φ100-150 mm) of ductile iron pipe (DCIP) to the
	Jardínes de Miraflores	
	Miraflores Sur	

No.	Name of Colony	Features
		secondary pipe (φ50 mm) of PVC, then from the secondary pipe to the house connections (φ13 mm) of PVC. The piping drawing is saved in CAD file. ・Supply time is once every five days for 15 hours (4:00-19:00).
2	Monteverde	・Receives water distributed by gravity (10-20m elevation difference) from the Universidad Norte distribution tank. The distribution pipeline was installed around 1990, about 30 years ago. The drawing is stored in the AMDC GIS system. It is not sectored into blocks. Water is supplied directly from the primary pipe (φ100-150 mm) of DCIP to the house connections (φ75 mm) of PVC. ・Supply time is once every five days for 15 hours (17:00-8:00).
3	Buenos Aires	It receives water distributed by gravity (300m elevation difference) from the drinking water tank of the El Picacho Water Treatment Plant. The pressure reducing valve is used to reduce pressure; however, in recent years the neighborhood has reported many leaks due to the failure of the pressure reducing valve. Like Colonia Miraflores, it was built in 2004 with grant aid from Japan. It is sectorized in blocks. Water is distributed by branching the primary pipe (φ100-150 mm) of DCIP to the secondary pipe (φ50 mm) of PVC, then from the secondary pipe to the house connections (φ13 mm) of PVC. The piping plan is stored in CAD drawings. ・Supply time is once every five days for 11 hours (19:00-6:00).

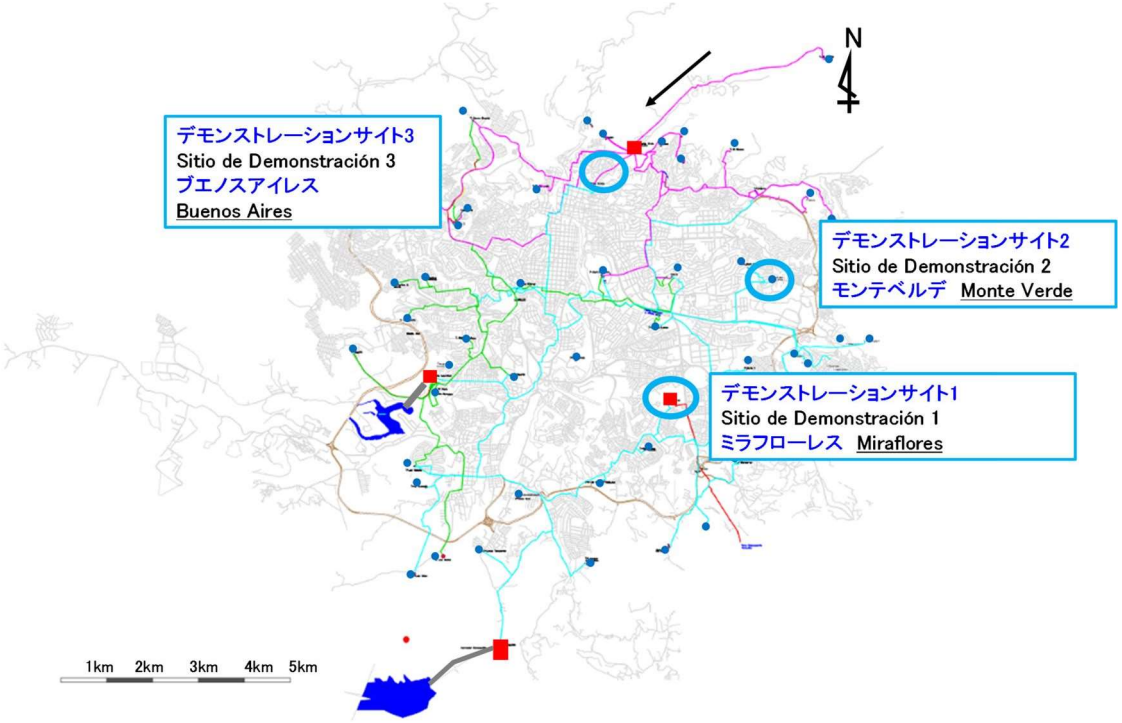


Figure 5-4-1 Colonies Subject to Demonstration

Detailed maps of each demonstration site are shown in Figure 5-4-2 for Colonia Miraflores, Figure 5-4-3 for Colonia Monteverde and Figure 5-4-5, Zona Buenos Aires.

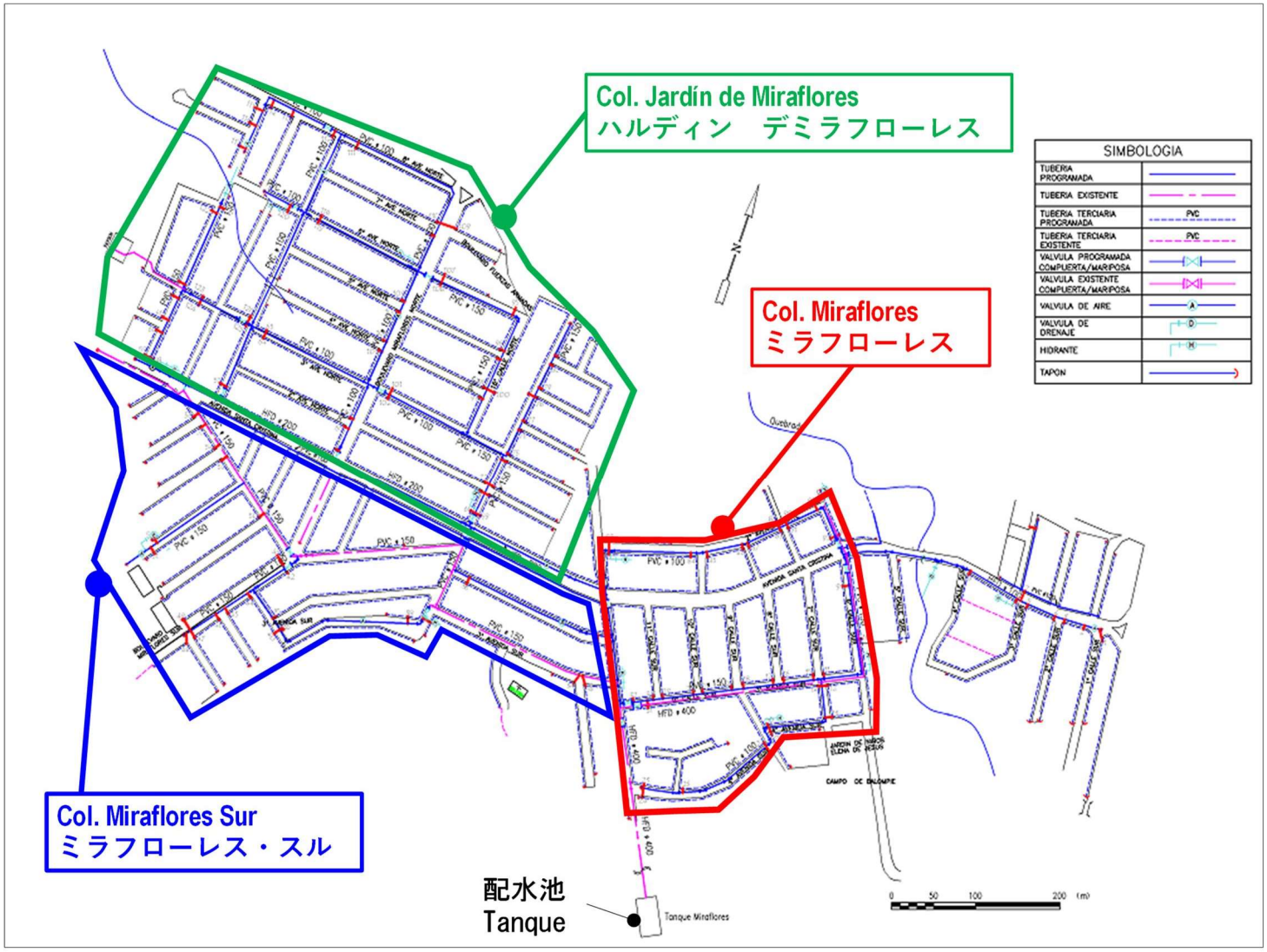


Figure 5-4-2 Map of Colonia Miraflores

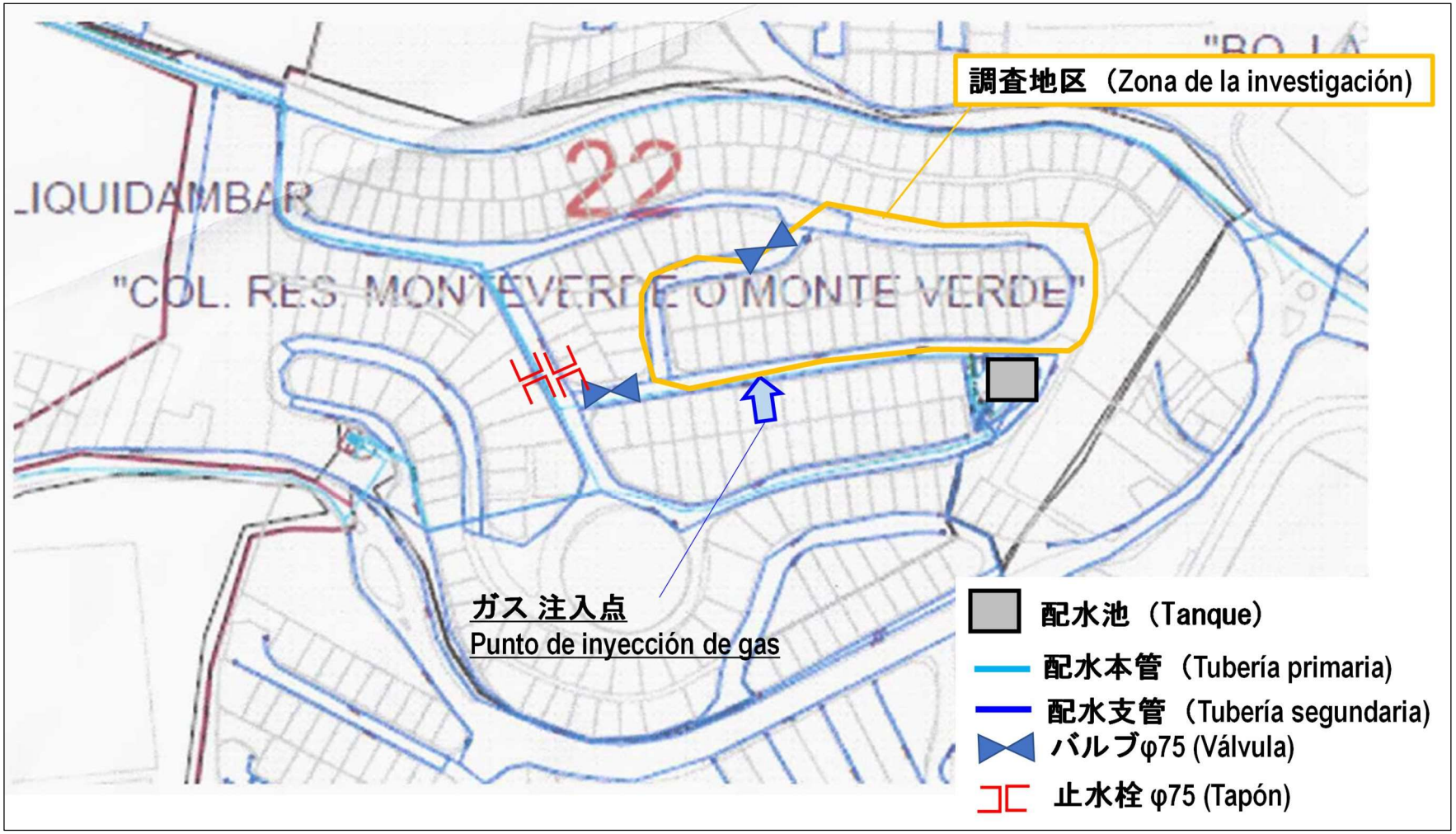


Figure 5-4-3 Map of Colonia Monteverde

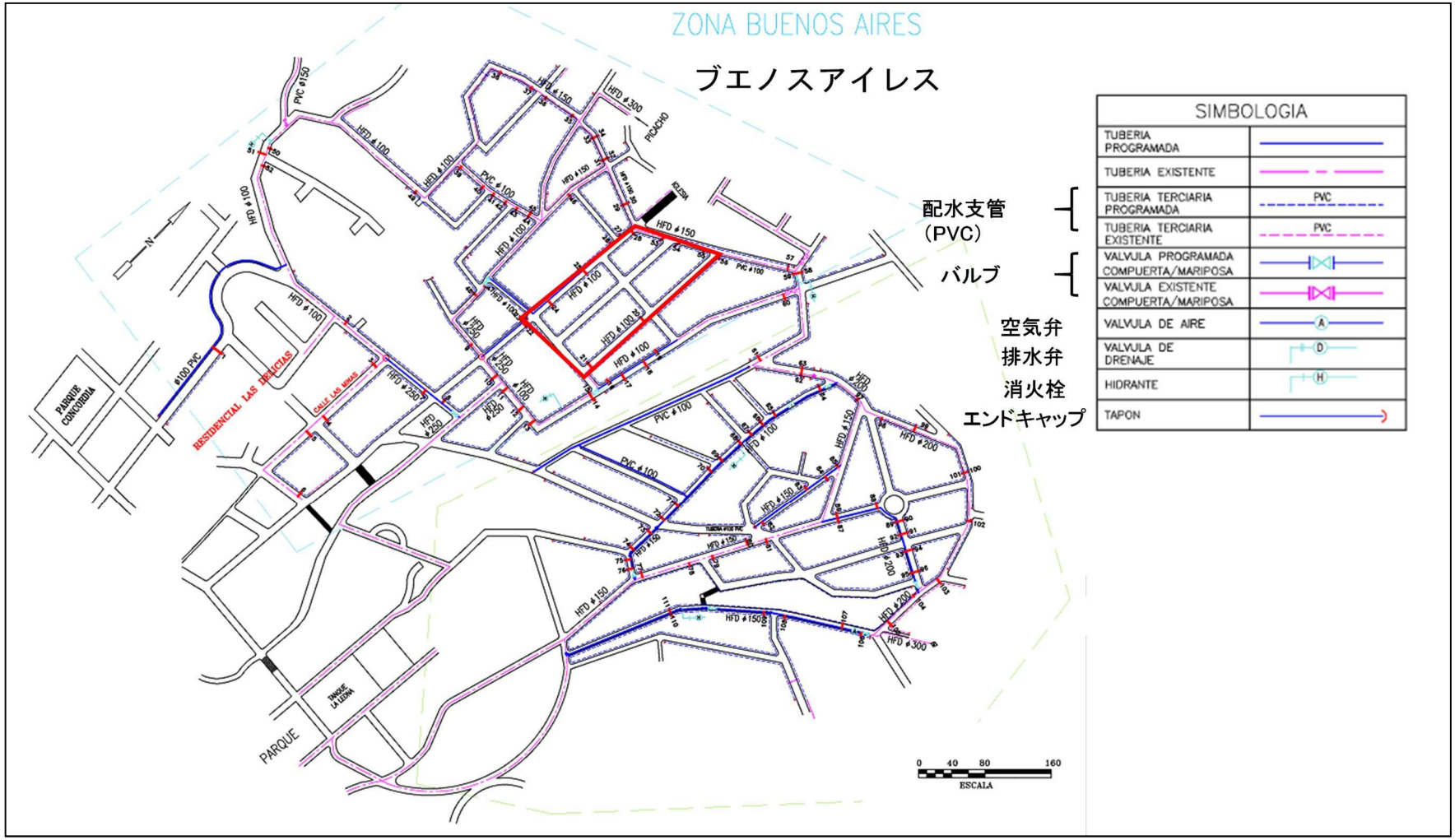


Figure 5-4-4Map of Buenos Aires Zone

5-5 Performance Results

Prior to the demonstration, a briefing on how to use the equipment was conducted. Subsequently, the OJT (on-the-job training) demonstration was conducted where all demonstration participants learned how to detect water leaks using the hydrogen gas leak detection unit.

5-5-1 Pre-Training

5-5-1-1 Dates

Pre-training was held July 26-29, 2021.

5-4-1-1-1 Content

(1) Classroom lecture

Table 5-5-1 shows the content of the explanation. As a preventive measure against the new coronavirus, crowding was avoided by dividing the classroom class into two groups of up to a maximum of 10 participants.

Table 5-5-1 Classroom Training

Date	Contents	Location
July 26th, 2021	・Explanation of equipment and materials. ・Water gas leak detection method. ・Demonstration areas. ・Explanation on operation of the equipment.	SANAA Los Filtros Office Auditorium
July 27th, 2021	・Measures against NRW ・Life cycle cost of pipelines ・Non-detectable flow rate of the meter ・Normalization of water meter calibration	

Introduction of Equipment

Participants (Group A)

Introduction of Equipment

Participants (Group B)

(2) OJT Training on Leak Detection within the Office

Table 5-5-2 shows the contents of the explanation. Explanation was made to the participants on how to detect water leaks both inside and outside the office, and the current equipment and materials were used to explain the handling and operation.

Table 5-5-2 Explanation Contents

Date	Contents	Location
July 28th, 2021	Electromagnetic induction PVC pipe locator Hydrogen gas detector ・Digital leak locator geophone	SANAA Los Filtros Office Auditorium
July 29th, 2021	・Tracer gas generator. ・Small electric generator. *OJT training to learn about both equipment.	

	
OJT training on electromagnetic induction PVC pipe locator	OJT training on electromagnetic induction PVC pipe locator
	
OJT Hydrogen Gas Detector Training	OJT Hydrogen Gas Detector Training

Table 5-5-3 Questions and answers

Questions	Answers
Are there any surfaces that hinder the passage of gases?	Gas from joints and cracks is detected, as it is difficult for gas to pass through concrete surfaces.
How long does it take to charge the D305?	A three-hour charge lasts approximately three days.
How long does it take to charge a gas detector?	Charging takes 3 hours and a charged battery lasts up to 8 hours.
Are there any restrictions on the area of application of D305 equipment?	There are no restrictions for the detection of PVC pipes.
What is the maximum voltage of HT-55 equipment?	A maximum of 130V is possible

5-5-1-2 Participants

A total of 21 participants from the AMDC and SANAA participated. Table 5-5-4 shows the names, positions, and organization names of the participants.

Table 5-5-4 List of Participants

No.	Name	Position	Organization
1	Ileana López	Head of Leak Control Departmenr	SANAA Leak Control Department
2	Carlos Martínez	Project Engineer	
3	Jeison Ramos	Leak Technician	
4	Gerson David Ortega	Assistant Leak Technician	
5	Mario Zapata	Leak Technician	
6	Aurelio Gonzales	Leak Technician	
7	José Neptalí Calix	Assistant Leak Technician	
8	Darwin García	System Technician	
9	José Nahum Palma	Assistant Leak Technician	
10	Carlos Humberto Hernández Rodas	Manager	SANAA (Metropolitan Division)
11	Fernando Padilla	Engineer	Operational Optimization
12	Denis Reyes	Assistant Engineer	Maintenance
13	José Antonio Ruiz	Engineer	Operational Optimization
14	Rita Zúñiga	Sectorization Engineer	Operational Optimization
15	Javier Salgado	Network Manager of SANAA	Operational Optimization
16	Allison Sánchez	Project Engineer	Operational Optimization
17	Javier Chávez	Leak Technician	Operational Optimization
18	José Adán Pérez	Laborer	Operational Optimization
19	Oscar O. Velásquez	Operations Manager	Operations
20	Dara Eliel Colindres	Distribution Engineer	UMAPS Distribution
21	Raúl Lanza	Sub-manger	UMAPS Distribution

5-5-2 Conducting Demonstration

5-5-2-1 Dates

Table 5-5-5 shows the schedule for conducting the demonstration. The leakage study was conducted for one week at each colony.

Table 5-5-5 Schedule of Performance

Date	Content	Place of Execution
2 to 6 August 2021	① Pipeline network check. ② Gas water leak detection, installation of electric generator and tracer gas	Miraflores
9 to 13 August 2021		Miraflores Sur
16 to 20 August 2021		Jardínes de Miraflores
23 to 29 August		Monteverde

Date	Content	Place of Execution
2021	generator, gas injection and leak detection. ③ Water pressure check. ④ Residual Chlorine check.	
30 August to 3 September 2021		Jardínes de Miraflores
6 to 10 September 2021	Further guidance and exchange of views on equipment and materials	SANAA, Filter Office
21, 23 & 28 September 2021	Gas detection and digging	・Miraflores ・Miraflores Sur ・Jardínes de Miraflores
11 to 15 October 2021	①Pipeline network check. ② Gas water leak detection, installation of electric generator and tracer gas generator and leak detection.	Buenos Aires

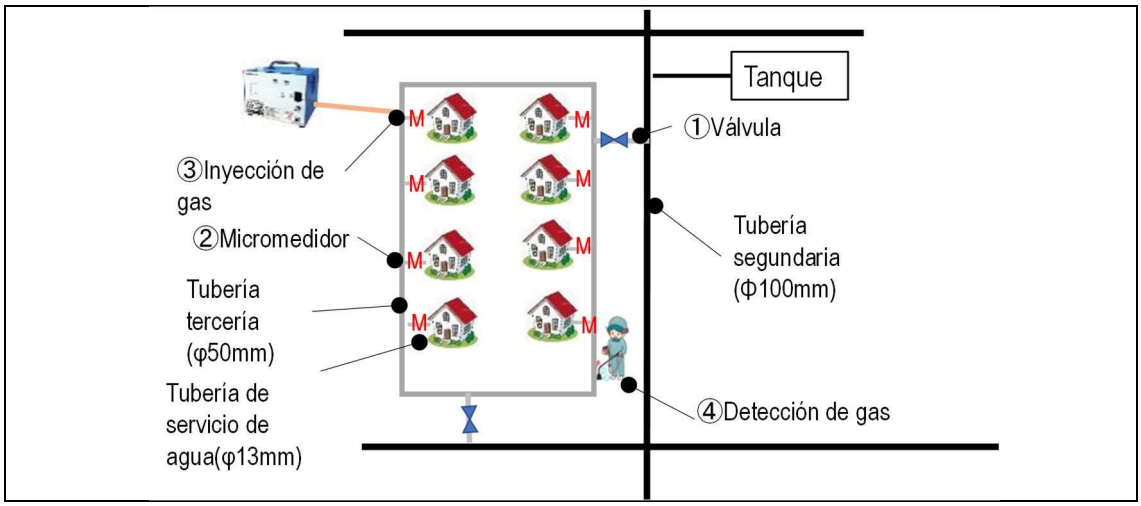
5-5-2-2 Method of Leak Detection

The following are the results of the leakage survey in each colony. Demonstrations of water leak detection were performed on the days when there were no water supply, mainly in the places that allow gas injection by isolating the section with a valve, etc. On water supply days, residual chlorine and water pressure were measured.

Figure 5-5-1 shows the conceptual scheme of water leak detection. Water is supplied from the 100 mm diameter primary pipe through the 50 mm diameter secondary pipe, then from the secondary pipe to the house connections. A valve and a water meter are installed from the secondary pipe to the house connections. In households that do not have a water meter, a valve is installed. However, in some homes that do not have a valve, the demonstration could not be carried out because the section could not be isolated.

The procedure is as follows. First, the valve from the primary pipe to the secondary pipe is closed (Conceptual diagram ①). Second, all valves from the secondary pipe to the house connections just before the water meter are closed (Conceptual drawing ②). The water meter in the isolated section is removed and the gas is injected from the plug side (Conceptual drawing ③). After confirming that gas was injected, gas detection is performed at the top of the secondary pipeline (Conceptual drawing ④).

.



Procedure
① Close the valve from the primary pipe to the secondary pipe.
② Close the valves from the secondary pipe to the house connections just before the water meter (all valves in the block).
③ Gas is injected from the water meter (about 30 minutes in case of a φ50 mm pipe with a total length of 500m).
④ Gas detection is performed at the part of the water meter joint located at the end of the gas injection point and it is confirmed that gas was filled into the house connections.
⑤ Gas detection is initiated at the top of the secondary piping.

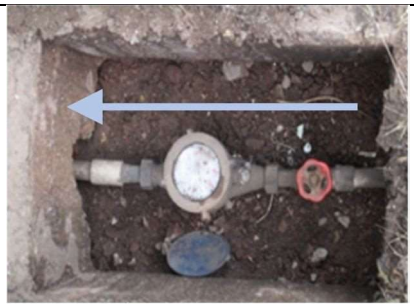
① Valve (from primary pipeline to secondary pipeline)	② Gas injection (from water meter connection)
	
③ Water meter	④ Leak Detection
	

Figure 5-5-1 Conceptual Scheme of Water Leak Detection with Gas

5-5-2-3 Water Leak Detection Results

The gas detection results are shown in Table 5-5-6. Two leak points were explored by patrol inspection accompanied by gas scanning and two leak points were explored by gas scanning. All leaks were from the water meter connections.

Table 5-5-6 Water Leak Detection Results

No.	Colony	Number of Detected Leaks	Remarks
1	Miraflores	1	One case detected by visual inspection.
2	Miraflores Sur	1	
3	Jardínes de Miraflores	2	One case detected by visual inspection.
4	Monteverde	0	
5	Buenos Aires	0	
Total		4	All leaks are from inside the water meter valve.

5-5-2-3-1 Colonia Miraflores

(1) Detection with Tracer Gas Leak Detector (August 2 to 6)

Primary pipeline is in the paved street. Secondary pipeline is on the sidewalk 1-2m wide concrete paved sidewalk. The sidewalk is public, although in some places a part of the sidewalk is decorated by its inhabitants with the same ceramics as the wall of the house.

Gas was injected from a water meter joint at each block (A through J), and 30 minutes later, gas was verified to be detected from the water meter located at the end of the gas injection point. Subsequently gas detection was performed at the top of the secondary pipe (φ50 mm) at each block. Figure 5-5-2 shows the results of the water leak detection. It should be noted that, in Colonia Miraflores, being the first demonstration site, even microleaks with a gas concentration of less than 2.0 ppm were recorded. Table 5-5-7 shows the number of detected cases classified by gas concentration.

Although this is not the testing of water leaks with tracer gas leak detector, when the inspection visit was being conducted prior to performing the leak detection demonstration, a water leak in the dwelling on the user's side was verified by visual inspection from the meter, so the user was informed that there was a water leak in their dwelling. Table 5-5-3 shows Situation of Water Leakage.

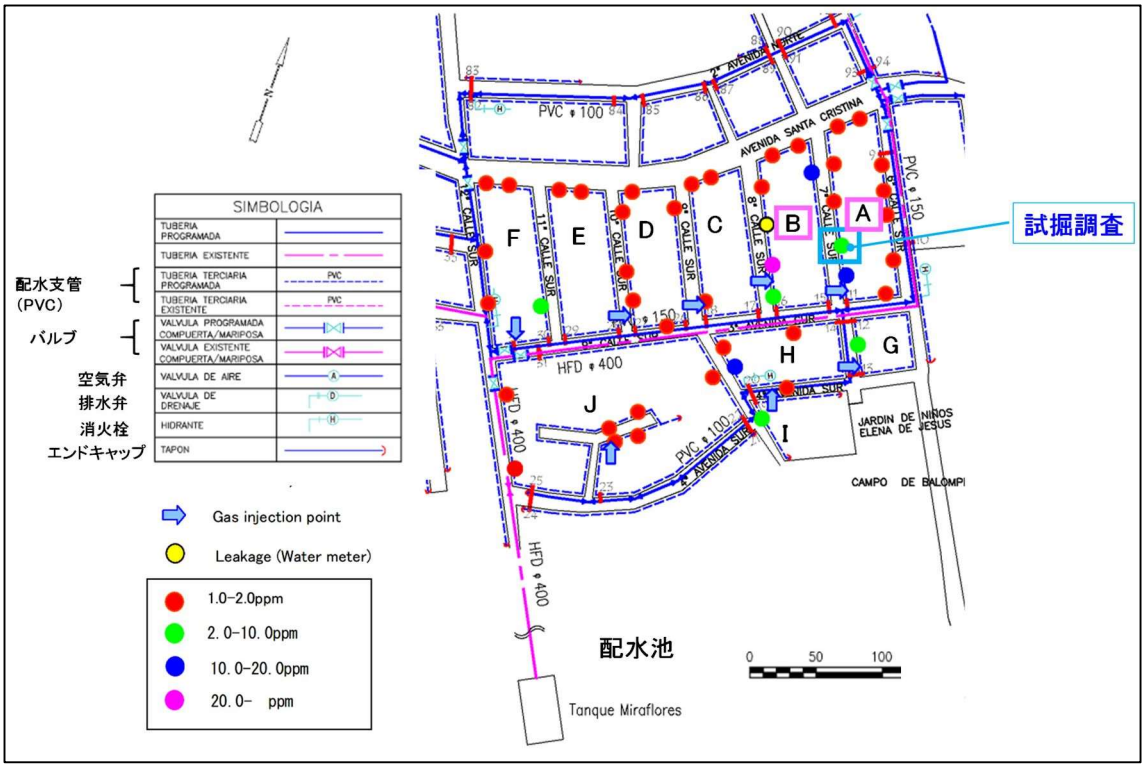


Figure 5-5-2 Water Leak Detection Results at Miraflores

Table 5-5-7 Results of Detected Cases by Gas Concentration

Gas Concentration (ppm)	Detected Cases
Less tan 2.0	37
2.0-10.0	5
10-20	3
More tan 20	1

Leakage from water meter

- ①User's area of responsibility.
- ②Area of responsibility of UMAPS
- ③Leakage from the house

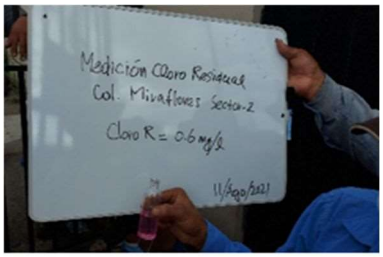
*Walls can be seen to be partially wet due to water leakage. (Less than 1m^3 in a month).

Figure 5-5-3 Situation of Water Leakage

(2) Measurement of Residual Chlorine and Water Pressure

On the water supply day, water pressure and residual chlorine measurements were performed at each meter. The pressure was between 0.3 and 0.4 Mpa. Residual Chlorine was between 0.1 and 0.6 mg/L. According to UMAPS standards, the water pressure should be between 0.1 and 0.6 Mpa and the maximum residual chlorine should be 0.5 mg/L. The water pressure is within the standards, but the residual chlorine is a little high.

Water pressure survey at the meter



Residual Chlorine at the meter

(3) Exploratory Excavation Survey

Subsequently, on September 23, gas injection was again performed to locate the leaks at the points in Blocks A and B where gas concentrations of more than 2.0 ppm were recorded in the detection of water leaks by tracer gas. However, gas was not detected at the point where a gas concentration of 2.0-10.0 ppm was recorded in Block A and at the point with a concentration of more than 20.0 ppm in Block B. Given this result, an exploratory excavation was performed at the suspected leak site in Block A. The exploratory excavation images are shown in Figure 5-5-4. However, the leak was unsuccessful after the excavation and subsequent opening of the distribution tank valve for 30 minutes. After examining the cause, it was found that the location of the gas detection was in the vicinity of the generator, so the gas could have been caused by the effect of temporary wind-driven exhaust gases.

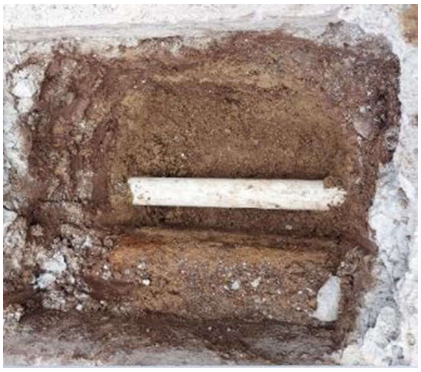
Around the exploratory excavation site	Image of the excavation
	
Image of the excavation	30 minutes after water distribution

Figure 5-5-4 Exploratory Excavation Survey

5-5-2-3-2 Colonia Miraflores Sur

(1) Detection with Tracer Gas Leak Detector (August 9 to 13)

Gas was injected from a water meter in each block (from A to E), and 30 minutes later, it was verified that gas was detected from the part of the water meter connection located at the end of the gas injection point. Subsequently gas detection was performed at the top of the house connections (φ50 mm) of each block. Figure 5-5-5 shows the results of the leak detection. Table 5-5-8 shows the number of detected cases classified by gas concentration.

In Block B, the outflow of the injected gas and remaining water in the pipe was observed from the gasket side of the water meter, and so a repair was performed. At that time, a gas concentration of over 100 ppm was detected. Pictures of the repair are shown in Figure 5-5-6. This location is in a relatively high pressure zone with a pressure of approximately 0.4 Mpa, and so it is assumed that the pipe had a crack due to deterioration from many years of use. .

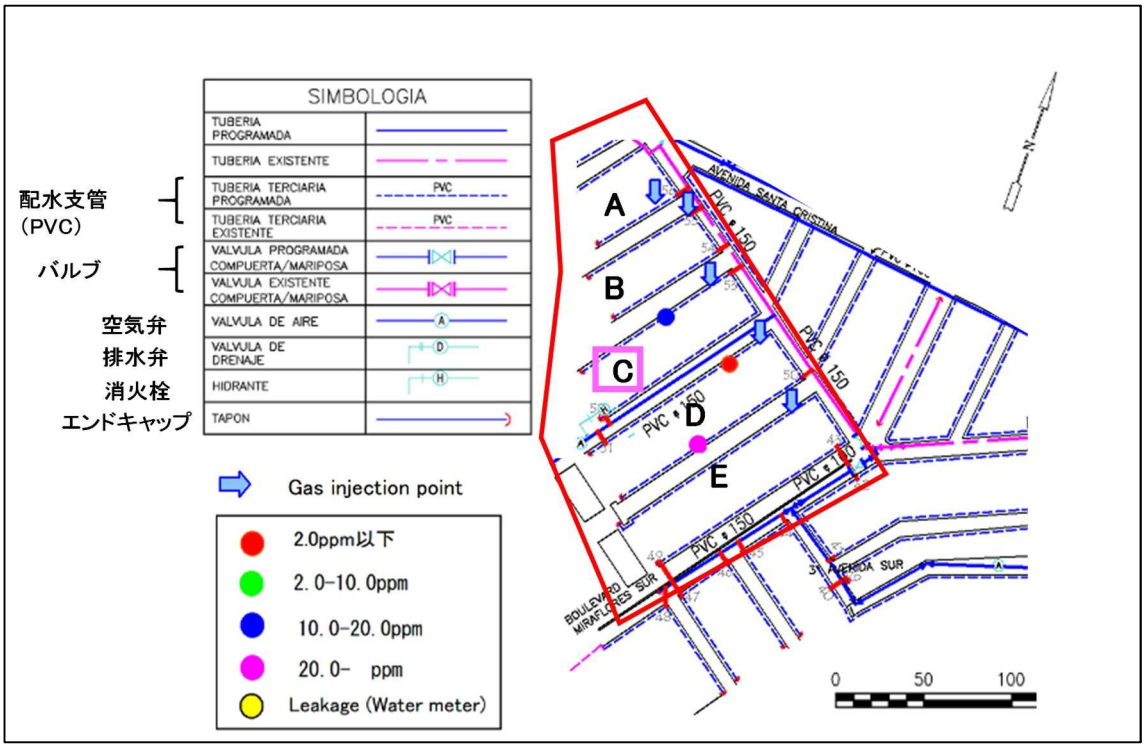


Figure 5-5-5 Water Leak Detection Results for Miraflores Sur

Table 5-5-8 Results of Detected Cases by Gas Concentration

Gas Concentration (ppm)	Detected Cases
Less than 2.0	1
2.0-10.0	1
10-20	0
More than 20	1

Water leakage before the meter

Image of the repair

After the repair

Image of tube crack

Figure 5-5-6 Repair Images

(2) Residual Chlorine and Water Pressure Measurement

On the water supply day, measurement of water pressure and residual chlorine was performed at each meter. The pressure was between 0.3 and 0.4 Mp. Residual Chlorine was between 0.1 and 0.6 mg/L. According to UMAPS standards, the water pressure should be between 0.1 and 0.6 Mpa and the maximum residual chlorine should be 0.5 mg/L. The water pressure is within the standards, but the chlorine residual is a little high.

(3) Exploratory Excavation Study

Subsequently, on September 28, in Block C, again gas injection was performed to locate water leaks in the vicinity of the suspected leak point where a gas concentration of 10-20 ppm was recorded in water leak detection by tracer gas. However, the gas was not detected. As with the Miraflores exploratory survey results, no exploratory survey was conducted at the previous leak detection site, as it was thought that the leak was caused by generator exhaust gases, since the area where the gas was detected was near the generator.

Around the point of the second survey

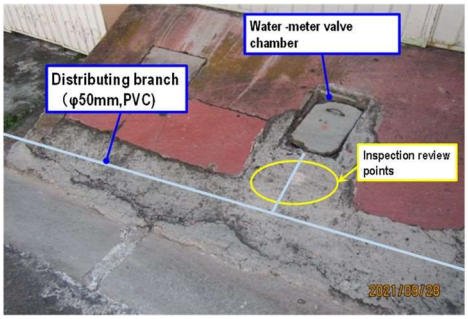


Image of the second survey point

Figure 5-5-7 Excavation Study

5-5-2-2-3 Jardines de Miraflores

(1) Detection with Tracer Gas Leak Detector (August 16 to 20)

Water leak detection was performed in each block (from A to G). However, in Block B, the valve installed between the primary pipe and the secondary pipe could not be checked due to street repair works, so gas was injected from a part of the water meter joint in each block except Block B, and 30 minutes later, it was checked that gas was detected from the water meter located at the end of the gas injection point. Then gas detection was performed at the top of the secondary pipe (φ50 mm) of each block. Figure 5-5-9 shows the results of the leak detection. Table 5-5-9 shows the number of detected cases classified by gas concentration.

In Block A, gas with a concentration of more than 100 ppm was detected in the meter valve chamber and gas leakage and water remaining in the pipe was observed, and so it was addressed by rolling the rubber waterproof tape over the pipe. Subsequently, on the water supply day, it was verified that there was no water leakage. Figure 5-5-2-3-3-3-2 shows the before and after photographs of the water leak.

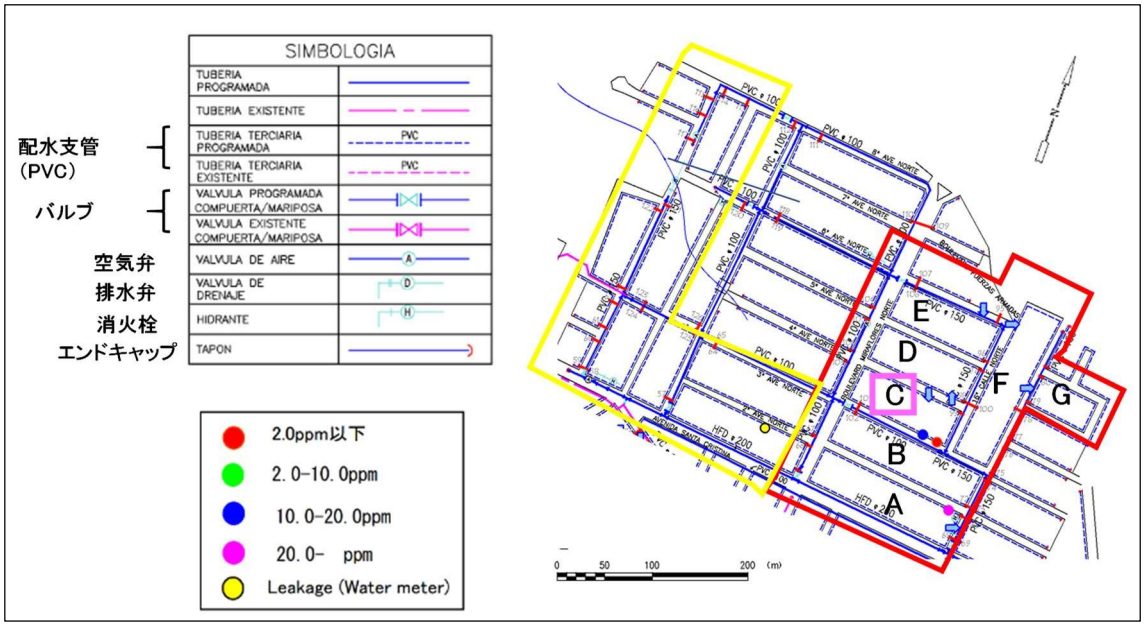


Figure 5-5-8 Water Leak Detection Results in Jardines de Miraflores

Table 5-5-9 Results of Detected Cases by Gas Concentration

Gas Concentration (ppm)	Detected Cases
Less than 2.0	1

2.0-10.0	1
10-20	0
More than 20	1

Water leakage from the meter connection

Image after repair

Figure 5-5-9Leak and Repair Images

(2) Measurement of Residual Chlorine and Water Pressure

On the day of water supply, water pressure and residual chlorine were measured at each meter. The pressure was between 0.4 and 0.5 Mp. Residual Chlorine was between 0.3 and 0.6 mg/L.

(3) Exploratory Excavation Survey

Subsequently, on September 28, a search for tracer gas leaks was conducted in Block C. Gas was re-injected to identify leaks in the vicinity of the 10-20 ppm level. However, no gas was detected. Since the location of the generator is far from the area where the gas was detected, it is unlikely that it was affected by generator exhaust, but on the other hand, due to the relatively high level of vehicle traffic, it is likely that the gas was detected immediately after the passage of the vehicle. Therefore, no test excavation was performed.

(4) Leakage Survey from Water Meter

This zone is a high pressure area and leaks were reported from the connection side of the water meter. Therefore, outside the leak detection survey areas, on the water supply day, a visual inspection visit was conducted mainly at the water meters. As a result, a water leak was found from the valve chamber of the meter. The repair was made with a rubber waterproof tape. Figure 5-5-10 shows the leak repair pictures.

Water leakage from meter connection

Image after repair

Figure 5-5-10Pictures of Leak and Repair

5-5-4-2-2 Colonia Monteverde

In this colony, some inhabitants complained that the water was not arriving, and for this reason, the counterpart (C/P) asked us for a leakage survey. However, as it is not sectorized in blocks, the survey was carried out concentrating in one area and installing 2 valves to isolate the study section

with the collaboration of the C/P.

(1) Detection with Tracer Gas Leak Detector (August 24)

Gas was injected from a water meter, and 60 minutes later, it was verified that gas was detected from the part of the water meter connection located at the end of the gas injection point. Subsequently gas detection was performed at the top of the house connections (φ75 mm). However, gas was not detected in this survey area.

(2) Measurement of Residual Chlorine and Water Pressure.

On the day of water supply, measurement of water pressure and residual chlorine was performed at each meter. The pressure was between 0.14 and 0.4 Mp. Residual Chlorine was between 0.1 and 0.4 mg/L. (UMAPS standards: water pressure 0.1 to 0.6 Mpa, maximum residual chlorine 0.5 mg/L).

(3) Water Meter Leakage Survey

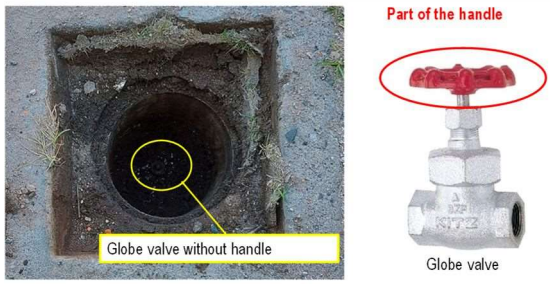
Since gas leak detection cannot be performed outside the study areas, on the water supply day, a visual inspection visit was conducted mainly on the water meters. As a result, no water leaks were found.

5-5-4-2-3 Buenos Aires Zone

This zone was sectorized into blocks in 2004 through Grant Aid from Japan. The El Picacho Water Treatment Plant supplies this zone. It is an area with many water leaks.

(1) Detection with Tracer Gas Leak Detector (October 11-15)

The areas that were the subject of the leak detection study are from Block A to D. In Blocks B and D it was not possible to isolate the section due to the lack of a valve handle that diverts water from the primary pipe (φ100 mm, DCIP) to the secondary pipe (φ50 mm, PVC) or due to the absence of the valve in the derivation part from some secondary pipes to the house connections. Pictures of the valve and house connection are shown in Figure 5-5-11.

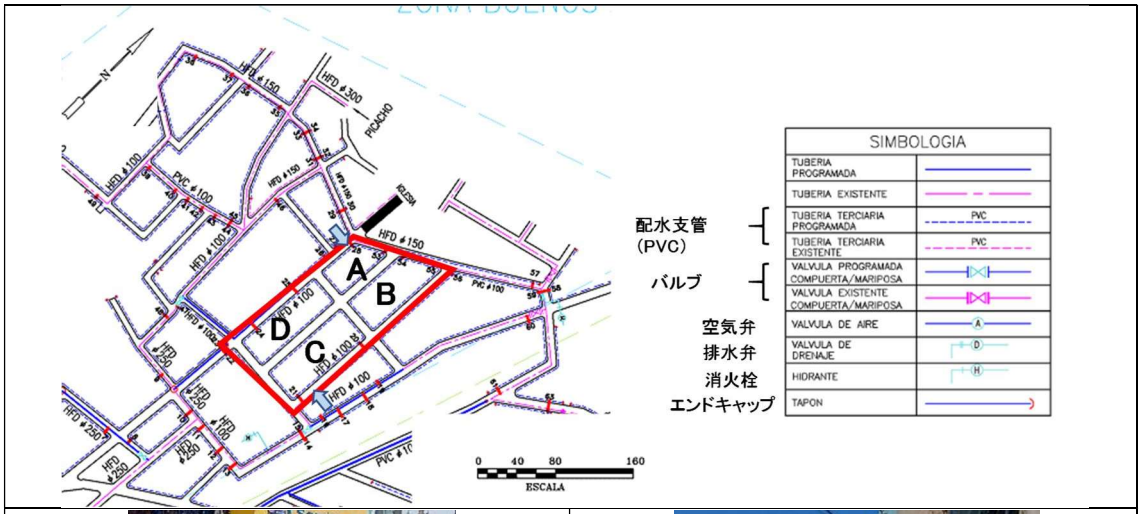


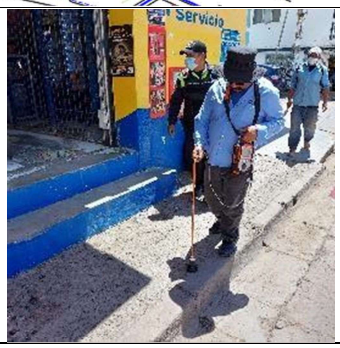
Valve without handle

House connection from secondary pipeline (without meter or valve)

Figure 5-5-11Images of Valve and House Connection

The detection with a tracer gas leak detector was carried out only in Blocks A and C. The gas was injected from a joint of the water meter, and 30 minutes later, it was verified that the gas was detected from the water meter located at the end of the gas injection point. Subsequently, gas detection was carried out in the upper part of the house connections (φ50mm). However, no gas was detected in Blocks A and C. The images of water leak detection are shown in Figure 5-5-12.





Detection in Block A	Detection in Block C

Figure 5-5-12Results of Water Leak Detection in Buenos Aires Zone and Survey Images.

5-5-3 Subsequent Orientation

A presentation was made on the detection of water leaks by tracer gas, again explaining how to use the equipment with the manual translated into Spanish. There was also an exchange of opinions about the equipment. Table 5-5-10 shows the contents of the main questions.

Table 5-5-10 Questions and Answers

Question	Answer
The tracer gas method requires isolation of the section with a valve, etc. and this is a lot of work.	Gas detection is performed by isolating the section and injecting the gas, and therefore, the work of isolating the section is laborious but necessary.
Can this be used for a primary pipe of more than Φ100?	The equipment brought for this demonstration generates gas up to a maximum of 55 L/min, and large diameter piping is time consuming, and therefore, impractical. However, there are products equipped on a vehicle with generation capacity up to 100 L/min, 200 L/min, etc. If these products are used, the gas injection time can be reduced.
How long does the battery last?	It usually lasts between 3 and 5 years.
Are spare parts available, including the battery?	We will draw up a list of contacts for spare parts and share it. Regarding the tracer gas generator, "Morales & Asociados" will be the

	manufacturer's distribution agency to guarantee the supply of spare parts.

	
Class on measures against leakage	Image of exchange of opinions

5-5-4 Evaluation

After conducting the demonstration on tracer gas water leak detection, the following results were obtained including the possibility of application of the tracer gas leak detector, lessons learned and recommendations for the future.

5-5-4-1 Trace Gas Leak Detector Application Potential

As a result of the demonstration of Japanese tracer gas leak detector technologies that can detect water leaks even under water rationing, it was possible to identify the location of leaks even when there is no water supply. Likewise, we were able to repair the leak sites. To date, only when users reported water leaks did SANAA (now UMAPS) respond to the call for repairs because it was not possible to physically locate the location of the leaks under water rationing once every five days. Through this demonstration, UMAPS realized that the leak survey could be conducted even on days when there is no water supply, and is willing to actively pursue tracer gas leak detection using the donated equipment. However, in order to detect tracer gas water leaks, it is necessary to prepare the surveyed section to be isolated using a valve, and for this it is necessary to check the pipe network with the plan and know which pipes are connected or buried through field exploration, and if there is no valve to isolate the surveyed section, one must be installed. In this demonstration, mainly the areas sectorized in blocks were selected for greater ease of isolation; however, in the areas not sectorized in blocks, time and work were required to install the valve. Through this demonstration, it was verified that the tracer gas leak detection technology is most effective in properly sectorized block areas and that the sectorization of distribution pipeline networks into blocks is an urgent challenge to carry out efficient water leak detection in the future.

5-5-4-2 Lessons Learned

5-5-4-2-1 False Reactions of Hydrogen Gas Detector

The hydrogen gas detector used in this demonstration allows locating the leak location by detecting hydrogen gas rising from the pipe leak location. However, in this demonstration, the gas detector was found to react to inert gases such as vehicle and electric generator exhaust. In Colonia Miraflores where the first demonstration was performed, all locations where the hydrogen gas detector reacted were recorded. After obtaining the data, it became clear that, in gas detection, the equipment detected hydrogen gas every time a vehicle passed by up to a maximum of 2.0 ppm. On the other hand, when the exploratory excavation study was carried out in Colonia Miraflores, Colonia Miraflores Sur and Colonia Jardines de Miraflores, it was found that the gas detector reacted to the exhaust gases from the electric generator that were emitted to supply electric power to the tracer gas generator. That is,

when the detector detected a gas concentration of 10-20 ppm in the first gas detection survey, the detection occurred near the gas injection point, so we believe that the equipment detected the exhaust gases.

To reproduce these phenomena, a gas concentration study was conducted on vehicles and motorcycles and in the vicinity of the exhaust gas outlet of the electric generator, the results of which are shown in Table 5-5-11.

Table 5-5-11 Detected Gas Concentration

Gas Generator	Gas Concentration
Vehicle and motorcycle (gasoline)	More than 500 ppm
Vehicle (diesel)	About 2.0 ppm
Electric generator (gasoline)	More than 500 ppm

Upon consultation with the manufacturer, they replied that the gas detector sensor reacted to combustible gases. Therefore, gas detection should be carried out when there is less traffic to avoid the influence of exhaust gases from vehicles and electric generators. It is also necessary to change the installation location of the electric generator. It should be noted that the manufacturer was requested that the product should have a mechanism that automatically detects hydrogen gas only when the hydrogen gas detector is installed on the street surface, so such a product will be manufactured in the future.

5-5-4-2-2 Selection of Suspected Leakage Sectors

Tracer gas leak detection is an effective method of identifying leaks, assuming there are any. However, UMAPS currently only conducts leak repairs when a customer reports a leak, and does not have a map or other information about the area where a leak is suspected. In order for UMAPS to manage leaks in the future, it is necessary not only to conduct leak surveys using the tracer gas leak detection method, but also to investigate the history, location, and causes of leaks that have been addressed, investigate trends, and select areas to identify leaks and perform leak detection.

5-5-4-2-3 Isolation of Target Segment

In this demonstration, areas with segments easy to isolate were selected. In the case of Colonia Miraflores, Colonia Miraflores Sur and Colonia Jardines de Miraflores where the survey was first conducted, planning was easy because there are preserved drawings thanks to the sectorization in blocks carried out in 2004 through the Grant Aid of Japan. However, some sections could not be isolated because there were changes in the plan or street construction works were executed and paved the valve installed between the primary pipeline and the secondary pipeline. Likewise, in the Buenos Aires Zone, which is an area sectorized in blocks in 2004 through Japan's Grant Aid, as well as Colonia Miraflores, in some cases it was difficult to isolate some sections because there was no valve handle installed between the primary pipe and the secondary pipe or there was no valve between the secondary pipe and the house connections. In addition, in areas not sectorized in blocks such as Colonia Monteverde, it took time to install new valves or plugs by cutting a part of the secondary pipe. Most of the distribution pipe networks in the city of Tegucigalpa have the same structure as the Colonia Monteverde network, and therefore, isolation of the section is a workload for the UMAPS leakage department. The leakage manager commented that this was a lot of work.

For this reason, in order to facilitate the detection of water leaks, it is necessary to sectorize the distribution pipe networks in blocks and install the valves in the connection part of the secondary pipes to the house connections.

5-5-4-2-4 Device Handling an Operation

There have been cases where the connecting hose of a hydrogen gas detector has been punctured and gas detection has failed because the hole was not noticed. The connection hose can be easily damaged, and so care must be taken when handling it. It is also necessary to check the connection hose for holes before and after use. We have explained the situation to the company from whom we purchased the manufacturer's hose, and we are advising them to make improvements.

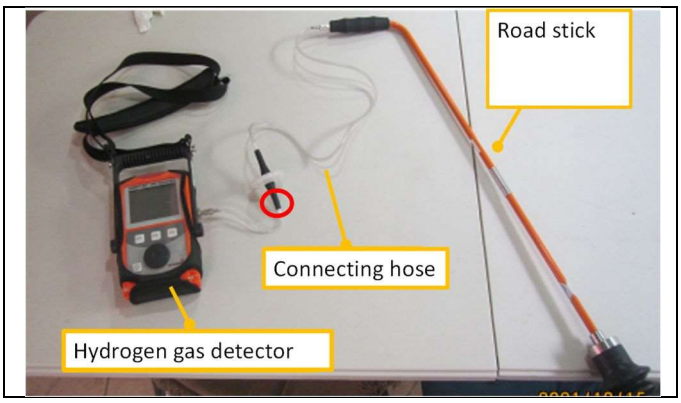


Figure 5-5-13Hydrogen Gas Detector Connection Hose Damage

In order for UMAPS to effectively perform tracer gas water leak detection and locate the locations of leaks, it is necessary to employ the following methods of operation of tracer gas leak detection.

Procedure	Work content
1	Water meter inspection visit where there are many water leaks from the meter.
2	Visualization of leaks from the meter mentioned above and attention to leaks (indicate them on the map)
3	Selection of high pressure and high leakage areas as leakage detection target areas
4	Isolation of the section under study with a valve
5	Water leak detection using tracer gas
6	Repair of the leakage site

It should be noted that, when performing tracer gas water leak detection, water leak detection should be momentarily suspended when a vehicle passes by. Likewise, when performing water leak detection around the electric generator, care must be taken not to be influenced by exhaust gases.

5-6 Holding Seminar on Japanese Technologies

5-6-1 Background

A Japanese technologies presentation seminar was held to present the products used in the demonstration and the most advantageous Japanese technologies in assisting in improving water supply service in the city of Tegucigalpa.

5-6-2 Dates

The seminar was held on Wednesday, September 8, 2021, 10:00 - 11:30 a.m.

It should be noted that the seminar was held online as part of the measures against the new coronavirus pandemic.

5-6-3 Participants

A total of 49 people from Honduras participated. Table 5-6-1 shows the list of participants. In addition to them, 3 persons from JICA Honduras Office and 1 person from JICA Headquarters, Latin America Department, Central America and Caribbean Division participated.

Table 5-6-1 Participants of Seminar on Japanese Technologies

No.	Name		Organization
1	Roberto	Granados Chahin	UMGIR,AMDC
2	Hugo	Medina	UMAPS, AMDC
3	Marco Rodolfo	Funes Raudales	UMAPS, AMDC
4	Mario	Zeron	UMAPS
5	Nelson	Durón	UGASAM, AMDC
6	Marco Antonio	Moreno Alvarado	UGASAM, AMDC
7	José	Teruel	UEBM, World Bank, AMDC
8	Cristina	Elvir	UEBM, World Bank, AMDC
9	Marcia Gabriela	Rauscher	UCP/AMDC
10	Juan	Agüero	UCP/AMDC
11	Milena	Castro	UCP/AMDC
12	Alfredo	Elvir	Deputy Manager of Finance, SANAA/UMAPS
13	Carlos	Reconco	Deputy Manger of Commercial Department, UMAPS
14	Cinthia	Borjas	Deputy Manager of SANAA
15	Jorge	Pérez	Deputy Manager of Sewerage, SANAA/UMAPS
16	Raúl	Lanza	Deputy Manager of Drinking Water, SANAA/UMAPS
17	Juan José	Urquiza Martínez	Finance Secretariat (Ministry of Finance)
18	José Ramon	Barahona	SANAA/UMAPS
19	Rita	Zúñiga	PROCOPE, SANAA
20	Allison	Sánchez	PROCOPE, SANAA
21	Roque	Andrade	Laureles Plant, SANAA/UMAPS
22	Oscar	Salgado	Concepción Plant, SANAA/UMAPS
23	Lourdes	Banegas	Standards and Supervision, SANAA
24	Denis	Carrasco	Maintenance, SANAA/UMAPS
25	Denis	Reyes	Maintenance, SANAA/UMAPS
26	José Antonio	Ruiz Cáceres	Head of PROCOPE, SANAA/UMAPS
27	Ileana	López	Head of Leaks, SANAA/UMAPS
28	Carolina	Fernández	Head of Commercial Department, SANAA/UMAPS
29	Miguel Ángel	Ramírez	Head of Commercial Department, SANAA/UMAPS
30	Daniel	Barrientos	Head of Collections, SANAA/UMAPS
31	Alejandro	Flores	Head of Cadastre, SANAA/UMAPS
32	Daniel	Mondragón	GOAL/UGASAM
33	Héctor	Sevilla	Manager, SANAA/UMAPS
34	Juan	Fuentes	ERSAPS
35	Arnoldo	Caraccioli	ERSAPS
36	Ricardo	Velásquez Lazo	Director of UGASAM, AMDC
37	Pedro Enrique	Ortiz B.	Director of CONASA
38	María Luisa	Pardo	Control and Monitoring, AMDC
39	Suriel	Torres	Control and Monitoring, AMDC
40	Luis Andrés	Villafranca	Control and Monitoring, AMDC
41	José	Barahona	General Accountant, SANAA/UMAPS
42	Luis	Romero	Independent Consultant
43	Gabriel Edmundo	Rivera Falope	Independent Consultant

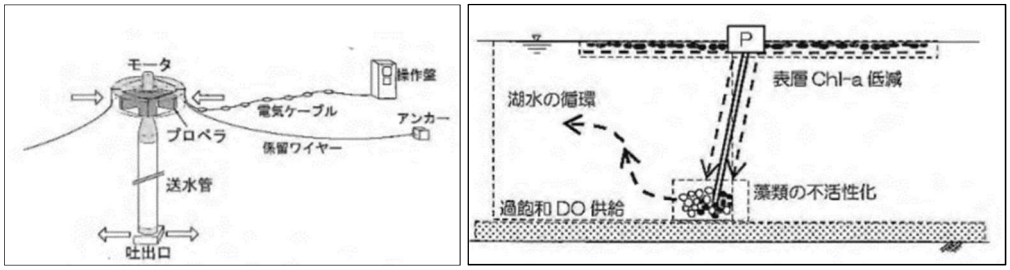
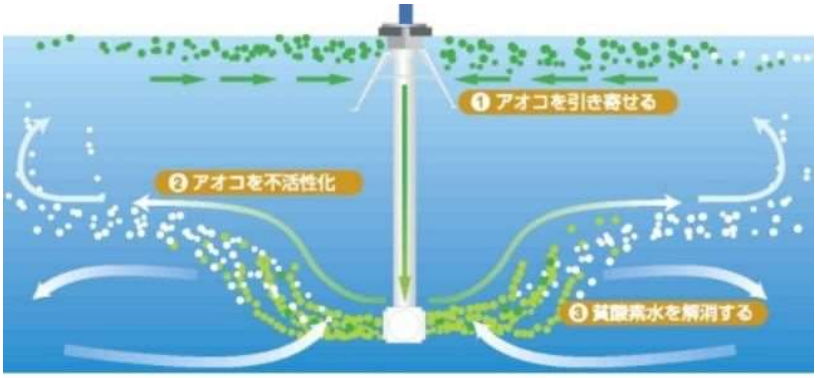
No.	Name		Organization
44	Nidia	Luque	CODEM, AMDC
45	Delberk	Simon	CODEM, AMDC
46	José Ramon	Anariba	CODEM, AMDC
47	Lilian	García	CODEM, AMDC
48	Mildred	Budde	Assistant Manager, SANAA
49	Jessica	Rodríguez	Sewerage, SANAA/UMAPS

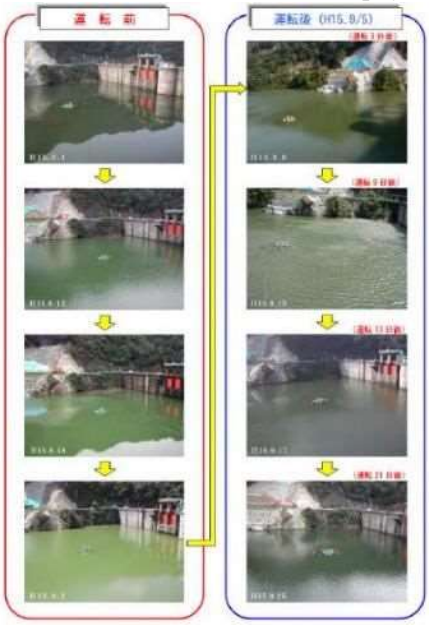
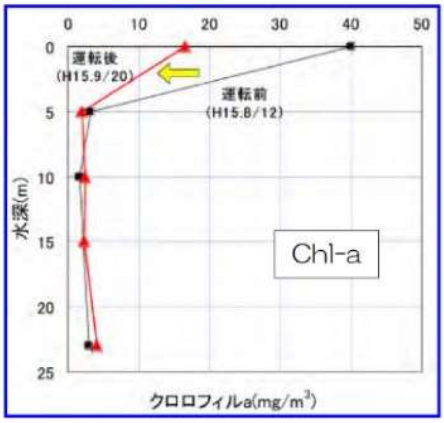
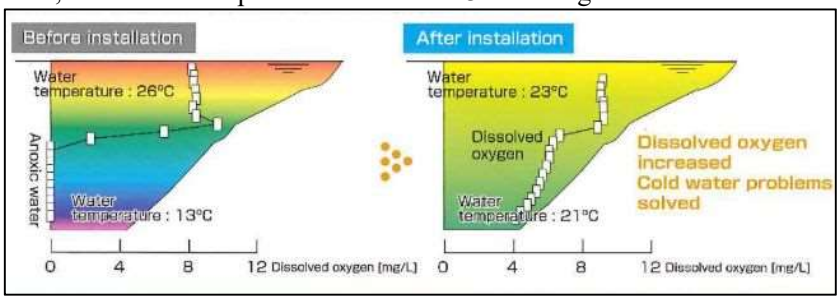
5-6-4 Content of Presentation

First, the summary of the survey was explained, and then the Japanese technologies were presented. Previously the Japanese companies had provided the technical documents and had authorized the presentation of the characteristics of their products. Table 5-6-4-1 shows the contents of the presentation.

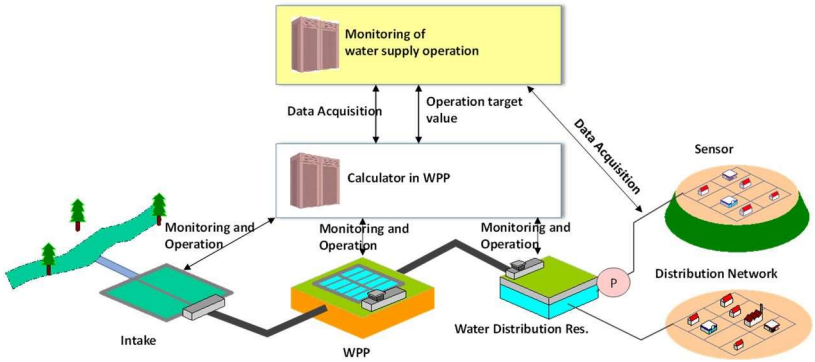
Table 5-6-2 Contents of Presentation

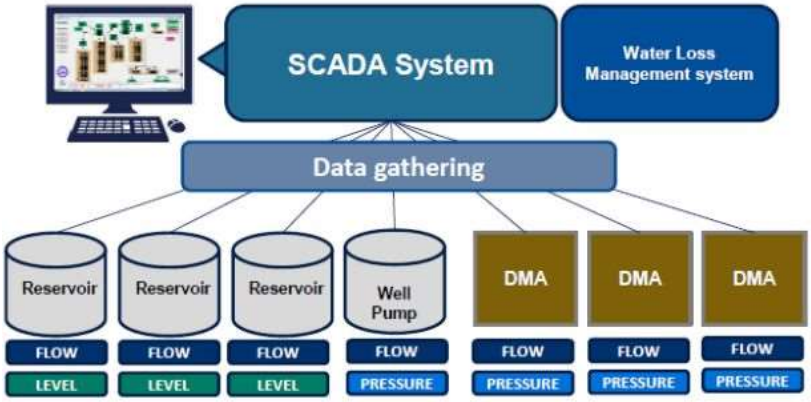
No.	Contents
1	**Tracer Gas Leak Detector** The devices used in the demonstration, the mode of use and processes were explained. (1) Features ・It can detect water leakage outside the water rationing schedule. ・It enables to confirm the locations of leakages which conventional acoustic wands cannot detect. ・Allows the survey to be conducted in noisy places and during the daytime. ・It does not require special techniques or knowledge, and anyone can handle it (2) Product: Tracer Gas Leak Detector Kit (Goodman Co., Ltd.) Explained about the following devices used in the demonstration and how to use them. ・Tracer gas generator (HT-55,HT-100,HT-200).  **・Gas detector (VARIOTEC 460)**  HT-55  HT-200
2	**Amplifier** (1) Characteristics ・Allows to amplify and hear through the hearing aid the sound of water leakage which is difficult to hear with conventional acoustic rods. **(2) Product: Kikuzo-kun (Goodman Co., Ltd.)**

No.	Contents
	 Kikuzo-kun" amplifier for acoustic rods Installed at the top of the rod
3	**Surface water removal device (lake water purifier with propeller)** (1) Features ・Collects algae from the surface layer using the propeller. ・Sends the algae to the bottom to deactivate them in a place where light cannot reach. ・Sends oxygen-containing surface water to the bottom and supplies oxygen to the bottom. The oxygen supplied to the bottom prevents the emission of harmful substances such as phosphorus and sulfur. Simultaneously it allows to solve the problem of low temperature in the bottom layer. (2) Product: NEOLOOP (ZENIYA OCEAN SERVICE ENGINEERING, LTD.) ①Structure and conceptual scheme of the device  ②Conceptual scheme of the water purification mechanism to improve water quality  ③ Photos of NEOLOOP  ④ Presentation of actual cases in Japan (dam in Saga prefecture).

No.	Contents
	・ Reduction of chlorophyll concentration in the surface layer.  Images of algae on the lake surface before and after the operation. * 21 days later, the algae in the surface layer visually disappeared. ・Chlorophyll "A" of surface layer Improved from 40 to 15mg/m^3.  ・It solves the problem of lack of oxygen at the bottom. After using the device, the oxygen concentration at the bottom improved from 0 to 4 - 8 mg/L. Also, the bottom temperature rose from 13 to 21 degrees. 
4	**Micro hydropower plant** The micro hydroelectric plant presented in this seminar is another type of existing micro hydroelectric plants built through the Grant Aid of Japan in the pipeline of the La Concepción Drinking Water Treatment Plant and in the transmission pipeline of the El

No.	Contents
	Picacho Drinking Water Treatment Plant. This micro plant presented in the seminar allows to generate electric energy with little difference in height, so it could be installed in the aeration point of the three existing water treatment plants. (1) Characteristics ・High generation efficiency with little head difference (less than 5 m) and low flow rate. ・Allows the generating device to be installed directly in the water channel. ・Easy installation of the device. ・Easy maintenance. (2) Product name: Power Archimedes (HOKURIKU SEIKI CO., LTD.) Specifications ・Q=0.95 m^3/s, H=3.5 m, 20kW Q=0.85 m^3/s, H=2 m, 10kW   [Results obtained from JICA projects] ・2013 Micro hydropower plant plan in the Republic of the Philippines (micro hydropower plant plan in Ifugao province). Specifications: Q=5 m^3/s, H=3.0 m, 50 kW   ・2014 JICA project for dissemination, demonstration and commercialization (SME support). Project for dissemination and demonstration of micro hydropower generation technology (Myanmar).
5	**Ultrasonic Flowmeter** The portable ultrasonic flowmeter is used for pump energy diagnostics. This company developed the world's first ultrasonic flowmeter. (1) Features ・High precision measurement: high precision design adopting Ultrasonic Pulse Velocity Propagation Velocity (VPU) method. ・Normally equipped with the function of pipe thickness measurement. (2) Product name: UPF-20 (TOKYO KEIKI INC.) * Equipment sold: 1500 pcs.

No.	Contents
6	**SCADA** The SCADA system was introduced at the El Picacho Water Treatment Plant in 2012 thanks to the Spanish cooperation; however, currently the system cannot be used due to the problem of spare parts and operation and maintenance. The Honduran Government believes that this system is important for the management of the drinking water system, and therefore, we have presented the best system of all the systems owned by Japanese companies. (1) Characteristics ・The SCADA (Supervisory Control and Data Acquisition) system is a computerized system for monitoring and process control of the drinking water system. It allows to monitor the operating status and data of all the equipment of the intake facilities, drinking water treatment plants and distribution tanks in one place. ・Some 5,000 products have been sold in total and are used in petroleum plants, private sector factories, and water and sanitation systems. The company has a worldwide presence with 280 offices in 80 countries, and so the supply of spare parts is easy. In the case of Honduras, it can serve the branch in the U.S. or Mexico. ① Conceptual scheme of SCADA  ② Name of product: Fast Tool (Yokogawa Electric Corporation)  [Results obtained from JICA projects] ・Grant ais: procured in 2016 for the "Metro Cebu Water District Drinking Water Supply Improvement Project".

No.	Contents
	 [Effects of the introduction of the application] ・Enables remote operations. ・Enables to collect and analyze the data easily. ・Allows to solve the areas of low water pressure. ・Drastically reduced user complaints. ・Operation and control work was reduced, as the operator does not have to go to the field frequently. It allows exact manipulation of the valves of the distribution tanks.

5-6-5 Participants' Questions and Comments

Table 5-6-3 Answers to comments and questions are as follows.

No.	Questions and Comments	Answers
1	The products you have presented can be used in our daily work. The surface water transfer system technology (lake water treatment propeller system) is effective in reducing the use of powdered activated carbon, which is currently used in water treatment. In addition, the 300 meter difference in elevation between the Picacho water treatment plant and the La Leona distribution tanks, where water is constantly pumped, can be used to generate hydroelectric power. We also believe that SCADA should be introduced as soon as possible. As for leak detection, tracer gas leak detection is effective because most leaks occur in distribution branches and water pipes.	A surface water transfer system would be especially useful for Laureles Dam.
2	The products presented can contribute to solving the current problems of the city of Tegucigalpa.	
3	Will there be a specific study to reduce blue-green algae in the reservoir?	No studies of the reservoirs will be carried out, as existing results will be used as a reference.
4	Will even the water pipes of customers in the city of Tegucigalpa be investigated?	In this article, we will only examine the information provided by SANAA to understand the current situation.
5	Thank you for introducing us to a new way of dealing with leaks. It is very interesting to be able to perform leakage studies even on days without	These equipment will be provided and we expect it to be actively used.

	water supply.	
6	Some disadvantages of tracer gas leak detection have been presented, but how do you plan to solve them?	The disadvantages are the need for a generator and the need to demarcate the area, which cannot be done without tracer gas leak detection. Procurement of generators is not a major problem, as they can be obtained locally at low cost.
7	Regarding SCADA, the existing SCADA is currently not being used due to lack of spare parts. So, what is your opinion on this matter?	Distributors are available in many countries and spare parts can be supplied through offices in Mexico and the United States.

CHAPTER 6 PROPOSED ASSISTANCE MEASURES TO IMPROVE DRINKING WATER SERVICES IN TEGUCIGALPA

Chapter 6 Proposed Assistance Measures to Improve Potable Water Services in Tegucigalpa

6-1 Content of the proposed assistance measures

In order to achieve development goals, including the SDGs and strategic partnership with relevant stakeholders, JICA has recently initiated the adoption of "Global Agenda / Cluster" modes, which is the development of strategic cooperation with greater development impact that goes beyond the boundaries between countries and between projects. The present Study is classified in the cluster "safe water supply and sanitation improvement" and in the cluster "assistance to the growth of WSP (Water Service Provider)". The "WSP growth assistance" consists of integrating financial assistance and technical cooperation, which are two schemes that are JICA's strength, to boost WSP business management towards development. For water supply services in Tegucigalpa, it is urgent to improve basic supply services, and it is expected to strengthen the WSP in the future for it to be able to develop distribution networks (infrastructure investment) and increase the number of customers who are sources of income, either with its own funds or using private funds to strengthen infrastructure (structural components) through financial assistance, institutional capacity and improving business management (non-structural components) through technical cooperation.

Based on JICA's assistance policy and guideline, and after analyzing the defined goals, analysis of the current situation, identification of challenges and difficulties, as well as assistance measures, it is proposed to implement projects covering the following structural and non-structural components.

【Structural】
PJ-1. Study for the medium- and long-term potable water facilities improvement plan in Tegucigalpa. PJ-2. Construction of sanitation facilities in the upper basin of Los Laureles Dam. PJ-3. Installation of dam water quality improvement equipment. PJ-4. Rehabilitation of existing water treatment plants. PJ-5. Aid for the development of water sources and new water treatment plants. PJ-6. Renovation of transmission facilities PJ-7. Renovation of distribution facilities
【Non-structural】.
PJ-8. Strengthening the management capacities of NRW and the pipelines of conduction and distribution networks. PJ-9 Strengthening capacities for operation and maintenance of drinking water utilities

Table 6-1-1 shows the details of each proposed assistance measure.

Table 6-1-1 Proposed Assistance Measures (Structural Components)

Project name	Content of the project
PJ-1. Study for the medium and long term improvement plan for potable water facilities in Tegucigalpa.	[Target]. Given that the construction of the San José Water Treatment Plant will be completed in 2024, hydraulic pipeline analysis based on the water demand forecast will be required, as well as plans for the renovation of the transmission and distribution facilities and the estimated cost of the project. [Contents] Design of the basic policies of the drinking water plan, social study, topographic study, pipe network analysis and renovation plans formulation. [Candidate project] Information gathering and verification study, Reimbursable Financial Cooperation (preparatory study)

Project name	Content of the project
	[Calendar] 2022 - 2023
PJ-2. Construction of sanitation facilities in the upper basin of Los Laureles Dam.	[Target]. Build the pipelines and residual waters treatment plant in the upper basin of Los Laureles Dam. [Contents] Construction of the pipelines (total length of about 13 km) and the residual water treatment plant (20,000 ^{3}m/day) in the upper basin of Los Laureles Dam. [Candidate project] Reimbursable Financial Cooperation [Calendar] 2023 - 2027
PJ-3. Installation of dam water quality improvement equipment.	[Target]. Install the water quality improvement device at Los Laureles Dam and La Concepción Reservoir and renew the dredging boat at Los Laureles Dam. [Contents] Install the water quality improvement device at Los Laureles Dam and La Concepción Reservoir and renew the broken dredging boat at Los Laureles Dam. [Candidate project] Non-Reimbursable Financial Cooperation [Calendar] 2022 - 2025
PJ-4 Rehabilitation work on existing water treatment plants	[Target]. Rehabilitate the existing water treatment plants (La Concepción and Los Laureles) since it is essential to renew the obsolete electromechanical equipment. [Content] Rehabilitation of the flow meter, renovation of the chemical dosing equipment, renovation of the rotating equipment, installation of the power plant, rehabilitation of the filtration tank, renovation of the chlorine gas equipment and safety measures. [Candidate project] [Reimbursable Financial Cooperation *In the event that the World Bank does not execute the project, it will be carried out through non-financial reimbursable cooperation. [Calendar] 2025 - 2026 * The World Bank plans to rehabilitate the water treatment plants between 2023 and 2025. This project will be executed in the event that the World Bank does not rehabilitate all of the plants.
PJ-5 Renovation work on water conduction and distribution facilities	[Objective] Renovate transmission facilities based on the PJ-1 Study for the medium and long term improvement plan of potable water facilities in Tegucigalpa. [Content] Optimization of transmission pipeline routes, renewal of transmission lines, renewal of transmission pumps and installation of meters. Renovation, construction and reconfiguration of distribution tanks, installation of water level meters and flow meters. [Candidate project] Reimbursable Financial Cooperation [Calendar] Construction: 2024 - 2028

Project name	Content of the project
PJ-6 Renovation of water distribution network	[Objective] Sectorize the distribution pipeline networks. [Content] ・Sectorization ・Installation of water micro-meters. [Candidate project] Reimbursable Financial Cooperation [Calendar] Construction: 2026 - 2028

Table 6-1-2 Proposed assistance strategies (non-structural components)

Project name	Content of the project
PJ-7 Strengthening of NRW management capacities and of the conduction and distribution network pipelines.	[Objective] Strengthen the management capacities of NRW and of the transmission and distribution networks. [Components] The following capabilities will be developed so that the WSP will be able to properly operate and maintain the conduction and distribution networks, reduce leakage, and control the NRW between 10-20 %, thus improving the managerial and financial situation. It is proposed to move from the evaluation level ③ WSP development assistance to level ④ sectoral governance assistance according to the "WSP Development Evaluation Standards in WSP Growth Assistance Strategies (Tentative)" of JICA Global Environment Department. It is proposed to assist in capacity building of the following aspects. • Strengthening of pipeline operation and maintenance capacity • Strengthening of the operation and maintenance capacity of transmission pumps • Strengthening the capacity to analyze pipeline networks • Improving water leak detection capability • Water meter dissemination activities • Strengthening asset evaluation and GIS capabilities • Strengthening of financial analysis capacity (support for drinking water tariff reform) • Strengthening customer service capabilities 【[Methodology]. Group of experts (water and sewerage planning, NRW management, leak detection technology, water pressure management, pipeline network analysis, asset management, GIS, management and financial analysis, promotion and outreach, water meter installation and rollout) [Candidate project] Technical Cooperation Project [Timeline] 2023-2028.
PJ-8 Strengthening of aqueduct's operation and maintenance capacities.	[Objective] Strengthen aqueduct operation and maintenance capabilities. [Content] Provide assistance to further strengthen operation and maintenance capabilities through infrastructure development. • Preventive maintenance of water treatment plants, revision of the operation and maintenance manual, asset management, etc. • Capacity building in water quality management (water supply sources, drinking water treatment plants, conduction and

	distribution systems). • Improvement of the financial situation and strengthening of managerial and financial capabilities to achieve self-profitability. • Capacity building to develop appropriate financial and investment plans • Assistance in the elaboration of capacity building policies and assistance in the construction of the human development system (construction of the training system in the topics of water and sewerage plan elaboration, leakage control technology, asset management, operation and maintenance of water treatment plants, pipeline network management capacity, water management, operation and maintenance of pumping stations, water quality analysis, etc.).) • Strengthening customer service capabilities [Methodology] • Group of Japanese experts (operation and maintenance of aqueducts and sewage systems, water treatment plants, operation and maintenance of electrical and mechanical installations, water quality management, training management, management and financial analysis, promotion and dissemination). • Training instructors (same region): aqueduct planning, leakage management technology, network management, water management, water quality analysis, asset management, etc. [Candidate project] Technical Cooperation Project [Timeline] 2030-2034

It is considered difficult to implement all assistance measures due to the limit on the amount of loan that can be assumed by the Government of Honduras. In addition, a water supply system can only provide customers with water services that meet their needs for water quantity, quality and pressure if water sources, water treatment plants, water conveyance facilities, distribution tanks and the installation of the distribution pipe network are upgraded

Therefore, to maximize the impact of the limited budget, the research team proposes two scenarios to consider. Supporting the Concepción subsystem is scenario 1, while supporting the Laureles subsystem would be scenario 2. On the other hand, the counterpart has asked us to focus our support on the aging water transmission pumping stations in the Concepción and Laureles subsystems. Therefore, the counterpart's request was set as scenario 3.

Table 6-1-3 shows three scenarios for future support measures. The schedule for the realization of each scenario is shown in Figure 6-1-1. It should be noted that the project start date for the proposed support measures is 2022.

Table 6-1-3 Scenarios of future assistance measures

NO	Water systems	Content	Beneficiary population	Benefits of each project
Scenario1.	La Concepción	***Structural components*** PJ-1.Study plan to improve potable water facilities in Tegucigalpa in the medium and long term (the entire project is subject to execution). PJ-3.Introduction of dam water quality improvement equipment. PJ-4.Rehabilitation of existing water treatment plants. * If the World Bank is unable to execute. PJ-5. Renovation works of water conduction and distribution facilities. PJ-6. Water distribution network renovation works. * Upgrading of distribution pipeline networks (10 out of 114 sectors planned, but needs to be examined thoroughly based on the estimated amount from PJ-1 with high precision.) ***Non-structural components*** PJ-7. Strengthening of NRW's management capacities and pipelines of conduction and distribution networks. (the entire project is subject to execution)	402,389 (Installation of water distribution network 137,649)	PJ-1: Development of a detailed renovation plan PJ-3: Reduction of chemical costs at water treatment plants 0.54-0.76 million USD reduction per year PJ-3: Assurance of water purification volume. PJ-5: Energy efficiency improvement of water transport and distribution and adequate control of water transport volume. PJ-6: Water Leakage Reduction In the case of NRW from 32.9% to 10%. 1.04 million USD reduction per year PJ-7: Reducing water leakage, improving financial situation, proper maintenance and management
Scenario 2	Los Laureles	***Structural components*** PJ-1. Study for the medium- and long-term potable water facilities improvement plan in Tegucigalpa. (The entire project is subject to execution) PJ- 2. Construction of sanitation facilities in the upper basin of the Los Laureles Dam PJ-3. Introduction of dam water quality improvement equipment. PJ- 4. Rehabilitation works for existing water treatment plants * If the World Bank is unable to execute. PJ-5. Renovation works of water conduction and distribution facilities.	196,516	PJ-1: Development of a detailed renovation plan PJ-2.3: Reduction of chemical costs at water treatment plants 0.54-0.76 million USD reduction per year PJ-4: Assurance of water purification volume PJ-5: Energy efficiency improvement of water transport and distribution and adequate control of water transport volume. PJ-6: Water Leakage Reduction

		PJ-6. Water distribution network renovation works* Upgrading of distribution piping networks (to be carried out in its entirety.) ***Non-structural components*** PJ-7. Strengthening of NRW's management capacities and pipelines of conduction and distribution networks. (The whole project is subject to execution)		In the case of NRW from 32.9% to 10%. 1.04 million USD reduction per year PJ-7: Reducing water leakage, improving financial situation, proper maintenance and management
Scenario 3	La Concepción and Los Laureles	***Structural components*** PJ-1. Study for the medium and long term potable water facilities improvement plan in Tegucigalpa. (The entire project is subject to execution) PJ-5. Renovation works of water conduction and distribution facilities. ***Non-structural components*** PJ-7. Strengthening of NRW's management capacities and pipelines of conduction and distribution networks. (The whole project is subject to execution)	628,693 （Installation of water distribution network0）.	PJ-1: Development of a detailed renovation plan PJ-5: Improvement of energy efficiency of water transport and distribution and adequate control of water transport volume. PJ-7: Reducing water leakage, improving financial situation, proper maintenance and management

* In addition to Scenario 3, the recipient government has also requested Scenario 1 PJ-3, PJ-4 and Scenario 2 PJ-2, PJ-3, PJ-4, depending on the budget.

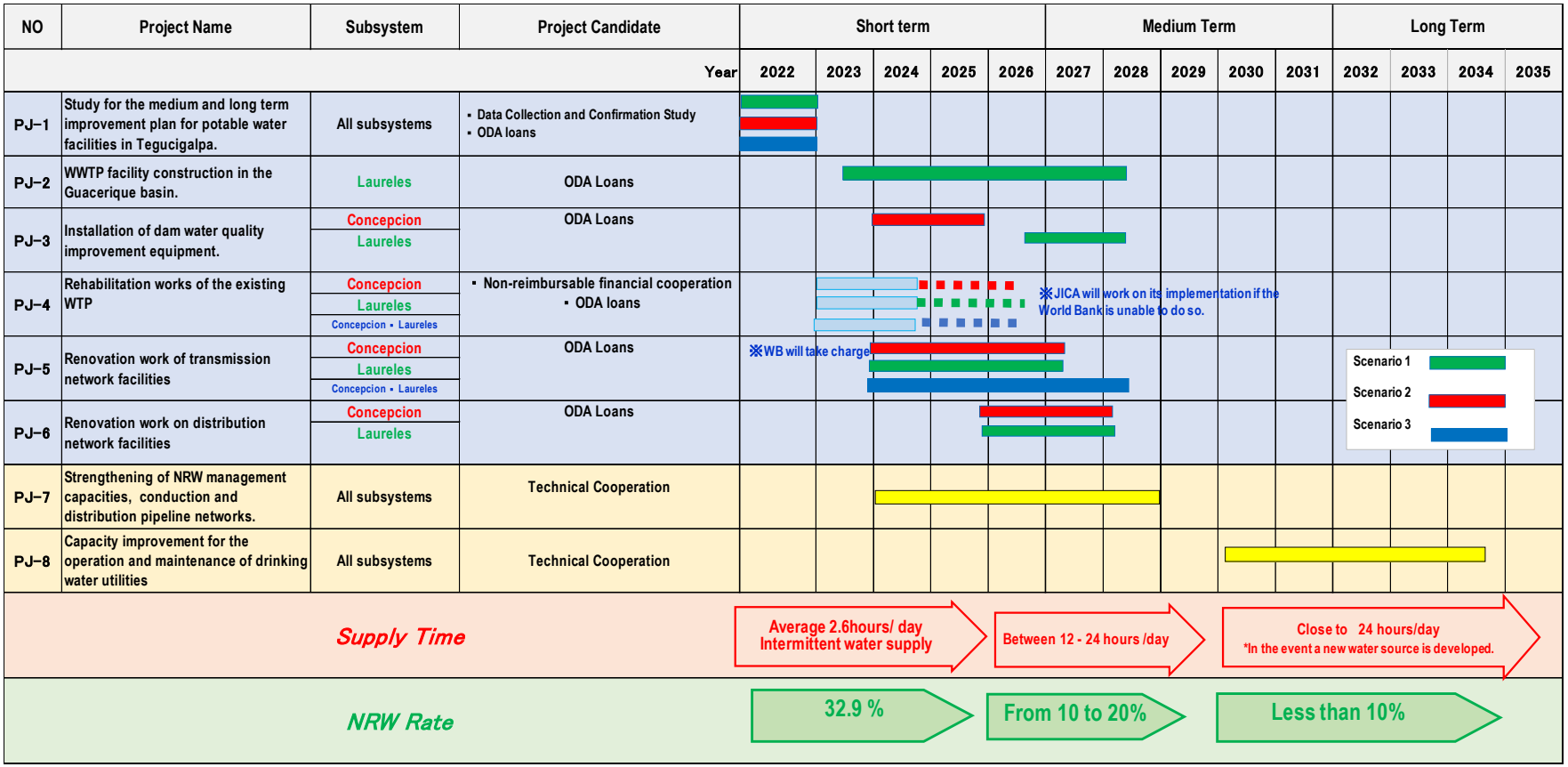


Figure 6-6-1Implementation schedule for the proposed content

6-2 Analysis process

This section discusses the analysis procedures for the following aspects in order to develop proposals for assistance strategies. Figure 6-2-1 shows the flow of analysis.

(2) Goal Definition

The levels of the WSP to be achieved in the short, medium and long term were defined for aqueduct services in Tegucigalpa, in order to have a milestone of assistance for the growth of WSP. For this purpose, the basic WSP checklist of JICA's "E/C Manual" used for the analysis of organizational capacities in Chapter 4, section 4-1-3 was used.

(3) Analysis of the current situation

Based on the results of the studies in Chapter 3 and Chapter 4, the basic WSP checklist was prepared by structural and nonstructural components, in accordance with the Capacity Assessment Guide.

(4) Challenge Identification

Challenges and difficulties in achieving short, medium and long-term goals were identified.

(5) Strategy development

Countermeasures were developed to address the short, medium and long-term challenges.

(6) Proposal for structural and non-structural assistance

The assistance strategies were proposed by classifying the components into structural and non-structural projects.

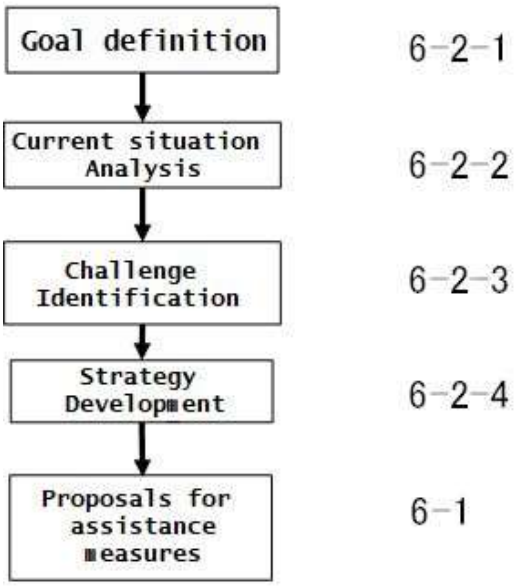


Figure 6-2-1Assistance flow of assistance proposals

6-2-1 Goal Definition

The basic WSP checklist of the E/C Manual is a tool to evaluate the gap between the current situation and the levels to be achieved, classifying the operational indicators into five levels. According to the results of the organizational capacity analysis in Chapter 4, section 4-1-3, the level of current SANAA and AMDC water services is at Level 2. The average score for improvements that can be achieved with investment in infrastructure and capacity building is 2.1, and the average score for improvements that can be achieved with programs is 3.5. The level of the main operational indicators and the current situation of Tegucigalpa are shown in the following table.

Table 6-2-1 Main operating indicators of water services according to service levels

Category	(Dimensions, aspects and elements)		Questions	Responses	Level	NO
Improvements that can be achieved through infrastructure investment (IF)	General		Q1. Medium and long term plan	They do exist, but the goal year has passed.	2	FI-1
			Q2. Continuity of water supply	Average 2.6 hours/day	1	FI-2
	Expansion	Drinking water service coverage	Q3. Overall average drinking water coverage	68.6 %	2	FI-3
			Q4. Water service for the poor stratum	Approx. half of the poor population receives water from the aqueduct.	2	FI-4
		Water treatment plants	Q5. Reserve capacity of the water treatment plants.	-23.3 %	1	FI-5
	Repair and replacement	Infrastructure conditions	Q6. Conditions and renovation of civil works	Leaks in civil works are a constant occurrence, which can be solved with partial repair.	2	FI-6
			Q7. Conditions of the main transmission and distribution lines	Use of obsolete asbestos pipes and cast iron pipes: less than 10%.	5	FI-7
			Q8. Terms and conditions of connection services	Between 60 and 70 % of the connection pipes are more than 25 years old since their installation.	3	FI-8
			Q9. Mechanical and electrical equipment conditions	Less than 10 % of mechanical and electrical installations are out of service due to serious failures	3	FI-9
Improvements to be achieved with capacity building (CD)	Technical Aspects	General	Q10. Operation and maintenance of infrastructure	There are operating and maintenance manuals for the facilities, but they are not effective.	3	CD-1

		Distribution network management	Q11. Drawings of piping installations	Almost all are available, and a simple GIS system has been implemented.	3	CD-2
			Q12. Zoning of the distribution network	There are systematized distribution areas, but there are almost no properly zoned distribution networks within each distribution district.	2	CD-3
			Q13. Water pressure at supply points	Water pressure at almost a quarter of the supply points is not within the 10-45 m range.	3	CD-4
		NRW Management	Q14. NRW Rate	32.9 %	3	CD-5
			Q15. Installation of water meters	Micro-meters are hardly used, fixed tariffs are applied.	1	CD-6
			Q16. Macrometer installations	The necessary macro meters have not been sufficiently installed.	2	CD-7
		Water quality management	Q17. Water quality tests at the drinking water treatment plant.	Water quality control is performed in accordance with the daily and continuous water quality monitoring plan, using appropriate test methods and properly maintained laboratory equipment.	4	CD-8
			Q18. Potability of tap water	There are some districts whose tap water does not meet benchmark water quality standards. However, it is potable when boiled.	3	CD-9
	Non-technical aspects	Financial management	Q19. Level of recovery cost	The operation and maintenance costs of the water systems are only partially covered by the tariff.	1	CD-10
			Q20. Fee collection rate	85 %	3	CD-11
		Institutional development	Q21. Human resources management and promotion rules	The labor and basic wage definition rules are not clear.	1	CD-12

			Q22. Execution of training	Training courses are given on certain topics.	2	CD-13
		Attention to the community	Q23. Claims handling	The system is in place and complaint handling procedures are established, but there is a large backlog of complaints.	3	CD-14
			Q24. Awareness-raising activities	Several awareness-raising activities have been carried out to date.	2	CD-15
Improvements that can be achieved through project implementation (PI)			Q25. Laws and regulations related to the drinking water sector	The General Water Law establishes the autonomy of the accounting management of drinking water services.	3	PI-1
			Q26. Sewerage service coverage	58.3%	4	PI-2

The following goals are proposed for the Tegucigalpa WSP to reach Level 3 in the short term (less than five years), Level 4 in the medium term (more than 10 years) and Level 5 in the long term (less than 15 years).

[Short term] Supply time: more than 12 hours/day, NRW rate 21-30 %.
[Medium term] Supply time: between 12 and 24 hours/day, NRW rate 10 - 20 %.
[Long term] Supply time: 24 hours/day, NRW rate 10% or less

6-2-2 Analysis of the current situation

Based on the results of the studies mentioned in Chapters 3 and 4, the categories that can be solved with ① infrastructure investment (FI), ② capacity building (CD) and ③ program approach (PA) by structural and nonstructural components were organized. Table 6-2-2-1 shows the five levels of assessment from level 1 to 5. The structural components are shown in Table 6-2-2-2-2 and the nonstructural components are shown in Table 6-2-2-3.

Table 6-2-2 -Level Scale

Level 1	Level 2	Level 3	Level 4	Level 5
Very Serious	Serious	Regular	Good	Very good

.

Table 6-2-3 Analysis of current status of structural components

NO	Subsystem name	Water source		WTP		Pipeline	Tank	Water piping network
		Quality of water	Facilities	Quality of water	Facilities			
H-1	Medium- and long-term planning (FI-1)	There is planning for the development of the Rio del Hombre water resources and the construction of WTP. (A detailed plan has been prepared with IDB support in 2015). *Consideration should be given to including the EIA as resettlement will occur. Consideration necessary due to road access and lack of water quality analysis samples.				(1) Water demand forecast (2) Hydraulic analysis considering San José WTP (3) Planning of pipeline renovation	New construction planning, integration and renovation	Development of a sectorization plan Picacho (25 sectors) Concepción (114 sectors) Laureles (10 sectors)
H-2	Picacho 25.2% of total water supply (261 thousand people)	Good	Intake works (23) and pipelines (93 km) are old and in danger of being damaged. (FI-6)	Good	Aging of electromechanical equipment *8 of the 16 sand filters are non-operative(FI-2FI-5)	(1) After hydraulic analysis, planning of pipeline renewal (FI-7)	(1) Aging (9 tanks)(FI-6) Metallic more than 30 years, concrete more than 50 years (2) No flow meter. Level gauge failure (CD-7)	(1) More than 85% of leaks occur in the water distribution network (tertiary pipelines and household water service pipelines). Leaks are caused by aging pipes, poor installation and high water pressure. (2) There are not enough water micro-meters (39% installed), which makes it impossible to analyze the volume of water supply. (3) Most of the networks do not have DMA (Sectorization) and there is no water pressure control. (CD-5,CD-6,CD-8)
H-3	Concepcion 52.1% of total water supply (422 thousand people)	Deterioration of water quality (Algae, odor)	Cost of chemicals for PTA increased (10 times higher than Picacho) (CD-10)	Good	Aging of electromechanical equipment (FI-5, FI-7)	(1) Same as H-2 (2) Deterioration of Pumping station's performance and aging (3) No flowmeter or pressure gauge (FI-8)	(1) Aging (12 tanks) (2) No flow meter. Level gauge failure (FI-9, CD-9)	
H-4	Miraflores *1.6% of total water supply (15 thousand people)	Good (river)	Planned to be discontinued (around 2024)	Good	-	-	No flow meter. Level gauge failure (FI-9, CD-9)	
H-5	Laureles 20.6% of total water supply (206 thousand people)	(Deterioration of water quality) (Algae, odor) Contaminated by wastewater	(1) Unable to discharge sludge. (dredge is in bad condition) (FI-6) (2) There is no WWTP in Guacerique watershed. Cost of chemicals for WTP increased (10 times higher than Picacho)	Good	Aging of electromechanical equipment (FI-5, FI-7)	(1) Same as H-3 (2)Same as H-3 (3)Same as H-3	(1) Aging (3 tanks) 2) No flow meter. Level gauge failure (FI-9, CD-9)	

Level 1 Level 2 Level3 Level4 Level5

6

Table 6-2-4 Analysis of the current status of nonstructural components

NO	Article	Water source	WTP	Pipeline	Tank	Water piping network
S-1	O & M of the facilities (CD-1) O & M of the pipeline (CD-2)	1) Picacho No renovation plans 2) Concepción (Maintenance and inspection of dams, O&M plans for booster pumps) 3) Laureles There is no sludge dredging plan, O & M of pumps in decanting	(1) The current situation is of post maintenance, with no plans to repair or renovate the facilities. (2) No record of repairs, renewals or accidents. (3) No asset management	(1)No plans to renew pipelines (2)No asset management (3)There is no plan for renewal or maintenance of the Pump Stations. (4) No record of pump operation	(1)No renovation or maintenance plan (2)No asset management (3)No record of the water distribution operation to the network.	(1) No renovation or maintenance plan (2) Updates, renewal history and history are not reflected in the GIS (asset management) data. (3) There is no record of operations such as opening and closing of water distribution.
S-2	NRW(CD-5) countermeasures	(1) No leak detection or monitoring patrols are conducted. (2) No record of leakage history in the GIS. (3) Micro-meters are not managed (There is water leakage in micro-meter connection (Demonstration result). (4) Since the management of water micro-meters is the responsibility of the customer, there is no control of renewal or lack of accuracy in micro-meters (Inaccurate Volume reading).				
S-3	Water quality management (CD-8)	(1) Raw water: water quality analysis is performed periodically. (Laureles: twice a month, Concepción: twice a year). (2) WTP water quality: Treated water meets water quality standards. (3) Distribution network water: Turbidity and residual chlorine may exceed water quality standards due to pipe breaks.				
S-4	Financial management (CD-10)	(1) Water rate *No result of O&M cost analysis and have not been able to establish beneficial rates. (2) 61% is fixed tariff. (3) No active effort to charge based on consumption.				
S-5	Organizational development (CD-12,13)	(1) Labor standards and wage setting are not clear. (2) There is no system for internal training, human resource development and technology transfer.				
S-6	Customer feedback (CD-15)	(1)Responses to complaints are recorded, but not all are addressed immediately. (2) Water conservation and information dissemination to customers is limited to social networks and websites, without being actively promoted.				
S-7	Water supply laws and regulations (PA-1)	(1) There is a Water Supply Law, which makes water services independent from accounting, and the legal and regulatory aspects are well developed.				
S-8	Sewerage coverage index (PA-2)	(1) Although the sewerage coverage rate is high, only about 10% of wastewater is treated due to leaks caused by aging sewer pipes (also a cause of sewage spills) and insufficient maintenance of WWTPs. (2) There is no master plan for sewerage.				

Level 1 Level 2 Level 3 Level 4 Level 5

7

6-2-3 Identification of challenges

First, medium- and long-term planning (FI-6) will be carried out and support will be provided on a structural and non-structural basis for those aspects that currently present serious problems at levels 1 and 2.

The target for the WSP in Tegucigalpa is to achieve a score of Level 3 in the short term (within 5 years), Level 4 in the medium term (within 10 years) and Level 5 in the long term (within 15 years) as a result of the assessment of the current situation using the Manual Checklist for Water Services in Table 4-6. The short-, medium-, and long-term challenges to achieve these objectives are summarized below.

(1) Challenges to overcome to reach the goal in the short term (less than 5 years)

To achieve the short-term targets (level 3 operational indicator: water supply time of at least 12 hours/day and non-revenue water rate between 21-30%), water utilities will focus on improving elements with score levels 1 and 2 in the operational indicators. Level 3 status is defined as: the state in which elements currently at levels 1 and 2 are being addressed in order to reach level 4.

Table 6-2-5 Short-term challenges

No.	Challenges	Identification of challenges
Structural components		
S-1	Medium- and long-term planning	At present, there is no medium and long term plan and no adequate investment plan has been made. In addition, the new San José water treatment plant is scheduled to be completed in 2024, under which is necessary to carry out by the target year the following: water demand forecasting, pipeline network model construction and pipeline network analysis to develop an adequate renovation plan for the water transmission and distribution facilities, as well as to develop a very precise renovation plan for the future.
S-2	Carrying out renovation work at water treatment plants	All water treatment plants have no backup for their equipment in case of electrical and mechanical failures, and the facilities need to be renovated to ensure a stable supply of clean water. The World Bank will initiate a detailed study of the water treatment plants in 2022, and will carry out the rehabilitation of the Picacho, Concepcion and Laureles plants in 2023, but if the rehabilitation is not carried out by the World Bank, assistance will be required.
S-3	Strengthening of operation and	Regarding the transmission and distribution facilities, data management of drawings and replacement history, operation and

No.	Challenges	Identification of challenges
	maintenance capacities of transmission and distribution facilities.	maintenance of pipelines and transmission pumps, data logging management and proper asset management have not been performed, so there is a need to improve operation, maintenance and asset management capacity.
S-4	Development of plans for the construction of a sewer and wastewater treatment plant in the upper section of the Laureles dam.	The raw water quality of the Laureles dam has deteriorated significantly due to the mixing of domestic and industrial effluents in the upper reach, a situation that the AMDC (SANAA) has not been able to improve due to lack of funds, although detailed plans have been made. Current plans will be reviewed and an appropriate plan will be developed.
Non-structural components		
S-5	Efforts to improve the maintenance and management capacity of water transmission and distribution facilities.	As for water transmission and distribution facilities, data management of drawings, construction history, maintenance of water transmission pipes and pumps, and data logging have not been implemented, so there is a need to improve maintenance management capacity. There is a need for UMAPS to understand these current problems and start working to improve the service.
S-6	Efforts to implement leakage control measures.	With a high non-revenue water rate of 32.9%, leakage control is a reactive measure. As a result of the demonstration, it is clear that there are many water meter leaks in areas with high water pressure, and it is necessary for UMAPS to inspect and repair water meters on a regular basis, identify areas where there are currently many leaks using GIS, analyze the causes of leaks on the ground, improve construction techniques around water meters, conduct leakage surveys using equipment such as to find and repair leakage points.
S-7	Start of water meter promotion activities	Water meter usage is approximately 39% as most customers have fixed tariffs. As a result, it is not possible to perform an analysis of the volume of water distributed and, therefore, it is not possible to calculate an accurate non-revenue water rate. In addition, customers tend to consume more water than they actually pay due to the flat rate system, and are unaware of water conservation due to this. In addition, the installation and maintenance of the water meters are at the customer's expense. As a result, some customers have been using water meters for more than 20 years and have never replaced them, so they continue to use inaccurate water meters.

No.	Challenges	Identification of challenges
		This means that they may not be able to obtain a correct water bills due to inaccurate water volumes. UMAPS needs to be aware of these issues and work on metered tariffs. For example, we need to compare the difference in water consumption and revenue between fixed and metered rates, and start working on getting customers to understand metered rates.
S-8	Improved financial management capacity	The company has been in the red continuously from 2016 through 2020. Current water and sewer rates are not sufficient to cover operation and maintenance. An analysis of the water supply cost and a review of water rates should be considered to improve the financial situation. There is also a need to acquire basic knowledge on how to organize and analyze data to improve financial capacity.
S-9	Customer feedback initiatives	Although advertising to customers has taken place through social media and websites, there has been no proactive advertising to customers about specific ways to save water and the importance of water meters. UMAPS recognized the importance of these initiatives and began working on them.

(2) Challenges to achieve in the medium-term goal (less than ten years)

To achieve the medium-term objectives (level 4 operational indicator, water supply time from 12 to 24 hours per day, non-revenue water ratio from 10 to 20%), means the issues raised in the short-term objectives have been achieved. To achieve the medium-term objectives (water supply time from 12 to 24 hours per day, non-revenue water ratio from 10 to 20%), the tasks listed in the short-term objectives must have been accomplished.

Table 6-2-6 Medium-term challenges

No.	Challenges	Identification of challenges
Structural components		
M-1	Renovation of water transmission and distribution facilities	The renovation work has been completed in accordance with the renovation plan established in the medium and long-term plan. (1) Water transmission facilities Renovation of water pipes, including their diameter and routing, based on pipe network analysis, and replacement of old or unsupported water pumps, with flow and pressure meters and other instruments installed on all pumps. (2) Water distribution tanks In the existing distribution tanks, the level gauges have failed and there are no flow meters, so it is not possible to determine the flow

No.	Challenges	Identification of challenges
		rate of the distributed water. The existing distribution tanks are made of steel, and after about 30 years the roof collapses and holes appear due to rust, while the RC tanks are made of concrete, and after 50 years the concrete cracks, causing water to leak from the subsoil. We would like to see the renovation, consolidation and construction of new distribution reservoirs based on the renovation plan. All distribution reservoirs will be equipped with flow meters and level gauges in order to properly monitor the flow to the distribution area.
M-2	Renovation of the water distribution network	In areas where water pressure is high, many leakage accidents occur, often due to the failure of pressure reducing valves in the distribution pipe network and poorly constructed water meter sections. Therefore, it is necessary to build a water distribution network that is easy to maintain and search for leaks by properly arranging pressure reducing valves and blocking the pipe network so that the pressure can be properly controlled. In addition, it is necessary to build a pipe network with a long life cycle using HDPE and suitable water meters.
M-3	Introduction of water quality improvement in dams	At the Concepción and Laureles dams, water quality improvement equipment should be installed to eliminate blue green algae in the dams, eliminate anoxia, and reduce chemical costs by injecting powdered activated carbon and polymers into the water treatment plants.
M-4	Construction of sewers and wastewater treatment plants in the upper section of the Laureles dam.	Collection sewers and wastewater treatment facilities need to be constructed in the area upstream of Laureles Dam to ensure that domestic and industrial effluents are adequately treated in Laureles Dam to improve raw water quality.
Non-structural components		
M-5	Improving the maintenance capacity of water transmission and distribution facilities.	The competencies addressed in S-5 have been enhanced as follows. The management of blueprint data and construction history of water transmission and distribution facilities are reflected in the GIS so that the information is available when needed. Pipeline maintenance and construction techniques have been mastered and the number of leaks due to poor construction has been reduced.

No.	Challenges	Identification of challenges
		Water pumps are properly maintained and managed with a daily checklist so that the condition of the pump, including flow rate and pressure, can be checked at all times.
M-6	Application of leakage control measures	The competencies addressed in S-6 have been enhanced as follows. UMAPS has prepared a manual for water meter installation and provided guidance to contractors, etc., which has reduced the number of leaks around water meters. Leak surveillance patrols are planned and conducted on a regular basis. The ability to identify data and trends in areas of high leakage and analyze the causes. The establishment of effective leak detection methods, including tracer gas surveys, and the acquisition of survey procedures and methods have improved leak repair capabilities.
M-7	Widespread use of water meters	As a result of the work initiated in S-7, water meters are now widely available. Pilot projects have shown that pay-as-you-go systems can increase revenues. UMAPS has proper management of water meters, including calibration standards. Customers understand the metering system and water meter usage is increasing. The metering system increases customer awareness of water conservation.
M-8	Improved financial management capacity	Financial capacity has been improved through the implementation of the following for S-8 We can analyze water costs and review water rates. Improved ability to organize and analyze financial data.
M-9	Customer response initiatives	The following has been done for the S-9 Customers are aware of the importance of saving water. Explain current water system issues and problems to customers. The customer understands the importance of the water meter.

(3) Challenges to achieve in the long-term goal (less than 15 years)

In order to achieve the long-term objectives (performance index level 5, 24-hour water supply time, percentage of non-revenue water is below 10%), in terms of structural items, the development of new water sources has been carried out, and in terms of technical items, once the medium-term problems have been solved, proper maintenance and management of water treatment plants, sustainable business management and human resources development mechanisms have been put in place.

Table 6-2-7 Long-Term Challenges

NO	Challenges	Identification of challenges
L-1	Water treatment plant operation and maintenance management capacity	Maintenance is basically corrective, so the water treatment plant stops when the facilities are shut down. There are also no records of repairs and accidents at the facilities. Therefore, it is necessary to develop a preventive maintenance program for the water treatment plants and to carry out proper asset management.
L-2	Capacity building for water quality management	It is necessary to implement environmental regulations in the upper basin of Los Laureles Dam and La Concepción Reservoir, improve the capacity for environmental conservation in water sources, carry out strict water quality control in water sources, drinking water treatment plants, and transmission and distribution facilities due to water quality incidents such as the mixing of turbid water in transmission and distribution facilities, and establish a system that allows autonomous implementation of measures and capacity building.
L-3	Strengthening of financial management capabilities	Once the medium-term goal is met, the water supply will be stabilized and the financial situation will improve. In any case, it is essential to strengthen capacities for proper operation and maintenance, and financial management, including the execution of the investment plan, cost management, etc.
L-4	Strengthening the human development system	In order to achieve sustainable business management, it is necessary to train young employees on an ongoing basis, including the transfer of the technology developed after the medium-term goal has been met. Currently, the WSP are not providing training courses, so it is necessary to build a personnel training system.
L-5	Strengthening of customer service capabilities	Once the medium-term goal is achieved, complaints will be reduced due to improved services. In any case, it is necessary to build a system that centrally analyzes customer requirements in order to achieve sustainable business management.

6-2-4 Strategy development

Propose actions to address the problems identified in 6-2-3, as shown in the table below.

Table 6-2-8 Content of strategies

(1) Short-term		
No.	Strategies	Description
Structural components		
PS-1	Formulation of the medium and long term plan	With 2030 as the target year, an analysis of the pipeline network will be conducted and a renewal plan for transmission and distribution facilities will be developed, based on projected water demand following the completion of the San Jose water treatment plant in 2024. (1) Establishment of a basic policy and objectives for waterworks planning. (2) Survey Social research Per capita water use, commercial water uses surveys, population projections by reservoir, residential water reservoir capacity surveys Survey Survey of water pipeline routes, confirmation of pumping station and distribution reservoir elevations, field inspection of buried pipelines (1) Pipe network analysis (2) Establish water demand per district (3) Construction of a piping network model (4) Pipe network analysis (5) Planning based on the analysis results (6) Planning for consolidation and replacement of distribution areas (7) Change of routing and diameter of water pipelines (8) Planning the replacement of water pumps (9) Summary Calculation of estimated project costs (1) Renovation plan (2) Development of financing plans
PS-2	Water treatment plants rehabilitation works	The following rehabilitation works should be carried out:

		(1) El Picacho Water Treatment Plant ① Rehabilitation of the flow meter for raw water and for transmission. ②Renovation of chemical dosing equipment. ③Renovation of backwash pump and blower. ④Electricity generation plant installation. ⑤ Rehabilitation of 8 suspended filtration tanks (gate and collector replacement). ⑥Renovation of chlorine gas equipment and safety measures. ・Renovation of cylinder scale and chlorine dosing unit. ・Chlorine gas fan and neutralizer. (2) La Concepción Water Treatment Plant ①Chemical dosing equipment refurbishment. ②Flow meter renewal. ③Renovation of backwash pump and blower. ④Backup Electricity generator improvement. ⑤Renovation of the pneumatic actuation valve. ⑥Renovation of chlorine gas equipment and safety measures. ・Renovation of cylinder scale and chlorine dosing unit. ・Chlorine gas fan and neutralizer. (3) Los Laureles Water Treatment Plant ①Chemical dosing equipment refurbishment. ②Flow meter renewal. ③Renovation of sand filter media (sand and anthracite). ④Renovation of backwash pump and blower. ⑤Backup Electricity generator improvement. ⑥Renovation of the pneumatic actuation valve. ⑦Renovation of chlorine gas equipment and safety measures. ・Renovation of cylinder scale and chlorine dosing unit. ・Chlorine gas fan and neutralizer. * Although execution by the World Bank is foreseen, it is necessary to execute what could not be executed.
PS-3	Renovation of the water treatment plant	The following renovation works are required at each of the following water treatment plants (I) El Picacho water treatment plant (1) Renewal of raw and treated water flowmeters 2) Renewal of chemical injection equipment (3) Refurbishment of backwash pumps and blowers Installation of private power generation equipment

		(5) Rehabilitation of 8 inactive filtration tanks (renovation of the floodgates and water collection system) 6) Renovation of the chlorine gas installations and safety measures. Renewal of cylinder and chlorine dosing machines Exhaust fan, chlorine gas neutralizer (II) Concepción water treatment plant (1) Renovation of chemical injection equipment (2) Renewal of the flow meter (3) Refurbishment of backwash pumps and blowers Installation of private power generation equipment Renewal of the pneumatic valve 6) Renovation of the chlorine gas installations and safety measures. Renewal of cylinder and chlorine dosing machines Exhaust fan, chlorine gas neutralizer (III) Laureles water treatment plant (1) Renovation of chemical injection equipment (2) Renewal of the flow meter 3) Sand filtration renovation (sand and anthracite) Backwash pump and blower replacement Installation of private power generation equipment (6) Renewal of pneumatic valves 7) Renovation of the chlorine gas installations and safety measures. Renewal of cylinder and chlorine dosing machines Exhaust fan, chlorine gas neutralizer In cases where the Bank has not done so, it is necessary to supplement it.
PS-4	Detailed design of the implementation plan for water quality improvement in dams.	At the Concepción and Laureles dams, water quality will be checked for blue-green algae and anoxia at the bottom of the dams, and the necessary water quality analyses will be performed. The various conditions will then be sorted out, water quality simulations will be carried out, and the number and specifications of water quality improvement devices will be studied in detail and a plan will be formulated. (1) Organization of the water quality data (2) Study of the effect of water quality via simulation. (3) Specifications (method, number of units, etc.) (4) Construction planning

		(5) Costing
Non-structural components		
PS-5	Improved maintenance capacity of water transmission and distribution facilities.	Strengthen the capacity of water transmission and distribution facilities to enable information sharing by reflecting construction records in drawings and maintenance of water transmission pumps and pipelines. (1) Drawing data management and computerization (GIS, CAD, etc.) (2) Recording of the installation update history (3) Maintenance and management of water transmission and distribution facilities (pumping facilities) (4) Operating records of water transmission and distribution facilities.
PS-6	Strengthening of the capacity to control non-revenue water	The following capacity building measures to combat non-revenue water will be adopted (1) Visualization of leakage points (exchange of information through GIS). (2) Analysis of the cause of the leak (3) Establishment of a leakage patrol and inspection system. (4) Improved leak detection capability. (5) Strengthen pipeline repair capability.
PS-7	Widespread use of water meters	Water meters will be installed in the model areas to promote water metering and, depending on the results of the verification and validation of the cost-effectiveness improvement, future plans will be developed to strengthen the company's ability to educate customers. (1) Survey of existing facilities (2) Planning (3) Selection of model districts (4) Installation of water meters (5) Verification of effectiveness (6) Customer awareness activities policy (7) Strengthening water meter maintenance and management capacity.
PS-8	Improved financial management capacity	The following basic analytical skills will be reinforced to improve financial capability (1) Strengthen water cost and price analysis capacity. (2) Strengthening basic financial management skills (3) Strengthen our ability to develop business plans and strategies.

PS-9	Improve customer responsiveness	Strengthen our responsiveness to customers and raise awareness of our work. (1) Analysis of customer's demands (2) Developing a public relations strategy (3) Consideration of advertising methods.
(2) Medium term		
No.	Strategies	Description
Structural components		
PM-1	Renovation of water transmission and distribution facilities	Renovation of water transport facilities and distribution tanks based on a medium and long-term plan. (1) Water conveyance facilities ①Optimize the routing of water pipes and renovate conduits. ②Renovation of water pumps. ③ Installation of instruments such as pressure gauges, flow meters, etc. ④ Water conduction history planning method. (2) Water distribution tanks ① Replacement of old/aging water distribution tanks. ②Reconstruction of water distribution facilities (consolidation, removal, new construction). ③Installation of flow meters, level gauges and other measuring equipment.
PM-2	Renovation of water distribution facilities	On the basis of medium and long-term planning, the following updates will be carried out Sectorization of the water distribution network ①Sectorization instruction. ② Development of a sectorization plan. ③Installation of water micrometer.
Non-structural components		
Implementation of PS-5,6,7,8,9 in the short term		
(3) Long-term		
No.	Strategies	Description
Structural components		
PL-1	Strengthening the operation and maintenance capacities of water treatment plants.	Strengthen the following capabilities to perform preventive maintenance of existing and new water treatment plants, and high-quality operation and maintenance by reviewing the relevant manuals. (1) Capacity building in the preventive maintenance of the facilities

		(2) Strengthening of asset management capabilities (3) Strengthening of operation and maintenance plan preparation capabilities.
PL-2	Capacity building for water quality management	Strengthen water quality management capabilities in water supply sources, potable water treatment plants, piping and distribution facilities. (1) Capacity building for monitoring and analysis of water quality in water supply sources. (2) Strengthening of aquatic environment conservation capacities. (3) Strengthening of water quality monitoring capabilities at the pipeline and distribution facilities.
PL-3	Strengthening of financial management capabilities	Once the medium-term goal has been met, the financial situation will be improved, and in order to achieve sustainable business management, it is proposed to strengthen the following capacities. (1) Capacity building for the preparation of the investment plan (2) Strengthening of cost management and financial management capabilities
PL-4	Strengthening the employee development system	Build a system of transferring technology to young employees and developing human resources in order to achieve sustainable business management (1) Creation of the training center (2) Strengthening the capacity of the training system (3) Improving the content of training courses (training of trainers: TOT)
PL-5	Strengthening of customer service capabilities	Strengthening the capacity to meet customer requirements in order to improve the level of customer satisfaction. (1) Strengthening of customer service capabilities (2) Strengthening of promotion and dissemination capabilities

6-3 Considerations to be taken into account for the execution of the Project

The following are the considerations to be taken into account when executing the proposals.

(2) Cooperation with the World Bank project

Since 2019, the World Bank has been implementing the "Project for the Strengthening of the Potable Water Service in Tegucigalpa", which is expected to be completed in 2025. Currently, under Component 1, support is provided for the transfer of operations from SANAA to UMAPS, and as of 2022, under Component 2, the rehabilitation works of the El Picacho, La Concepción and Los Laureles water treatment plants will be executed and the sectorization of the El Picacho system into DMAs, the reduction of NRW and the strengthening of the management of Los Laureles and La Concepción will

be carried out. Component 2 includes hiring consultants and carrying out the studies starting in 2022, and in 2023, executing the rehabilitation works for the water treatment plants and sectorizing the El Picacho system into DMAs. According to the results of the consultation with the people involved in the World Bank, the budget to execute Component 2 is US$ 50 million, and at this moment it is not known if all the rehabilitation works of the water treatment plants and sectorization in DMA can be executed. They say that if not all of them can be executed, they will provide support prioritizing the El Picacho system.

The study team believes that renovation of water treatment plants is necessary to achieve stable water services, and if the Bank is unable to renovate all plants, additional support will be necessary.

(3) Possibility of cooperation with the IDB

The IDB has launched the Central District Water and Sanitation Utilities Reform Program, which includes relocation assistance, policy support and guideline development. The program aims to strengthen governance and management of the sector. The guidelines for water and sewerage tariff policy and the development of a water supply master plan developed under this program should be used as a reference in future proposed projects. The IDB plans to initiate the second phase of a similar project in 2022. After an interview with the IDB on the status of the grants, we confirmed that there are no plans to undertake any renovation or construction of facilities at this time. The IDB and JICA have a positive stance on coordinated support to the water sector in Tegucigalpa, and considering the loan limits of each lending institution as mentioned in item (3) below, coordinated support to the same sector will contribute to increased results.

(4) Japan Reimbursable Financial Cooperation Loan Limit Amount

Honduras has a limit on the amount of loans financed by international organizations, and according to SEFIN, that amount is about US$ 30 million per year for each sector. The World Bank and IDB are financing between US$ 50-60 million for the water sector, so JICA could finance up to US$ 150 million in 5 years. Therefore, since it is not possible to implement all of the above proposed content, it is recommended to select and implement the strategic components from the above proposed components. Since it is not possible to implement all the proposals, it is important to focus the scope of the project to support water sources, water treatment plants, water transmission facilities and water distribution facilities, and to make it clear that the project will improve water services to customers.

In particular, it is necessary to carry out the PJ-1 Tegucigalpa City Water Supply Facilities Improvement Plan Study as soon as possible, design a very precise renovation plan, calculate the estimated cost of the project and determine the scope of the project.

(5) Social and environmental considerations

In the case of building dams in Honduras, it is necessary to carry out the EIA, disseminate information on the EIA and communicate with NGOs and the community. If it is not possible to build social

consensus or convince the population affected by displacement or resolve opposition to the sources of supply in the case of building the reservoirs, this situation would compromise the viability of the proposals in this study, and environmental and social considerations must therefore be fully taken into account from the design phase of the project.

(6) Institutional capacity of the AMDC (UMAPS)

Currently, the operation and maintenance services of the aqueduct and sewerage systems are being transferred from SANAA to AMDC, with a view to completing the transfer process to UMAPS in December 2021. The results of the analysis of institutional, business and financial management capacities detailed in this Study correspond to the capacities of the Metropolitan Division of SANAA to date. While it is believed that these results will not change substantially, as SANAA employees have been hired by UMAPS, it is necessary to reassess the institutional, managerial and financial capacities of UMAPS once the transfer is completed, in order to have a baseline in the case of implementing the Project.

(7) Security management

The JICA Honduras Office has designated the area around the Laureles Water Treatment Plant and the water distribution area as a hazardous area. The southern part of the water distribution area in Concepcion is also a hazardous area, so it is necessary to implement comprehensive security measures against water meters theft, site inspections and during construction.

.

FIN

ANNEX

Estudio de Recolección de Datos sobre el Abastecimiento de Agua en Tegucigalpa

Seminario para presentar tecnologías japonesas

ALCALDÍA MUNICIPAL DEL DISTRITO CENTRAL

8 de Septiembre 2021

SERVICIO AUTONOMO NACIONAL DE ACUEDUCTOS Y ALCANTARILLADOS

JAT NJS JICA

1

Resumen del Estudio

1-1 Objetivos del estudio

El Estudio tiene por objetivo poner en orden la situación actual y los problemas pendientes del servicio de agua potable en el municipio del Distrito Central y proponer un esquema de asistencia dirigida al mejoramiento del servicio de abastecimiento de agua.

- Componente infraestructuras: Renovación de instalaciones, equipos y materiales
- Componente técnico: apoyo por medio de cooperación técnica

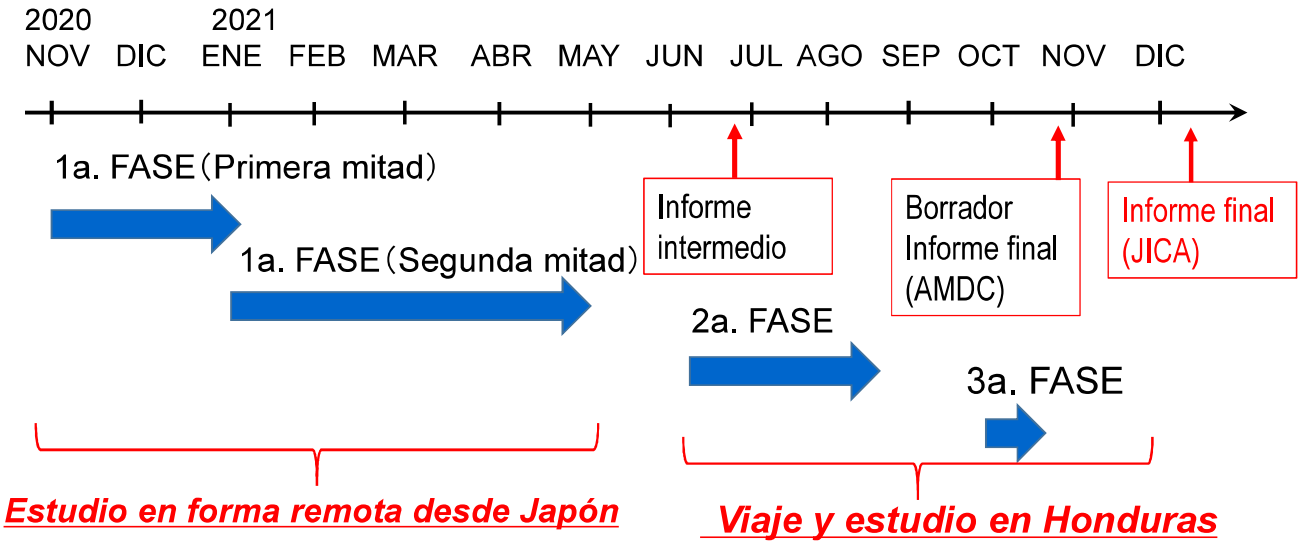
1-2 Integrantes del Equipo de Estudio

Nombre	Función
Nobuyuki Sato	Líder/ Plan de Servicio de Agua Potable 1
Toshiki Horie	Sublíder/ Plan de Servicio de Agua Potable 2/ Plan de Equipos
Hiroki Fujiwara	Plan de Instalaciones
Kiyoko Takamizawa	Análisis Institucional
Kenji Nakanosono	Demostración
César A. Morales	Coordinador
Edmond Madrid Rivera	Ingeniero de abastecimiento de agua
Eduardo Daniel Blanco	Ingeniero eléctrico
Carlos Emanuel Sánchez	Análisis Institucional

2

1 RESUMEN DEL ESTUDIO

1-3 Calendario del Estudio



※Equipo de Estudio Locales:
Todos los viernes: reunión a distancia con C/P

HORIE：8/10−11/13
NAKANOSONO：7/13 −9/11
FUJIWARA:8/10−9/22
TAKAMIZAWA：8/25−9/11

3

Seminario para presentar Tecnologías Japonesas

1. Detección de fugas de agua
2. Mejorar de la calidad del agua en embalse
3. Pequeños generadores hidroeléctricos
4. Caudalímetro ultrasónico
5. SCADA

4

1. Detección de fugas de agua

1. Problema pendiente

- Actualmente, SANAA repara las tuberías cuando los usuarios avisan de una fuga de agua. No realizar detectar de fugas de una manera activa
- El proyecto AQUARUM de España entregó los siguientes equipos de detección de fugas. Estos equipos solo pueden detectar fugas si hay agua en las tuberías. Sin embargo, es difícil buscar siempre fugas en un suministro de agua intermitente como el actual en Tegucigalpa.

Seba KMT : Hydrolux HL 500	CORRELUX P-1	Vivax vLocPro
		

2.Solucion

Actualmente, la mayoría de las zonas de la ciudad de Tegucigalpa se suministra de agua una vez cada cinco días, y proponemos un sistema de detección de fugas por gas trazador para detectar la fuga de agua cuando no hay agua en tubería.

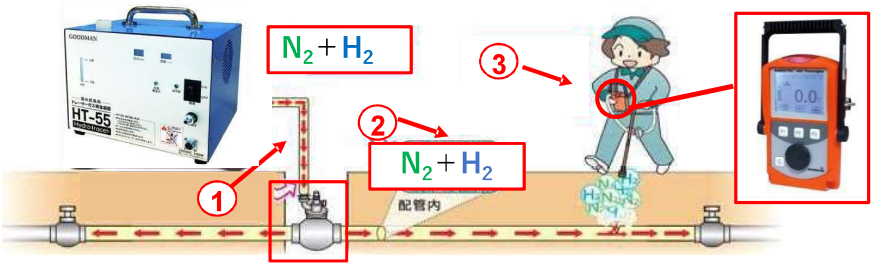
5

1. Detección de fugas de agua

Unidad detectora de fugas tipo hidrógeno (GAS)

Generador de mezcla de gases de hidrógeno y nitrógeno

Producción de gas (55L/min)



①	Desde un micromedidor se introduce la mezcla de gases de hidrógeno y nitrógeno a la tubería secundaria o terciaria.
②	Llenar la tubería con gases de hidrógeno y nitrógeno.
③	Detectar el hidrógeno con el detector y los puntos de fuga.

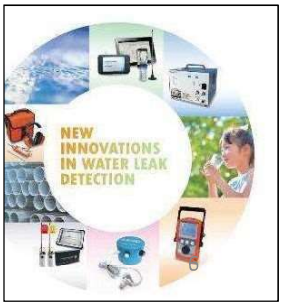
- Tecnología Japón:

(1) Nombre de empresa : GOOD MAN
https://www.goodman-inc.co.jp/english/goodman

GOODMAN
探索機のグッドマン

(2) Nombre de producto: Hydro Tracer-55

(3) Registro de casos
169 casos (Japón) 10 casos(Proyecto de JICA)



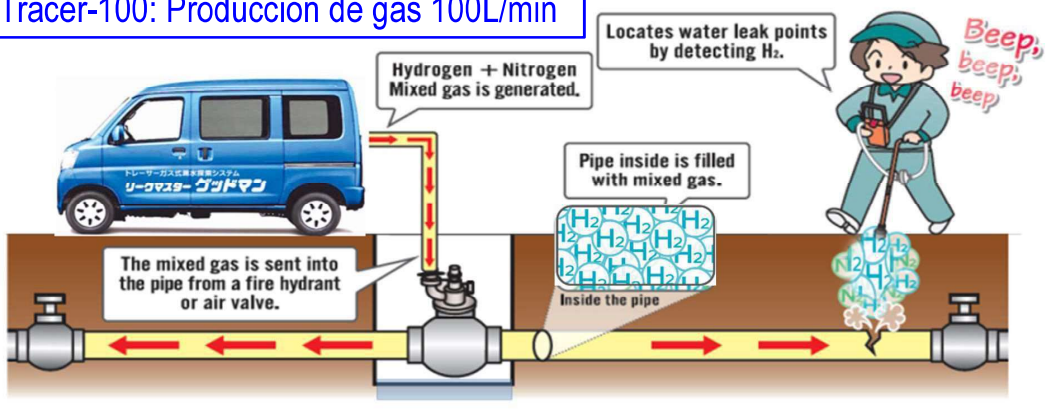
1. Detección de fugas de agua

Ventaja	Desventaja
▪Es posible detectar fugas mínimas o a baja presión, que un método acústico convencional no puede detectar. ▪Es posible detectar fugas en áreas con limitadas horas de servicio. ▪Es posible trabajar de día en los lugares con alto tráfico o mucho ruido. ▪No queda afectado por la profundidad, tipo y diámetro de la tubería instalada . ▪No requiere conocimientos ni experiencia especiales	▪Se necesita un generador para la detección de fugas en sitio. ▪Cuando se inyecta gas, es necesario separar las tuberías con válvulas. Si no es posible separar las zonas, es necesario instalar nuevas válvulas. ▪Se necesita tiempo para inyectar el gas. 60minituos para la inyección de gas :2 pulgada de diametro,1000m 90 minutos para la inyección de gas :3 pulgada de diametro,1000m

1. Detección de fugas de agua

Los generadores de gas trazador montados en vehículos se utilizan para buscar fugas de agua en diámetros medianos y grandes y en largas distancias.

Hydro Tracer-100: Producción de gas 100L/min



Hydro Tracer-200: Producción de gas 200L/min

**Los vehículos se puede acondicionar en Honduras.*

1. Detección de fugas de agua

1. KIKUZO（Amplificador de sonido)

Para confirmar fuga de agua, confirmar sonido de fuga.
Generalmente, se utiliza Varilla acústica.

Varilla acústica

Varilla acústica con KIKUZO

Generalmente, se necesita larga experiencia para detectar sonido de fuga de agua

Varilla Acústica con Amplificadora (KIKUZO)
Es fácil de saber diferente de sonido.

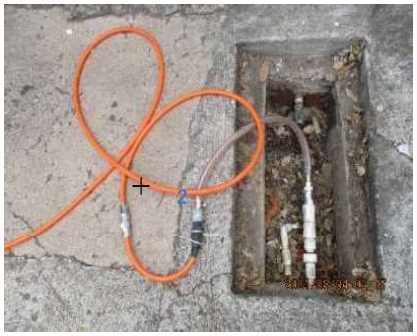
1. Detección de fugas de agua

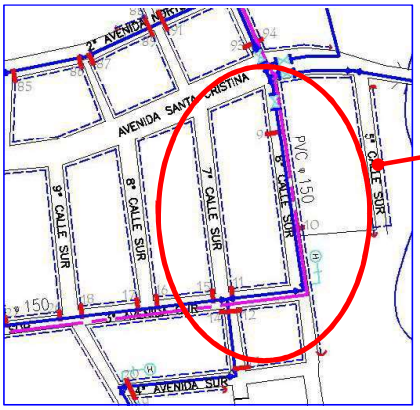
1. Resultado de demonstración

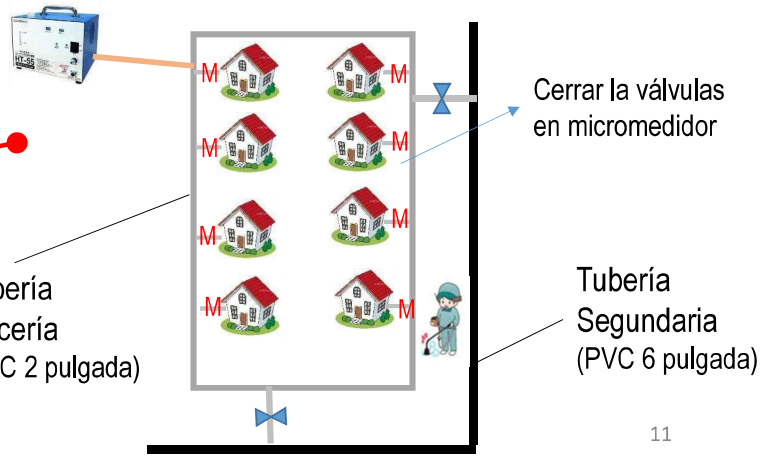
(1) Entrenamiento
1. Participantes
SANAA: Departamento de Optimización Operativa, AMDC(21 persona)
2. Fecha
De 26 a 29 de Julio 2021
3. Contenido
- La importancia del control de fuga de agua
- Uso de los Equipos (HT-55, VarioTech, PVC Locator, KIKUZO)
- Medición de cloro residual y presión de agua en tubería

Resultado de demonstración

(2) Demonstración (Mira Flores)



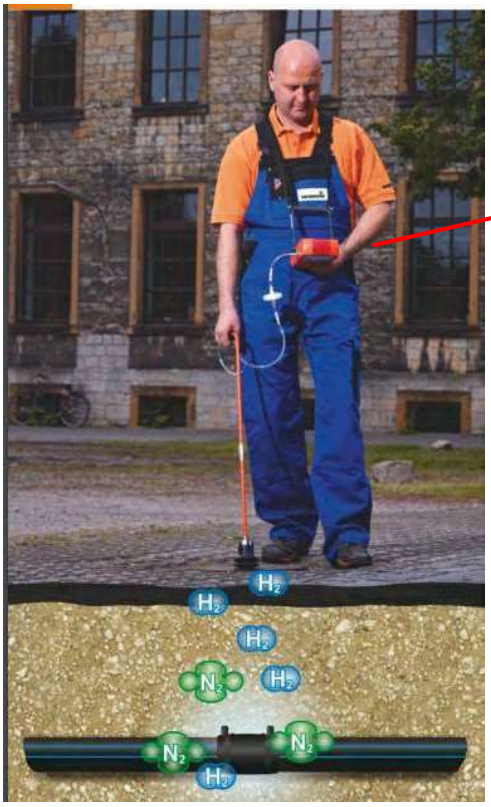




11

Resultado de demonstración

(2) Demonstración (Mira Flores)



Detectar
PPM de hidrogeno

12

Resultado de demonstración

Detectar fuga de agua







Resultado de demonstración

(3) Demonstración (Mira Flores)

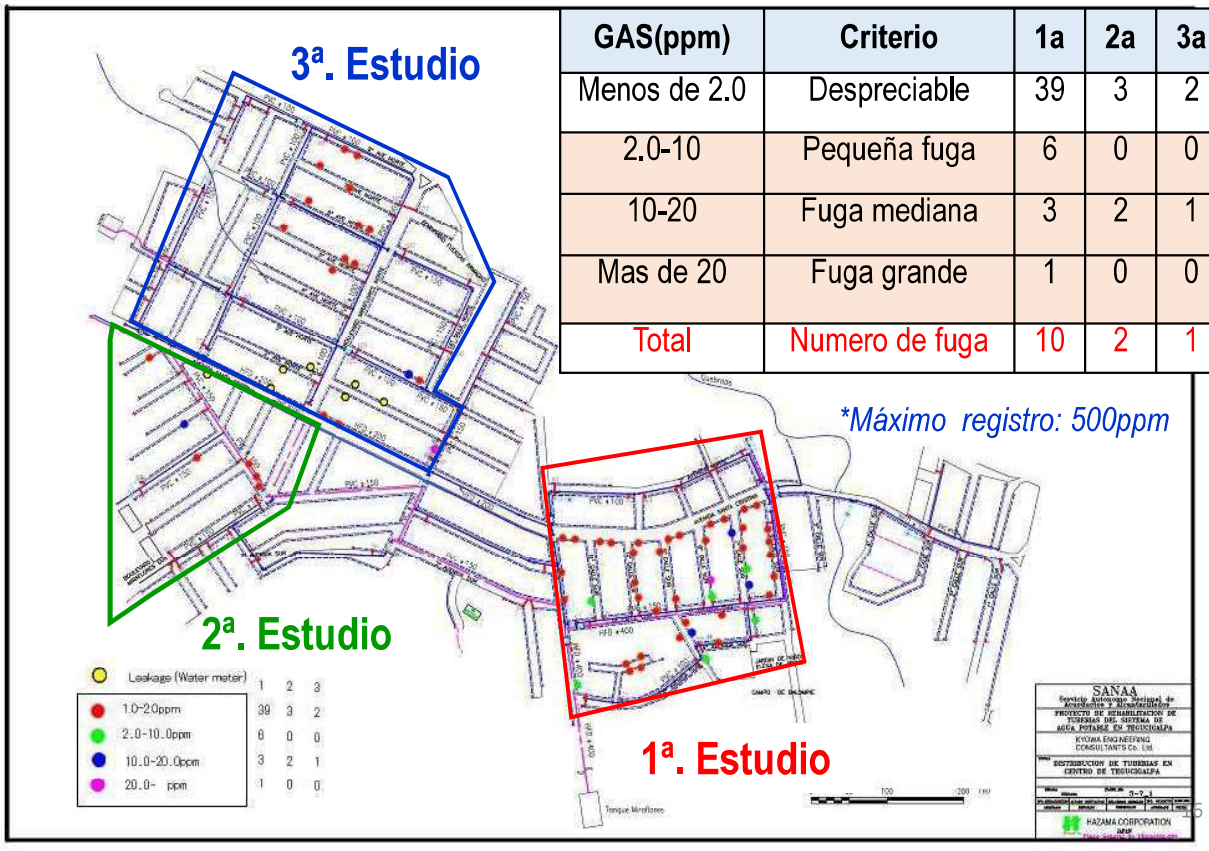
Resultado de demonstración

(3) Demonstración (Mira Flores)

El pavimento de hormigón dificulta el paso de los gases, por lo que hay que explorar.

Resultado de demonstración

(3) Demonstración (Mira Flores)



GAS(ppm)	Criterio	1a	2a	3a
Menos de 2.0	Despreciable	39	3	2
2.0-10	Pequeña fuga	6	0	0
10-20	Fuga mediana	3	2	1
Mas de 20	Fuga grande	1	0	0
Total	Numero de fuga	10	2	1

2. Mejorar de la calidad del agua en embalse

1. Problema pendiente

En el caso de la embales de Laureles, la calidad del agua se está deteriorado por la eutrofización. PTA Laureles y Concepción utilizan carbón activado en polvo para tratar agua cruda. Debido al elevado coste del carbón activado en polvo, los costes de mantenimiento de PTA son elevados.

2.Solucion

- Las aguas residuales vertidas por los hogares y los instalación aguas arriba de la embalse deben ser tratadas.
- En Japón se han introducido sistemas de circulación de aireación por hélice como medida para controlar el crecimiento de las algas.
- Los paneles solares pueden utilizarse para generar energía si no se dispone de una fuente de energía.

3. Tecnología Japón:

(1) Nombre de empresa:
ZENIYA OCEAN Service Engineering,LTD

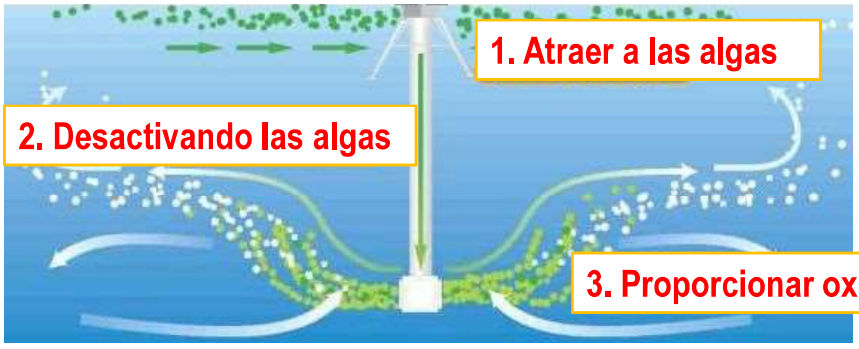
(2) Nombre de producto
NEO LOOP(Circulador tipo propulsor)

(3) Registro de caso en Japón
24 casos (Desde 2002-2020) http://www.zeniya-k.co.jp/

2. Mejorar de la calidad del agua en embalse

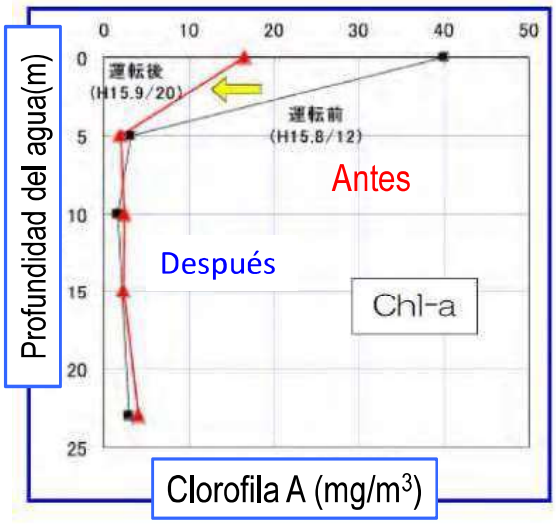
4. Características

- Enviando el agua de la superficie a la capa inferior y desactivando las algas en la superficie.
- El oxígeno de la superficie se envía a la capa inferior y por medio de aireación, lo que reduce la producción del fósforo, el hierro y el manganeso del lodo del fondo y de sulfuro de hidrógeno.



2. Mejorar de la calidad del agua en embalse

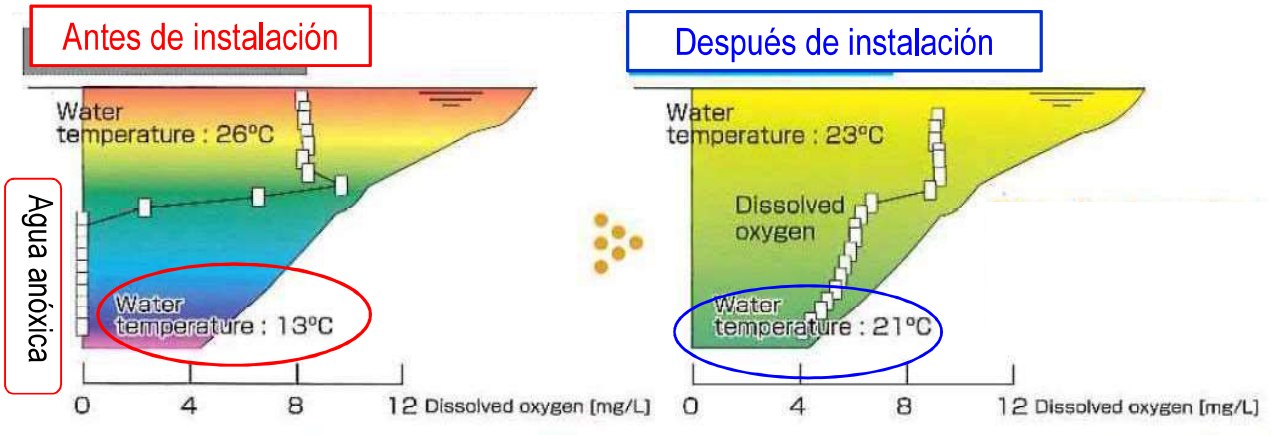
5. Efecto（En caso del embalse en prefectura de saga)



*Indicador de calidad del agua para la cantidad de fitoplancton

2. Mejorar de la calidad del agua en embalse

Los dato de Oxigeno disuelto y temperatura de agua



Oxigeno disuelto ： 0mg/L → Oxigeno disuelto ：4-8 mg/L

3. Pequeños generadores hidroeléctricos

1. Antecedentes

La ciudad de Tegucigalpa tiene un alto potencial para instalar la pequeña hidroelectricidad debido a su terreno ondulado. En 2015 se instalaron micro hidroeléctricas en la línea de transmisión de agua de PTA Concepción y línea 22 de PTA Picacho.

Esto es tipo diferente de Picacho y Concepción, introducir pequeños generadores hidroeléctricos que puedan utilizarse en canales abiertos y tubería.

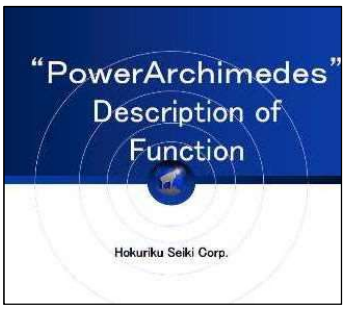
2. Tecnología Japón:

(1) Nombre de producto
Power Archimedes

(2)Nombre de empresa:
Hokuriku Seiki Corp.

(3) Registro de entrega en Japón
36 casos(Japón), 4 casos(Filipinas y Myanmar)

http://www.s-hokuriku.com/product/archimedes/english



21

3. Pequeños generadores hidroeléctricos

3. Características

- Alta eficiencia de generación de energía con baja caída y pequeño caudal (para 100kw o menos)
- Los equipos de generación de energía pueden instalar directamente en canal abierto.
- Fácil de instalar (Se puede instalar en vías navegables con un desnivel de 5 m o menos)

Especificaciones	Caudal: 0.95m^3/s Caída: 3.5m Potencia: 20kW	Caudal: :0.85m^3/s Caída: :2.0m Potencia:10kW
Foto		

*Se puede utilizar en punto de aeración de PTA

22

3. Pequeños generadores hidroeléctricos

En caso de Filipinas en proyecto de JICA (2015)

Especificaciones	Caudal: 5 m³/sec Caída: 3.0m Potencia: 50kW (25kW x 2)
Foto	 

4. Caudalímetro ultrasónico

1. Antecedentes

Para controlar el volumen de agua bruta, agua tratada y agua distribuida en un sistema de suministro de agua, es necesario medir con precisión de agua y el caudal y el nivel de agua del tanque. Entonces, presentaremos los instrumentos de medición japoneses.

2. Tecnología Japón

(1) Nombre de producto
UPF-20
(2) Nombre de empresa:
TOKYO KEIKI
*La primera empresa del mundo en desarrollar un caudalímetro ultrasónico
(3) Registro de casos
Mas de 1500 casos

https://www.tokyokeiki.jp/e/

4. Caudalímetro ultrasónico

Nombre de producto	Caudalímetro ultrasónico fijo	Caudalímetro ultrasónico portátil	Medidores de nivel por radiofrecuencia
Foto			
Especificación	DN 25mm -6000mm Precisión ±1.0%	DN 65- 500mm Precisión±1.0-2.0%	Altura máxima : 30m

En este estudio, estamos utilizando un caudalímetro ultrasónico para realizar una auditoría energética de la bomba. El caudalímetro ultrasónico se entregara a UGASAM, y le daremos instrucciones y manuales sobre cómo medir.

Nota: En caso de las tuberías viejas con óxido, limo, no se pueden medir bien el caudal con el caudalímetro ultrasónico.

25

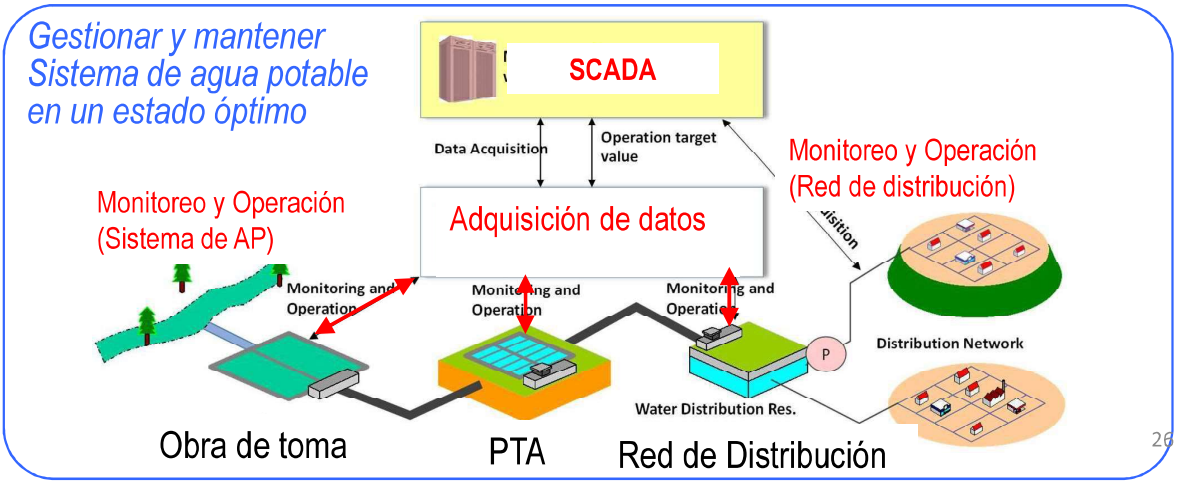
5. SCADA

1. Antecedentes

- El sistema de suministro de agua de la ciudad de Tegucigalpa no lleva un registro del caudal de entrega y distribución de agua, datos de la presión , el caudal de agua en las bombas y el nivel de agua en los tanques.
- El SCADA se instaló en la PTA Picacho en 2014, sin embargo, no se ha utilizado en los dos primeros años de funcionamiento debido a la falta de capacidad del memoria en el servidor y a la dificultad para obtener repuestos.

SCADA ＝*Supervisory Control And Data Acquisition System*

Sistemas de recolección de datos a distancia, supervisión centralizada, operación y control.



26

5. SCADA

2. Tecnología Japón:

(1) Nombre de producto
Fast Tools.

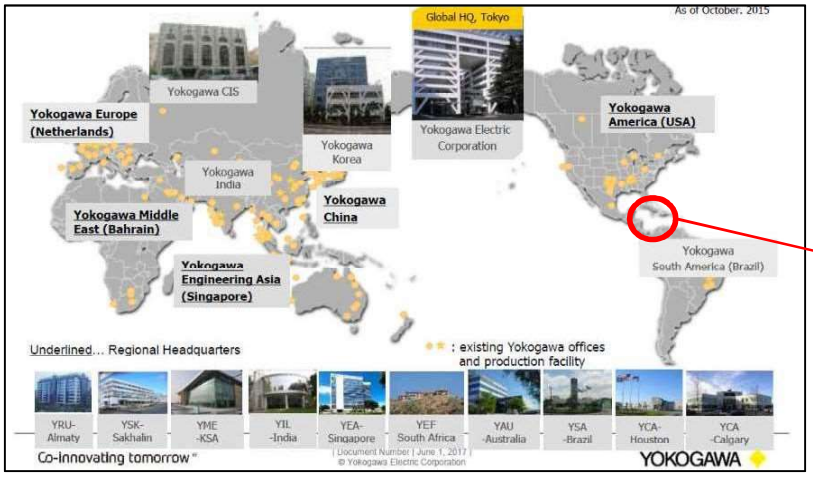
(2)Nombre de empresa:
Yokogawa Electric Corporation

(3) Registro de casos
13 casos (Proyecto de JICA) , aproximadamente 500 casos

YOKOGAWA

https://www.yokogawa.com/solutions/products-platforms/control-system/supervisory-control-and-data-acquisition-scada/#Overview

Estructura del servicio

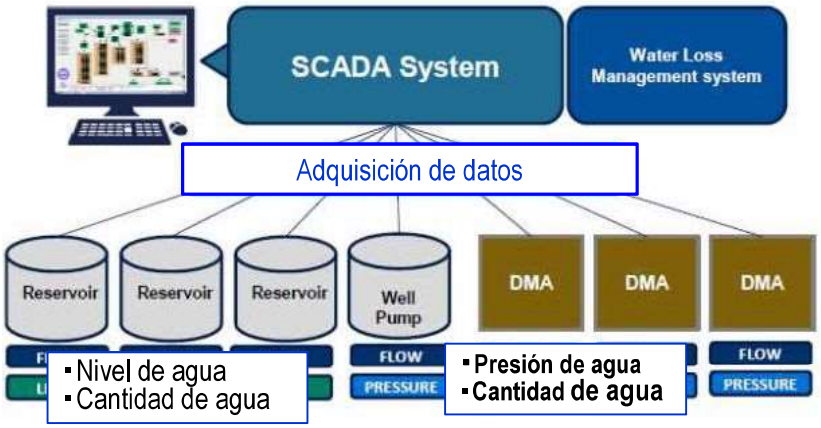


- *230 oficinas de servicio en 80 países*
- *2000 ingenieros de servicio*

En Honduras se puede atender en Oficina de México o EEUU

5. SCADA

Uso de Proyecto de JICA en caso de Filipinas:Cebu Water District



Desafío del cliente
- No hay señal, no hay operación remota
- No hay datos horarios ni diarios
- Baja presión del agua

Efecto del proyecto
- Operación remota desde la sala SCADA
- Recolección de datos de forma eficiente
- Suficiente presión de agua en todas partes

Comentario de Empresa de Servicio de agua potable después de instalación

- *El número de reclamaciones de los usuarios ha disminuido considerablemente.*
- *¡El personal no necesita ir al sitio local con frecuencia cuando ocurre algún problema!*
- *Ahora sabemos el tiempo óptimo de abrir y cerrar de una válvula de tanque a través de SCADA*

Palabras finales

Deseamos que los productos, las tecnologías y las ideas japonesas podrían contribuir al mejoramiento del sistema de agua potable en Tegucigalpa.

Muchísimas Gracias por su atención!

E-mail: thorie@jat.co.jp

Annex2 Data collection list

DATA COLLECTION SUEVEY ON WATER SUPPLY IN TEGUCIGALPA INTHE REPUBLIC OF HONDURAS

NO	Material title	Format	Original /Copy	Issuing authority	Year of issue
1	8.5 Norma Tecnica Nacional para la Calidad de Agua.	PDF	Copy	SESAL	1995
2	8.5 Normas Tecnicas de las Descargas de Aguas Residuales a cuerpos receptores y alcantarillado sanitario.	PDF	Copy	SESAL	1996
3	8.5 Codigo Hondureño de la Construccion - CAPITULO XII, 1.5.3-2.11	PDF	Copy	CICH	2000
4	8.5 Codigo Hondureño de la Construccion - CAPITULO XII, 3-3.5.5	PDF	Copy	CICH	2000
5	8.5 Codigo Hondureño de la Construccion - CAPITULO XII, 3.5.6-3.9.1	PDF	Copy	CICH	2000
6	8.5 Codigo Hondureño de la Construccion - INDICE	PDF	Copy	CICH	2000
7	8.5 Codigo Hondureño de la Construccion - PORTADA	PDF	Copy	CICH	2000
8	Plan Maestro - Estudio del sistema de abastecimiento de agua para el area urbana de Tegucigalpa en la Republica de Honduras	PDF	Copy	JICA	2001
9	Master Plan (English) - The Study on Water Supply System for Tegucigalpa urban area in the Republic of Honduras	PDF	Copy	JICA	2001
10	ESPECIFICACIONES GENERALES DE CONSTRUCCION/ SISTEMAS DE ALCANTARILLADO	PDF	Copy	SANAA	2001
11	NORMAS Y ESPECIFICACIONES PARA DISEÑO Y CONSTRUCCIÓN DE SISTEMAS	PDF	Copy	SANAA	2001
12	8.4 Ente Regulador de Servicios de Agua Potable y Saneamiento (ERSAPS)	Document	Copy	ERSAPS	2003
13	LEY MARCO del sector agua potable y SANEAMIENTO	PDF	Copy	La Gaceta	2003
14	Proyecto de abastecimiento de Agua para Tegucigalpa - Informe Final Volumen 3	PDF	Copy	SOGREAH	2004
15	Proyecto de abastecimiento de Agua para Tegucigalpa - Informe Final Volumen 3	PDF	Copy	SOGREAH	2004
16	Proyecto de abastecimiento de Agua para Tegucigalpa - Informe Final Volumen 4	PDF	Copy	SOGREAH	2004
17	Proyecto de abastecimiento de Agua para Tegucigalpa - Informe Final Volumen 4	PDF	Copy	SOGREAH	2004
18	8.5 Anexos(aguas potables).	PDF	Copy	SANAA	2004
19	8.5 bibliografia(Agua potable)	PDF	Copy	SANAA	2004
20	8.5 Glosario(Agua potable)	PDF	Copy	SANAA	2004
21	8.5 Indice de Normas	PDF	Copy	SANAA	2004
22	8.5 Introduccion General (AP y AS)	PDF	Copy	SANAA	2004
23	8.5 Normas de diseño de agua potable, modificado en Marzo	PDF	Copy	SANAA	2004
24	8.5 Anexos Aguas residuales nuevo	PDF	Copy	SANAA	2004
25	8.5 BIBLIOGRAFIA(Aguas residuales)	PDF	Copy	SANAA	2004
26	8.5 Glosario(Aguas residuales)	PDF	Copy	SANAA	2004
27	8.5 Indice de Normas de aguas residuales	PDF	Copy	SANAA	2004
28	8.5 Normas de aguas negras de Marzo	PDF	Copy	SANAA	2004
29	8.5 Guias técnicas para la incorporación de medidas de mitigacion de desastres en el diseño y construcción de sistemas	PDF	Copy	SANAA	2004
30	Proyecto de Abastecimiento de Agua para Tegucigalpa I3. Informe Final- Volumen 3 Anexos Estudio de Factibilidad	PDF	Copy	SOGREAH/TECNISA	2004
31	8.4 Reglamento de calidad del servicio	PDF	Copy	ERSAPS	2005
32	8.4 Reglamento de Servicios	PDF	Copy	ERSAPS	2006
33	Informe del Estudio Preliminar sobre el Proyecto de Abastecimiento de Agua para el Área Urbana de	PDF	Copy	JICA	2006
34	INFORME DEL ESTUDIO DE DISEÑO BÁSICO PARA EL PROYECTO URGENTE PARA EL ABASTECIMIENTO	PDF	Copy	JICA	2007
35	Plantas de Tratamiento de Aguas Residuales de San José de la Vega y PRRAC-ASAN, Descripción de Proyecto	PDF	Copy	SANAA	2009
36	(ENCC) Estrategia Nacional de Cambio Climatico Honduras Sintesis para tomadores de Decision	PDF	Copy	SERNA/GTZ/PNUD	2010
37	8.5 Codigo Hondureño de la Construccion -	PDF	Copy	CICH	2010
38	8.5 Codigo Hondureño de la Construccion - CAPITULO XII "Cargas y Fuerzas estructurales" Normas Tecnicas	PDF	Copy	CICH	2010
39	PLAN MAESTRO DEL SISTEMA DE AGUA POTABLE DE LA CIUDAD DE TEGUCIGALPA	Document	Copy	AQUARUM	2011
40	SANAA - Sectorizacion de AQUARUM (Sectorizacion AQUARUM)	PDF	Copy	Departamento: Optimizacion Operativa SANAA	2011
41	Politica de Descentralizacion para el desarrollo	Document	Copy	La Gaceta / Presidencia de la Republica en Consejo de Ministros	2012

NO	Material title	Format	Original /Copy	Issuing authority	Year of issue
42	Servicios de Ingeniería, Obras, Bienes y Servicios para un Programa de Gestión de Pérdidas de Agua	PDF	Copy	UTGP (UNION TEMPORAL GESTIÓN DE PÉRDIDAS)	2012
43	ANEXO XXIV RESULTADOS PROYECTADOS CON LA IMPLEMENTACIÓN	PDF	Copy	UTGP (UNION TEMPORAL GESTIÓN DE PÉRDIDAS)	2012
44	XVII Censo de poblacion y VI de Vivienda 2013	PDF	Copy	INE	2013
45	Politica Nacional del Sector Agua Potable y Saneamiento de	PDF	Copy	CONASA	2013
46	Politica Nacional del Sector Agua Potable y Saneamiento de Honduras	PDF	Copy	Consejo Nacional de Agua Potable y Saneamiento (CONASA)	2013
47	8.4 Plan de Capacitación, Comisiones Municipales de Agua Y saneamiento(COMAS)	Document	Copy	CONASA	2013
48	8.4 Politica Nacional del Sector Agua Potable y Sanieamiento de Honduras	PDF	Copy	CONASA	2013
49	The Feasibility Study on the construction of Guacerique II Dam, in Tegucigalpa (Final Report)	PDF	Copy	KOICA/KECC	2013
50	Monitoring Country Progress in Drinking Water and Sanitation	PDF	Copy	CONASA	2013
51	PLAN NACIONAL DE AGUA POTABLE Y SANEAMIENTO (PLANASA)	PDF	Copy	CONASA	2014
52	8.4 Reglamento Interno para regular el funcionamiento de "COMAS"	PDF	Copy	AMDC	2014
53	Estudio de Impacto Ambiental, Factibilidad Represa Río del Hombre	MS Powerpoint	Copy	Secretaria de Energía, Recursos Naturales, Ambiente y Minas (Mi Ambiente +)	2014
54	Ex-Post Evaluation of Japanese ODA Grant Aid Project Urgent Water Supply Project in Tegucigalpa	PDF	Copy	JICA	2014
55	Plan de Accion Tegucigalpa Tegucigalpa y Comayaguela, Capital sostenible, Seguar y abierta	PDF	Copy	AMDC / BID (ICES)	2015
56	Estudio de Factibilidad Técnica, Financiera y ambiental del Proyecto Represa de Río del Hombre	PDF	Copy	egis	2015
57	Estudio y Diseño Final Proyecto de Aprovechamiento Embalse de rio Nacaome para Agua Potable para el municipio del Distrito	MS Word	Copy	Inypsa/ CONASH / SEISA	2015
58	TABLA DE CATEGORIZACIÓN AMBIENTAL EL SECRETARIO DE ESTADO EN LOS DESPACHOS DE	PDF	Copy	LA GACETA	2015
59	Datos pob_AMDC vf 08112016	Document	Copy	AMDC	2016
60	8.4 Politicas Regulatorias de Agua Y Saneamiento de Honduras	PDF	Copy	ERSAPS	2016
61	Auditoría de Gestión Ambiental a la Subcuenca del Rio Guacerique	PDF	Copy	Tribunal Superior de Cuentas	2016
62	Datos calidad del agua Planta de Tratamiento de Aguas Residuales La Vega	excel	Copy	SANAA	2016
63	Crease_unidad_agua_potable_saneamiento_DC	PDF	Copy	La Gaceta	2017
64	Recopilación de Información y Estudio de Verificación para la Cooperación JICA-BID Relacionada a los Sectores de Agua y	PDF	Copy	JICA	2017
65	Síntesis del Plan Nacional de Adaptación al Cambio Climático (PNA) de Honduras para el Distrito Central (DC)	Document	Copy	Secretaria de Energía, Recursos Naturales, Ambiente y Minas (Mi Ambiente +)	2018
66	Plan Nacional de Adaptacion al Cambia Climatico Honduras - Version Resumen	PDF	Copy	Secretaria de Energía, Recursos Naturales, Ambiente y Minas (Mi Ambiente +)	2018
67	Plan de Acción al Cambio Climático del Distrito Central	PDF	Copy	AMDC	2018
68	Sistema General de alcantarillado de Tegucigalpa	Autocad	Copy	SANAA	2018
69	Plan de Negocios Ajustado de la UMAPS	PDF	Copy	CETI S.A. | Centro de Estudios de Transporte e Infraestructura S.A.	2018
70	"Estudio y Diseño de Varias Obras para el Mejoramiento del Sistema de Agua Potable del Distrito Central" Informe Final Etapa	PDF	Copy	ACI	2018
71	PROGRAMA DE REFORMA DE LOS SERVICIOS DE AGUA Y SANEAMIENTO EN TEGUCIGALPA (HO-L1207)	PDF	Copy	BID	2018
72	Estudio y Diseño Final Proyecto de Aprovechamiento Embalse de rio Nacaome para Agua Potable para el municipio del Distrito	PPT	Copy	ACI/SEISA	2018
73	Plan Sectorial de Agua y Saneamiento en el Distrito Central para	PDF	Copy	BID	2019
74	Prontuario de Disposiciones Legales atinentes a los Servicios de Aguas Potable y Saneamiento	PDF	Copy	ERSAPS	2019
75	8.4 Proyecto de mejoramiento de los servicios de Agua Potable de Tegucigalpa	PDF	Copy	AMDC / UMAPS	2019
76	“Plan Sectorial de Agua y Saneamiento en el Distrito Central para dar Cumplimiento a los Objetivos de Desarrollo Sostenible”	PDF	Copy	BID	2019
77	Proyecto de Mejoramiento de los Servicios de Agua Potable de Tegucigalpa	PDF	Copy	AMDC	2019
78	Lineamientos para el Desarrollo del Plan Director de Agua Potable y Saneamiento con Enfoque de Género y Cambio Climático de la	PDF	Copy	BID	2019
79	INTERNATIONAL DEVELOPMENT ASSOCIATION PROJECT APPRAISAL DOCUMENT ON A PROPOSED CREDIT	PDF	Copy	WORLD BANK	2019
80	Formulación del Plan de Negocios y Formulación del Acuerdo de Mejoramiento del Prestador Municipal Urbano de	PDF	Copy	ERSAPS	2019
81	Plan de Consulta y Participación Ciudadana para el Proyecto de Mejoramiento de los Servicios de Agua Potable de Tegucigalpa	PDF	Copy	AMDC	2019
82	BOLETÍN DE PRECIPITACION PLUVIAL 2015 - 2019	PDF	Copy	INE	2019
83	6.1と6.2 Reporte consolidado de información requerida en la Sección “6.1 y	PDF	Copy	UMAPS	2020

NO	Material title	Format	Original /Copy	Issuing authority	Year of issue
84	Reporte consolidado de información requerida en la Sección “7 Instituciones Ejecutoras” del “Estudio de Recolección de Datos	PDF	Copy	UMAPS	2020
85	Archivo 7_1 Organigrama UMAPS.jpg	Image	Copy	UMAPS	2020
86	Archivo 7_1 Organigrama SANAA UMAPS AMDC UGASAM.vsdx	Document	Copy	UMAPS	2020
87	Archivo 7_1 Organigrama AMDC.jpg	Image	Copy	UMAPS	2020
88	Plan Local de Adaptacion al Cambio Climatico del Municipio del Distrito Central, Zona Urbana y Rural	PDF	Copy	AMDC / Secretaria de Energía, Recursos Naturales, Ambiente y Minas (Mi Ambiente +)	2020
89	Informacion Adicional FA - Fuentes de Agua AMDC	Document	Copy	AMDC	2020
90	Informacion Adicional FA - Lista de Donaciones UGASAM	Document	Copy	UGASAM	2020
91	Informacion Adicional FA - Presupuesto Fuentes Agua AMDC	Document	Copy	AMDC	2020
92	Informacion Adicional FA - Resumen Periurbanos	Document	Copy	SANAA	2020
93	Informacion Adicional FA - Asistencia de otros donantes	PDF	Copy	UGASAM	2020
94	DISEÑO Y CONSTRUCCION DE LA REPRESA EN LA CUENCA DE LOS RIOS SAN JOSE Y JACALEAPA	PDF	Copy	AMDC	2020
95	TEGUCIGALPA: WATER SUPPLY STRENGTHENING PROJECT (P170469) Implementation Status & Results Report	PDF	Copy	the World Bank	2020
96	"Elaboración de un estudio de Evaluación de Impacto Ambiental y Social preliminar y anteproyecto de plan de gestión ambiental y social ara mejoras a la represa José Cecilio del Valle" (Nacaome)	PDF	Copy	Secretaria de Energía, Recursos Naturales, Ambiente y Minas (Mi Ambiente +)/ Invest H	2020
97	Catastro de Usuarios	MS Excel	Copy	SANAA	2020
98	Proyecto para fortalecer los Servicios de Agua Potable de Tegucigalpa	PDF	Copy	AMDC/Banco Mundial	2020
99	Diagnóstico de la Situación Actual de la Red de Colectores y Sub-Colectores de Alcantarillado Sanitario de Tegucigalpa y	MS Word	Copy	SANAA	2021
100	Copia de Volumen Evacuado y Cuadro Estadistico Concepcion2020-1 (003)	excel	Copy	SANAA	2021
101	Lineamientos para la implementación de un plan de Recursos Hídricos para Tegucigalpa (Honduras)	MS Word	Copy	BID-WSA/CHO	2021
102	Resumen Incidencias 2018-2020 (REPARACIONES)	MS Excel	Copy	SANAA	2021
103	Informe Plantas de Generación Micro Hidroeléctricas de la División Metropolitana del SANAA.	PDF	Copy	SANAA	2021
104	Datos de licitación Presa San José	MS Word	Copy	AMDC	2021
105	Resumen Presa San José	MS Word	Copy	AMDC	2021
106	Sectores y Colonias catastrales	MS Excel	Copy	SANAA	2021
107	Inversiones Ejecutadas en Proyectos de Agua Potable y Saneamiento de la División Metropolitana SANAA	MS Word	Copy	UGASAM/AMDC	2021
108	Registro de Agua para Tu Barrio DC (Camiones cisterna)	MS Excel	Copy	AMDC	2021
109	Lista de Camiones Cisterna Privados (Registrados en SANAA)	MS Excel	Copy	SANAA/AQUABLOCK	2021
110	Cuadro de Tarifas por Consumo de Agua	MS Excel	Copy	SANAA	2021
111	Copia Muestreo de Tanques de Distribución (calidad del agua) 2020	MS Excel	Copy	SANAA	2021
112	Copia Muestreo de Tanques de Distribución (calidad del agua) 2019	MS Excel	Copy	SANAA	2021
113	Copia muestreo de Red de Distribución (calidad del agua) año 2019	MS Excel	Copy	SANAA	2021
114	copia de Muestreo de Llenaderos y AQUABLOCK, (calidad del agua) 2019-2020	MS Excel	Copy	SANAA	2021
115	Propuesta de Inversiones para el Acueducto del area urbana del Municio del DC	MS Powerpoint	Copy	UGASAM/AMDC	2021
116	Red de Distribución Tegucigalpa	Shape file	Copy	AMDC	2021
117	Mapas Actualizados de los Subsistemas de Agua Potable de Tegucigalpa	PDF	Copy	UMAPS	2021
118	Datos sobre la Cuenca del Rio Guacerique	PDF	Copy	UGASAM/AMDC	2021