Republic of Honduras
Alcaldia Municipal del Distrito Central (AMDC)
Unidad Municipal de Agua Potable y Saneamiento (UMAPS)

Republic of Honduras
Preparatory Survey for Tegucigalpa Water Supply Improvement Project

Final Report
(Advanced Version)

February 2024

Japan International Cooperation Agency

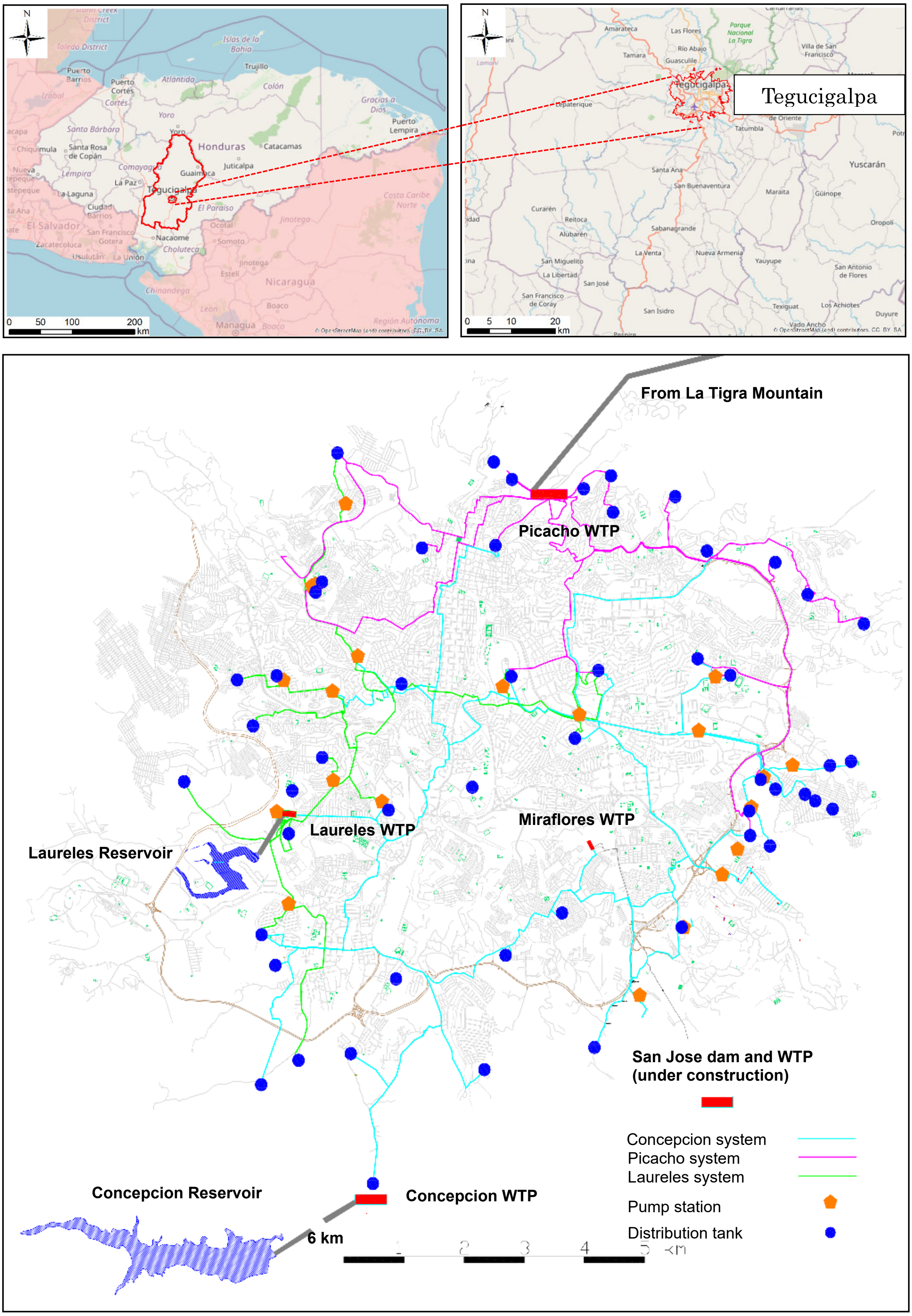
Nippon Koei Co., Ltd.
Japan Techno Co., Ltd.
NJS Co., Ltd.

5R
JR(P)
24-007

Exchange Rate applied in this Report

(As of August 2023)

USD 1.0	= JPY 141.154
USD 1.0	= HNL 24.578
HNL 1.0	= JPY 5.743



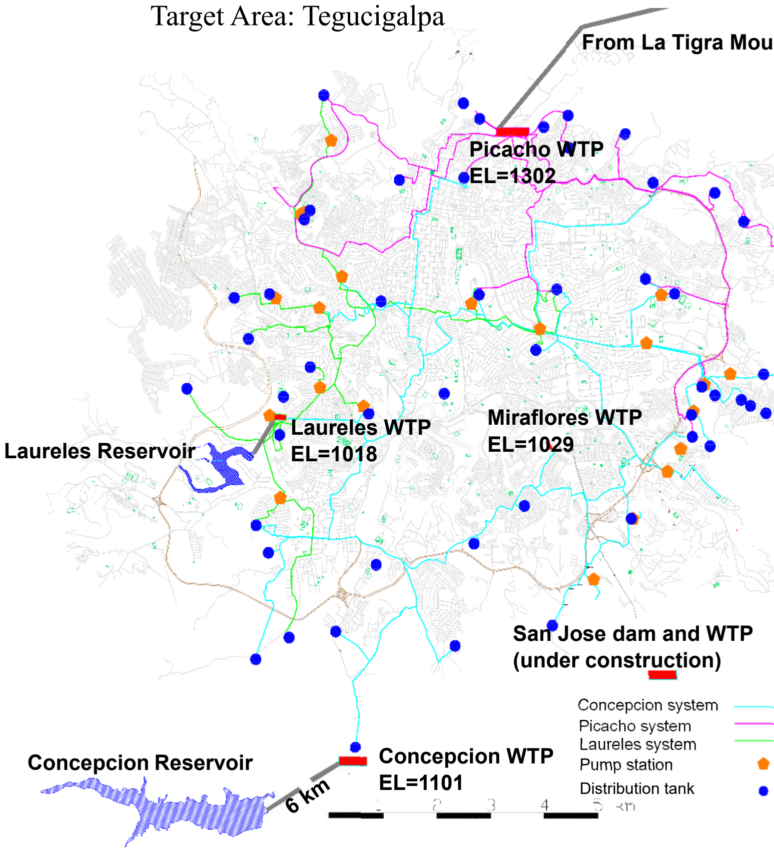
Location Map

SUMMARY

1. Water Supply Plan

Target Year: 2038

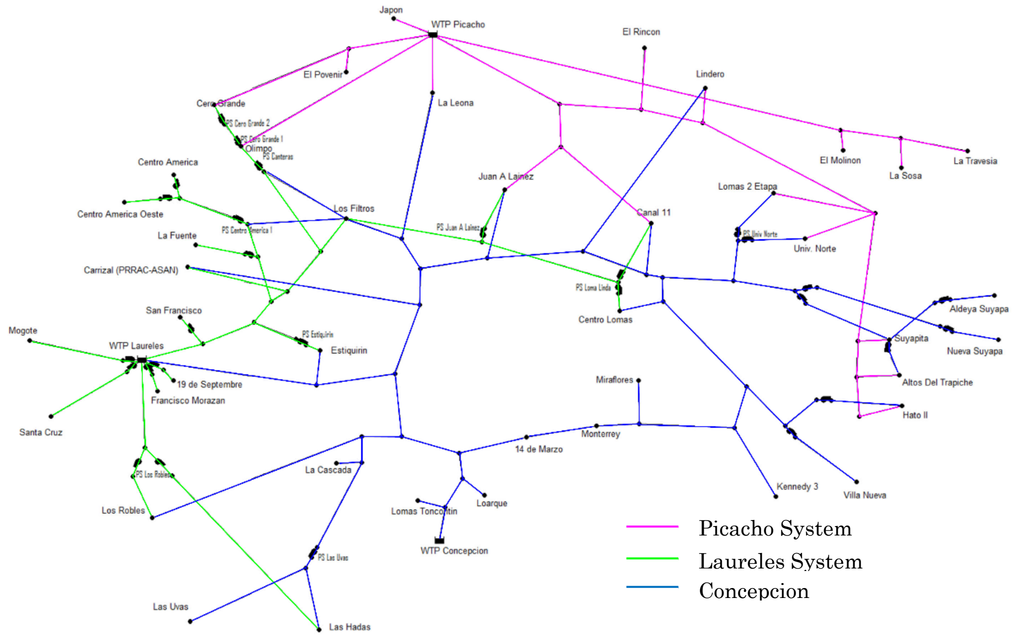
Target Area: Tegucigalpa



Water Demand Projection (2038)		
	Population (2038)	Water demand (m3/day)
Piped supply area	1,225,773	390,404
Non-piped supply area	116,211	34,341
Total	1,341,983	424,745
Available Treated Water from Surface Source (m3/day)		
Rainy season		303,524
Dry season		218,715

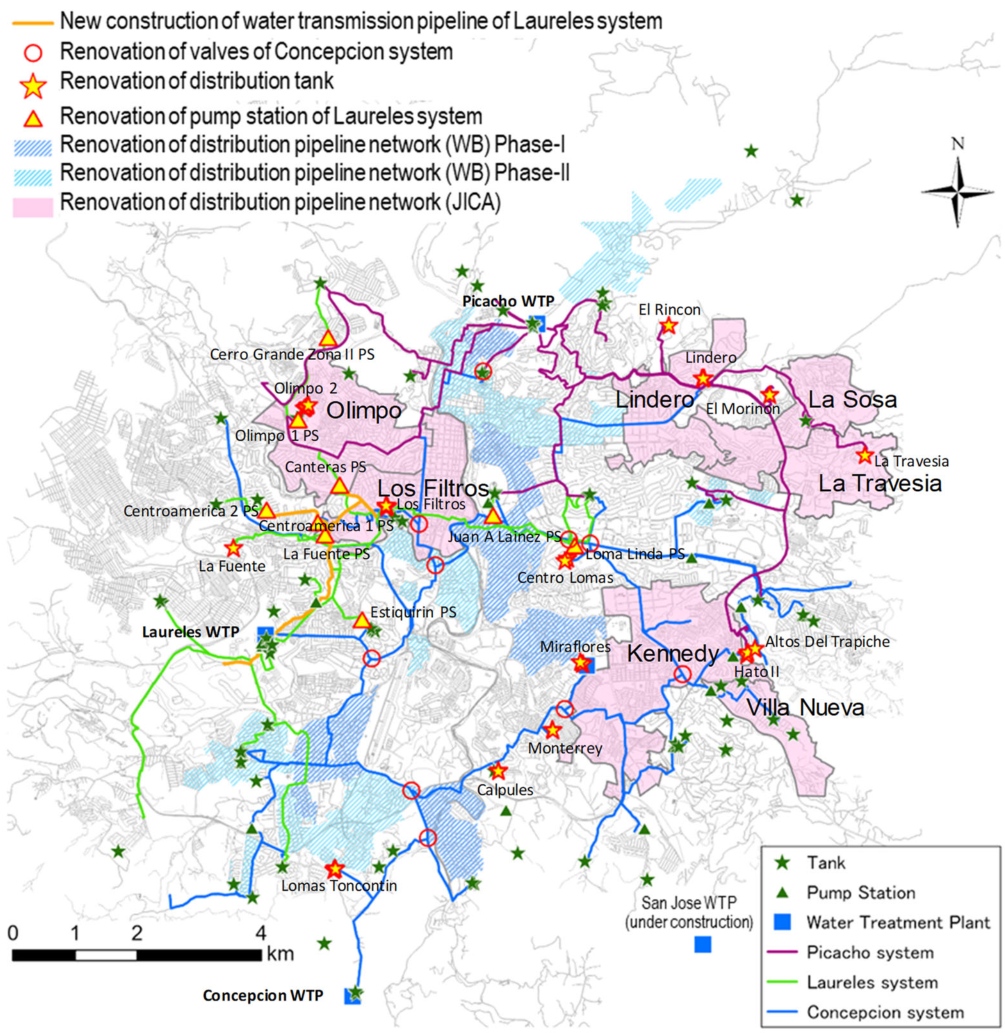
Note:
- Water demand in piped supply area includes 30% loss which is tentatively assumed.
- Available treated water includes those from San Jose WTP which is under construction.

<u>Water Allocation and Transmission Plan</u>



The water allocation plan and water transmission plan to each distribution tank were prepared.

2. Project Component



Proposed Project Component

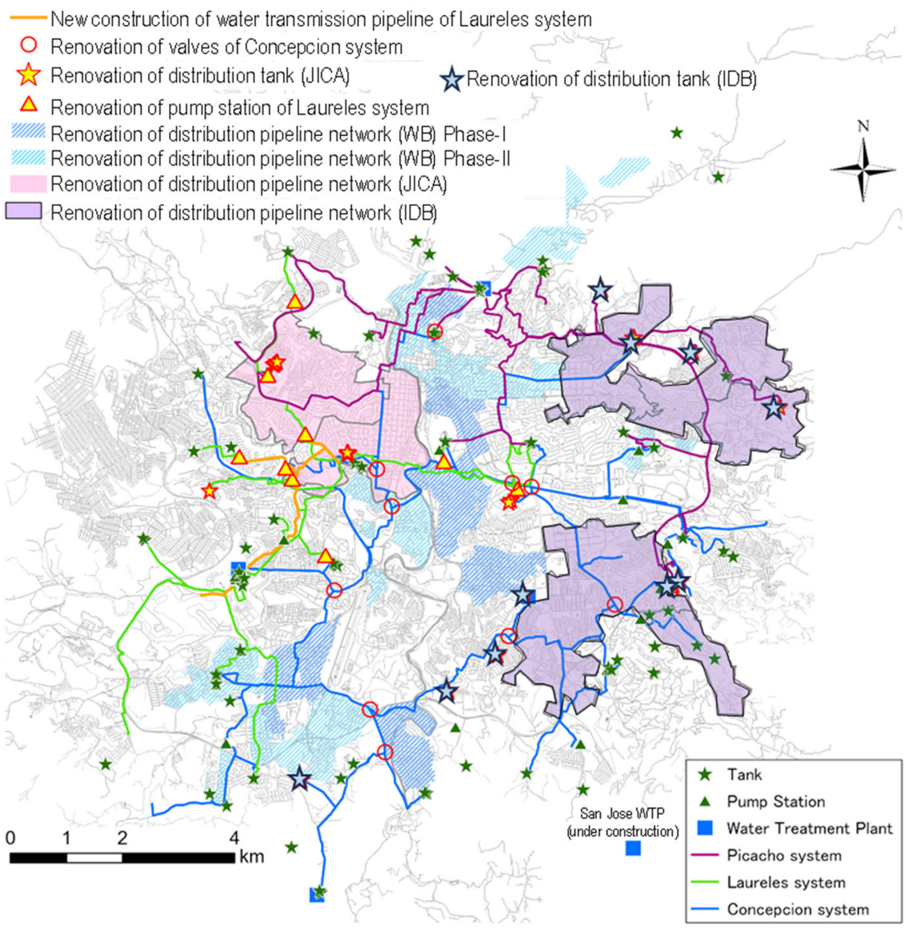
Component	Contents
1. Water transmission pipeline	- Renovation of transmission pipeline of the Laureles System. D150 – D1000 L= 6.5 km - Renovation of valves of the Concepcion system.
2. Water transmission pump station	- Replacement of transmission pump and renovation of associated facilities at nine pump stations.
3. Instrumentation and SCADA	- Monitoring system of inflow rate and water level of distribution reservoirs. Monitoring point: 43 points - Monitoring system of outlet flow rate of the distribution tanks
4. Water distribution tank	- Demolish existing distribution tanks and construct new tanks at 14 tank sites.
5. Water distribution network	Renovation of distribution pipe network at 12 distribution blocks - Installation of additional distribution main pipeline, pressure reducing valve, and air valve, for establishing distribution sub-block. - Replacement of distribution pipe and replacement/installation of associated customer meter.
6. Procurement of customer meter	- Procurement of customer meters to be installed at the above-mentioned seven distribution blocks.

3. Project Implementation Plan

Demarcation of Project Component between JICA and IDB

IDB decided to finance a part of this Project.

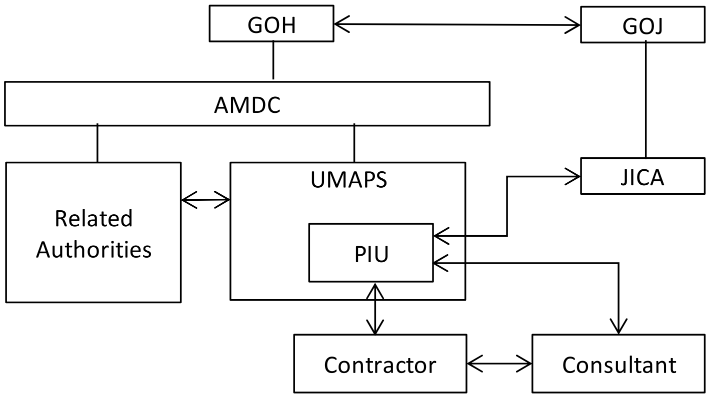
JICA Portion	IDB Portion
Component 1: Water transmission pipeline	
Component 2: Water transmission pump station	
Component 3: Instrumentation and SCADA	
Component 4: Water distribution tank Supplied from Laureles system La Fuente Supplied from Laureles and Concepcion system Los Filtros, Centro Lomas Supplied from Laureles, Concepcion, and Picacho system Olimpo 2	Component 4: Water distribution tank Supplied from Concepcion system Lomas Toncontin, Calpules, Monterrey, Miraflores Supplied from Concepcion and Picacho system Lindero, Altos del Trapiche, Hato II Supplied from Picacho system La Travesia, El Molinon, El Rincon
Component 5: Distribution network Supplied from Laureles and Concepcion system Los Filtros block Supplied from Laureles, Concepcion, and Picacho system Olimpo block	Component 5: Distribution network Supplied from Concepcion system Kennedy block, Villa Nueva block Supplied from Concepcion, and Picacho system Lindero block Supplied Picacho system La Sosa block, La Travesia block
Component 6: Procurement of customer meter 5,000 nos.	Component 6: Procurement of customer meter 5,000 nos.



Followings are the implementation plan of JICA portion

Project Implementation System

It is proposed that Project Implementation Unit (PIU) be established in UMAPS.



Proposed Staffing of PIU

Position	Nos. of Staff	Remarks	
Project Director	1	May be held concurrently with regular position	
Deputy Project Director	1	Should be full-time	
Secretary	1	Should be full-time	
Technical Manager	5	- Transmission pipeline - Pump station - Instrumentation - Distribution tank - Distribution pipeline network	May be held concurrently with regular position
Supporting staff	2	- Transmission system - Distribution system	Should be full time
Chief account officer	1	May be held concurrently with regular position	
Accountant	2 *	Should be full time Depend on nos. of contract package	

Proposed Contract Packages

Project Implementation Schedule

Required Activity of UMAPS

Activities before employment of the Consultant

- Establishing PIU (Project Management Unit)
- Organize and update facility inventory information (drawings, GIS data, etc.)
- Agreement between the landowner of the tunnelling section of the transmission pipeline
- Clarification of tax exemption procedure

Activities during detailed design and construction

- Coordination with the Operation Department regarding the detailed design
- Obtaining permission from related authorities including environment authorities for construction works
- Coordination with customers regarding installation of customer meter
- Coordination with customers regarding water outages
- Coordination with project implementation unit of IDB portion for detailed work demarcation and work scheduling of Component 3.

Activities after construction

- Incorporation of the as-built drawings into the facility inventory
- Establishing design and construction standard of house connection
- Establishing facility inventory management system
- Establishing facility operation and maintenance system
- Establishing water transmission control system
- Establishing water distribution volume analysis system
- Establishing water leakage reduction system
- Establishing water meter management system
- Establishing financial management system including water tariff setting
- Implementation of the customer survey for post-evaluation of the Project

4. Project Cost (JICA Portion)

Conditions of Cost Estimate

Total Project Cost

5. Project Evaluation

Technical Evaluation

The following are the points to be considered for project implementation:

- Pipe jacking method is to be applied for the renovation of the water transmission pipeline. It is necessary to mobilize the foreign companies which can apply this new technologies.

- During the construction of the pump station of Laureles System, it is necessary to consider sending water to the affected distribution tanks from the Concepcion System and Picacho System.
- UMAPS is required to provide the inventory data of the existing water transmission and distribution pipeline to the Consultant who conducts the detailed design of instrumentation and SCADA system as well as improvement of the distribution pipeline network.
- The communication method between each tank and the monitoring center (cellular phone network or UHF frequency band radio) needs to be determined at the time of the detailed design of SCADA system.
- It is necessary to determine the detailed specification of the customer meter as well as the air valve and UFR.

Economic and Financial Evaluation

- FIRR of the Project was calculated to be minus, under the present tariff condition.
- On the other hand, EIRR was calculated to be 13.06%. This provides a rationale for moving forward with the project.

Environmental and Social Evaluation

- No serious environmental impacts have been found.
- As for the social aspect, the transmission pipeline will pass under private land. However, the permission of the landowner has been obtained, and thus, no land acquisition is required.

Preparatory Survey for
Tegucigalpa Water Supply Improvement Project

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Abbreviations

AC	Asbestos Cement
ADH	advanced HIV diseases
AHPRA	Asociación Hondureña Protectora de los Animales y su Ambiente
AJAASSFRAM	Asociación de Juntas de Administradoras de Agua y Saneamiento Similares de Francisco Morazán
AMAHSA	Ama Honduras S.A de. C.V
AMDC	Alcaldía Municipal del Distrito Central
AMITIGRA	Fundación Amigos de La Tigra
ATP	Affordability to Pay
BOD	Biochemical Oxygen Demand
CABEI	Central American Bank for Economic Integration
CABEI	Central American Bank for Economic Integration
CASM	Comisión de Acción Social Menonita
CCF	Consejos Consultivos Forestales
CEO	Centro Estudiantil Odontológico
CESAMO	Centros de Salud con Médico y Odontólogo
CESAR	Centros de Salud de Atención Rural
CESCCO	Centro de Estudios y Control de Contaminantes
CIS	Centro Integral de Salud
CLIPER	Clínica Periférica
CMI	Clínica Materno Infantil
CO2	Cabon Dioxide
COD	Chemical Oxygen Demand
CODEM	Comité de Emergencia Municipal
CONASA	Consejo Nacional de Agua Potable y Saneamiento
COPECO	Comisión Permanente de Contingencias de Honduras
COSEMSA	Compañía Constructora y Servicios Múltiples S.A.
CP	Contract Package
CRD	Consejos Regionales de Desarrollo
DALY	Disability-Adjusted Life Year
DCI	Ductile Cast Iron
DECA	Dirección General de Evaluación y Control Ambiental
DFR	Draft Final Report
EAS	Environmental Audit Study
EIA	Evaluación de Impacto Ambiental
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value

EOCC	Economic Opportunity Cost of Capital
EPS	Entes Prestadores de Servicio
ERSAPS	Ente Regulador de los Servicios de Agua Potable y Saneamiento
EU	European Union
FIPADEH	Fundación Integral para el Desarrollo de Honduras
FIRR	Financial Internal Rate of Return
FNPV	Financial Net Present Value
FOCC	Financial Opportunity Cost of Capital
FUNAPAT	Fundación Agua Para Todos
GDP	Gross Domestic Product
GER	Gerencia de evaluación de riesgos
GHG	Greenhouse Gas
GM	Gobiernos Municipales
GOH	Government of Honduras
GOJ	Governement of Japan
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HNL	Honduran Lempiras
HONDUCOR	Empresa de Correos de Honduras
HOSPIMED	Hospital y Centro de Especialides Médicas
ICF	Instituto de Conservación Forestal
ICPP	Intergovernmental Panel on Climate Change
IDB	Inter-American Development Bank
IDOM	Ingeniería, Dirección de Obras y Montaje
IHAH	Instituto Hondureño de Antropología e Historia
IHSS	Instituto Hondureño de Seguridad Social
ILO	International Labor Organization
INAM	Instituto Nacional de la Mujer de Honduras
INE	Instituto Nacional de Estadística Honduras
ITR	Interim Report
IWRM	Integrated Water Resources Management
JAA	Juntas Administradoras de Agua
JCCCA	Japan Center for Climate Change Actions
JICA	Japan International Cooperation Agency
KOICA	Korea International Cooperation Agency
MIAMBIENTE	Secretaría de Recursos Naturales y Ambiente
MINSALUD	Secretaría de Salud
MOCAPH	Asociación Mesa de Organizaciones Comanejadoras de Áreas Protegidas de Honduras
NDC	Nationally Determined Contribution

NDF	Nordic Development Fund
NRW	Non Revenue Water
OC	Organismos de Cuencas
ODEF ONGD	Organización de Desarrollo Empresarial femenino
ONCC-DS	Observatorio Nacional de Cambio Climático para el Desarrollo Sostenible
O&M	Operation and Maintenance
PDM	Plan de Desarrollo Municipal
PIEGH	Plan de Igualdad y Equidad de Género de Honduras
PIU	Project Implementaion Unit
PLANASA	Plan Nacional De Agua Potable Y Saneamiento
PM	Particulate Matter
POA	Plan Operativo Anual
POL	Hospital Policlínico
PROMDECA	Procesadora Metropolitana de Carnes
PROMOSAS	Proyecto de Modernización del Sector de Agua y Saneamiento
PRONIRAPS	Programa Nacional de Inversiones Resilientes en Agua Potable y Saneamiento
PS	Pump Station
PSA	Prestador de Servicios Ambientales
PVC	Poly Vinyl Chloride
RDS-HN	Red de Desarrollo Sostenible de Honduras
SANAA	Servicio Autónomo Nacional de Acueductos y Alcantarillados
SCADA	Supervisory Control and Data Acquisition
SCF	Standard Conversion Factor
SDGs	Sustainable Development Goals
SEFIN	Secretaría de Finanzas
SERNA	Secretaría de Energía, Recursos Naturales y Ambiente (MIAMBIENTE)
SGJD	Secretaría de Estado en los Despachos de Gobernación y Justicia
SINEIA	Sistema Nacional de Evaluación de Impacto Ambiental
SMN	Servicio Meteorologico National
SSP	Shared Socioeconomic Pathways
STI	Sexually Transmitted Infection
TC	Technical Cooperation
TGR	Tesorería General de la República
TOR	Terms of Reference
TSP	Total Suspended Particulate Matter
UAPS	Unidad de Atención Primaria en Salud
UGAM	Unidad de Gestión Ambiental Municipal
UGASAM	Unidad de Gestión de Agua y Saneamiento Municipal
UICN	Unión Internacional para la Conservación de la Naturaleza

UIIC	Uniform International Industrial Code
UMAPS	Unidad Municipal de Agua Potable y Saneamiento
UMGIR	Unidad Municipal de Gestión del Riesgo
UN	United Nation
UNAH	Universidad Nacional Autónoma de Honduras
UNDP	United Nations Development Programme
USD	United States Dollar
USEPA	United States Environmental Protection Agency
WASH	Water, Sanitation, and Hygiene
WB	World Bank
WHO	World Health Organization
WTP	Water Treatment Plant
WTP	Willingness to Pay
WWF	World Wide Fund for Nature
YLD	Years Lived with Disability
YLL	Years of Life Lost

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Government of Honduras (GOH) has been promoting social development in accordance with the national development plan entitled "Country Vision 2010 – 2038 and Plan of the Nation 2010 – 2022" formulated in 2010. This national development plan has the following goals:

- By the year 2022, Honduran society will have reduced by half the percentage of people without sustainable access to safe drinking water.
- By the year 2034, Honduran society will have reduced the percentage of people without sustainable access to safe drinking water to less than 10%.

Under this national development plan, GOH established the National Plan for Drinking Water and Sanitation (PLANASA) in 2014. PLANASA established the national goal of drinking water supply service as well as its strategy and necessary investment amount. PLANASA set seven strategic lines: 1) decentralization of services, 2) citizen participation and social auditing, 3) institutionalization and sectoral governance, 4) provision of services, 5) capacity building, 6) infrastructure development, and 7) sector financing. The evaluation results of eight water supply indicators of 6) infrastructure development as of 2020 are shown in Table 1.1.1.

Table 1.1.1 Evaluation of PLANASA's Indicators as of 2020

Indicator	Baseline 2013	Target		Achievement in 2020	Achievement Level
		2018	2022		
1. No. of water supply systems with more than 5,000 service population which satisfies water quality standard (turbidity).	24	70	70	Insufficient information	Insufficient information
2. No. of water supply systems with more than 5,000 service population.	24	70	70	Insufficient information	Insufficient information
3. No. of water supply system with disinfection facility.	No data	2,080	2,600	2,649	Target met
4. No. of water supply system with more than 30,000 service population that provides continuous water supply greater than 15 hours/day.	5	5	7	2	**Target not met**
5. Percentage of measurement by water meter of water supply system with more than 30,000 service population.	35%	60%	75%	31%	**Target not met**
6. Percentage of non-revenue water of the water supply system with more than 30,000 service population.	52%	50%	48%	47.76%	Target met
7. Service coverage ratio of water supply service in the urban area.	74%	78%	87%	99%	Target met
8. Service coverage ratio of water supply service in the rural area	87%	89%	93%	88%	**Target not met**

Source: PLANASA 2022-2030

As shown above, improving water supply hours and percentage of measurement by water meter in urban areas is a challenge. Moreover, the present percentage of non-revenue water is uncertain as to its calculation basis.

In 2015, the Municipality of Tegucigalpa (*Alcaldia Municipal del Distrito Central*, hereinafter "AMDC") established a municipal water supply and sanitation bureau (*Unidad Municipal de Agua Potable y Saneamiento*, hereinafter UMAPS) in line with the national decentralization policy in the water supply and sanitation sector. The transfer of functions of water supply and sanitation service from the National Autonomous Water Supply and Sewerage Service (*Servicio Autonomo Nacional de Acuedutos y Alcantarillado*, hereinafter SANAA) to UMAPS was completed in 2022, aiming at improving drinking water supply and sanitation service.

However, the water supply capacity of UMAPS is not keeping up with the water demand in Tegucigalpa which is increasing along with the rapid population growth due to rural to urban migration in Honduras. The urban population ratio as % of total population has increased from 46.6% in 2002 to 59.6% in 2022. Water supply hour in Tegucigalpa is limited to once every three to seven days, 12 to 15 hours per day. Improving water production facilities and enhancing the efficiency and reliability of water transmission and distribution systems are urgently needed.

In 2019, the World Bank-funded project, Tegucigalpa Water Supply Strengthening Project (WB project), commenced and is scheduled to be completed in 2025. The scope of the WB project consists of:

1) Assistance in the transition of water supply service from SANAA to UMAPS

2-1) Infrastructure development

  i) Rehabilitation/upgrading of WTPs

  ii) Improvement of several water distribution networks by formulating district-metered areas

  iii) Activities for reducing non-revenue water with emphasis on physical losses in the selected distribution area

2-2) Strengthening the safety of the Laureles and Concepción dams

3) Developing tools for enhanced watershed management and climate resilience

As shown above, the WB project includes the improvement of water source and water treatment facilities and several water distribution networks. However, it does not include the improvement of the water transmission system and water distribution tank.

The Inter-American Development Bank, hereinafter IDB, has supported the municipalization of water and sanitation services (from SANAA to AMDC/UMAPS) through Programmatic Policy-based Loans (the first phase was approved in 2019, and the second phase has been approved in 2023). The objective of this programmatic series is to help increase access and improve the quality of water and sanitation services in the Central District through a process of reforms that permit decentralization of those services to the municipal level, thereby enhancing sector governance and management in a context of climate change and with a view to achieving water security. The objective of the first phase was to contribute to the design and enactment of legal and sector instruments. The objectives of the second phase are to: (i) promote operational and management development so as to increase the efficiency of water and sanitation services provided by the Municipal Water and Sanitation Unit (UMAPS); (ii) help increase the financial sustainability of services provided by UMAPS; (iii) strengthen UMAPS planning; and (iv) strengthen the sector framework though better governance, regulation, and management of resources in a context of climate change, and improve service delivery to better meet demand.

Moreover, a development project for a new water source and water treatment plant (San Jose Project) has commenced, southeast of Tegucigalpa, which will provide an additional water production of 690 L/s (59,616 m^3/d).

In parallel, the Japan International Cooperation Agency (JICA) conducted a study titled “Data Collection Survey on Water Supply in Tegucigalpa” in 2021 to confirm the current situation and challenges in the water supply service in Tegucigalpa and to propose necessary assistance. The study revealed that the existing water transmission and distribution facilities are deteriorated. Moreover, it also revealed that inefficient and improper operation of water transmission and distribution is being conducted. Thus, the study recommended that a project to improve water transmission and distribution should be implemented.

As a result, GOH and JICA agreed to conduct a study to formulate the “Tegucigalpa Water Supply Improvement Project” (the Project), which will improve the water transmission and distribution facility in Tegucigalpa.

The contract for the present study titled “Preparatory Survey for Tegucigalpa Water Supply Improvement Project” (the Study) was signed in December 2022.

1.2 Objective of the Study

The objective of the Study is to compile information on the water supply sector in the metropolitan area of the Central District (Distrito Central), so called Tegucigalpa, by updating the results of the existing studies. Based on the results of the Study, the appropriate scale of the Project will be examined. Then, the project plan and the project cost for international financial cooperation will be formulated, after JICA’s appraisal and discussion between GOH and JICA for L/A of the Project.

1.3 Study Area

The Study area is the metropolitan area of the Distrito Central, so called Tegucigalpa, with an area of approximately 110 km^2. Estimated population in 2023 is 1,152,388.

1.4 Composition of the Report

The output of the Study is presented in the following chapters:

Chapter 1: Introduction
Chapter 2: Present conditions of the Study area

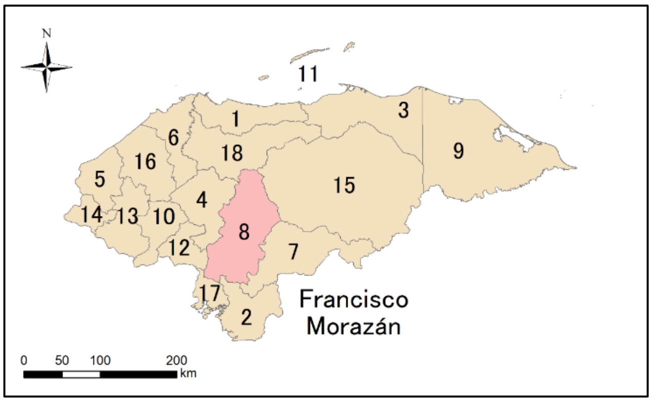
Chapter 3:	Present status of water supply works in Tegucigalpa
Chapter 4:	Water supply plan
Chapter 5:	Formulation of project component
Chapter 6:	Conceptual design of project facility
Chapter 7:	Project implementation plan
Chapter 8:	Project cost
Chapter 9:	Operation management plan
Chapter 10:	Environmental and social consideration
Chapter 11:	Gender consideration
Chapter 12:	Study on climate change aspects
Chapter 13:	Economic and financial analysis
Chapter 14:	Project evaluation and evaluation indicators

CHAPTER 2 PRESENT CONDITION OF THE STUDY AREA

2.1 Administrative Boundary and Demography

The Republic of Honduras is in the center of Central America and has an area of 112,490 km^2 (approximately one third of Japan). It borders Guatemala to the west, El Salvador to the southwest, and Nicaragua to the southeast. It is also bordered to the north and east by the Caribbean Sea and to the south by the Pacific Ocean through the Fonseca Gulf.

The territorial division of Honduras is distributed into 18 departments. Figure 2.1.1 shows the map locations of the departments. Table 2.1.1 shows the name, area, and population of each department.



Source: GADM (https://gadm.org/)

Figure 2.1.1 Location of 18 Departments in Honduras

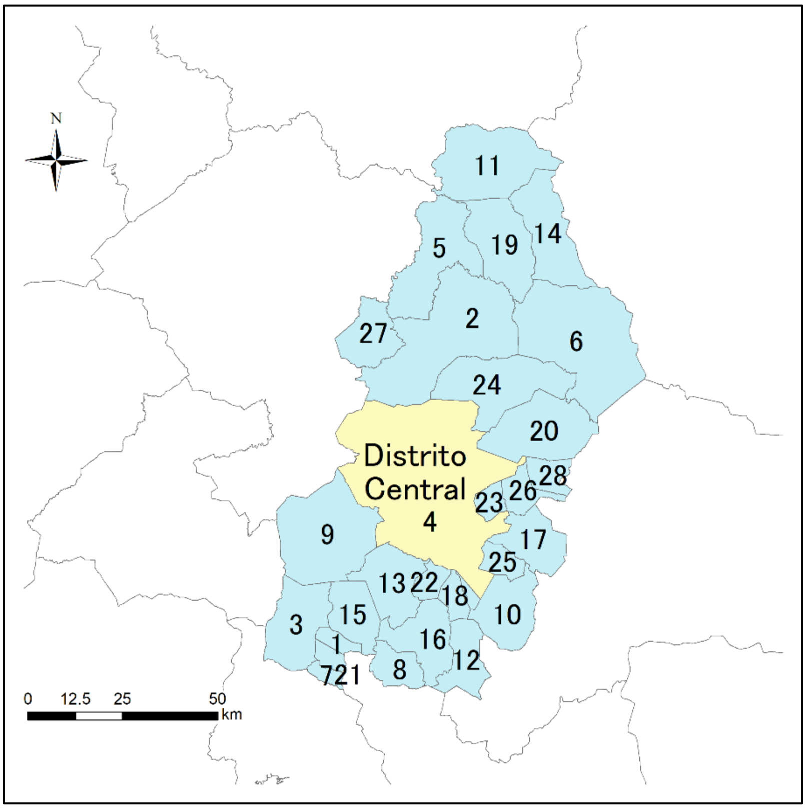
Table 2.1.1 Name, Area, and Population of 18 Departments in Honduras

No.	Name	Area (km^2)	Population (2022)
1	Atlantida	4,251	500,846
2	Choluteca	4,211	486,120
3	Colón	8,875	355,436
4	Comayagua	5,196	582,860
5	Copán	3,203	424,904
6	Cortes	3,954	1,852,772
7	El Paraíso	7,218	510,431
8	Francisco Morazán	8,550	1,724,409
9	Gracias a Dios	16,630	108,262
10	Intibucá	3,072	274,380
11	Bay Islands	261	78,630
12	La Paz	2,331	231,898
13	Lempira	4,290	376,139
14	Ocotepeque	1,680	171,251
15	Olancho	24,351	594,910
16	Santa Barbara	5,115	483,203
17	Valle	1,565	194,166
18	Yoro	7,939	647,122
	Total	112,692	9,597,739

Source: National Institute of Statistics (INE) of Honduras

Cortes Department includes San Pedro Sula City which is the economic center of Honduras. The water supply system of San Pedro Sula is being operated by a private operator under a concession contract. On the other hand, Francisco Morazán Department includes Tegucigalpa, capital of Honduras.

The territorial division of Honduras is distributed into 298 municipalities and 28 out of 298 municipalities belong to Francisco Morazán. Figure 2.1.2 shows the map locations of the municipalities in Francisco Morazán, and Table 2.1.2 shows the name, area, and population of each municipality.



Source: GADM (https://gadm.org/)

Figure 2.1.2 Location of 28 Municipalities in Francisco Morazán

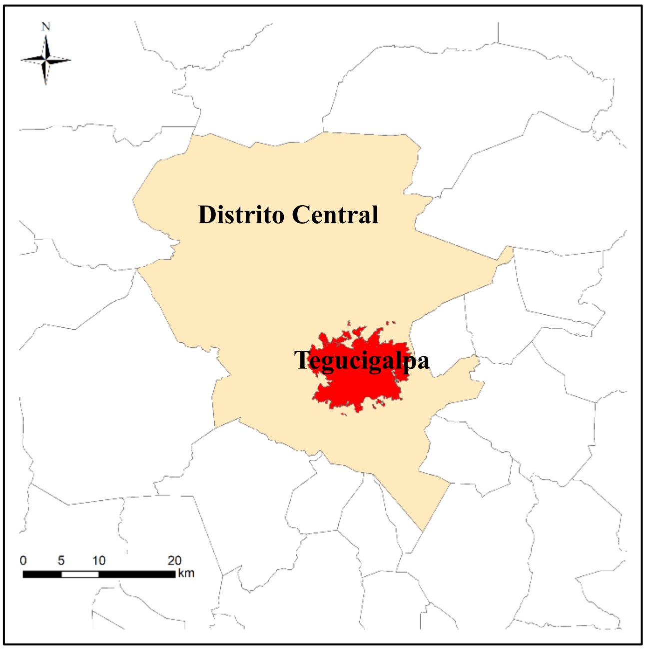
Table 2.1.2 Name, Area, and Population of 28 Municipalities in Francisco Morazán

No.	Name	Area (km^2)	Population (2022)
1	Alubarén	46	5,642
2	Cedros	787	28,748
3	Curarén	302	21,746
4	Distrito Central (Tegucigalpa)	1,477 (109)	1,310,204 (1,138,273)
5	El Porvenir	413	30,619
6	Guaimaca	784	32,456
7	La Libertad	36	3,079
8	La Venta	123	6,819
9	Lepaterique	557	24,612
10	Maraita	258	7,258
11	Marale	470	9,297
12	Nueva Armenia	173	4,419
13	Ojojona	258	11,783
14	Orica	339	15,709
15	Reitoca	192	10,924

No.	Name	Area (km^2)	Population (2022)
16	Sabanagrande	247	23,582
17	San Antonio de Oriente	211	16,389
18	San Buenaventura	67	3,391
19	San Ignacio	337	9,553
20	San Juan de Flores	391	19,018
21	San Miguelito	43	2,052
22	Santa Ana	85	18,088
23	Santa Lucía	59	17,614
24	Talanga	424	38,991
25	Tatumbla	79	9,240
26	Valle de Angeles	98	21,823
27	Vallecillo	207	9,371
28	Villa de San Francisco	88	11,982
	Total	8,550	1,724,409

Source: National Institute of Statistics (INE) of Honduras

The metropolitan area of Distrito Central is called "Tegucigalpa", the target area for this study. Figure 2.1.3 shows the location of Tegucigalpa in Distrito Central, and Table 2.1.3 shows the area and population of Tegucigalpa.



Source: GADM (https://gadm.org/), AMDC

Figure 2.1.3 Location of Tegucigalpa in Distrito Central

Table 2.1.3 Area and Population of Tegucigalpa in Distrito Central

No.	Name	Area (km^2)	Estimated Population (2023)
1	Tegucigalpa	109	1,152,388

Source: National Institute of Statistics (INE) of Honduras

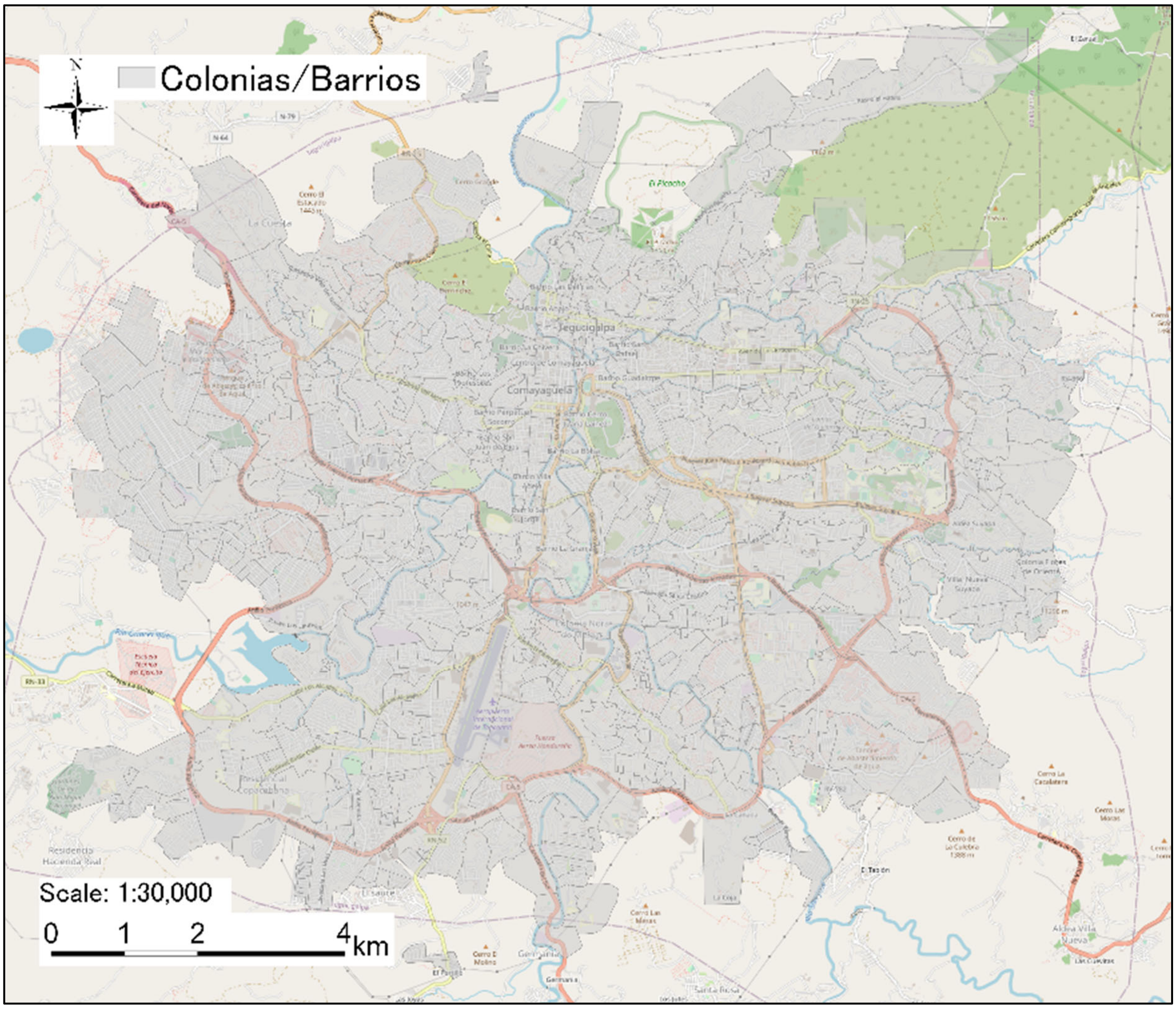
In Honduras, rural to urban migration has been continued, and Tegucigalpa's population has increased accordingly. Table 2.1.4 shows the historical trend of urban population ratio in Honduras.

Table 2.1.4 Concentration of Population in Urban Area in Honduras

Name	Urban population (% of total population)				
	2002	2007	2012	2017	2022
Honduras	46.61	49.91	53.20	56.46	59.60

Source: World Bank (https://databank.worldbank.org/source/world-development-indicators)

The territorial division of Tegucigalpa is divided into 761 colonias/barrios. Figure 2.1.4 shows the boundaries of the colonias/barrios in Tegucigalpa, and the name, area, and population of each colonia/barrio is shown in the Appendix 2.1.1 and Appendix 2.1.2.



Source: AMDC

Figure 2.1.4 Boundary of 761 Colonias/Barrios in Tegucigalpa

2.2 Socioeconomic Conditions

2.2.1 Socioeconomic Conditions in Honduras

In the 16th century, Honduras was part of the vast territorial expanse governed by the Viceroyalty of New Spain. In 1821, Honduras became independent and has since been a republic. However, its political stability has been frequently challenged by a series of social upheavals, including border disputes with neighboring nations, internal conflicts between conservative and liberal factions, and military interventions in the political arena. Currently, the country is under civilian control, with its first female president, who assumed office in 2022, leading the government.

The socioeconomic indicators of Honduras are summarized in Table 2.2.1. With a population of 9.598 million in 2022, 55.2% of whom reside in urban areas, the country has experienced a steady population growth of 1.6%. Despite this, poverty remains a persistent issue, with relative poverty affecting 17.9% of the population and absolute poverty impacting 53.2%. Honduras' Gini index of 48.2 in 2019 implied an unequal wealth distribution, suggesting also relatively high wealth inequality compared with neighboring countries: El Salvador (38.8 in 2022), Nicaragua (46.2 in 2014), and Guatemala (48.3 in 2014). Among Latin American countries, Honduras has the third highest Gini index after Bolivia and Guatemala.

In recent years, Honduras' real GDP has experienced both growth and decline. While it saw a 2.7% increase in 2019, the onset of the COVID-19 pandemic, compounded by the devastating effects of two hurricanes in 2020, resulted in a sharp 9% contraction. However, the economy experienced a robust rebound in 2021 with a growth rate of 12.5%, and a modest 4.0% growth in 2022, which resulted in a total GDP of USD 31.6 billion and a per capita GDP of USD 3,290. It is anticipated that the economy will maintain its upward trajectory as concerns related to the pandemic subside.

The service sector dominates the Honduran economy, accounting for a significant 61% of the GDP. The agriculture and industry sectors contribute 14% and 25% to the GDP, respectively. While the export of traditional primary products such as bananas and coffee remain an important aspect of the economy, Honduras has successfully diversified its export portfolio to encompass a wider range of primary products, such as palm oil and shrimp. Additionally, there has been a marked increase in the exportation of goods from Maquilas (i.e., export-processing zones), including textiles, clothing, footwear, and electronics. Honduras' main imports are mineral fuels, oils, and distillation products (14 percent of total imports), vehicles (8 percent), electronic equipment (7 percent) and machinery (7 percent). Others include: iron, steel, pharmaceutical products and plastics. Honduras' main import partner is the United States with 35 percent of total imports, China (18 percent), Mexico (8 percent) and Guatemala (5 percent). Others include: El Salvador, Costa Rica and Brazil.

Table 2.2.1 Socioeconomic Conditions in Honduras

	Y 2019	Y 2020	Y 2021	Y 2022
Poverty and Social Data				
Population (thousand)	9,158	9,304	9,451	9,598
of which, urban population	54.8%	55.0%	55.2%	55.4%
Population increase	1.6%	1.6%	1.6%	1.6%
Relative poverty * (% of population)	22.4%	n/a	17.9%	n/a
Extreme poverty ** (% of population)	40.7%	n/a	53.2%	n/a
Gini index	48.2	n/a	n/a	n/a
Life expectancy at birth (years)	76.4	76.6	76.9	77.1
Infant mortality (per 1,000 live births)	15.9	15.4	14.9	14.5
Iliteracy	11.5%	n/a	12.0%	11.8%
Economic Data				
Nominal GDP (Lempira billion)	615	586	684	777
Nominal GDP (US$ billion)	25.0	24.3	28.1	31.6
Nominal GDP growth	6.9%	-4.7%	16.8%	13.5%
Real GDP growth	2.7%	-9.0%	12.5%	4.0%
Exchange rate (Lempira per US$; end of year)	24.64	24.11	24.35	24.60
GDP per capita (Current Lempiras)	67,143	62,952	72,397	80,919
GDP per capita (current US$)	2,726	2,611	2,974	3,290
Inflation (rate in December)	4.1%	4.0%	5.3%	9.8%
Unemployment	5.5%	10.7%	7.9%	7.1%
Structure of Economy (% of GDP)				
Agriculture	12%	13%	12%	14%
Industry	25%	24%	26%	25%
Manufacturing	18%	18%	18%	18%
Services	63%	62%	62%	61%
Structure of Economy (% of GDE)				
Final consumption expenditure	95%	97%	99%	100%
Household consumption	82%	82%	85%	86%
Government consumption	13%	15%	15%	14%
Gross fixed capital formation	23%	19%	23%	22%
Business investment	20%	16%	20%	19%
Government investment	3%	3%	3%	3%
Changes in inventories	0%	0%	1%	2%
Net imports of goods and services	-18%	-15%	-23%	-24%
Exports of goods and services	40%	35%	38%	41%
Imports of goods and services	58%	51%	62%	65%
Trade				
Total exports (fob, US$ million)	9,981	8,389	11,069	13,264
Total goods exports (fob, US$ million)	8,788	7,684	10,216	12,169
General merchandise exports	4,151	4,144	5,039	5,987
Coffee	947	870	1,244	1,405
Parm oil	324	379	554	668
Banana	479	530	312	638
Shrimp and lobster	285	296	326	346
Goods exported from MAQUILA zone	4,522	3,392	4,980	6,033
Garment	3,418	2,309	3,555	4,310
Electrical machinery and parts	610	558	859	1,106
Knitwear	250	183	225	265
Services exports	1,193	706	853	1,094
Total imports (cif, US$ million)	14,555	12,060	17,655	20,797
General merchandise imports	10,354	8,969	13,261	15,238
Fuels and lubricants	1,616	1,051	1,910	2,869
Electrical machinery and materials	1,742	1,350	2,122	2,117
Chemical proudcts	1,479	1,496	1,807	2,075
Food industry proudcts	1,179	1,188	1,510	1,761
Base metals	757	658	1,243	1,248
Goods imported for MAQUILA zone	2,942	2,265	3,343	4,306
Textile material	2,383	1,698	2,538	3,412
Services imports	2,406	1,807	2,582	3,216
Trade balance (US$ million)	-4,574	-3,671	-6,586	-7,533
Current account balance (US$ million)	-653	666	-1,487	-1,080
Current account balance /GDP (%)	-2.6%	2.7%	-5.3%	-3.4%

* People living in households with income below the cost of Basic Basket but above Basic Food Basket costs.
** People living in households with income below the cost of Basic Food Basket.
Sources: Compiled by JICA Study Team based on data of BCH and World Bank

2.2.2 Socioeconomic Conditions in Tegucigalpa

Tegucigalpa has been the political and administrative center of Honduras since the 16th century. It was combined with Comayaguela in 1938 to form the Distrito Central. The Distrito Central is situated within the department of Francisco Morazán. As the legal capital of Honduras, Tegucigalpa, the municipality of the Distrito Central, is governed by a mayor elected by the constituents.

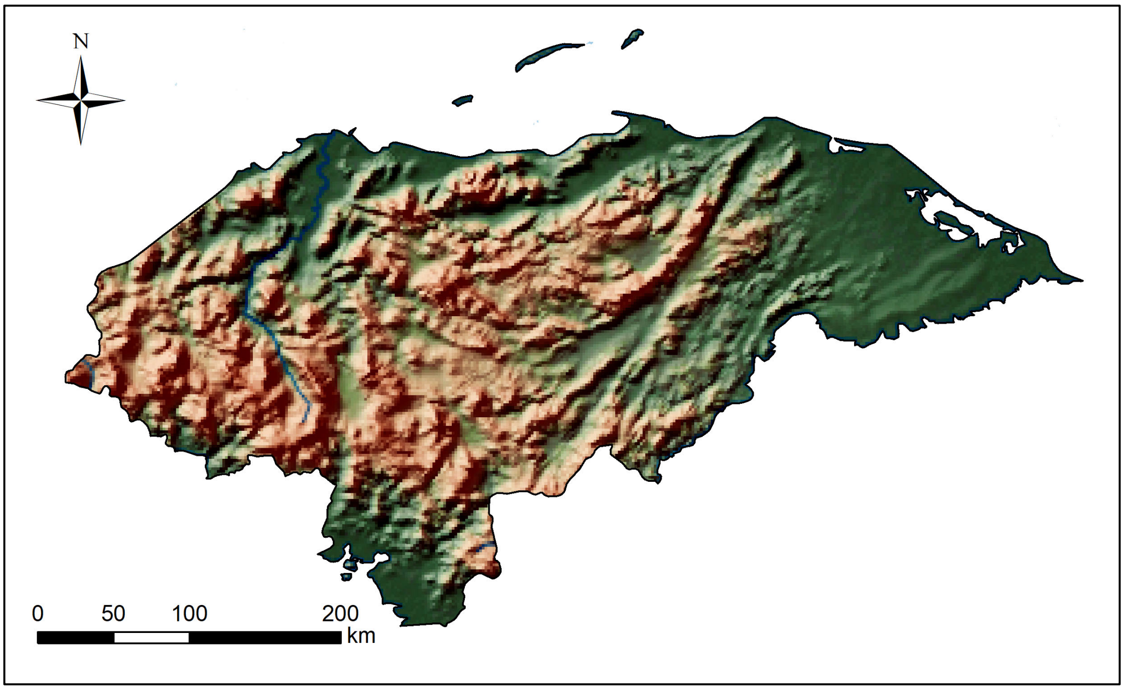
Although initially founded as a mining town, the city's economy is now primarily driven by commercial and service sectors. With over 500 industrial facilities and over 30,000 commercial establishments, the city serves as a focal point of the Honduras economy, contributing 14% of the country's GDP.

It is estimated that as of 2021, the total population of the Distrito Central is 1,293,611. The National Institute of Statistics (INE) data shows that in Tegucigalpa, 90% of the housing units are situated in urban areas. Additionally, 89% of the population has access to water via public or private systems, while 82% of households have access to electricity. As for telephone communication, approximately 79% of the population uses mobile phones.

2.3 Natural Condition

2.3.1 Geographical Feature

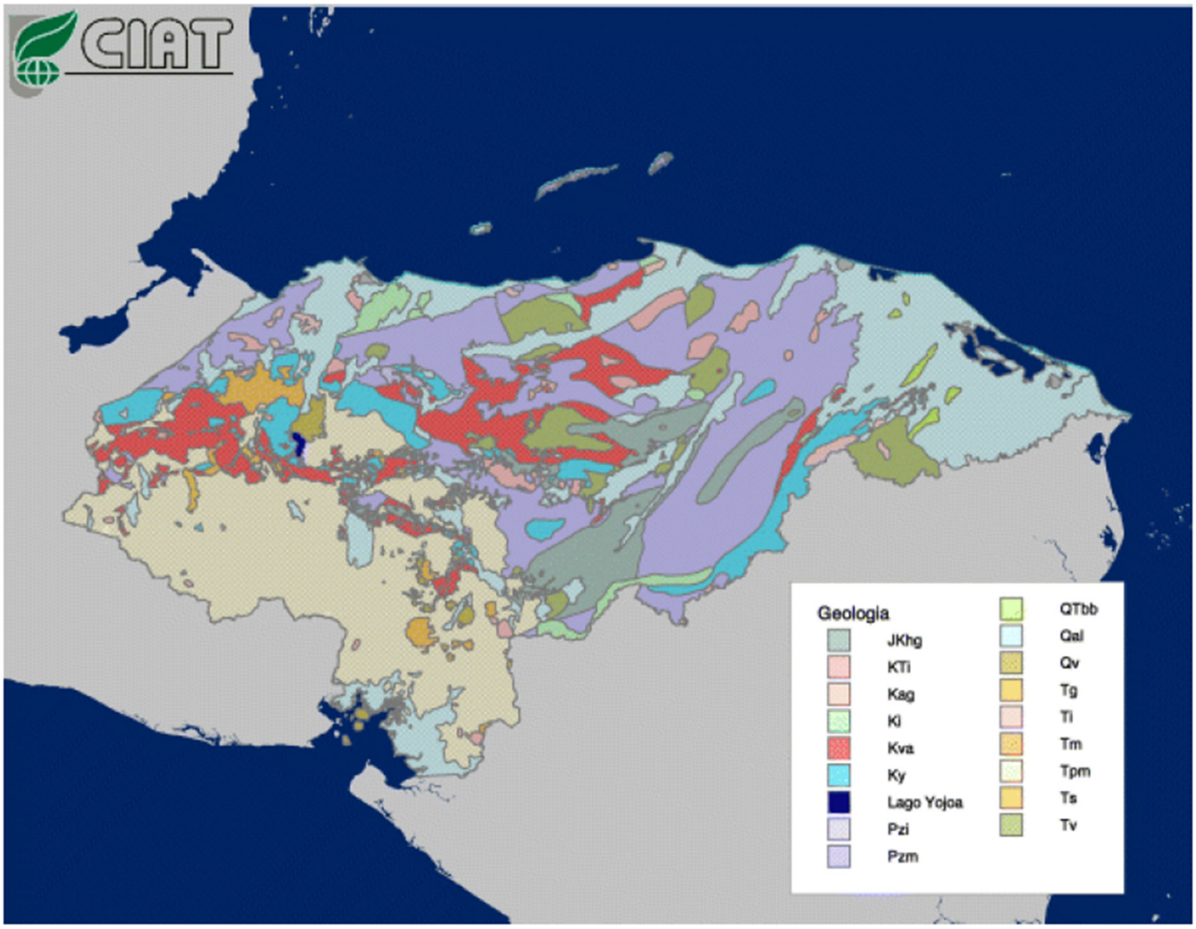
The Honduran territory is divided into three zones: Northern Coastal Plain (Caribbean Coast), Central Mountain Region, and Southern Coastal Plain (Pacific Coast). Sixty-five percent of the national territory is mountainous, and the rest are plains between 1,000-1,500 m in elevation extending from the center to the south as shown in Figure 2.3.1.



Source: Natural Earth (https://www.naturalearthdata.com/)

Figure 2.3.1 Geographical Feature of Honduras

From a geological point of view, the Republic of Honduras is situated on what has been called "Bloque Chortís", which is formed by metamorphic rocks, mainly sedimentary rock with low-grade metamorphism. The dominant types of rocks are phyllite and granite shells, although they can appear with variable metamorphism, from gneiss and migmatites to quartzite and marbles as shown in Figure 2.3.2.

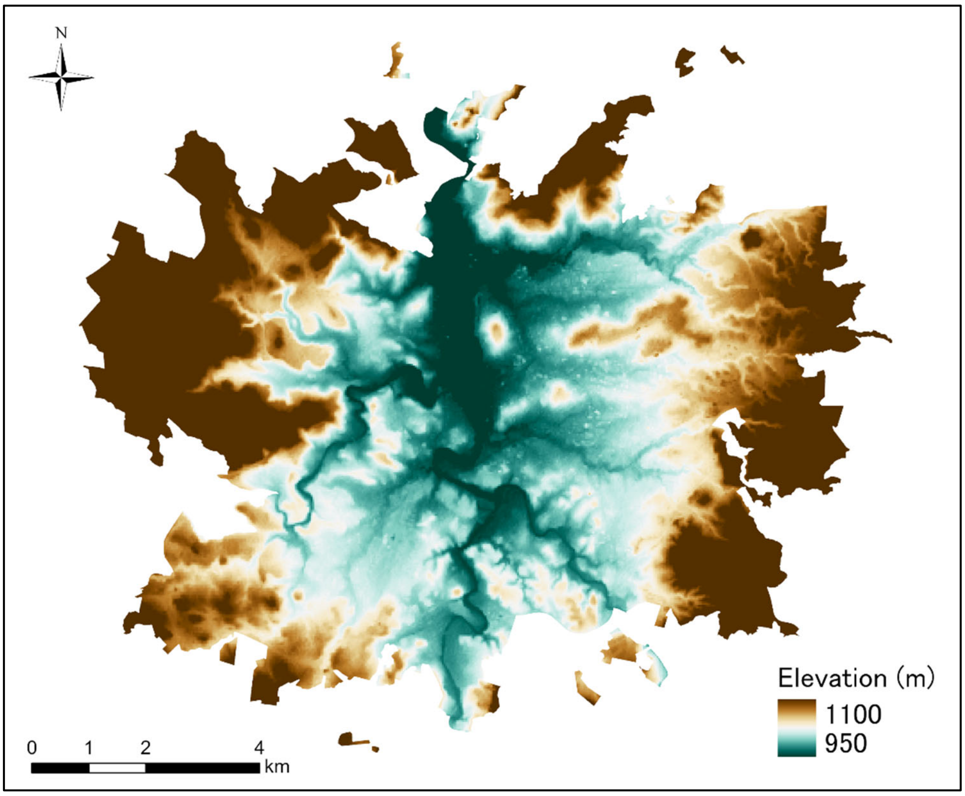


Source: GEOMORFOLOGÍA, ESPEOLOGÍA Y GEOSITIOS DEL TERRITORIO HONDUREÑO 2019

Figure 2.3.2 Geological Map of Honduras

Tegucigalpa, the study area, has an area of approximately 110 km2 (11 km from east to west and 10 km from north to south). Tegucigalpa is surrounded by hills with 1,200-1,800 m elevation; the urban center area has steep hills and the periphery also has a wavy topography, i.e., the topography of the area is complex as shown in Figure 2.3.3. In order to make the water pressure as uniform as possible within a water distribution area, the water distribution area should be divided according to elevation .

The geological structure is divided into two parts, the eastern and western parts, due to the division made by the Choluteca River that flows from south to north almost through the middle of the city. The eastern part consists of many strata of sedimentary rocks of different types of conglomerates and the western part is composed mainly of volcanic rocks.



Source: Global Digital Surface Model "ALOS World 3D – 30 m"

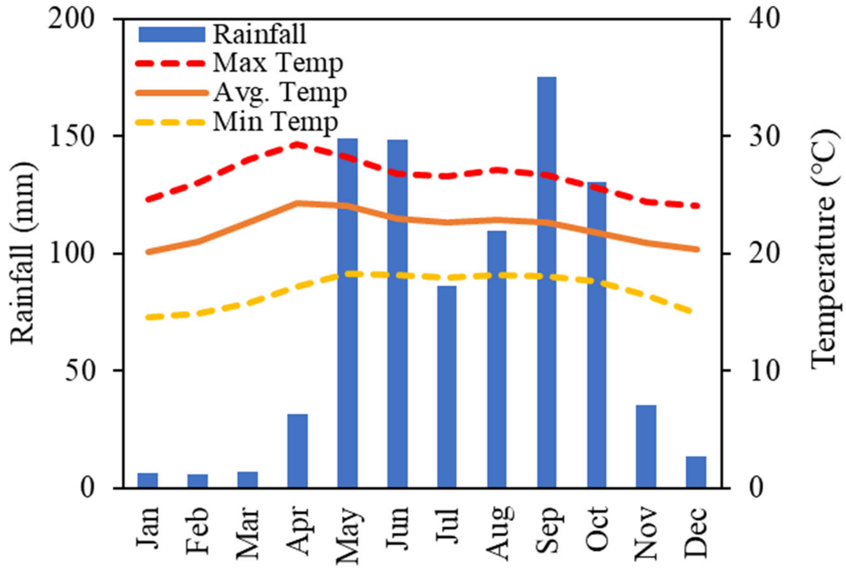
Figure 2.3.3 Geographical Feature of Tegucigalpa

2.3.2 Climate Condition

Honduras is classified as a tropical zone. The climate of the northern coastal plain is humid tropic, characterized by high temperatures and high humidity with annual rainfall of more than 1000 mm. The rainy season is May to October and the dry season is November to April.

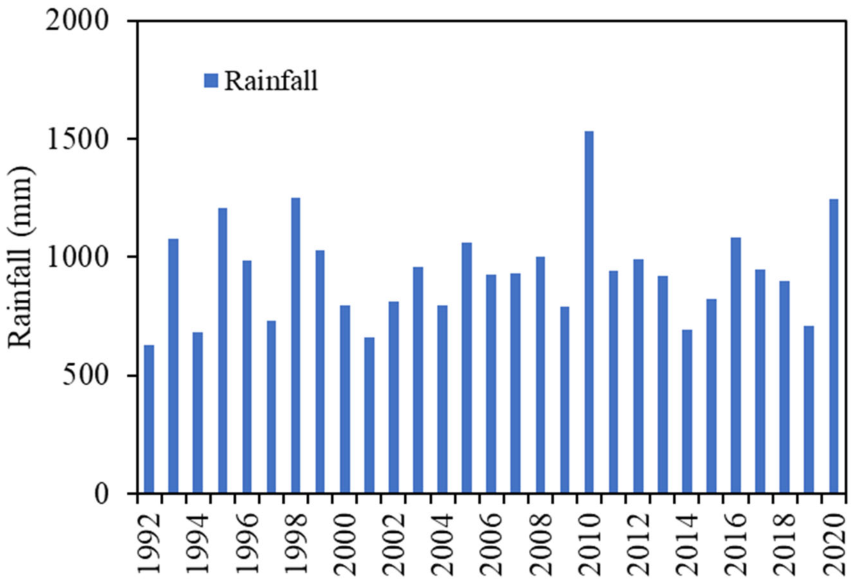
Tegucigalpa, which belongs to the central mountain region, has a temperature above 20 ˚C all year round. Figure 2.3.4 shows the average value from 2016 to 2020 of the temperatures and precipitation. September through November is the most humid season of the year due to hurricanes and other weather systems. In 1998, Hurricane Mitch caused devastating damage. The water transmission pipeline from Picacho WTP was damaged by the flooding of Choluteca river. In 2020, hurricanes Eta and Iota caused enormous damage. Flooding has occurred in the coastal regions and landslides and mudslides have occurred in the urban area of the municipality of the Distrito Central.

Figure 2.3.5 shows the annual precipitation. In 2019, precipitation was lower than other years and the catchment volume in La Concepción Reservoir and Los Laureles Dam dropped considerably. On the other hand, in 2020, precipitation was more than double in relation to 2019 due to hurricanes. All this indicates that Honduras is susceptible to the effects of climate change. During the dry season, water withdrawal from the dam is restricted, so the production of clean water drops to about 80% of that in the rainy season.



Source: UMAPS

Figure 2.3.4 Temperature and Rainfall of Tegucigalpa (Mean Values for 1980-2015)



Source: UMAPS

Figure 2.3.5 Annual Precipitation of Tegucigalpa

CHAPTER 3 PRESENT STATUS OF WATER SUPPLY WORKS IN TEGUCIGALPA

3.1 Overview of Water Sector in Honduras

3.1.1 Laws and Regulations in the Water Sector

(1) Laws and Regulations related to Drinking Water and Sanitation

Table 3.1.1 lists the legal instruments related to drinking water and sanitation.

Table 3.1.1 Laws and Regulations Related to Drinking Water and Sanitation

	Laws and Regulations	Year Enacted	Decree
1	Constitutive Law of the National Autonomous Service of Aqueducts and Sewerage (SANAA)	1961	No. 91
2	Municipalities Law	1990	No.134-90
3	Health Code	1991	No.65-91
4	General Environmental Law	1993	No. 104-93
5	General Regulations of the General Environmental Law	1993	No. 109-93
6	General Environmental Health Regulations	1998	(Agreement) No.0094
7	Drinking Water and Sanitation Sector Framework Law	2003	No. 118-2003
8	Land Management Law	2003	No. 180-2003
9	Model Regulation for Drinking Water and Sanitation Services	2006	No. 001-2006
10	Forestry, Protected Areas and Wildlife Law	2008	No.98-2007
11	General Water Law	2009	No. 181-2009
12	Law for the Establishment of a Country Vision and the Adoption of a National Plan for Honduras	2010	No. 286-2009
13	National Strategy for Watershed Management in Honduras	2011	(Ministerial Agreement) No.014-2011
14	Constitution of the Republic	2012	No. 270-2011
15	Special Regulation for the Attention of Requests and Claims from Users	2014	No. 27-2014
16	Operating Regulations of the UMAPS	2017	(Agreement) No. 043
17	National Regulation for Discharge and Reuse of Wastewater	2020	No. 003-2020
18	General Regulations of the UMAPS	2020	(Agreement) No. 016-A
19	Service Regulations of the UMAPS	2020	(Agreement) No. 017
20	Performance Agreement of the UMAPS	2020	(Agreement) No. 021

Source: JICA Study Team

The contents of the above laws and regulations are included in Appendix 3.1.1.

(2) Standards Related to Drinking Water and Sanitation

Table 3.1.2 presents the standards related to drinking water and sanitation.

Table 3.1.2 Drinking Water and Sanitation Standards

	Standards	Year Established	Decree
1	National technical standard for drinking water quality	1995	No. 84-1995
2	Technical standards for wastewater discharges to receiving bodies and sanitary sewers	1996	No. 58-1996
3	Regulation on Quality of Service of Potable Water and Sanitary Sewage Service	2005	No. 001-2006
4	Design standards for drinking water systems	2004	N/A
5	Design standards for sanitary sewerage, storm sewerage and wastewater treatment	2004	N/A
6	Technical guidelines for the incorporation of disaster mitigation measures in the design and construction of water and sanitation systems	2005	N/A
7	Measurement Regulation	N/A	N/A

Source: JICA Study Team

The contents of the above standards are included in Appendix 3.1.2.

3.1.2 National Policy on Water Sector

(1) National Drinking Water and Sanitation Sector Policy

The Government of Honduras enacted the Drinking Water and Sanitation Sector Framework Law in 2003, creating the National Drinking Water and Sanitation Council (CONASA) as the governing body whose powers include the formulation and approval of sector policies, development of national strategies and plans, definition of objectives and sector goals, preparation of investment program, and coordination with other national, regional, and municipal entities for the drinking water and sanitation sector. CONASA's members include the Ministry of Health, the Ministry of Interior and Justice, the Ministry of Natural Resources and Environment, the Ministry of Finance, the President of the Association of Municipalities of Honduras, a representative of the water administration board, and a representative of the users with the General Director of SANAA as executive secretary. The government drafted the National Drinking Water and Sanitation Sector Policy in 2014 under the leadership of CONASA, establishing the sector's development policies and goals. This policy instrument also includes the main strategic elements to comply with the policy goals and constitutes the general conceptual and methodological guideline for the elaboration of the development programs and plans, through inter-institutional coordination.

The aforementioned policy covers the entire national territory with a broad approach and establishes 2038 as the target year, as stipulated in the Law for the Establishment of a Country Vision and the Adoption of a National Plan for Honduras.

This policy presents a general guideline for the development of the entire sector, involving all municipal governments. However, due to the peculiarity and complexity of the sector in a large metropolitan area, it establishes that it is necessary to elaborate specific and concrete development strategies and plans for Tegucigalpa and San Pedro Sula.

Vision

In the year 2038, the Honduran population has access to improved drinking water and sanitation services that meet service quality standards, promote the country's socio-economic development, and are developed through actors capable of fulfilling their responsibilities efficiently and effectively, within the framework of sustainable water resource management and risk prevention.

Policy Guidelines and Specific Objectives

1. Achieve universal access to drinking water and sanitation services with a focus on social inclusion, taking into account the priorities and specific conditions of the different categories of localities.
2. Improve drinking water and sanitation service levels in existing systems, according to the conditions of the different categories of localities.
3. To achieve integral sustainability of drinking water and sanitation services.
4. To develop the provision of drinking water and sanitation services within the framework of sustainable management of water resources.
5. Achieve sector governance through institutional strengthening and capacity building at the municipal level.
6. Strengthen the governance of the sector at the national level through institutional strengthening.
7. To operate the sector through a transparent and adequately managed and administered financial framework that covers all categories of costs and investments.

The strategic framework provides the basis for all actions and interventions of the sector's stakeholders and defines how specific objectives will be achieved. The strategies are aimed at developing the following components:

1. Strategy for infrastructure development
2. Strategy for service delivery
3. Strategy for decentralization and local development
4. Strategy for institutional development and governance of the sector
5. Strategy for capacity development and strengthening
6. Financial strategy of the sector

3.1.3 National Development Plan for Water Sector

(1) National Plan for Drinking Water and Sanitation (PLANASA)

The Government of Honduras and CONASA has developed in December 2014 the National Drinking Water and Sanitation Plan (PLANASA) based on the national policies mentioned above, which sets out the plans, strategies, goals, and required investments until 2022. Its successor, PLANASA 2022-2030, was prepared with the support of the IDB and approved by CONASA in April 2022.

PLANASA 2022-2030 is the planning instrument of the water and sanitation sector, which was developed with the purpose of guiding decisionmakers at the central and local government level, international cooperation, and multilateral banks to know the investment priorities required by the sector, for the strengthening of institutions and urban and rural service providers, in the construction of infrastructure resilient to climate change, and addressing the universalization of services with a focus on human rights, gender equity, and inclusion of indigenous and afro-descendant populations of the country.

PLANASA 2022-2030 validated the sector diagnostics, evaluated the goals of PLANASA 2014-2022 approved in 2014, and developed the seven strategic objectives, guidelines, goals, and indicators for the new period.

The seven sector strategic objectives and their respective action plans are listed in Table 3.1.3.

Table 3.1.3 Strategic Objectives and Actions

Strategic Objective	Actions
1. Effectively coordinate, plan, and monitor actions at all levels to facilitate the comprehensive, sustainable, and resilient development of the sector	➢ Strengthen CONASA to properly exercise its role as Governing Body of the Sector; ➢ Design and implement an effective mechanism for sectoral coordination at all levels of government; ➢ Update and implement a participatory investment planning process sectors from the local to the national level; ➢ Formulate and approve programs and projects articulated based on the strategic objectives of PLANASA and manage the financial resources for their implementation; and ➢ Structure and implement the monitoring, follow-up, and evaluation mechanism of PLANASA and other sectoral planning instruments.
2. Provide services under conditions of quality, transparency, sustainability, and resilience to climate change	➢ Establish providers with technical, administrative, and financial autonomy for the Provision of services; ➢ Update and approve the National Water Quality Plan for Human Consumption; ➢ Improve the quality of provision of urban services (localities >2,000 inhabitants); ➢ Improve the quality of provision of rural services (localities between 250-2,000 hab.); ➢ Achieve financial sustainability of the provision of services based on the transparency of the management of its providers; ➢ Strengthen laboratory capacities for the control of water quality potable and sewage; and ➢ Strengthen the culture of knowledge management in the sector.
3. Exercise effective ownership, regulation, control, and surveillance to ensure the quality of service provision under conditions of transparency and sustainability	➢ Effectively exercise municipal ownership over the conditions of provision of the services; ➢ Effectively regulate drinking water and sanitation service providers; ➢ Effectively monitor the quality of water for human consumption delivered by service providers to users; and ➢ Effectively monitor the quality of wastewater discharges to the body receivers.
4. Develop capacities for the management and provision of quality	➢ Restructure SANAA as Executive and Technical Secretariat of CONASA and Sectoral Technical Entity;

Strategic Objective	Actions
services and under conditions of transparency, sustainability, and resilience to climate change	➢ Design and implement the National Program for the Development of Capacities for the Provision of Services; ➢ Update and/or develop and disseminate sectoral technical regulations that promote the provision of quality services and an Integrated Water Resources Management (IWRM), Climate Change Adaptation, and Disaster Risk Reduction approach; and ➢ Promote technology and innovation in the production and delivery processes of services.
5. Manage and develop service infrastructure resilient to the effects of change climate	➢ Formulate and approve the National Program for Resilient Investments in Drinking Water and Sanitation (PRONIRAPS) linked to the Municipal Development Plans (PDM); and ➢ Implement the National Program for Resilient Investments in Drinking Water and Sanitation (PRONIRAPS) linked to the Municipal Development Plans (PDM)
6. Ensure the availability of financial resources to implement the plans, programs, and projects of the sector with a focus on resilience to climate change	➢ Strengthen the traditional financing mechanisms of the sector; ➢ Implement innovative financing mechanisms for the sector; and ➢ Develop capacities and mechanisms to access drinking water and sanitation investment resources.
7. Contribute to comprehensive management of water resources to ensure their availability in quantity and quality appropriate for human consumption, adaptation to climate change, and disaster risk management	➢ Put into operation tools to systematize data at the basin level of availability and use of the resource; ➢ Determination of current and future demands for potable water; ➢ Reduction of water losses and incentives to save the resource; ➢ Comprehensive and rational use of water resources; ➢ Reduction of the contamination of the water resource; ➢ Development of sustainable drinking water and sanitation infrastructure; ➢ Development and implementation of new technologies in drinking water and sanitation – savings; ➢ Implementation of non-structural IWRM measures; and ➢ Effective monitoring, collaboration, and regulation of compliance with the plans.

Source: PLANASA 2022-2030

(2) Master Plan

Table 3.1.4 presents a summary of the master plans for potable water service in Tegucigalpa.

Table 3.1.4 Outline of the Master Plans for Potable Water Service in Tegucigalpa

Name	Year of Production	Author/ Donor	Description
P/M JICA (JICA Master Plan)	2001	PCI/JICA	It establishes the following goals: (1) Achieve stable water supply service with 99% reliability against drought, which is equivalent to the driest month in 10 years; and (2) Continuous 24-hour water supply service with adequate quantity and quality. The Plan estimated the production in 2000 and the production required for the year 2015 is based on the projected population and demand and performed a comparative technical and economic analysis of the following Master Plan candidate projects: The dredging project at Los Laureles Reservoir;

Name	Year of Production	Author/ Donor	Description
			- Los Laureles II Project (consisting of the construction of Los Laureles II Dam and the necessary water supply facilities as well as the excavation of the existing Los Laureles reservoir); - Quiebra Montes Project, which consists of the construction of the Quiebra Montes Dam and the necessary water supply facilities; - Sabacuante Project, which consists of the construction of the Sabacuante Dam and the necessary facilities for water supply; - Tatumbla Project, which consists of the construction of the Tatumbla Dam and the necessary water supply facilities; and Tatumbla Dam, which consists of the construction of the Tatumbla Dam and the necessary water supply facilities; and - Water leakage reduction project (replacement of water pipes of a certain diameter). The Los Laureles II Project was selected as the priority project for which the Feasibility Study was conducted.
P/M SOGREAH (SOGREAH Master Plan)	2004	SOGREAH/France	The Master Plan on the development of water sources is a study of the primary water supply system (water sources - reservoirs), population projection and water demand, and hydrological analysis, among others, was carried out, proposing four alternative sources, namely the Hombre, Guacerique, Sabacuante, and Nacaome rivers, which were subjected to a comparative analysis from the technical, economic, and environmental perspectives. The study analyzed the hydrological information, hydrological functions of the dams, construction of the dams, adduction lines, and water treatment plants for each of the identified sources. It also included the estimation of the cost of the project and the economic analysis, leading to the selection of Guacerique II as the priority project, for which the preliminary design was carried out.
P/M AQUARUM (AQUARUM Consolidated Master Plan)	2011	AQUARUM/Spain	It includes an extensive study and analysis of the distribution networks and proposes a master plan. The diagnosis of the existing potable water supply system included the projection of water demand, evaluation of sources and their productive capacity, distribution system, losses and current state of distribution pipes, hydrological analysis through modeling, measures against water leakage and NRW, and the study of pump energy. It proposes to improve the aqueduct system by managing water pressure with sectorization (distribution blocks), improvement measures in low pressure areas, and improving the pressure regulation capacity of the distribution networks.
Action plan (Climate Change Action Plan)	2018	NDF/IDB	This plan has been developed as a regional plan for climate change adaptation with a focus on watersheds. The plan serves as a means of multidisciplinary coordination for climate change adaptation in the central municipalities, including Tegucigalpa. The plan identifies integrated management of drinking water security and sanitation as one of the priority components.

Source: JICA Study Team

3.1.4 Institutional Framework of Water Sector

Table 3.1.5 presents the list of relevant agencies and institutions in the water and sanitation sector in Honduras. These agencies and institutions exercise powers attributed by the legal framework, establishing the respective functions and responsibilities in the area of drinking water and sanitation.

Table 3.1.5 Drinking Water and Sanitation Sector Agencies and Institutions

No.	Organizations and Institutions / Official Name	Acronyms
1	Ministry of Health	MINSALUD
2	Ministry of Natural Resources and Environment	MIAMBIENTE
3	Ministry of Finance	SEFIN
4	Ministry of Governance, Justice and Decentralization	SGJD
5	National Water and Sanitation Council	CONASA
6	Drinking Water and Sewage Services Regulatory Entity	ERSAPS
7	National Autonomous Service of Aqueducts and Sewage Systems	SANAA
8	National Institute of Forest Conservation and Development, Protected Areas and Wildlife	ICF
9	Municipal Governments	GM
10	Service Providers	EPS
11	Water Management Boards	JAA
12	Regional Development Councils	CRD
13	Forest Advisory Councils	CCF
14	Basin Organizations	CO

Source: Luis Moncada Gross 2019[1]

For the purpose of putting institutional attributions in perspective, these have been grouped under different concepts that are illustrated in Table 3.1.6.

Table 3.1.6 Institutional Attribution

No.	Attribution	Description
1	Sector Steering	Participation in the Board of Directors of CONASA and SANAA
2	Planning	Formulation of plans at the national, municipal, local, and sector levels
3	Financing	Obtaining financial resources at the national and municipal level
4	Sector Coordination	Coordination of actions of organizations in relation to services
5	Infrastructure	Design and construction of works to provide services
6	Authorizations	Issuance and cancellation of permits
7	Normative	Issuance of technical and regulatory standard
8	Control	Supervision and monitoring of compliance with the legal framework
9	Source Protection	Control of activities detrimental to water quantity and quality
10	Territorial Planning	Regulating land use in watersheds of water sources
11	Outsourcing	Carrying out municipal activities by other public or private entities
12	Citizen Participation	Access of the population to decisions about construction and service management
13	Management Services	Operation, maintenance, and administration of drinking water and sanitation services
14	Financial Management	Billing and collection of drinking water and sanitation services based on micro metering
15	Environmental Protection	Sanitary disposal of sewage and waste from operating services
16	Risk management	Facilities vulnerability assessment and adequate mitigation measures
17	User Education	Sanitary and environmental aspects and rational use of water.
18	Offenses	Non-compliance with regulations on construction or system operation

[1] Prontuario de Disposiciones Legales Atinentes a los Servicios de Agua Potable y Saneamiento, Luis Moncada Gross 2019

19	Sanctions	Administrative and judicial actions to penalize infractions
20	Technical assistance	Technical and financial support from the government to municipalities, EPS and JAA

Source: Luis Moncada Gross 2019[2]

The institutional attribution of each organization is shown in Table 3.1.7 and the distribution of institutional attribution is shown in Figure 3.1.1.

Table 3.1.7 Institutional Attribution of the Organizations

Organization	Instituional Attribution					
1.Ministry of Health (MINSALUD)	1.Sector Steering	5. Infrastructure	6.Authorizations	7.Normative	8.Control	9.Source Protection
	18.Offenses					
2.Ministry of Natural Resources and Environment (MIAMBIENTE)	1.Sector Steering	2.Planning	6.Authorizations	7.Normative	8.Control	9.Source Protection
	10.Territorial Plann	12.Citizen Participation		19.Sanctions	20.Technical Assistance	
3.Ministry of Finance (SEFIN)	1.Sector Steering	9.Source Protection				
4.Ministry of Governance, Justice and Decentralization (SGJD)	1.Sector Steering	6.Authorizations	8.Control	9.Source Protection		
5. National Waster and Sanitation Control (CONASA)	1.Sector Steering	2.Planning	3.Financing	9.Source Protection	12.Citizen Participation	
6.Drinking Water and Sewage Services Regulatory Entity (ERSAPS)	2.Planning	6.Authorizations	7.Normative	8.Control	9.Source Protection	13.Management Services
	19.Sanctions	20.Technical Assistance				
7.National Autonomous Service of Aqueducts and Sewage Systems (SANAA)	1.Sector Steering	5. Infrastructure	20.Technical Assistance			
8.National Institute of Forest Conservation and Development, Protected Areas and Wildlife (ICF)	2.Planning	3.Financing	4.Sector Coordinati	8.Control	9.Source Protection	10.Territorial Planning
	12.Citizen Participa	16.Risk Managemen	17. User Education	20.Technical Assistance		
9.Municipal Governments (GM)	1.Sector Steering	2.Planning	3.Financing	4.Sector Coordinati	5. Infrastructure	6.Authorizations
	7.Normative	8.Control	9.Source Protection	10.Territorial Plann	11.Outsourcing	13.Management Services
	14.Financial Manag	15.Environmental P	16.Risk Managemen	19.Sanctions	20.Technical Assistance	
10.Service Providers (EPS)	2.Planning	3.Financing	7.Normative	13.Management Ser	14.Financial Manag	15.Environmental Protecti
	17. User Education	18.Offenses				
11.Water Management Boards(JAA)	1.Sector Steering	3.Financing	5. Infrastructure	9.Source Protection	12.Citizen Participa	13.Management Services
	14.Financial Manag	15.Environmental P	17. User Education	18.Offenses		
12.Regional Development Council (CRD)	2.Planning	10.Territorial Planning				
13.Forest Advisory Conucil (CCF)	9.Source Protection					
14.Basin Organizations (OC)	9.Source Protection					

Source: Luis Moncada Gross 2019[3]

[2] Ibid.
[3] Ibid.

Attribution \ Organization	1. MINSALUD	2. MAMBIENTE	3. SEFIN	4. SGJD	5. CONASA	6. ERSAPS	7. SANAA	8. ICF	9. GM	10. EPS	11. JAA	12. CRD	13. CCF	14. OC	Total
1.Sector Steering	■	■	■	■	■		■		■		■				8
2.Planning		■			■	■		■	■	■		■			7
3.Financing					■			■	■	■	■				5
4.Sector Coordination								■	■						2
5. Infrastructure	■						■		■		■				4
6.Authorizations	■	■		■		■			■						5
7.Normative	■	■				■			■	■					5
8.Control	■	■		■		■		■	■						6
9.Source Protection	■	■	■	■	■	■		■	■		■		■	■	11
10.Territorial Planning		■						■	■			■			4
11.Outsourcing									■						1
12.Citizen Participation		■			■			■			■				4
13.Management Services						■			■	■	■				4
14.Financial Management									■	■	■				3
15.Environmental Protection									■	■	■				3
16.Risk Management								■	■						2
17.User Education		■						■		■	■				4
18.Offenses	■									■	■				3
19.Sanctions		■				■			■						3
20.Technical Assistance		■				■	■	■	■						5
Total	7	11	2	4	5	8	3	10	17	7	10	2	1	1	89

Source: Luis Moncada Gross 2019[4]

Figure 3.1.1 Distribution of Attributions among Sector Institutions

From the above figure, it can be seen that the institution with the greatest power is GM (17), followed by MIAMBIENTE (11), ICF (10), JAA (10), ERSAPS (8), MINSALUD (7), and EPS (7). Smaller number of attributions appears in CONASA (5), SGJD (4), SANAA (3), SEFIN (2), CRD (2), CCF (1), and OC (1).

GM and EPS are the organizations responsible for providing drinking water and sanitation services to the residents of their jurisdictions. GM is the owner of the facilities and assets that provide drinking water and sanitation services within its jurisdiction and is responsible for overall planning, financial, sector coordination, and monitoring and supervision of EPS activities. It also has a responsibility for the review and approval of rates. EPS, on the other hand, is responsible for the operation, management, and

[4] Ibid.

maintenance of the drinking water and sanitation infrastructure, including treatment plants, water supply systems, and sewage systems. This includes billing and collection, user education, etc. In addition to their respective roles, GM and EPS share common responsibilities, including environmental protection.

AMDC as the GM and UMAPS as the EPS are the organizations that implement drinking water and sanitation services in the study area.

3.1.5 Activities of Other Donors

(1) Other Donor Activities Carried Out in Recent Years

Japan has been implementing projects, mainly within the non-reimbursable financial cooperation (grant aid) framework, for the potable water and sanitation sector in Tegucigalpa, which include the reconstruction of water conduction and distribution lines, construction of water supply stations, supply of equipment and materials, construction of micro-hydroelectric plants, etc. On the other hand, the Government of Spain, the World Bank, the Inter-American Development Bank (IDB), and the Central American Bank for Economic Integration (CABEI) have implemented loan projects for the construction of treatment plants, study of the distribution network, reconstruction works, and capacity building. Currently, the World Bank is implementing the Project for the Strengthening of the Potable Water Service in Tegucigalpa that will be completed in 2025. The IDB is implementing some projects under combination of loan and technical cooperation. Table 3.1.8 presents a list of the assistance provided to the water and sewerage sector in Tegucigalpa.

Table 3.1.8 Assistance Projects Executed in the Potable Water and Sanitation Sector in Tegucigalpa

No.	Year of Execution	Executing Agency	Beneficiary Institution	Project	Estimated Cost (USD)	Modality	Description
1	2003-2007	EU	SANAA	Project for aqueducts and sewer system in marginal (poor) districts of Tegucigalpa (PRRAC-ASAN)	26.7 million	Grant	- Construction of drinking water systems for the northwest area of Tegucigalpa - Construction of sewage systems for the southeast area of Tegucigalpa
2	2011	JICA	SANAA	Water Supply Project for Tegucigalpa's Urban Area	17 million	Grant	- Reconstruction of El Picacho water treatment plant - Construction of pipelines and tanks
3	2011	World Bank	SANAA	PROMOSAS	1.0 million	Loan	Study of existing distribution networks
4	2009-2012	Government of Spain	SANAA	Optimization of Drinking Water Supply System and Improvement of Distribution	17 million	Loan	- Analysis of the distribution network - Leak investigation program

No.	Year of Execution	Executing Agency	Beneficiary Institution	Project	Estimated Cost (USD)	Modality	Description
				Pipelines			- Plan of hydrometric areas (75 sectors) - Diagnostics of energy consumed by pumps
5	2012	World Bank	SANAA	PROMOSAS	1.3 million	Loan	Drinking water services optimization study
6	2013	World Bank	SANAA	PROMOSAS	0.65 million	Loan	Study of existing sewerage networks
7	2013	World Bank	SANAA	PROMOSAS	6.5 million	Loan	- Plan of hydrometric areas (53 sectors) - Study of distribution networks - Study of tanks and pump stations
8	2013	CABEI	SANAA	Reconstruction of the Los Laureles Dam floodgate	4.2 million	Loan	Reconstruction of the Los Laureles Dam floodgate
9	2014	KOICA	SANAA	Feasibility study for Guacerique II Dam	0.9 million	Grant	Upgrade study for dam construction
10	2014	World Bank	SANAA	Water leakage reduction program	1.1 million	Loan	Supervision of water leakage reduction works
11	2015	CABEI	SANAA	Reconstruction of Los Laureles catchment facilities	1.2 million	Loan	Reconstruction of intake facilities
12	2015	JICA	SANAA	Micro-Hydroelectric Power Generation Project in the Metropolitan Area of Tegucigalpa	12.7 million	Grant	Supply of micro-hydroelectric power generation equipment for the Picacho and Concepción water treatment plants.
13	2015	JICA	SANAA	Extension of the L22 pipeline system	0.7 million	Grant	
14	2015	CABEI	SANAA	Reconstruction of the Colonia Villanueva Tank and Pump Station	2.3 million	Loan	Reconstruction of the Colonia Villanueva Tank and Pump Station
15	2015	IDB	SANAA	Rio del Hombre dam	0.82 million	Loan	Detailed design and environmental

No.	Year of Execution	Executing Agency	Beneficiary Institution	Project	Estimated Cost (USD)	Modality	Description
				feasibility study			study of the Rio del Hombre Dam
16	2016	CABEI	SANAA	Community capacity building	0.8 million	Loan	Reforestation for the protection of aquifer recharge areas
17	2016	World Bank	SANAA	PROMOSAS	0.52 million	Loan	Diagnosis for the transfer of SANAA to AMDC
18	2018	CABEI	AMDC	Optimization of Los Laureles drinking water treatment plant	1.4 million	Loan	Reconstruction of Los Laureles drinking water treatment plant
19	2018	CABEI	AMDC	Reconstruction of the water treatment plant in La Concepción	1.4 million	Loan	Reconstruction of the water treatment plant in La Concepción
20	2018	CABEI	AMDC	Reconstruction of Los Laureles drinking water treatment plant	1.5 million	Loan	Reconstruction of Los Laureles drinking water treatment plant
21	2018	CABEI	SANAA	Project to transfer raw water from Los Laureles reservoir to the aerator of the Concepción reservoir water treatment plant.	9.7 million	Loan	Detailed design and execution of raw water transfer works.
22	2019	IDB	AMDC	Support for the Preparation of the Reform Program for Water and Sanitation Services in Tegucigalpa (HO-T1334)	0.35 million	Grant	Technical cooperation to support the preparation of the Program for the Reform of Water and Sanitation Services of Tegucigalpa (HO-L1207)
23	2019	IDB	AMDC	Central District Water and Sanitation Services Reform Program (HO-L1207)	60 million	Loan	Assist in the transfer of operations from SANAA to UMAPS
24	2019-2025	World Bank	AMDC	Project for the Strengthening of the Potable	50 million	Loan	- Assistance in the transfer to UMAPS - Upgrading of

No.	Year of Execution	Executing Agency	Beneficiary Institution	Project	Estimated Cost (USD)	Modality	Description
				Water Service in Tegucigalpa			water treatment plants and distribution networks - Strengthening of dam operation and maintenance capabilities - Strengthening of operation and maintenance capabilities
25	2021	IDB	UMAPS	Water and sanitation services reform program in Central District II (HO-L1229)	59.25 million	Loan	Contribute to improving the quality and increasing access to water and sanitation services in the Central District through a process of reforms
26	2021	IDB	UMAPS	Support for the Second Phase of the Water and Sanitation Services Reform Program in the Central District (HO-T1396)	0.35 million	Grant	Technical cooperation to support the implementation of the Water and Sanitation Services Reform Program in Central District II (HO-L1229)

Source: JICA Study Team

(2) WB's Current Assistance Status

The WB is currently implementing a water and sanitation project targeting Tegucigalpa, and it is necessary to ensure that there is no overlap in scope and content when considering the scope of JICA's cooperation. The details of the WB's assistance are shown below.

1) Overview of Assistance

The objective of the Project for the Strengthening of the Potable Water Service in Tegucigalpa is to increase the efficiency and reliability of water services in selected areas of Tegucigalpa by contributing to the operationalization of a new service provider, UMAPS, and improvements in infrastructure and resource management tools. The major components of the project are listed in Table 3.1.9.

Table 3.1.9 Major Components and Details

Component	Details of Components
Component 1. Operationalization of the UMAPS (Total cost of USD	This Component set seven specific targets associated with the transfer of Tegucigalpa's water supply and sanitation system from SANAA to UMAPS and the strengthening of UMAPS' administrative, operational, commercial, and financial capacity to effectively manage the system.

89 million, of which USD 18 million is IDA financing)	1: Adoption of governance arrangements and gender policy of UMAPS 2: Transfer of administration and finance functions from SANAA to UMAPS. 3: Transfer of commercial function from SANAA to UMAPS. 4: Transfer of the Picacho subsystem from SANAA to UMAPS. 5: Transfer of the Laureles subsystem from SANAA to UMAPS. 6: Transfer of the Concepción subsystem from SANAA to UMAPS. 7: Transfer of the sanitation system from SANAA to UMAPS.
Component 2.1 Improving water availability (Total cost of USD 24 million, of which USD 20 million is IDA financing).	This subcomponent will make households more resilient to droughts and rising temperature (which increases demand for water and evaporation rates, thereby exacerbating the impact of droughts). It will finance: (i) rehabilitation/upgrading of WTPs to increase flexibility in redistributing water among the three main subsystems, recover water from sludge and filter backwash, and improve energy efficiency throughout the system; (ii) implementation of district metered areas (DMAs) in Picacho and other targeted areas to isolate specific sectors of the distribution network, regularize pressure throughout the water mains, and diagnose the main causes of water losses within these sectors; and (iii) activities to improve the efficiency of the gravity-fed distribution network by reducing NRW, with emphasis on physical losses, thus increasing water availability.
Component 2.2 Strengthening the safety of the Laureles and Concepción dams (Total cost of USD 5 million, all is IDA financing)	To ensure the ongoing security of these two dams for providing water to the Tegucigalpa water supply system, the following activities will be carried out as part of a dam safety action plan: (i) establishment and operation of a Dam Safety Panel of Experts (POE) to review and advise AMDC on the studies, from the terms of reference, elaboration on the final design review, and works to be carried out; (ii) comprehensive dam safety assessments, including a risk assessment of the impact of climate change on the dams' structural integrity and definition of safety measures; (iii) elaboration of dam safety plans including instrumentation and operation and maintenance (O&M); (iv) emergency preparedness; (v) construction supervision and quality assurance plan for the minor remedial works; (vi) immediate minor remedial works such as downstream slope clearing in Laureles and water tightening of the Concepción spillway slab joints as well as the implementation of early warning systems in both dams; and (vii) dam safety capacity building for UMAPS and other stakeholders.
Component 2.3 Developing tools for enhanced watershed management and climate resilience (Total cost of USD 2 million, all is IDA financing)	This subcomponent will improve planning to manage key watersheds in UMAP's jurisdiction with a view to enhance climate change adaptation in the sector. Well-managed and healthier, less contaminated watersheds will reduce the probability and impact of extreme weather events and erosion. The activities will include: (i) assessment of the impact of climate risks identified in the water resources diagnostic for the Laureles watershed carried out by AMDC; (ii) update of the diagnostic on the impact of anthropogenic interventions in selected watersheds; (iii) assessment of the climate risks and development of a strategy and plan to build the resilience of Tegucigalpa's water services; (iv) development of a watershed management and conservation plan for selected watersheds that will include activities to increase forest coverage and land use regulation while acting as a potential carbon sink, which will help reduce the rate of erosion; and (v) activities aiming to reduce pollution in key water bodies near Tegucigalpa. The latter will include: (i) development of a city-wide inclusive sanitation strategic plan; (ii) prefeasibility study, feasibility study, preliminary design, and safeguard studies for select infrastructure; and (iii) installation of instruments and equipment to monitor the quality of water flowing into the reservoirs prior to treatment.

Source: World Bank

2) Current Status of Assistance

Table 3.1.10 shows the status for each component as of May 2023.

Table 3.1.10 Status as of May 2023

Component	Status
Component 1. Operationalization of the UMAPS	All completed in May 2022.
Component 2.1 Improving water availability	The consultancy for the design of the rehabilitation of the three main Drinking Water Treatment Plants: It was expected to end in November 2022 but to date, it is still under development. The contracted consortium (Hazen and Sawyer) delivered a draft design for the Picacho plant, which has been reviewed by AMDC and UMAPS but to date, the bidding process for the works to be executed agreed between the consortium, AMDC, and UMAPS of Picacho has not been launched. Regarding Concepción and Laureles, the contracted consortium (Hazen and Sawyer) delivered a draft design of the proposed improvements for both plants, which to date is under review by AMDC, UMAPS, and the consortium. The sectorization project and reduction of non-revenue water (NRW) in 14 selected coverage areas: This activity is central to the project, directly impacting the Development Objectives which has a considerable delay and constitutes the critical path of the project. To date, the evaluation of the companies that showed an interest in participating in it is about to begin. The sectorization and reduction works of NRW were readapted to be carried out in at least two batches, taking advantage of the sequential delivery of sectors designed by the study consultant. This will allow the execution time to be reduced and the first batch could be expected to be completed and operational in the third quarter of 2024.
Component 2.2 Strengthening the safety of the Laureles and Concepción dams	During the week of February 27 to March 3, 2023, experts in Hydrology, Hydromechanics, Instrumentation, and Geology will be making their first visit to the Los Laureles and La Concepción dams.
Component 2.3 Developing tools for enhanced watershed management and climate resilience	It is currently in the evaluation process in hiring a consulting firm for the updating of the management plans of the La Concepción and San José de Río Grande, in the same way it is in the process of evaluation for the firms that presented their expression of interest to carry out the study and design for the control of contamination of the sub-basins of Guacerique and San José de Río Grande. The tender document for the study and design of climate resilience of the water sources that supply the Central District are currently under review.

Source: JICA Study Team

(3) IDB's Current Assistance Status

The IDB is currently implementing several water and sanitation projects targeting Tegucigalpa, and it is necessary to ensure that there is no overlap in scope and content when considering the scope of JICA's cooperation. It should be noted that there is a possibility of co-financing. The details of the IDB’s assistance are shown below.

1) Overview of Assistance

The IDB supports the water and sanitation sector in the Central District through a combination of loans and technical cooperation. Table 3.1.11 summarizes the projects that have been implemented in recent years.

Table 3.1.11 Summary of IDB Project in Recent Years

Project Number	Project Title	Project Description
HO-T1334 Grant, USD 0.35 million	Support for the Preparation of the Reform Program for Water and Sanitation Services in Tegucigalpa	The objective of the technical cooperation (TC) is to support the preparation of the Program for the Reform of Water and Sanitation Services of Tegucigalpa (HO-L1207) in Honduras. This TC will contribute to the sustainability of the provision of water and sanitation services in Tegucigalpa through the financing of studies, plans, and strategies to consolidate the transfer of services from the central level to the municipal level and strengthen the municipality with tools that allow you to increase the efficiency, quality, and coverage of water supply and sanitation in the city.
HO-L1207 Loan, USD 60.00 million	Central District Water and Sanitation Services Reform Program	The objective of this programmatic series is to help increase access and improve the quality of water and sanitation services in the Central District through a process of reforms that permit decentralization of those services to the municipal level, thereby enhancing sector governance and management in a context of climate change and with a view to achieving water security. The objective of this first operation is to contribute to the design and enactment of legal and sector instruments. The specific objectives are: (i) to promote operational and management development so as to increase the efficiency of water and sanitation services provided by UMAPS; (ii) to help increase the financial sustainability of services provided by UMAPS; (iii) to strengthen UMAPS planning; and (iv) to strengthen the sector framework through better governance, regulation, and management of resources in a context of climate change and improve service delivery to better meet the demand. This is the first loan in a series of two consecutive single-tranche operations that are technically related to one another but independently financed as programmatic policy-based loans.
HO-L1229 Loan, USD 56.1 million	Water and Sanitation Services Reform Program in Central District II	Contribute to improving the quality and increasing access to water and sanitation services in the Central District through a process of reforms that allow consolidating the municipalization of water and sanitation services by improving sector governance and their management, in a context of climate change and conducive to water security.
HO-T1396 Grant, USD 0.35 million	Support for the Second Phase of the Water and Sanitation Services Reform Program in the Central District	The objective of the TC is to develop inputs that allow the implementation of the reforms identified in operation HO-L1229, helping to improve quality and increase access to water and sanitation services in the Central District. By supporting the loan, the TC is consistent with the update of the Institutional Strategy 2010-2020 and is aligned with the development challenges of: (i) Social Inclusion and Equality, by strengthening the governance, management, and capacity building to increase and improve access to water and sanitation services in the Central District; and (ii) Productivity and Innovation, through the use of tools such as HydroBID to model supply and demand balances. Likewise, with the cross-cutting themes of: (i) Climate Change and Environmental Sustainability through the incorporation of climate change considerations in plans; (ii) Institutional Capacities and the Rule of Law, through the creation and strengthening of regulatory frameworks for better management of water and sanitation services; and (iii) Gender Equality through the incorporation of specific gender activities in different policy reforms, as well as the implementation of a gender action plan.

Source: JICA Study Team

2) Current Status of Assistance

Table 3.1.12 shows the status for each project as of January, 2024.

Table 3.1.12 Status of IDB Project as of January, 2024

Project Number	Status
HO-T1334 Grant, USD 0.35 million	Approval Date: October 15, 2019 Status: Closed Since this technical cooperation is intended to facilitate the transition of work from SANAA to UMAPS using HO-L1207 funds, this project has been closed in 2023.
HO-L1207 Loan, USD 60.00 million	Approval Date: October 16, 2019 Status: Closed This loan consisted of two loan agreements (4879/KI-HO and 4878/BL-HO) between the Government of Honduras and IDB, each in the amount of USD 30 million, signed in 2019. Of this amount, 4878/BL-HO was earmarked for labor benefits for SANAA employees upon their retirement.
HO-L1229 Loan, USD 59.25 million	Approval Date: September 20, 2023 Status: Under implementation This project is a continuation of HO-L1207. The loan is approved on September 20, 2023. This loan is the second of two operations that are technically related to one another but independently financed under the programmatic policy-based loan modality.
HO-T1396 Grant, USD 0.35 million	Approval Date: December 2, 2021 Status: Under implementation The technical cooperation is underway and will support the final designs and bidding documents for the Guacerique collector (for the sanitation of the Choluteca River)

Source: JICA Study Team

3.2 Waterworks Entity

3.2.1 Organization Structure of UMAPS and Related Organizations

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

1) Overview of Organization

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:

a) Definition of drinking water and sanitation sector goals and policies, elaboration of financing and investment strategies, operation and maintenance proposals, etc.;

b) Execution of the studies and analyses necessary for PLANASA's planning and periodic review and evaluation;

c) Preparation of urban and rural investment programs and coordination of the investment mechanism;

d) Opinion on access and investment opportunities for construction and expansion projects of water and sewerage systems;

e) Promotion of linkages with the financial and private sectors and developing financing strategies for public and private investments; and

f) Promotion of innovation and technology transfer.

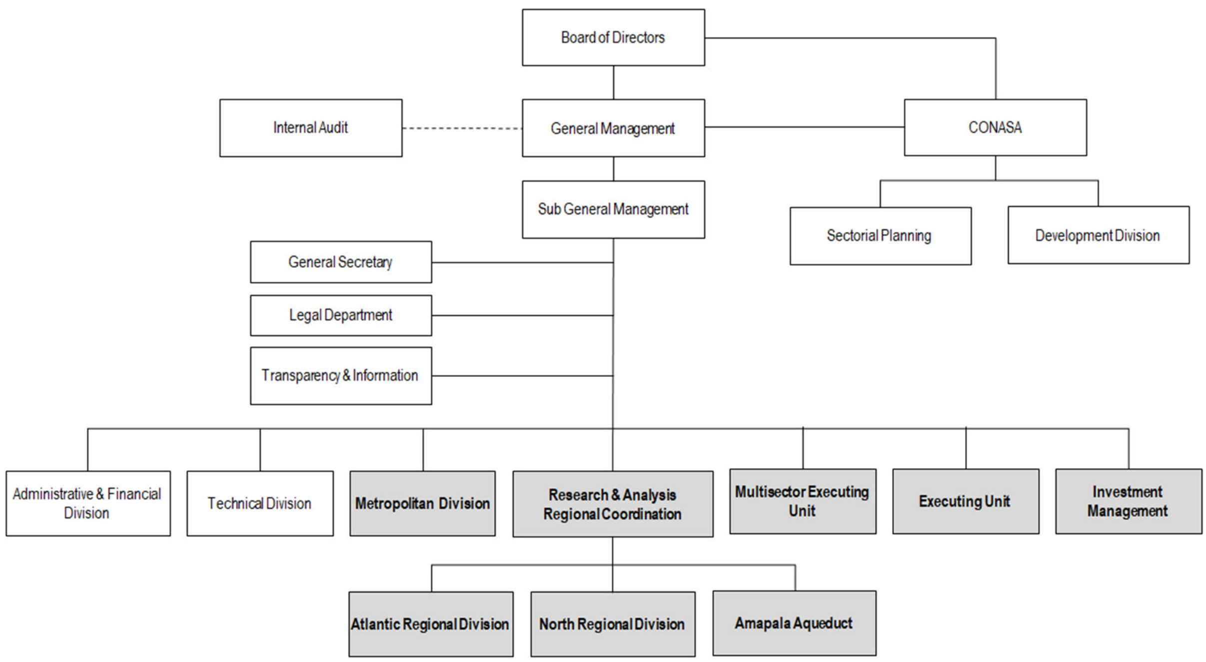
As of April 2021, there were 1,260 SANAA employees nationwide, of which 1,021 belonged to the Metropolitan Division, which operates Tegucigalpa's water and sewer systems. Subsequently, operations were transferred to UMAPS and by March 2023, SANAA had 385 employees, 102 of whom belonged to the Metropolitan Division.

Currently, four departments remain in the Metropolitan Division:
- Water Distribution Network Management Department
- Watershed Management Department
- Neighborhoods in Development Department
- Laboratory Department

Employees in the four departments of the Metropolitan Division must be paid their labor rights prior to termination and the payment process is currently underway. Upon completion of the payment process, these four departments of the Metropolitan Division will be dissolved.

2) Organizational Chart and Duties of Each Division

The figure below shows the organizational chart of SANAA. The departments colored gray are scheduled to be discontinued.



Source: SANAA

Figure 3.2.1 Organizational Chart of SANAA

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

1) Overview of Organization

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:

a) Elaboration and execution of financial and public investment policies;

b) Elaboration of the strategic infrastructure development plan and expansion targets;

c) Project development and service delivery optimization, assurance of technical and economic efficiency, and financial feasibility;

d) Promotion of technical assistance, education, and training;

e) Approval of the regulation and tariff system for drinking water and sanitation services;

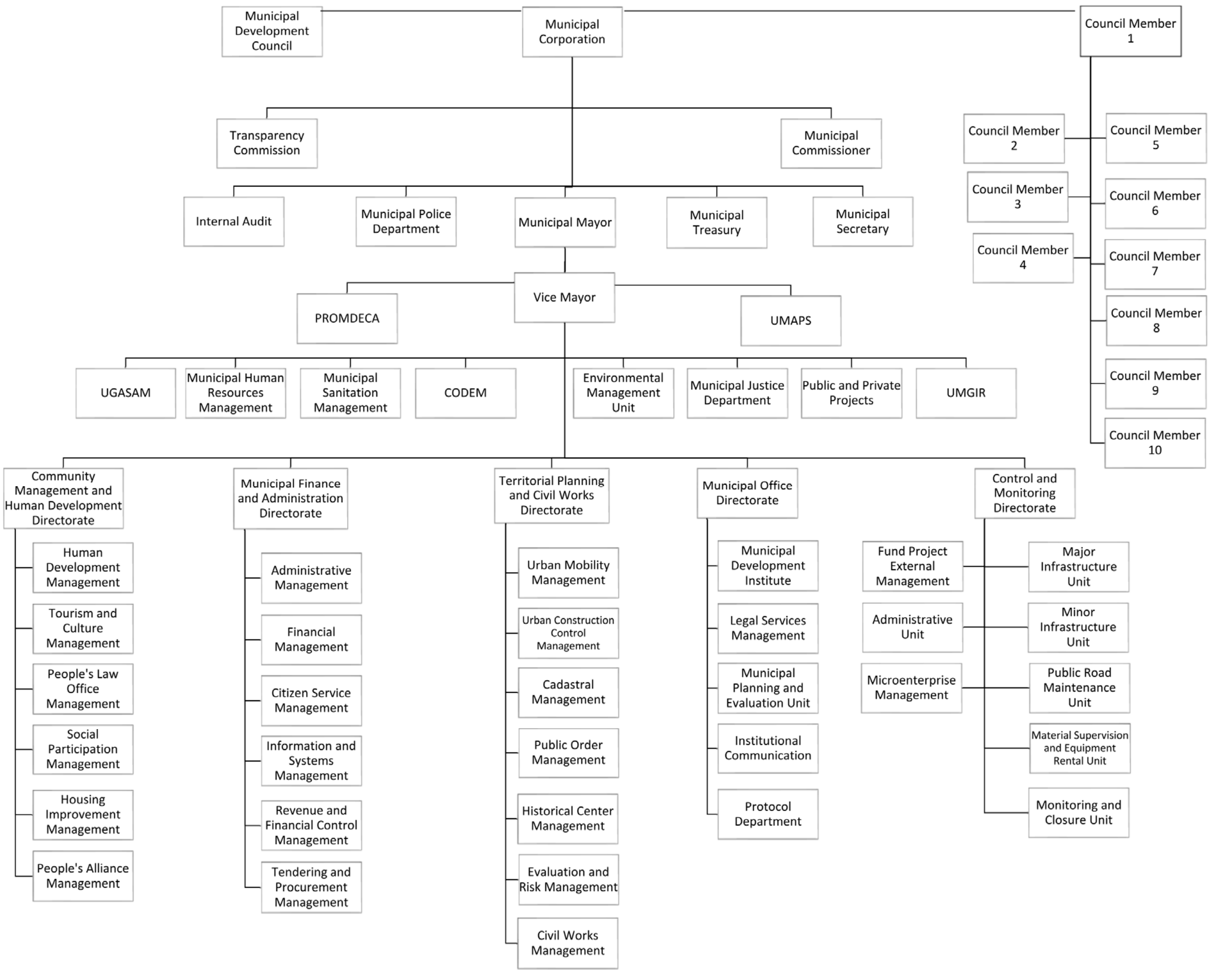
f) ERSAPS quality of service and tariff compliance and citizen participation; and

g) Attention to rural areas and the socially vulnerable population and protection of users' rights.

In 2015, AMDC created the Municipal Drinking Water and Sanitation Unit (UMAPS), to which SANAA authority is transferred, and the Municipal Water and Sanitation Management Unit (UGASAM), which is responsible for implementing the policies. In April 2021, AMDC reported 2,541 employees, of which 360 were in UMAPS and 72 were in UGASAM but in April 2022, SANAA operations were completely transferred to UMAPS and as of March 2023, AMDC has 3,026, with 900 employed in UMAPS and 4 in UGASAM.

2) Organizational Chart and Duties of Each Division

Figure 3.2.2 shows the organizational chart.



Source: AMDC

Figure 3.2.2 Organizational Chart of AMDC

The duties of each department are listed in Appendix 3.2.1.

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

1) Overview of Organization

In May 2015, the Municipal Unit of Potable Water and Sanitation of the Central District (Unidad Municipal de Agua Potable y Saneamiento, UMAPS) was instituted to serve as the local service provider responsible for delivering water supply and sanitation services to the metropolitan area of Tegucigalpa. This establishment is based on "Certificacion Acuerdo 011-A contenido en el Acta 008-2015". Due to the delay in the transfer of operations from SANAA to UMAPS, UMAPS began to operate provisionally from January 2021 and, at that time, only the finance and accounting areas had already completed the transfer. Subsequently, the transfer of operations progressed and in September 2021, the following areas were gradually moved: 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.

The transfer of operations was completed in April 2022 and UMAPS has been performing all water supply and sanitation service operations since May 2022.

The specific attributions of UMAPS in the General Regulations of UMAPS which was developed in 2020 are presented below.

a) Provide drinking water, sanitation, and storm drainage services, and operating, managing and maintaining the infrastructure and assets for this purpose.

b) Efficiently provide services under the required conditions of quality and continuity, observing the principles of equity, generality, solidarity, transparency and accountability, respect for the environment, and citizen participation.

c) Formulate its institutional strategic plan, management and results plan, and investment program to improve the services provided.

d) Measure the flow rates of surface and subsurface sources used for the provision of services.

e) Contribute to the protection of the catchment sources in the municipality.

f) Propose to AMDC the tariff structure for the rendering of services and other related activities, reflecting the real costs of the services, including the operating and maintenance costs of the integral management, and the profit margins for UMAPS and, where appropriate, incorporating the investment costs and related capital expenses, under efficiency conditions, in accordance with the regulations of the ERSAPS.

g) Collect fees for the provision of services and related activities and invest them exclusively in activities related to the maintenance, improvement, and expansion of the systems and watershed management, in accordance with the approved budget.

h) Contract the works, supplies, services, leasing of premises or other acquisitions that may be necessary for the fulfillment of its purpose, observing the budgetary provisions and legal contracting procedures.

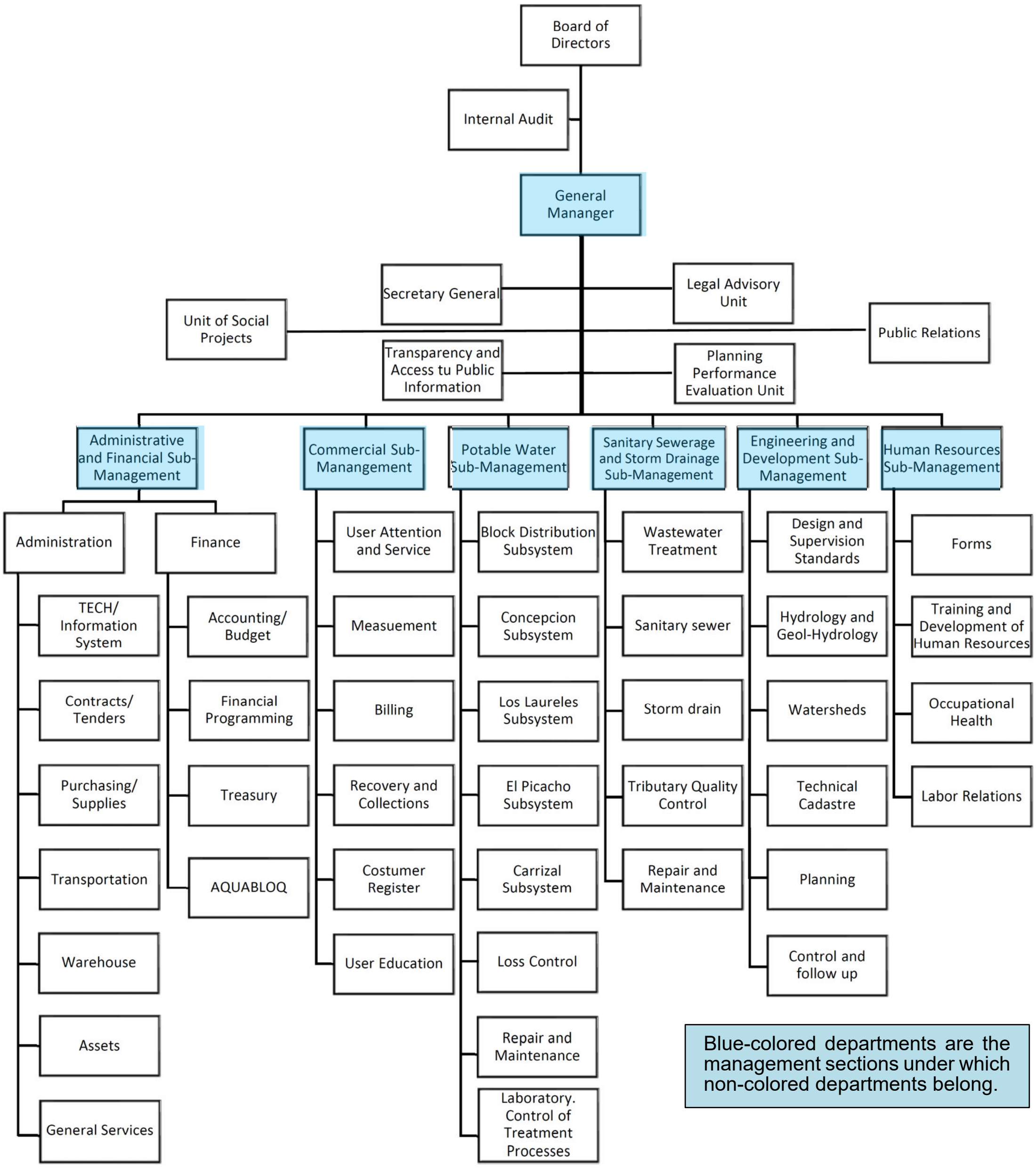
i) Promote the implementation of alternative programs for the storage and delivery of water in those cases with social justification, when it is not possible to provide piped water service; for such purposes, water in block or other supply modalities will be considered.

j) Develop promotional programs on environmental protection and rational use of water.

k) Any other tasks related to its purpose that may be entrusted to it by AMDC.

2) Organizational Chart and Duties of Each Division

Figure 3.2.3 and Table 3.2.1 show the organizational chart and duties of each department. As of July 2023, UMAPS has 944 employees. The most heavily staffed sub-management is the Potable Water Sub-Management, which has about half of the total staff (437), of which the Block Distribution Sub-System has the largest number (253). On the other hand, some divisions have not yet been assigned personnel and have zero staff.



Source: UMAPS

Figure 3.2.3 Organizational Chart of UMAPS

Table 3.2.1 Duties of Each Department

Department (Number of Staff)	Duties of Each Sub-Management / Department
General Management (19)	Responsible for the administration and management of the drinking water, sanitary sewer, and storm drainage services of the Capital.
Legal Advisory Unit (7)	Advise and exercise the power of the general management to represent UMAPS in all administrative and judicial processes in which it is related.
Secretary General (4)	Responsible for all administrative files that enter the UMAPS and the issuance of their information to third parties. The main functions are: 1. Receive and turn over the applications and petitions submitted by individuals to UMAPS, forming a file and keeping the corresponding record of each one for its monitoring, control, and custody. 2. Ensure that the matters in process are dispatched within the established legal deadlines. 3. Certify the signature of the General Manager in the orders, agreements, or resolutions that are issued in matters of competence of UMAPS and any other institutional document. 4. Notify the interested parties of the orders or resolutions issued in the files being processed, issuing, where appropriate, certifications or reasoning documents at the request of the party.
Transparency and Access to Public Information Unit (1)	It consists of collecting and disseminating information from UMAPS, guaranteeing citizens the right of access to public information.
Public Relations (4)	It is in charge of building and managing the image of the company, coordinating interviews of the Manager requested by the media, going to the projects carried out by the crews to prepare the information that will be uploaded to the networks, and carrying out media monitoring.
Planning Performance Evaluation Unit (0)	It consists of coordinating, organizing, and sending to the Municipal Planning and Evaluation Unit, the Annual Operating Plan (POA) of UMAPS, and following up on the presentations of the execution of the POA.
Unit of Social Projects (0)	Complete with coordination functions of water and sanitation projects in the most vulnerable communities of the Central District. It provides accompaniment so that the water boards are properly constituted according to the guidelines required by ERSAPS and also provides support to the rest of the sub-managements that require social intervention in those communities where UMAPS has presence. Some of its main functions are: -Coordinate community water and sanitation projects; -Monitor and oversee the election of water board authorities; -Articulate the work of the different UMAPS sub-managers to attend to the needs of the communities in relation to water and sanitation; and -Accompany, support, and advise on the social components of macro water and sanitation projects to be executed by UMAPS with own or external funds. Five staff members from General Management will be assigned to this department.
Administrative and Financial Sub-management (12)	It is responsible for the management of financial resources and administrative management, implementing processes, and control systems that guarantee balance in their use and that UMAPS operates under the conditions of financial sustainability in respect to the established guidelines.
Administration (2)	Support the Financial Administrative Sub-management in the coordination and monitoring of the daily operations of the Departments of: Transportation, Warehouse, Goods, and General Services.
Technology and Information Systems (6)	Manage development and maintenance of the hardware and software necessary for the proper functioning of UMAPS for billing, collection, technical and commercial cadastre, accounting, filing, inventory management, and others that are required.
Contracts and Tenders (5)	Authorize all types of purchases and supplies required by the UMAPS, based on the State Procurement Law, the General Provisions of the Republic Budget and its Regulations, and other legal norms

Department (Number of Staff)	Duties of Each Sub-Management / Department
Purchasing and Supplies (5)	Manage administrative procedures for the contracting, acquisition, leasing, construction, or contracting of minor goods and services.
Transportation (73)	Provide the mobilization service to all UMAPS units for the normal development of their daily operations and manage preventive maintenance and corrective repairs of the entire vehicle fleet.
Warehouse (8)	Custody and manage the inventory of supplies required for proper operation and maintenance of services.
Assets (8)	Take control of assets and their custody, as well as the discharge of unproductive assets.
General Services (85)	Provide preventive and corrective maintenance in the different campuses and buildings of UMAPS, including minor adjustments and installations. Likewise, security and surveillance services for 24/7 and also cleaning, in UMAPS campuses.
Finance (0)	Direct and monitor the financial, accounting, and budget operations of UMAPS and provide financial logistical support so that the unit can function properly and support the Administrative and Financial Sub-management with the monitoring of budget, treasury, and accounting.
Accounting and Budget (1)	Keep accounts according to the financial standards and principles.
Financial Programming (2)	Manage the preparation of the preliminary project, the execution and liquidation of the annual budget of UMAPS, and prioritizing the goals of the investment and public spending officially established in the corresponding planning, in accordance with the current provisions.
Treasury (4)	Make payments charged to the approved budget to meet obligations derived from the activities of UMAPS and request the issuance of checks for payment and transfers through the trust, jointly with the General Manager.
AQUABLOQ (11)	- Sale of bulk water through private tankers duly authorized and registered in UMAPS. - Delivery of orders for deposit to the bank, according to the amount of tickets requested by the client. - Delivery of tickets to the client. - Accounting in the system by daily income tickets of the paid orders, to then pass at the end of the month a report to the General Management and Administrative and Financial Sub-management. - Control of the water volume counted by filling of each tanker.
Commercial Sub-Management (2)	It is in charge of managing the financial resources of the institution for the sale of drinking water and sanitary sewer services, collection of rights, fees, supervisions, cuts, and investigations.
User Attention and Service (24)	Reception of requests for new services, attention to claims, calculation of supply rates, installation and change of meters, and various charges to the client for services in the sub-management of sanitary sewerage.
Measurement (41)	Meter reading and invoice delivery.
Billing (9)	Activation of accounts, control at the system level of the user database, creation of accounts, and review of billing routes.
Recovery and Collections (30)	Execution of blackouts for default, reconnections, preparation of payment arrangements, monitoring of government accounts and water boards, management of collections through calls, and requirements.
Costumer Register (30)	Keeping the client registry updated, reviewing requests for new services, detecting clandestine accounts, and reviewing name change requests.
User Education (4)	Preparation of initiatives for education on the use of water and user notices, monitoring of various purchase processes for the commercial department, liaison with the Transparency Unit of UMAPS and management data for the ERSAPS, and monitoring of the Annual Operating Plan (POA), the Annual Purchasing, and Contracting Plan.

Department (Number of Staff)	Duties of Each Sub-Management / Department
Potable Water Sub-management (11)	Responsible for water management from collection, purification, and drinking water distribution network: composed of the primary distribution network, secondary and tertiary network, distribution tanks, and pump system, through which the water service is provided to the population of the Central District.
Block Distribution Sub-systems (253)	Control of the distribution of all distribution centers and lift stations in the capital city. - Customer service to customers that claims for lack of water in the capital city. - Attention for tank cars due to the lack of water in high areas of the capital city. - Revisions for the air compressor obstructions to home glues. - Repair of domiciliary glues. - Preparation of service calendars for the entire capital city.
La Concepción Sub-system (63)	Responsible for water management from: the collection, purification, and delivery of water in a storage tank.
Los Laureles Sub-system (13)	Responsible for water management from: the collection, purification, and delivery of water in a storage tank.
El Picacho Sub-system (42)	Responsible for water management from: the collection, purification, and delivery of water in a storage tank.
El Carrizal Sub-system (0)	- Potable water distribution in the area of influence of Carrizal to the southwest of the city. - Preventive and corrective maintenance of the electromechanical components of the system. - Report of damages in the physical structures of the system (distribution tanks and lifting stations) and management of their repair. - Management of procurement of spare parts, accessories, and materials for the entire system. - SCADA system maintenance for remote operation of the system. 46 staff members from Block Distribution Sub-system will be assigned to this department.
Loss Control (12)	- A set of activities to achieve and maintain a level at which the components of losses due to leaks, tank overflows, operational consumption, special consumption, unauthorized water use, waste, metering errors, and estimation errors are minimized under conditions of technical, economic, financial, institutional, political, and social feasibility. - For non-revenue water reduction programs to work, a combined methodology must be implemented that includes leak detection, reduction of unauthorized consumption, pipeline evaluation, pressure management, and hydraulic modeling. Studies have revealed that even with a fully integrated approach, it can take considerable time to minimize operational risks and leakage.
Repair and Maintenance (43)	Carry out preventive and corrective maintenance (repairs, rehabilitation, and renewal) of the drinking water distribution network of the aqueduct of the capital city.
Laboratory Control of Treatment Processes (0)	- Determination of optimum coagulant dosages. - Chlorine demand determination. - Process quality control monitoring (raw water, decanting, filtration). - Determination of basic control parameters corresponding to Stage I required by the National Technical Standard for Drinking Water. - Bacteriological analysis. - Carry out sampling in the distribution network and distribution tanks to have a proper record of the quality of water supplied to the population. - Make the corresponding reports on water quality to ERSAP.
Sanitary Sewerage and Storm Drainage Sub-management (3)	Plan, organize, and control all the activities necessary to comply with the attributions of the Sanitary Sewerage and Storm Drainage Sub-management within the framework of the provision of the collection, transport, and treatment of residual water and the operation and maintenance of the sewage network.
Wastewater Treatment (9)	Strengthen and increase the treatment coverage of the wastewater treatment plant:

Department (Number of Staff)	Duties of Each Sub-Management / Department
	1. Carry out the operation of cubic meters of treated water carried by the sewerage network and transported to the plant by tanker vehicles. Complying with the technical standard for discharge to receiving bodies. 2. Carry out operation of cubic meters of treated grease that are transported to the plant by tanker vehicles. 3. Carry out water analysis at the entrance and exit of the treatment plant.
Sanitary Sewer (69)	Carry out the optimization of the actions required by the operation and maintenance of the sanitary sewerage network of the urban zone of the Central District, for the benefit of the population, to provide quality services, satisfying the expectations of the users: 1. Reduce response times to complaints about specific problems in the sanitary sewerage network in the urban area of the Central District. 2. Increase the number of linear meters of the pipe replaced, either for specific repairs or for renewal of sections of the sanitary sewerage network of the Central District. 3. Increase the number of cubic meters extracted from septic tanks and thus maintain adequate sanitation in peri-urban areas, as well as generate income for the institution. 4. Maintain the operation and production of the caps, lids, and potable water register boxes manufacturing workshop, in order to have sufficient stock if required.
Storm Drain (0)	Carry out the optimization of the actions required by the operation and maintenance of the Storm Drainage network of the urban zone of the Central District for the benefit of the population to provide quality services that satisfies the expectations of the users: 1. Reduce response times to complaints about specific problems in the Storm Drainage network in the urban area of the Central District. 2. Increase the number of linear meters of the pipe replaced, either for specific repairs or for renewal of sections of the Drainage network Central District Pluvial. 3. Maintain the operation and production of the workshop for the elaboration of caps, lids, and leg breakers, in order to have enough stock if required.
Tributary Quality Control (0)	Implement a program for measuring the quality of discharges from wastewater treatment plants in the metropolitan area of the Municipality of the Central District (MDC), within the framework of the actions necessary to monitor the effluents from treatment plants to comply with the Technical Standard for Wastewater Discharge to Receiving Bodies and Sanitary Sewerage.
Repair and Maintenance (0)	Carry out the optimization of the actions required by part of the operation and maintenance of the Sanitary Sewerage and Storm Drainage network in the urban area of the Central District through the use of combined trucks for cleaning and removing of obstructions in sections of the sanitary sewerage pipes and Pluvial, for the benefit of the population, to provide quality services, meeting the expectations of users.
Engineering and Development Sub-management (5)	Within the attributions of the sub-management are: Execute improvements and expansions of the service infrastructure, within the framework of its competence and in accordance with the regulations. Carry out the technical evaluation and opinion committee where the feasibility of the construction projects of urbanizations, horizontal and vertical condominiums, commercial premises, etc. is carried out.
Design and Supervision Standards (1)	Apply the technical standard for the development of a third-party conventional and unconventional networks and for the treatment and disposal of wastewater. Provide supervision and follow-up to projects for the expansion and improvement of the drinking water, sanitation, and storm drainage network proposed by third parties.
Hydrology and Geo-Hydrology (2)	Coordinate actions related to the management and conservation of water resources from supplying sources and sub-accounts; carry out hydrological and geohydrological studies within the Central District.
Watersheds (2)	Carry out the biophysical characterization of the basins that generate water for the Capital City and monitor their status; the periodic determination of the degree of siltation and eutrophication of the reservoirs.

Department (Number of Staff)	Duties of Each Sub-Management / Department
Technical Cadastre (1)	Keep updated the technical cadastre of potable water, sanitary sewerage, and storm drainage services which must be linked to the information of the Potable and Commercial Water Sub-managements.
Planning (0)	Keep a record of the qualification of contractors and supervisors, establish, coordinate and follow up jointly with the Territorial Planning Directorate of AMDC, to the plans, guidelines regarding territorial planning.
Control and Follow Up (0)	Carry out the control and follow-up of the projects carried out by UMAPS for the improvements and extensions of the drinking water, sanitary sewerage and storm drainage services, under the technical, financial, social and institutional aspects.
Human Resources Sub-management (8)	It is in charge of organizing, conducting, executing and evaluating the activities of personnel administration, labor relations, training and development, social welfare, salary administration of the company's human resources.
Forms (6)	Preparation of contracts in the system, validate contracts in the system, authorize contracts in the system, receive memorandum of overtime from UMAPS collaborators, prepare an excel file, receive and enter social security disabilities, apply deductions to the system for salary and wage sheets.
Training and Development of Human Resources (0)	It consists of coordinating, organizing and planning training for employees to improve job performance, thus responding adequately to the needs of UMAPS, and providing optimal service to subscribers.
Occupational Health (2)	Identify the chronic pathologies of the collaborators through the evaluation. - Request strategic alliances and obtain synergies in order to attend to the diseases and the prevention of these. - Identification and approval of allies. - Realization and planning of strategic alliances (conferences of vaccination, medical brigades among other activities). - Maintain an active relationship to effectively carry out health projects and activities that may arise for the benefit of collaborators.
Labor Relations (3)	It consists of implementing, advising and maintaining the labor standards of the Internal Labor Regulations. Likewise, stimulate the continuous improvement of UMAPS employees, through activities and training, aimed at developing a positive attitude towards work.

Note: Blue-colored departments are the management sections under which non-colored departments belong.
Source: UMAPS

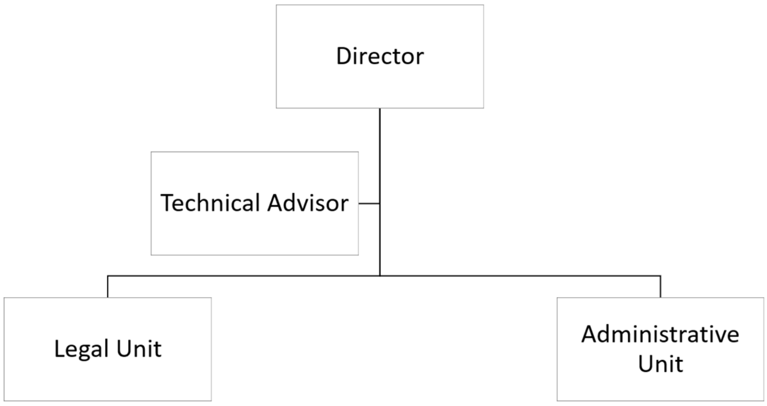
(4) Municipal Drinking Water and Sanitation Unit: (UGASAM)

1) Overview of Organization

UGASAM has been constituted as the municipal administrative unit responsible for AMDC, and had 72 employees as of April 2021 and 4 staff as of March 2023. 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. Currently, UGASAM's primary task is planning for water and wastewater systems.

2) Organizational Chart

Figure 3.2.4 shows the organizational chart of UGASAM.



Source: UGASAM

Figure 3.2.4 Organizational Chart of UGASAM

3.2.2 Water Tariff Collection

UMAPS water tariff details are shown in Table 3.2.2. The water rate structure employs a progressive volumetric charging system, with the unit water price rising as consumption increases. The meter maintenance charge remains constant at HNL 1.50 per month, while the fixed connection charge varies based on customer classification. Domestic users are divided into four categories based on their house locations in the cadastral map, generally reflecting residents' housing conditions and living standards. The distribution of the four categorized locations is shown in Appendix-3.2.2.

Unmetered customers or customers with faulty meters are charged a fixed water rate based on estimated consumption or average of past consumption. The sewerage tariff is set at 25% of the water rate. The customers can pay their water bills through banks and mobile payment applications. Currently, UMAPS has no direct collection points.

The unit water tariff in 2022 was HNL 8.92 per cubic meter. This calculation is based on billed water from May to December 2022. The unit water tariff is derived by dividing the billing amount of HNL 318.4 million for that period by the total billing volume of 35.7 million cubic meters.

The collection efficiency, indicating billing collectability, was around 84% in 2022. This figure is derived from comparing the collected amount of HNL 389.7 million to the total billing amount of HNL 466.7 million during the period from May to November 2022.

It should be noted that the water tariff in Tegucigalpa has remained unchanged since 2010, with no rate increase in over 13 years. As a result, the UMAPS water tariff is considered inexpensive. For example, the minimum monthly bill is as low as HNL 33.30 for a low-income domestic customer and about HNL 300 for a commercial customer. Those are lower than electricity, gas, and telephone bills, as well as the water tariff in San Pedro Sula, another large city in Honduras. Public entities, as well as industry customers, incur higher tariffs than domestic customers, with no special treatment or exemptions from charges.

Residents who purchase water from AQUABLOQ, a water vendor, pay the highest water charges, approximately HNL 317 per cubic meter. These residents live in hilly areas that are not covered by the UMAPS water supply system, and either are not covered by AMDC's free water supply service, or even if they are included, the water supply is inadequate. Despite UMAPS selling water to vendors at HNL13 per cubic meter, the water fee charged to residents by vendors is disproportionately steep. Although the water vendors' operational costs are undisclosed, they seemingly generate substantial profits. UMAPS is required to increase the number of residents who have access to UMAPS water, rather than to water vendors, by expanding its service area in the long term.

To revise the UMAPS water tariff, three essential steps must be taken as part of the process: First, UMAPS conducts an economic study of water tariffs. Second, the municipal corporation decides a new tariff plan derived from the study. Finally, ERSAPS approval is required for the new tariff to be implemented. At the moment, UMAPS' primary concern is to improve water supply services for customers, rather than implementing an immediate tariff increase.

Table 3.2.2 Water Tariff of UMAPS

Customer Classification	Consumption (m^3/ month)	Unit Price (HNL /m^3)	Minimum Rate (HNL/month)	Fixed Charge (HNL /month)	Example of Bill Calculation	
Domestic 1	0-20	1.59	31.80	Exempted	When 20 m^3/month consumption,	
	21-30	3.17			20 m^3 x HNL 1.59	31.80
	31-40	5.23			Sewerage fee HNL 31.80 x 25 %	7.95
	41-50	9.10			Meter maintenance fee	1.50
	51-55	12.92			Fixed connection charge (exempted)	0.00
	56 or more	15.11			Total	41.25
Domestic 2	0-20	3.28	65.60	25.00	When 25 m^3/month consumption,	
	21-30	4.05			25 m^3 x HNL 4.05	101.25
	31-40	6.18			Sewerage fee HNL 101.25 x 25 %	25.31
	41-50	10.54			Meter maintenance fee	1.50
	51-55	13.12			Fixed connection charge	25.00
	56 or more	16.79			Total	153.06
Domestic 3	0-20	4,42	88.40	70.00	When 35 m^3/month consumption,	
	21-30	5.23			35 m^3 x HNL 7.37	257.95
	31-40	7.37			Sewerage fee HNL 257.95 x 25 %	64.49
	41-50	11.4			Meter maintenance fee	1.50
	51-55	14.42			Fixed connection charge	70.00
	56 or more	18.24			Total	393.94
Domestic 4	0-20	7.08	141.60	150.00	When 50 m^3/month consumption,	
	21-30	8.90			50m ^{3}x HNL 13.58	679.00
	31-40	10.93			Sewerage fee HNL 679.00 x 25 %	169.75
	41-50	13.58			Meter maintenance fee	1.50
	51-55	16.86			Fixed connection charge	150.00
	56 or more	19.42			Total	1,000.25
Commercial	0-20	5.95	119.00	175.00		
	21-30	7.96				
	31-40	12.17				
	41-50	16.03				
	51 or more	22.48				
Industrial	0-20	14.98	299.60	250.00		
	21-40	19.67				
	41 or more	29.12				
Government	0-20	14.98	299.60	250.00		
	21-40	19.67				
	41 or more	29.12				
Water committee	0-40	2.90	116.00	Exempted		
	41 or more	2.90				
Aquablock (Water vendor)	0 or more	13.21 (HNL 0.05 per gallon)			Aquablock's water selling price to residents is around HNL 60 per 50 gallons, equivalent to HNL 317 /m^3.	

Source: Compiled by JICA Study Team based on UMAPS data

3.3 Water Supply Facility Condition

3.3.1 Overview of Water Supply Facility

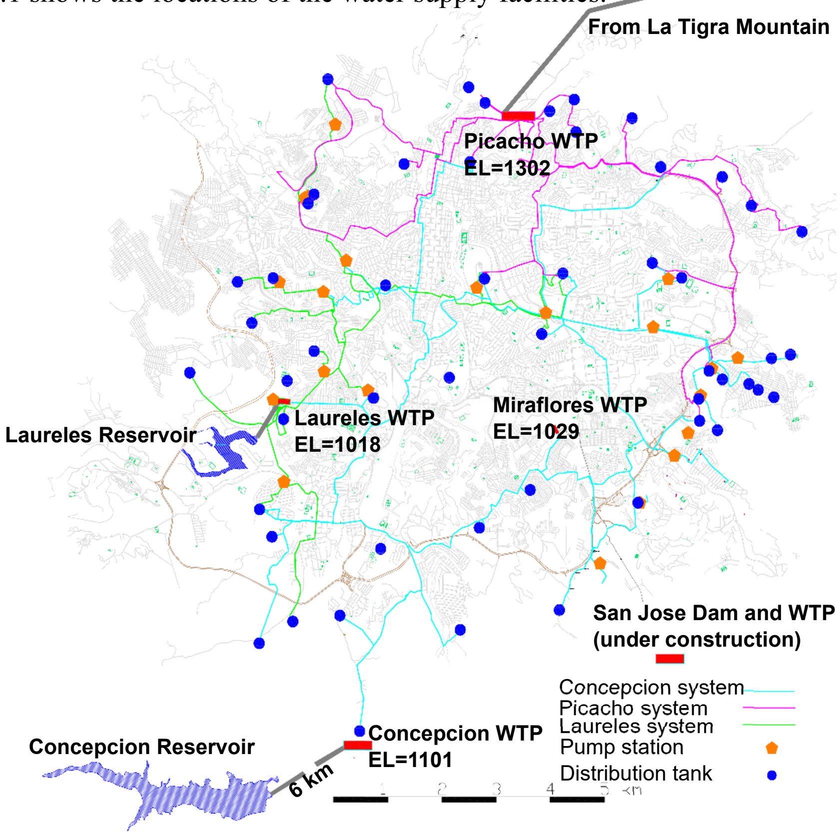
The water source of Tegucigalpa is surface water from mountain streams in the northern area and two dam lakes in the southern area. The treated water is first transmitted to distribution tanks and thereafter distributed to the customers by gravity. Table 3.3.1 shows the outline of the water supply facility of Tegucigalpa.

Table 3.3.1 Outline of Water Supply Facility of Tegucigalpa

Facility	Description		
WTP	Name	Production (m^3/d)	Water Source
	Picacho WTP	37,000 – 64,000	Mountain spring/stream in the northern area
	Laureles WTP	36,000 – 55,000	Dam lake at the southwest of the city
	Concepcion WTP	105,000 – 122,000	Dam lake located 12 km southwest of the city
	Miraflores WTP	2,900 – 3,900	Jacaleapa River
	Boreholes	550	Four boreholes near Toncontin Airport
Transmission pipeline	D150 – D1000; L= 132 km		
Pump station	26 nos. (Laureles system: 9 nos., Laureles and Concepcion system: 4 nos. Concepcion system: 13 nos.)		
Distribution tank	30 m^3 – 5,850 m^3; 111 nos. (74 Locations)		
Distribution pipeline	D15 – D600; Total length is approximately 1,500 km (74 distribution zones)		

Source: JICA Study Team

Figure 3.3.1 shows the locations of the water supply facilities.



Source: JICA Study Team

Figure 3.3.1 Location of the Water Supply Facility in Tegucigalpa

The location of the facility indicated on the DEM drawings is shown in Appendix-3.3.1.

3.3.2 Water Source and WTP

(1) Picacho WTP

The water source of Picacho WTP is the mountain spring/stream of La Tigra Mountain. The water is conveyed to Picacho WTP via four conveyance pipelines (D250 – D600; Total length = 93 km) by gravity. The intake flow fluctuates seasonally from 290 L/s in the dry season to 910 L/s in the rainy season. Picacho WTP is located at EL. 1,300 m in the northern part of the city. The WTP was originally constructed in the 1920s, equipped only with chlorination facility. The present WTP was constructed in 1997 with a capacity of 900 L/s, which was expanded to 1100 L/s in 2010. The treatment type is rapid sand filtration.

(2) Laureles WTP

The water source of Laureles WTP is from the Laureles Dam Lake located at the southwest of the city. The dam was constructed between 1973 and 1976. The raw water is conveyed from the dam lake to the WTP via D900-1000; L = 900 m pipeline. On the way, there is a booster pump station equipped with three pumps of 185 kW each. The intake flow fluctuates seasonally from 270 L/s in the dry season to 740 L/s in the rainy season. Laureles WTP is located at EL. 1,029 m in the southwest part of the city. The WTP was constructed in 1976 with capacity of 670 L/s, which was expanded to 720 L/s in 2000. The treatment type is rapid sand filtration. In 2007, compact unit type WTP with capacity of 100 L/s was installed. In 2012, unit type rapid flocculation equipment were installed. These unit type equipment are currently not working.

(3) Concepcion WTP

The water source of Concepcion WTP is from the Concepcion Dam Lake located 12 km southwest of the city. The dam was constructed between 1986 and 1990. The raw water is conveyed from the dam lake to the WTP via D900-1100; L = 6,200 m pipeline. On the way, there is a booster pump station equipped with three pumps of 110 kW each. The intake flow fluctuates seasonally from 1,000 L/s in the dry season to 1,500 L/s in the rainy season. The Concepcion WTP is located at EL. 1,099 m in the southern edge of the city. The WTP was constructed in 1992 with capacity of 1,200 L/s, which was expanded to 1,500 L/s in 2002. The treatment type is rapid sand filtration.

(4) Other Water Source

Miraflores WTP located in the southeast part of the city is a unit type WTP with source from the Jacaleapa River. It was built in 1996 with capacity of 25 L/s, which was expanded to 75 L/s in 2022. The WTP supplies treated water to nearby areas only. There are four boreholes near Toncontin Airport. However, their production is only 500 m^3/d in total.

(5) Production Record of WTPs

Table 3.3.2 shows the maximum and minimum daily production which are the average from 2015 to 2022. The monthly record of 2015-2022 is presented in the Appendix 3.3.2.

Table 3.3.2 Maximum and Minimum Daily Production of WTPs (Average of 2015–2022)

WTP	Picacho	Laureles	Concepcion	Miraflores	Total
Maximum (m^3/d)	63,892	54,614	121,545	3,857	243,908
Minimum (m^3/d)	37,450	36,257	104,957	2,898	181,562

Source: JICA Study Team based on the data from UMAPS

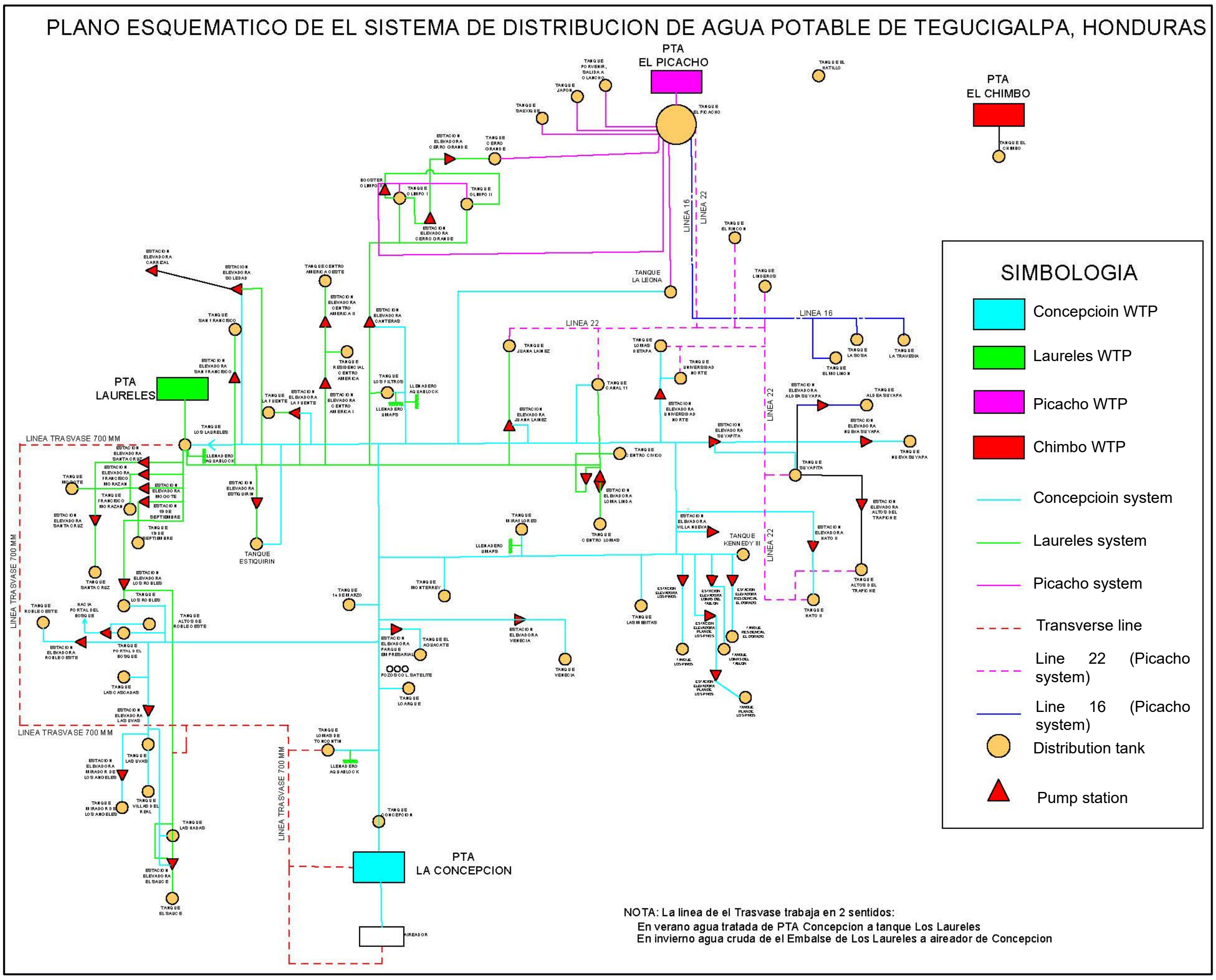
(6) Operation and Maintenance

The staff of the three systems: 62 employees in Concepcion system, 38 employees in Picacho system, and 16 employees in Laureles system, operate and maintain their respective intake, conduit, purification, and transmission facilities. They operate 24 hours a day in two shifts, daytime and nighttime.

3.3.3 Water Transmission Pipeline

There are four water treatment plants in Tegucigalpa. The water is distributed from the four WTPs to the water distribution tanks. The Picacho WTP, located at an elevation of 1,298 m, the highest elevation of all the WTPs, supplies water by gravity from the Picacho Water Transmission System to the water distribution tanks on the north side of the city. From the Concepcion WTP, located at an elevation of 1,085 m, water is delivered by gravity to the water distribution tanks in the southern and eastern parts of the city through the Concepcion Water Transmission System. Some of the water distribution tanks at higher elevations are served by water transmission pumps (16 locations). The Laureles WTP, located at an elevation of 1,015 m, supplies water through the Laureles Water Transmission System, with 12 water distribution pumps, mainly in the vicinity of the Laureles WTP and to the high-elevation distribution tanks in the western part of the city. Some of the distribution tanks are supplied by gravity. In 2018, a water conveyance pipeline was constructed from the Laureles Dam to the Concepcion WTP. The purpose of this pipeline is to divert excess raw water from the Laureles Dam to the Concepcion WTP during the rainy season. During the dry season, when the water source from the Laureles Dam is insufficient, some of the water treated at the Concepción Water Treatment Plant is delivered through the same pipeline to the clear water tank of the Laureles WTP by gravity flow. The pipes are cleaned before the water is delivered.

The location map of the water transmission pipeline and distribution tanks is shown in Figure 3.3.1 and a schematic diagram is shown in Figure 3.3.2.



Source: UMAPS

Figure 3.3.2 Schematic Diagram of the Water Transmission System

(1) Specifications of Each Water Transmission Pipeline and Current Issue

The diameter, total length, year of construction, and repair requests from UMAPS for each water transmission system are shown in Table 3.3.3. The water transmission pipes are between 20 and 50 years old.

The Concepcion and Picacho water transmission systems were found to be leaking mainly from the large diameter gate valves. UMPAS requests to replace these valves with butterfly valves. In addition, there is information from UMAPS that some water transmission pipes in the Laureles Water Transmission System are buried at a depth of approximately 90 cm and water leakage is suspected.

Table 3.3.3 Specifications of Each Water Transmission Pipeline

No.	Name of Transmission Line	Diameter (mm)	Length (m)	Material	Construction Year	Current Issue
1	Concepcion	1,000 800 700 600 500 400	5,150.00 7,836.00 4,140.00 7,587.00 1,060.00 7,557.00	DCIP	1993	Renovation of valves (21sets) φ1000: 2 sets φ800: 3 sets φ700: 1 set φ600: 8 sets

No.	Name of Transmission Line	Diameter (mm)	Length (m)	Material	Construction Year	Current Issue
		300 250 200 150	2,752.00 3,086.00 7,118.00 18,709.00			φ500: 1 set φ400: 2 sets φ300: 3 sets φ250: 1 set
		Sub Total	64,995.00			
2	Picacho	400 300 150	6,739.00 27,522.00 3,505.00	DCIP	1980～ 2010	-
		Sub Total	37,766.00			
3	Los Laureles	1,000 600 500 400 300 200 150	3,141.00 5,195.00 3,691.00 914.00 4,314.00 5,711.00 6,293.00	DCIP	1976	φ1,000×3,210 m φ600×230 m φ400×910 m
		Sub Total	29,259.00			
4	Transevase	700	10,701.00	DCIP	2018	Part of transmission line φ400 mm×1.0 km
		Sub Total	10,701.00			
		Total	142,721.00			

Source: JICA Study Team based on the data from UMAPS

(2) Operation and Control Procedures

The operation of the water supply control system is managed by the block distribution sub-system of Potable Water Sub-Management of the Comayaguela office of UMAPS, which keeps records of the water levels in the Picacho, Concepcion, and Laureles clear water tanks and in each of the water distribution tanks through radio communication with the operators stationed in each area on a 24-hour operation system.

Four employees are assigned to each pump station, which operates 24 hours a day in two shifts, daytime and nighttime. There are approximately 20 pump stations, so about 80 employees are engaged in operation and maintenance work. The pump station operators communicate with the distribution tank operators to turn the transmission pumps on and off. The transmission pumps are not equipped with flow meters and flow records are not kept. In addition, there are no records of pump operation, pressure, etc. Only incidents such as pump malfunctions are recorded.

For water supply control and management, water distribution days and hours per week (e.g., once every three days for 10 to 12 hours) are determined for each water distribution area and operations are conducted accordingly. Although there are no specific manuals or standards, a monthly water distribution schedule is created and distributed to the operators of each water distribution tank and pumping station. Although records of the water distribution reservoirs are kept, there are no records of the operation and management of the pumps. Measurement devices (pressure gauges, flow meters, and water level gauges) at the pumping stations and water distribution tanks are either broken or not installed, making it impossible to accurately record data. As a result, water supply control and management cannot be conducted properly.

3.3.4 Water Distribution Facilities

(1) Water Distribution Tank

The list of water distribution tanks that receive the treated water transmitted from the water treatment plants is shown in Table 3.3.4. Each water distribution tank was constructed as needed in conjunction with residential development in the city. In total, there are 74 blocks and 111 water distribution tanks. In general, the smaller water distribution tanks are constructed of brick and the larger ones of concrete. When constructing water distribution tanks, steel, which is relatively easy to install, is used when there is no space due to land issues or when there is not enough room for a delivery route. However, steel construction causes water leaks after about 30 years due to peeling paint and oxidative deterioration. Level gauges are installed in each water distribution tank but they are often damaged.

Results of the survey for existing distribution tank are as shown in Appendix 3.3.3.

Table 3.3.4 List of Water Distribution Tanks

No.	BLOCK Name	Tank NO	Tank Name	Source ※	Elevation(m)	Constuction year	Material	Capacity(m^3)
1	Japon	1	Japon	P	-	2007	Concrete	120
2	Saucique	2	Saucique	P	-	1996	Masonry	50
3	Sagastume	3	Sagastume	P	-	1994	Concrete	560
4	El Porvenir	4	El Porvenir	P	1046	2007	Bloque	44
5	El Rincon	5	El Rincon	P	1058	1992	Brick	79
6	Guillen	6	Guillen	P	-	1991	Concrete	400
7	Canaan	7	Canaan	P	-	1995	Concrete	400
8	Estanzuela	8	Estanzuela	P	-	2000	Concrete	50
9	El Molinon	9	El Molinon	P	1108	2002	Concrete	1500
10	La Sosa	10	La Sosa	P	1110	2003	Brick	2500
11	La Travesia	11	La Travesia	P	1198	1992	Concrete	1800
12	Cerro Grande	12	Cerro Grande	PLC	1215	1992	Concrete	2124
13	Olimpo1	13	Olimpo 1	PLC	1103	2004	Steel	1245
		14	Olimpo 1	PLC	1107	2004	Steel	2540
14	Olimpo 2	15	Olimpo 2	PLC	1120	2004	Steel	1000
		16	Olimpo 2 (Nuevo 2)	PLC	1120	2004	Steel	1000
		17	Olimpo 2 (Viejo 2)	PLC	1024	1992	Steel	851
		18	Olimpo 2 (Viejo)	PLC	1121	1992	Steel	846
15	La Flor	19	La Flor	PLC	-	2001	Brick	60
16	Juan A. Lainez	20	Juan A. Lainez 1	PLC	1045	1962	Concrete	650
		21	Juan A. Lainez 2	PLC	1045	1962	Concrete	1700
17	Canal 11	22	Canal 11	PLC	1070	2009	Concrete	2100
		23	Canal 11 (Viejo)	PLC	1070	1985	Concrete	1500
18	La Leona	24	La Leona 1	PC	1006	1982	Masonry	1477
		25	La Leona 2	PC	1006	1982	Masonry	1294
		26	La Leona 3	PC	1007	1982	Masonry	1100
		27	La Leona 4	PC	1007	2009	Concrete	2103
19	Lindero	28	Linderos 1	PC	1069	1967	Masonry	622
		29	Linderos 2	PC	1070	1972	Concrete	548
		30	Linderos 3	PC	1069	1972	Concrete	639
20	Lomas	31	Lomas 2da. Etapa	PC	1084	1997	Concrete	757
21	Universidad Norte	32	Universidad Norte 1	PC	1081	2004	Concrete	882
		33	Universidad Norte 2	PC	1081	2004	Concrete	60
22	Suyapita	34	Suyapita	PC(S)	1110	1987	Concrete	1897
23	Hato	35	Altos del Trapiche	PC(S)	1147	1992	Concrete	600
		36	Hato de Enmedio	PC(S)	1110	1992	Steel	880
		37	Covespul/San Juan	PC(S)	1118	1992	Concrete	1150
24	Los Laureles	38	Los Laureles 1	L	1015	1976	Concrete	3593
		39	Los Laureles 2	L	1015	1976	Concrete	3593
25	Mogote	40	Mogote 1	L	1254	1992	Concrete	1200
		41	Mogote 2	L	1250	1992	Steel	800
26	Altos de los Laureles	42	Altos de los Laureles	L	1035	2017	Concrete	113
27	Santa Cruz	43	Santa Cruz	L	1159	2016	Concrete	189
28	Los Robles	44	Los Robles	L	1056	1982	Concrete	500
		45	Roble Oeste Etapa 1, 2 y 3	L	-	1982	Concrete	550
		46	Roble Oeste 4ta. Etapa	L	-	2014	Steel	140
29	Francisco Morazan	47	Francisco Morazan	L	1045	2007	Brick	421
30	19 de Septiembre	48	19 de Septiembre	L	1040	2002	Concrete	43
31	San Francisco	49	San Francisco 1	L	1100	2004	Concrete	50
		50	San Francisco 2	L	1100	2004	Concrete	1344
32	La Fuente	51	La Fuente	L	1049	1982	Steel	539
33	Roble Alto	52	Roble Alto 1ra. Etapa	LC	-	-		-
		53	Roble Alto 2da. Etapa	LC	-	-		-

34	Las Hadas	54	Las Hadas 1	LC	1085	2002	Concrete	260
		55	Las Hadas 2	LC	1085	2002	Steel	600
35	El Sauce	56	El Sauce	LC	-	2015	Concrete	57
36	Estiquirin	57	Estiquirin 1	LC	1044	1989	Concrete	3148
		58	Estiquirin 2	LC	1045	2004	Concrete	3950
		59	Estiquirin (Nuevo)	LC	1044	2004	Concrete	5850
37	Carrizal	60	Carrizal	LC	1097	2005	Concrete	360
38	Centro America Este	61	Centro America Este	LC	1105	1992	Brick	1010
39	Centro America Oeste	62	Centro America Oeste	LC	1127	1992	Brick	1342
		63	Centro America Oeste 2	LC	1127	1992	Brick	90
40	Los Filtros	64	Los Filtros 1	LC	1008	1967	Masonry	233
		65	Los Filtros 2	LC	1003	1982	Concrete	3500
		66	Los Filtros (Nuevo)	LC	1019	2009	Concrete	32
41	Altos de Primavera	67	Altos de Primavera	LC	-	-	-	-
42	Divanna	68	Divanna	LC	-	2005	Concrete	104
43	Centro Lomas	69	Centro Lomas	LC	1034	1992	Concrete	923
		70	Centro Lomas (Nuevo)	LC	1034	2009	Concrete	1000
44	Concepcion	71	Concepcion	C	1099	1994	Concrete	2520
		72	Concepcion (Nuevo)	C	1099	2004	Concrete	5000
45	Res. Concepcion	73	Res. Concepcion	C	1128	2006	Brick	189
46	Toncontin	74	Lomas Toncontin 1	C	1078	1992	Concrete	427
		75	Lomas Toncontin 2	C	1078	1992	Concrete	427
		76	Altos de Toncontin	C	1078	1992	Steel	150
		77	Palma Real	C	1055	1987	Brick	530
47	Jardines de Loarque	78	Jardines de Loarque	C	-	1991	Masonry	45
48	Altos de Loarque	79	Altos de Loarque	C	1057	2002	Concrete	37
49	San Jose de Loarque	80	San Jose de Loarque	C	1051	2002	Brick	32
50	Loarque	81	Loarque 1	C	1053	1982	Concrete	3504
		82	Loarque 2	C	1057	1977	Concrete	133
51	Yaguacire	83	Yaguacire	C	1112	1997	Brick	135
52	La Cascada	84	La Cascada	C	1070	1997	Brick	412
53	Las Uvas	85	Las Uvas	C	1130	1991	Concrete	546
54	Villas del Real	86	Villas del Real	C	1130	2002	Concrete	454
55	14 de Marzo	87	14 de Marzo	C	1042	2022	Brick	820
		88	14 de Marzo (Nuevo)	C	1042	2004	Concrete	3722
56	Calpules	89	Calpules 1 (Alto)	C	1047	1992	Steel	96
		90	Calpules 2 (Bajo)	C	1042	1992	Steel	293
57	Venecia	91	Venecia	C	1107	2007	Concrete	254
58	Monterrey	92	Monterrey	C	1024	1992	Concrete	329
59	Los Llanos	93	Los Llanos	C	1028	1992	Steel	35
60	Miraflores	94	Miraflores 1	C	1026	1982	Concrete	735
		95	Miraflores 2	C	1026	1982	Concrete	719
		96	Miraflores (Nuevo)	C	1024	2004	Concrete	1000
61	Grupo Empresarial	97	Grupo Empresarial	C	-	2011	Concrete	570
62	Las Mesitas	98	Las Mesitas	C	1060	2002	Concrete	556
63	Kennedy 3	99	Kennedy 3	C(S)	1068	1977	Concrete	3971
64	Los Pinos	100	Los Pinos	C(S)	1233	1996	Brick	151
65	Altos de los Pinos	101	Altos de los Pinos	C(S)	1233	1996	Brick	151
66	Villa Nueva 5	102	Villa Nueva 5	C(S)	1219	1997	Brick	113
67	Honduras Res	103	Honduras Res. Alto	C(S)	1080	2002	Concrete	50
		104	Honduras Res. (Bajo)	C(S)	1069	2002	Concrete	848
68	Villa Nueva 1	105	Villa Nueva 1	C(S)	1055	1997	Brick	95
69	Villa Nueva 2	106	Villa Nueva 2	C(S)	1099	1997	Brick	95
70	Villa Nueva 3	107	Villa Nueva 3	C(S)	1179	1997	Brick	95
71	Villa Nueva 4	108	Villa Nueva 4	C(S)	1205	1997	Brick	95
72	Villa Nueva 6	109	Villa Nueva 6	C(S)	1118	1997	Brick	113
73	Aldea Suyapa	110	Aldea Suyapa	C(S)	1207	1992	Brick	139
74	Nueva Suyapa	111	Nueva Suyapa	C(S)	1236	1992	Brick	206

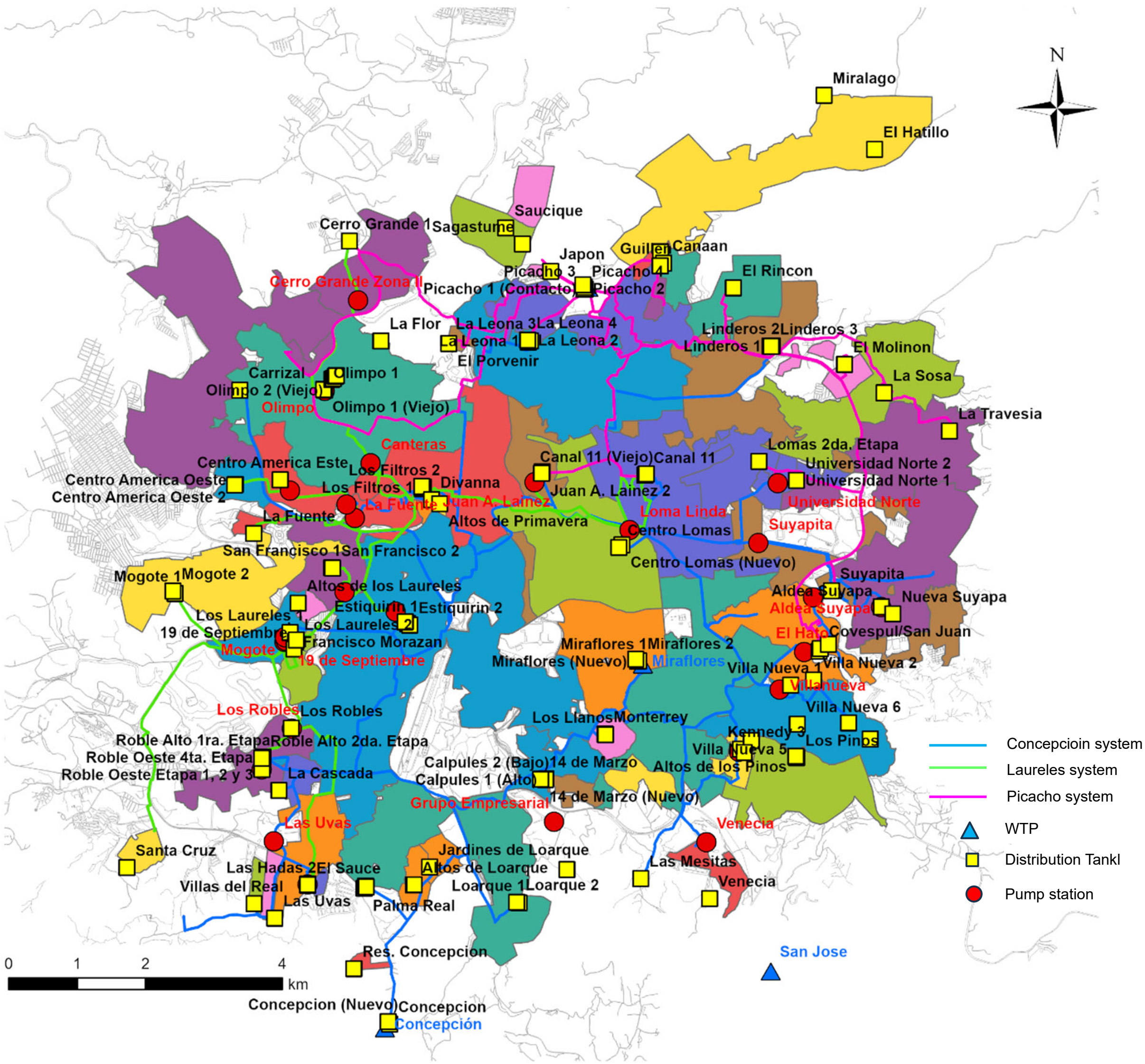
Note: ※ P: Picacho, L: Laureles, C: Concepcion, S: San Jose
Source: JICA Study Team based on the data from UMAPS

(2) Water Distribution Pipeline Network

Water is distributed from each water distribution tank to the distribution area by manually opening and closing valves. The water distribution schedule is announced to the residents through social networking services (Facebook, Twitter, or HP). The water distribution schedule is basically once every three days for 12 hours. During the dry season in April and May, water can be distributed once every 6 to 9 days for 10 to 12 hours, depending on the water storage capacity of the dam.

Figure 3.3.3 shows the distribution area for each tank.

Water distribution tanks are located at the highest elevation, from which water is distributed to each household by gravity. Water pressure and quantity vary with the elevation of the area served by the same tank. This is because areas at higher elevations near the tanks have low water pressure, making it difficult for water to flow from the tanks. On the other hand, areas at lower elevations have higher water pressure, making it easier for water to flow out of the tanks. There is also more leakage due to the high water pressure. According to interviews with UMAPS, immediately after water is delivered from the distribution tank, it is distributed from the lower elevation areas to the underground tanks of each household. When these are full, water is distributed to each household in the higher elevation areas. Customers in the higher elevation areas sometimes complain to UMAPS because they have not received water for some time after the scheduled water delivery time.



Source: JICA Study Team based on the data from UMAPS

Figure 3.3.3 Distribution Area for Each Tank

1) Pipe Length

The length of the water distribution pipe network is as shown in

Table 3.3.5. The total length is 1,485 km. From this, 85.9% is PVC, 7.7% is galvanized steel pipe, 5.7% is DCIP, and 0.6% is AC.

Table 3.3.5 Length of the Water Distribution Pipe Network

(Unit: m)

Diameter (Inch)	PVC	Galvanized Steel Pipe	DCIP	AC
1/2"	205	-	-	-
3/4"	-	188	-	-
1"	1,321	597	-	-
1・1/2"	798	2,291	258	-
2"	1,023,898	44,188	549	1,994
3"	105,311	15,791	885	2,802
4"	76,315	41,955	14,048	654

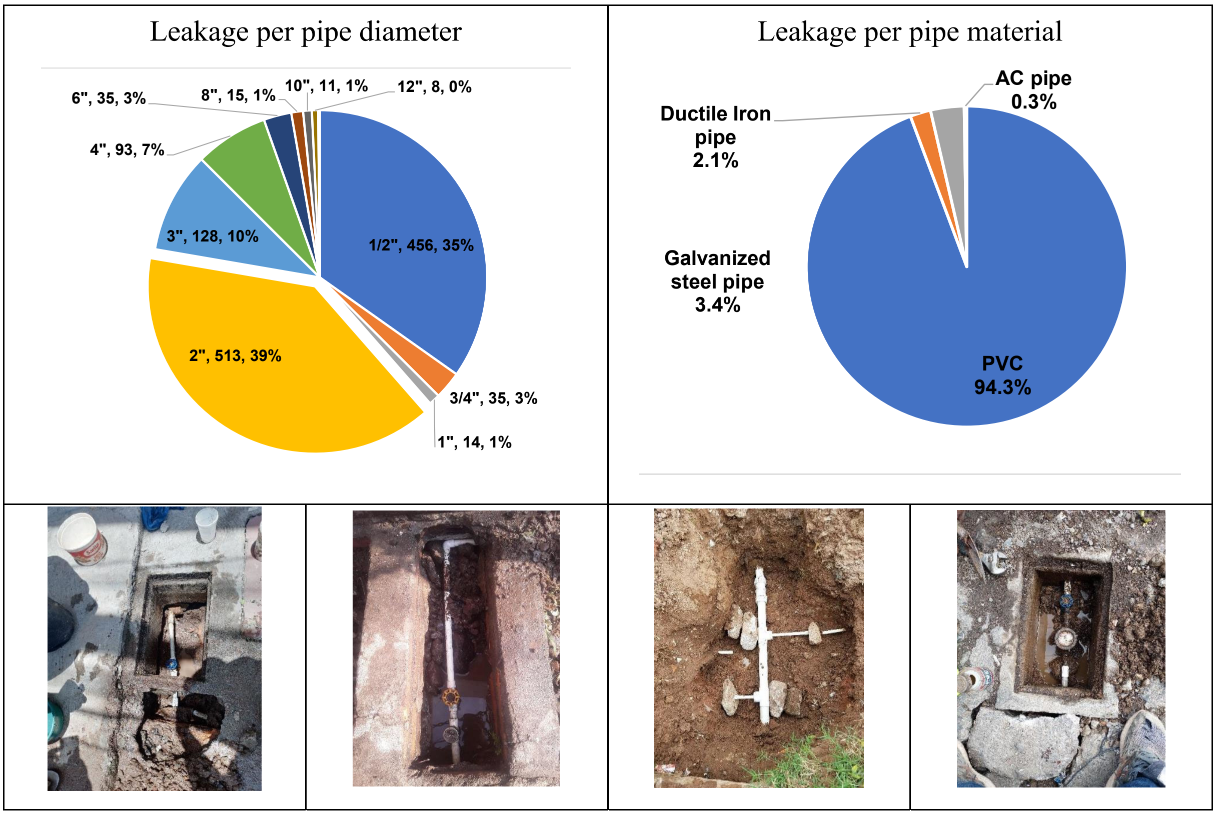
6"	47,294	6,284	21,263	1,584
8"	12,627	2,395	28,380	1,177
10"	3,241	1,134	10,140	437
12"	4,496	-	2,962	-
14"	52	-	2,392	93
16"	697	-	2,358	-
18"	-	-	693	-
20"	-	-	1,152	-
24"	-	-	155	-
Sub Total (m)	1,276,255	114,822	85,234	8,742
Total (m)	1,485,053			

Source: JICA Study Team based on the data from UMAPS

2) Leakage Incidents

UMAPS is recording leakage incidents in the water distribution area; 4,000 to 5,000 leakage incidents have occurred annually by 2020. The type of pipe, the diameter of the pipe, and the cause of the leak are recorded. A total of 77% of the leakage incidents occurred in distribution and water supply pipes less than 2 inches in diameter. There have been many leakage incidents of PVC pipes. Figure 3.3.4 shows the leakage incidents by diameter and pipeline type.

UMAPS has been recording photos of water leakage since 2023. Many water leakages occur at the water meter connections and at the connections of the PVC saddle taps. These are assumed to be due to inadequate pipe installation. The leakage at water meter connection tends to occur where the difference in elevation from the distribution reservoir is 20-30 m or more.



Source: UMAPS

Figure 3.3.4 Leakage Incidents

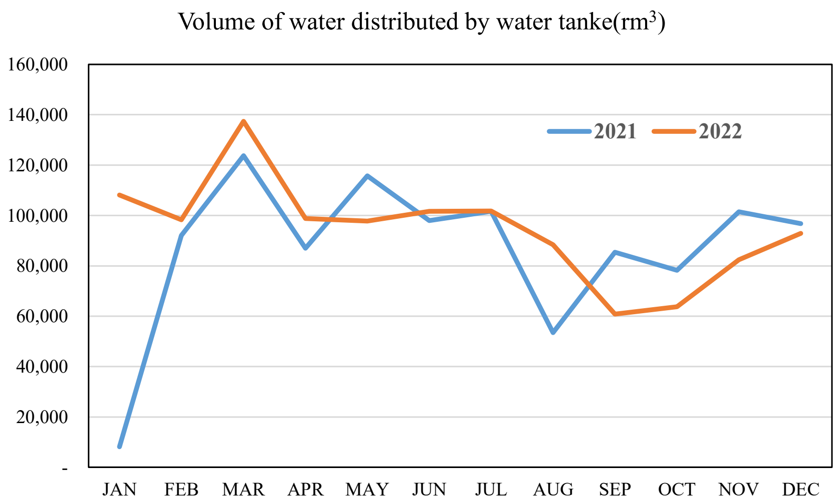
An analysis of the causes of leakage incidents in 2020 shows that leakage incidents are caused by high water pressure (85.6%), age-related deterioration of pipelines (6.6%), damage incidents due to other construction work (0.5%), and theft of flow meters (3.5%).

It should be noted some of the operational records have not been recorded since 2021. The data obtained in 2022 are only partially organized.

The World Bank project (Tegucigalpa Water Supply Strengthening Project) will provide technical assistance for the sectorization of water distribution zones, installation of water meters, and leakage management to improve the water distribution network. Fourteen water distribution zones have been selected as target area for the project and the World Bank is selecting a consultant to implement the project. First phase of the project is expected to be completed in October 2024. The target area of the project may change depending on the budget.

3) Water Distribution by Water Tankers

There are two types of distribution by water tanker managed by UMAPS. The first type is free of charge by water tankers of municipality, for the areas without pipes and areas where water cannot be distributed due to pipe repairs. The second type is called "AQUABLOQ" and is provided by 220 water tankers registered with UMAPS. There are a total of three water stations for the water tankers: the Laureles WTP, the Toncontin District, and Los Filtros (UMAPS Comayagua office). The records of the water distribution for both 2021 and 2022 are shown in Figure 3.3.5.



	2021			2022		
Month	Water Tanker	AQUABLOQ	TOTAL	Water Tanker	AQUABLOQ	TOTAL
JAN	8,148	-	8,148	17,549	90,649	108,199
FEB	8,588	83,456	92,044	15,280	82,959	98,239
MAR	8,936	114,807	123,742	17,605	119,813	137,418
APR	6,779	80,232	87,011	11,608	87,145	98,752
MAY	11,803	103,957	115,759	13,517	84,212	97,729
JUN	13,037	84,889	97,926	6,891	94,765	101,656
JUL	14,903	86,808	101,710	6,031	95,743	101,775
AUG	15,428	38,047	53,476	5,573	82,787	88,360
SEP	15,289	70,131	85,420	5,442	55,376	60,819
OCT	15,078	63,112	78,190	4,715	59,015	63,731
NOV	22,131	79,352	101,483	6,105	76,269	82,374
DEC	-	96,782	96,782	5,299	87,546	92,845
TOTAL	140,119	901,574	1,041,693	115,615	1,016,280	1,131,896

Source: JICA Study Team based on the data from UMAPS

Figure 3.3.5 Records of Water Distribution

(3) Operation and Maintenance

Four employees are assigned to each distribution tank and the facilities are operated for 24 hours a day in two shifts, daytime and nighttime. Since there are approximately 70 distribution tank locations (Total 111 distribution tanks), approximately 280 employees are engaged in operation and maintenance work. A monthly water distribution schedule is prepared by four employees in charge of water distribution planning. Four employees are assigned to operate valves in accordance with the water distribution schedule.

The distribution tank operator checks the tank water level gauge, communicates with the pump station operator, and makes requests to turn on and off the transmission pumps. The water level in the distribution tanks is reported to the head office at regular intervals. The distribution of water from each distribution tank to each distribution area is done by opening and closing a valve every three days, so that the water level in the distribution tanks is always kept at a constant level.

However, the current operators do not know the flow rate into each water distribution tank, so adjustments are made based on experience and intuition. Although all the distribution tanks are monitored, the water level in the tanks is not always known because only a total of 35 tanks are recorded on the record sheets. The flow to and from each distribution tank is not actually measured because no flow measurements are equipped.

In order to efficiently distribute the insufficient amount of water, a system that can continuously monitor the distribution tanks, accurate inflow rates, and distribution flow rates from the tanks should be installed.

3.3.5 Service Facility

The service facilities are operated and maintained by the Commercial Sub-Management, which employs about 140 people and is responsible for registering new users, reading customer meters, billing, bill collection, customer education, etc.

Water is supplied to each house through a water meter connected to the distribution pipe. Figure 3.3.6 shows the installation of the water meter. The water meter is installed in a meter box in front of the house.

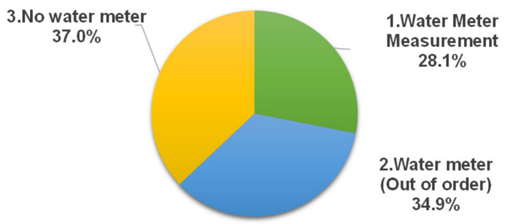
Source: JICA Study Team

Figure 3.3.6 Installation of Water Meter

Approximately half of the 124,732 customers in 2023 have water meters but only 28% actually have water meters that can be read on a monthly basis. Legally, water meters are owned by the municipal government and maintained by the water utility. However, customers actually purchase meters at a local market in the city, which are certified by UMAPS. The water meters purchased by customers have been in use for more than 10 to 20 years because there is no obligation to maintain or replace them. In case a water meter malfunctions, UMAPS bills the customer based on the average water consumption for the previous three months. Customers without water meters are billed on a flat rate basis. A breakdown of the connection in 2023 is shown in Figure 3.3.7.

In 2023, 28.1% of the total connection is billed with a water meter and the remaining 71.9% is based on considered consumption, such as historical averages. Some water meters have not been replaced for more than 20 years and there are doubts about their metering accuracy.

It is necessary for UMAPS to take over the installation and maintenance of water meters, promote customer understanding and education, and collect tariffs based on water meters. The water meters should be replaced at regular intervals, e.g. 8 years, as is the case in Japan.



Item	Number of Connection (2023)	Remark
1.Water Meter Measurement	35,019	Most of them are obsolete.
2.Water meter (Out of order)	43,508	Average of the last 3 months due to broken
3.No water meter	46,205	Billing based on estimated water consumption(Flat Rate)
Total	124,732	

Source: JICA Study Team

Figure 3.3.7 Breakdown of Connection in 2023

3.3.6 Mechanical Facility

(1) Current Status of the Existing Pump Station

As a result of the existing facilities survey, the operating conditions of pumps, pipes, and other instruments are not satisfactory for rated operation. Some major pumps have recently been replaced by UMAPS funds but the reality is that almost all pumps are more than 15 to 20 years old after installation and are being operated while being repaired many times. That is, almost all pumps are aging compared with the standard life of the pump equipment, which 15 years as prescribed in Public Enterprise Act in Japan. According to the IDB's 2012 survey and JICA's 2021 data collection survey, it has been confirmed that the pumps are operating at low efficiencies of around 50-60% due to aging, whereas new construction would have a pump efficiency of around 80%. Therefore, the unit energy consumption per cubic meter seems to be high and the transmission flow of each pump station is not sufficient to meet the design flow. In addition, documents are not well managed.

- When the operation and maintenance of the facilities are transferred from SANAA to UMAPS in 2023, the transfer was incomplete in terms of drawings, specifications, and other documents. Without the above information, it is not easy to evaluate the original design condition, such as pump flow and head.
- Operating data and replacement/ repair records are not kept. The engineer and operator are not in the habit of recording the above data.

Most of the transmission pumps are vertical in-well type. These pumps are mainly imported from USA, or surrounding countries. Pumps are well maintained by electro-mechanical technicians in case of easy repair such as replacement of grand packing and rewinding of the motor. They are repaired by local agent in case of serious problems.

An updated list of the total 26 pump stations (PSs) is shown in Table 3.3.6 below.

Table 3.3.6 Current Status of PSs

No	Name	Construction Year	Replace/ Repair Year	Specifications Duty + Standby x Q(L/s) x H(m) x P(kW), V/HB/VB	Pump Room/ Top Roof/ Outdoor	Status of standby pump	Reference
1	Estiquirin	1975	minor repair only	1D+1S x 110 x 54 x 112, V	Outdoor	Broken	
2	Sauce	2010		1D+1S x 79 x 53 x 56, V	Pump room		3,600 rpm is not preferable
3	Venecia	2006		1D+1S x 30 x 60 x55, V	Outdoor		
4	Roble Oeste VI Etapa	2008		2xQx30kW, V			Managed by private contractor, not UMAPS.
5	Francisco Morazan	1995		1D+1S x 5.7 x 151 x 15, V	Pump room 5 years ago		
6	19 de Septiembre	2005		1D x 6-7 x 30-40 x 11, S	Outdoor		
7	Aldea Suyapa	1997		2Dx0.93x69.5x22.38, V	Only Roof		Managed by water committee
8	Nueva Suyapa/ Suyapita	2000	One	1D+1S x 37 x 167 x 93,V 1D+1S x 114 x 75 x 112,V	Only roof		Water Committee has a responsibility for M2 Tank line

No	Name	Construction Year	Replace/ Repair Year	Specifications Duty + Standby x Q(L/s) x H(m) x P(kW), V/HB/VB	Pump Room/ Top Roof/ Outdoor	Status of standby pump	Reference
			motor replaced in 2020				Both water hammer devices are not working
9	Altos del Trapiche	2002		1D+1S x 50 x 57 x 45, VB	Pump room		Pump suction is in the civil foundation, then difficult to maintain
10	Grupo Empresarial	2010		1D+1S x Q x H x 15,V 1D+1S x Qx H x P ,VB (not used since 5 years)	Only roof Outdoor		All are constructed and managed by industrial committee (landowner is industrial committee)
11	Canteras	1977	1992	2D+2S x 87 x 143 x 186,V 1D +2S x 141 x 70 x 150,VB	Pump room Pump room	2 standby pumps Broken	Constructed in 1977, but it was demolished. Then, both PSs were re-constructed in 1992.
12	Universidad Norte	2002	Motor removed on Nov 2021,	1D+1S x Q x H x 45, V 1D+1S x Q x H x 45, V	Outdoor		Only one motor is working for Lomas 2da Etapa. No label data available.
13	La Fuente	30 years or more		1DxQx94.94x37.3, V 1D+1SxQx22.38, V	Outdoor		Smaller capacity pump is used as booster. One of the 50 HP motor pumps is not connected
14	Olimpo	1982 2000	2019 (P1)	1D+1S x Q x H x 100 (VFD) and 75,V 1D +1S x 83 x 26 x 37,VB	Outdoor Pump room	Broken	
15	Cerro Grande Zona Ⅱ	30 years ago more		1D+1S x 39 x 75 x75, V	Outdoor		Two pumps are operated due to low efficiency. 39 L/s is measured flow from 2012 report. Unit flow may be higher.
16	Juan A Lainez	1976	15 years ago, Motors replaced	1D+1S x 33 x 64 x P, V	Outdoor	Broken	
17	Loma Linda	1976 1976 2019	2019 replaced Not working New	1D+1S x 37 x 149 x 75, V 1D+1S x 37 x H x 45, V 1D+1S x 37 x H x 15, V	Outdoor Outdoor Only roof	Broken	
18	Las Hadas/ Los Robles		2011	1D+1S x1.14x37.3, V 1D+1S x0.95x18.5, V	Outdoor Only roof		Las Hadas pump (50 HP) is not in use, only for emergency.
19	Centro America I	1980	Recently repaired only motors	1D x Q x H x 55, V 2S x 95 x 83 x 112, V	Outdoor		1 standby is sometimes operated, but short period only due to overflow at ET.
20	Centro America Ⅱ	1996		1D+1S x 47 x 66 x 45, V 1D+1S x 47 x 93 x 55, V	Outdoor		
21	Hato	1992		1D+1Sx2.0x37.3, V	Pump room		One motor+pump broke down due to overuse
22	Mogote	1995	Recently replaced two pumps	2D+2S x 66 x 285 x 300, V	Only roof		

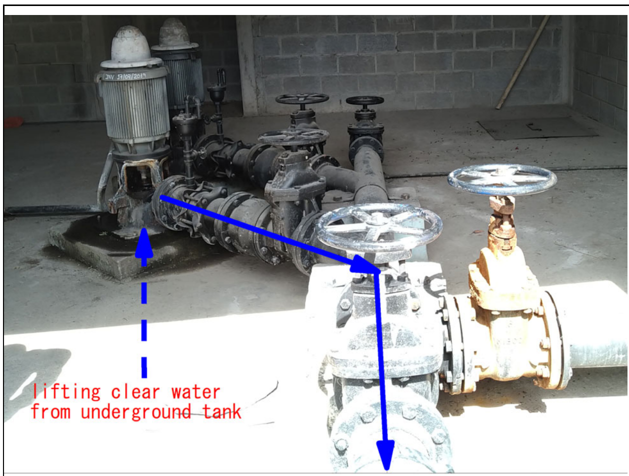
No	Name	Construction Year	Replace/ Repair Year	Specifications Duty + Standby x Q(L/s) x H(m) x P(kW), V/HB/VB	Pump Room/ Top Roof/ Outdoor	Status of standby pump	Reference
23	Las Uvas	2000		1D+1S x 28 x 96 x 37, V	Only roof		Water hammer device is not working
24	Villa Nueva	2013 2017	Motor winding 4 years ago	1D+1S x3.54x79.25x74.6,V 1D+1S x4.11x111x112, V 1D+1S x4.11x143.25x149, V	Pump room Pump room		Previously managed by water committee, now under UMAPS.
25	Los Pinos	1996		1D+1S x0.92x55, V 1D+1S xQx11.2, V 1D+1S xQx29.8, V	Only roof Pump room Pump room		Smaller pumps managed by water committee
26	San Francisco	1980	One pump was replaced in 2005	1D+1S x 35 x 97 x 55,HB	Outdoor		

Source: JICA Study Team (some information is still under investigation)

Regarding the operation hours per day, Aldea Suyapa PS, Nueva Suyapa/Suyapia PS, Canteras PS, Mogote PS, and Villa Nueva PS work continuously, but other pump stations work every 3 days or when there is a scheduled supply service.

(2) Type of Existing Pump Stations

There are two types of pump stations. As mentioned above, almost all types are vertical in-well type mounted on the wet well as shown in the photo on the left side of Figure 3.3.8 below and the remaining are direct in-line type installed on the dry well as shown in the right side of Figure 3.3.8 below.



Major Method (In-well Type)	In-line Type

Source: JICA Study Team

Figure 3.3.8 Type of Existing Pump Station

(3) Current Configuration for Each Transmission Pump Station

Unfortunately, after hearing from the mechanical and electrical departments, there seems to be little detailed information such as as-built drawings and specifications for pump stations. Therefore, the JICA Study Team has visited all the 26 pump stations with key mechanical engineers and operators from UMAPS and made a configuration figure of each pump station.

Results of the survey for existing pump station are as shown in Appendix 3.3.4.

1) Estiquirin PS

The flow rate of this pump station is approximately 110 L/s. It was constructed in 1976. Clear water is received from the Laureles WTP by gravity flow to the wet well and clear water is transferred to the Estiquirin Tank through a 400 mm diameter transmission main. The current major issues are as follows:

- The standby pump is completely damaged and inoperable and operational duty pump requires occasional repairs.
- Water level gauges are not installed. A flow meter and pressure gauges are not working properly.
- Safety level seems to be unstable around here.

The schematic drawing and photos of this pump station are shown in Figure 3.3.9 and Figure 3.3.10, respectively.

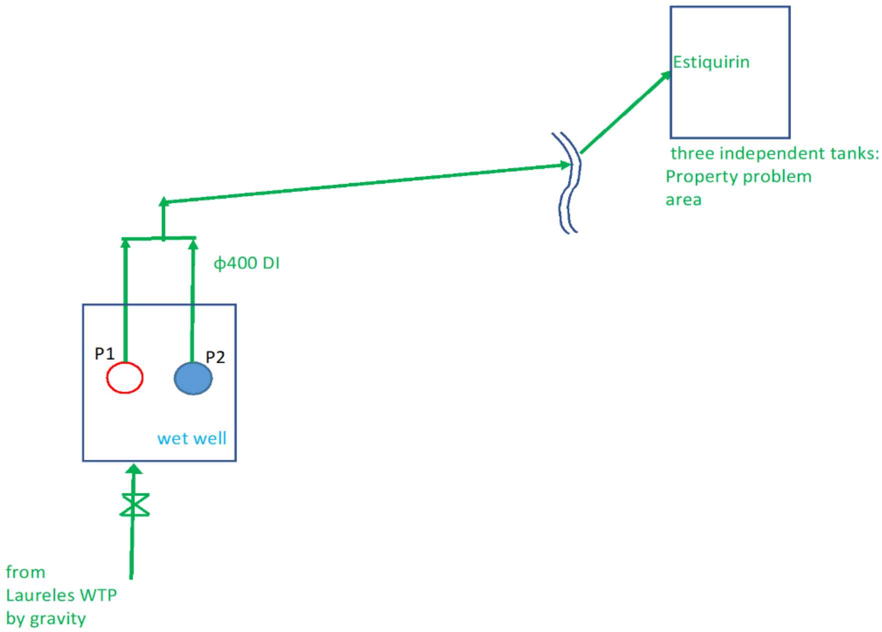


Figure 3.3.9 Current Flow Schematic of Estiquirin PS

	
Overall View	Electro-mechanical technitians are replacing a grand packing for the pump.

Source: JICA Study Team

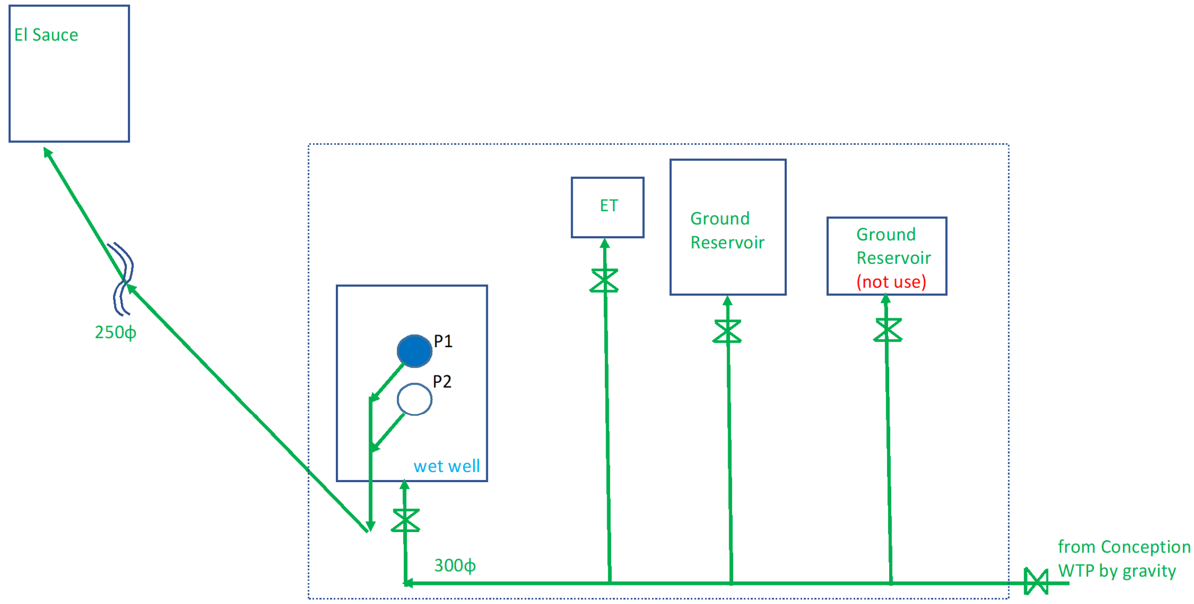
Figure 3.3.10 Current Situation of Estiquirin PS

2) Sauce PS

This pump station was built in 2010. Clear water from the Conception WTP is received here by gravity flow to the wet well and clear water is transferred to the El Sauce Tank through a 250 mm diameter transmission main. An elevated tank and two ground tanks are constructed right next to this pump station. The current major issues are as follows:

- One pump is not working due to electrical problems and needs minor repairs.
- The condition of the pumps is not good as the design rotation speed of 3,600 rpm of both pumps is higher than other pump stations. Therefore, it is difficult for these pumps to operate continuously for long periods of time.
- No water level gauge. A flow meter and pressure gauges are not working properly.
- Pumps are installed in the pump room.
- Surge device for water hammer does not work at all.

The schematic drawing and photos of this pump station are shown in Figure 3.3.11 and Figure 3.3.12, respectively.



Source: JICA Study Team

Figure 3.3.11 Current Flow Schematic of Sauce PS

	
Overall View	Elevated Tank Constructed in 2011

Source: JICA Study Team

Figure 3.3.12 Current Situation of Sauce PS

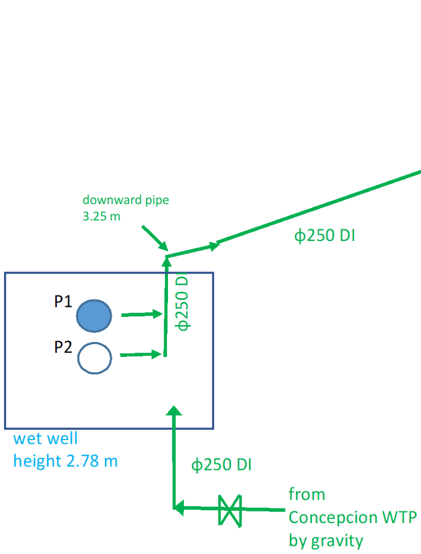
3) Venecia PS

This pump station was constructed in 2006. Clear water is received from the Conception WTP by gravity flow to the wet well and transferred to the Venecia Tank through a 250 mm diameter transmission main. The current major issues are as follows:

- Water level gauges, flow meter, and pressure gauges are not installed.

- ➢ Pumps are installed outdoors.
- ➢ Detailed specifications are unclear.

The schematic drawing and photos of this pump station are shown in Figure 3.3.13 and Figure 3.3.14, respectively.



Source: JICA Study Team

Figure 3.3.13 Current Flow Schematic of Venecia PS

	
Overall View	Vertical In-well Pumps

Source: JICA Study Team

Figure 3.3.14 Current Situation of Venecia PS

4) Roble Oeste VI Etapa PS

This small pump station is under the management of the contractor who built it in 2008 for private use of the neighbourhood. Therefore, UMAPS can neither access nor maintain it. UMAPS informed this PS shall be maintained under the responsibility of the contractor. The photos of this pump station are shown in Figure 3.3.15.

	N/A
Overall View	

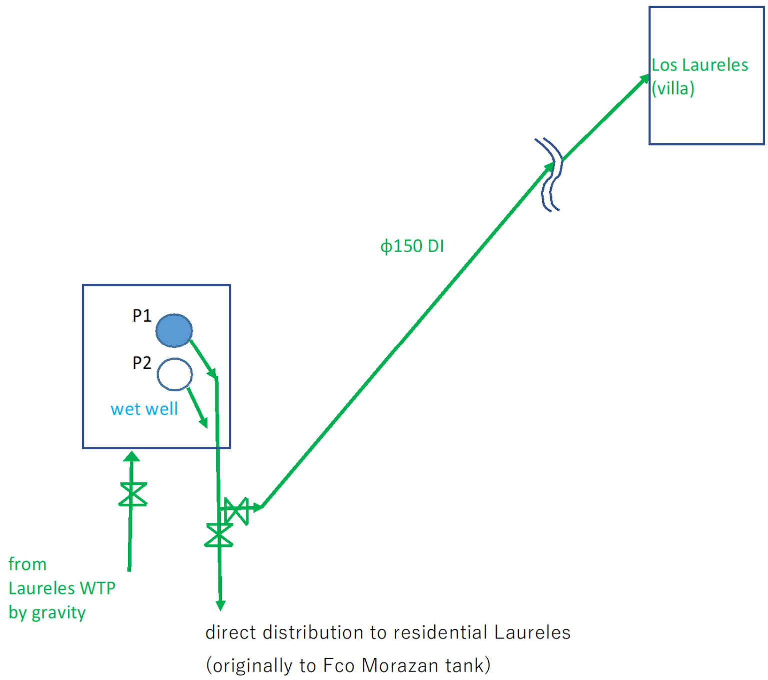
Figure 3.3.15 Current Situation of Roble Oeste VI Etapa PS

5) Francisco Morazan PS

The transmission flow of this pump station, which was constructed in 1995, is approximately 5 to 6 L/s. Clear water is received from the Laureles WTP by gravity flow to the wet well and transferred to the Los Laureles Villa Tank or direct distribution to residential Laureles through a 150 mm diameter transmission main. The current major issues are as follows:

- Water level gauges, flow meter, and pressure gauges are not installed.
- Limited operation: 4 hours on Tuesday and Saturday to Laureles Villa, and 21 hours on Thursday and Sunday to other area.
- Pump room was constructed 5 years ago.

The schematic drawing and photos of this pump station are shown in Figure 3.3.16 and Figure 3.3.17, respectively.



Source: JICA Study Team

Figure 3.3.16 Current Flow Schematic of Francisco Morazan PS

	
Pump room was added 5 years ago.	Vertical In-well Pumps

Source: JICA Study Team

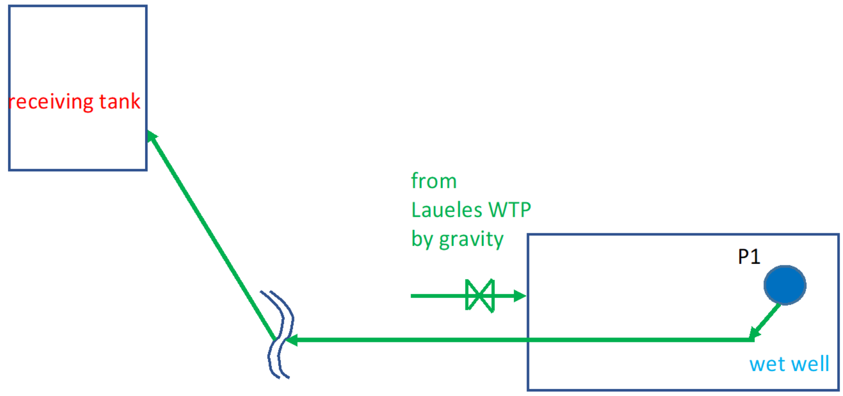
Figure 3.3.17 Current Situation of Francisco Morazan PS

6) 19 de Septiembre PS (inside of Laureles WTP)

The flow rate of this pump station is approximately 6 to 7 L/s. It was constructed in 2005. Clear water is received from the Laureles WTP by gravity flow to the wet well and transferred to the tank for the surrounding residential area through a transmission main. The current major issues are as follows:

- There is no standby pump.
- Pump cannot be lifted for maintenance without removing the tank water due to small opening.
- Water level gauges are not installed. The flow meter and pressure gauges are not functioning properly.

The schematic drawing and photos of this pump station are shown in Figure 3.3.18 and Figure 3.3.19, respectively.



Source: JICA Study Team

Figure 3.3.18 Current Flow Schematic of 19 de Septiembre PS

	N/A
Overall View	

Figure 3.3.19 Current Situation of 19 de Septiembre PS

7) Aldea Suyapa PS

This pump station was built in 1997. Clear water is received from the Nueva Suyapa Tank located here via Nueva Suyapa/ Suyapita PS and transferred to the Aldea Suyapa Tank through a 150 mm diameter transmission main by two pumps including one standby. Both pumps need gaskets replaced as they are leaking too much water. Water level gauges, flow meter, and pressure gauges are not installed. The schematic drawing and photos of this pump station are shown in Figure 3.3.20 and Figure 3.3.21, respectively.

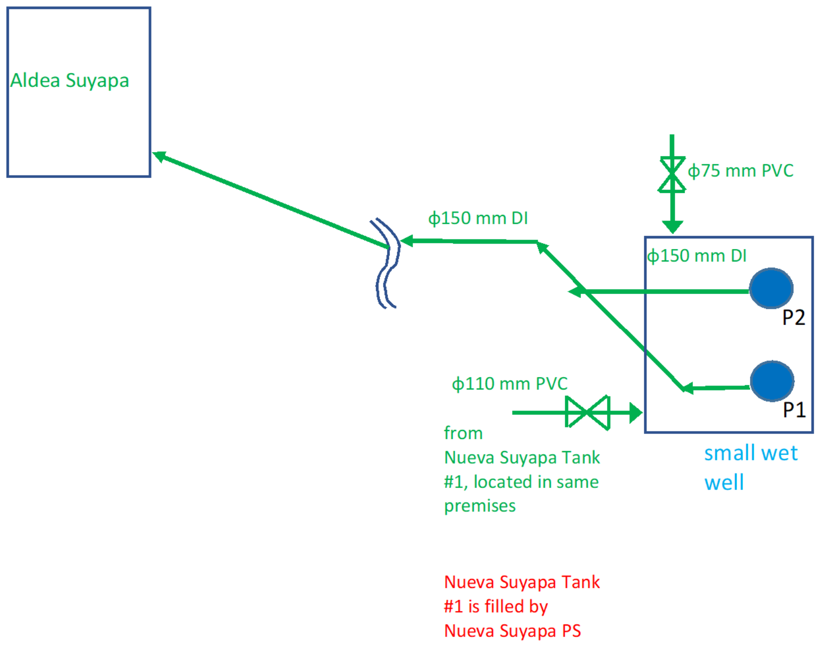


Figure 3.3.20 Current Flow Schematic of Aldea Suyapa PS

	
Overall View	Vertical Turbine Submersible Pumps

Figure 3.3.21 Current Situation of Aldea Suyapa PS

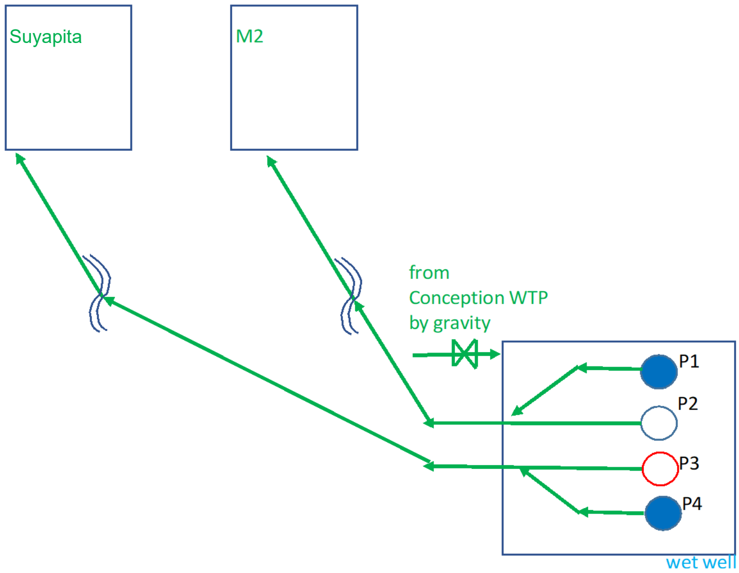
8) Nueva Suyapa/ Suyapita PS

This pump station was built in 2000. Clear water is received from the Conception WTP by gravity flow to the wet well, and transferred to the M2 Tank through a transmission main by one pump with standby, and to the Suyapita Tank by another pump with standby, respectively. The current major issues are as follows:

- The motor of the duty pump for Suyapita Tank was replaced in 2020 but the standby pump is completely damaged and not working.
- Two pumps for M2 Tank are fully managed by the water committee, which is a private sector.
- Water level gauges are not installed, and flow meters and pressure gauges are not working properly.

- Pumps are installed outside with roof.
- Surge device is completely not working.

The schematic drawing and photos of this pump station are shown in Figure 3.3.22 and Figure 3.3.23, respectively.



Source: JICA Study Team

Figure 3.3.22 Current Flow Schematic of Nueva Suyapa/ Suyapita

Overall View

Flow Meter and Surge Device

Source: JICA Study Team

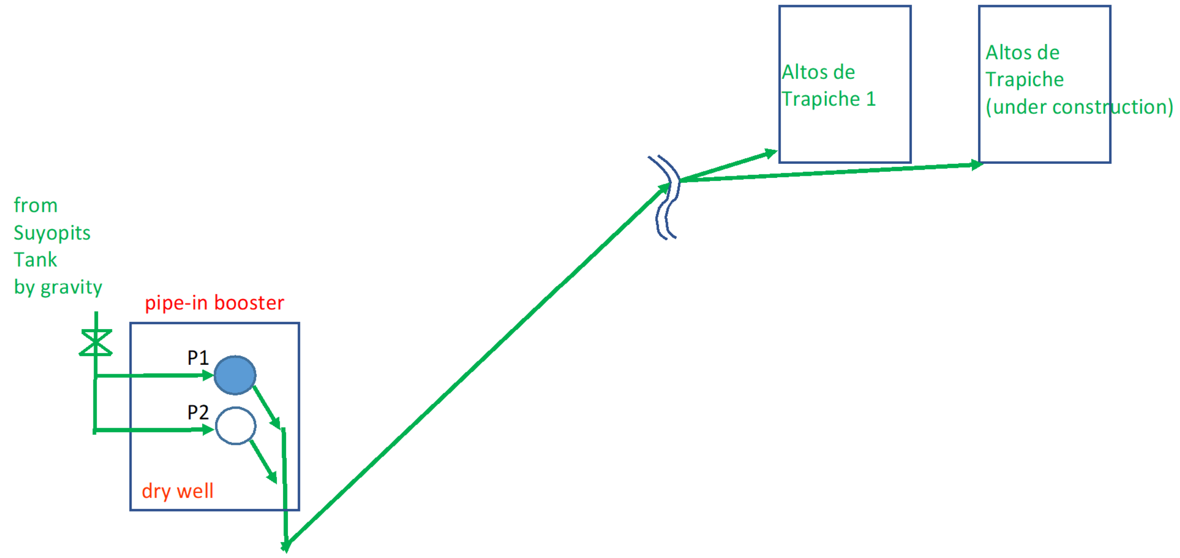
Figure 3.3.23 Current Situation of Nueva Suyapa/ Suyapita

9) Altos del Trapiche PS

The transmission flow of the direct pipe-in booster station is approximately 50 L/s, which was constructed around 2003. Clear water is received from the Conception WTP by gravity flow through the Suyapita Tank and transferred to the Altos de Trapiche 1 Tank through a transmission main. In addition, the Altos de Trapiche 2 Tank is under construction on the side of the Altos de Trapiche 1 Tank. The current major issues are as follows:

- Water level gauges are not installed. The flow meter and pressure gauges are not working properly.
- Pumps are installed in the pump room; therefore, the condition seems good.

The schematic drawing and photos of this pump station are shown in Figure 3.3.24 and Figure 3.3.25, respectively.



Source: JICA Study Team

Figure 3.3.24 Current Flow Schematic of Altos del Trapiche PS

	
Overall View	In-line Pumps

Source: JICA Study Team

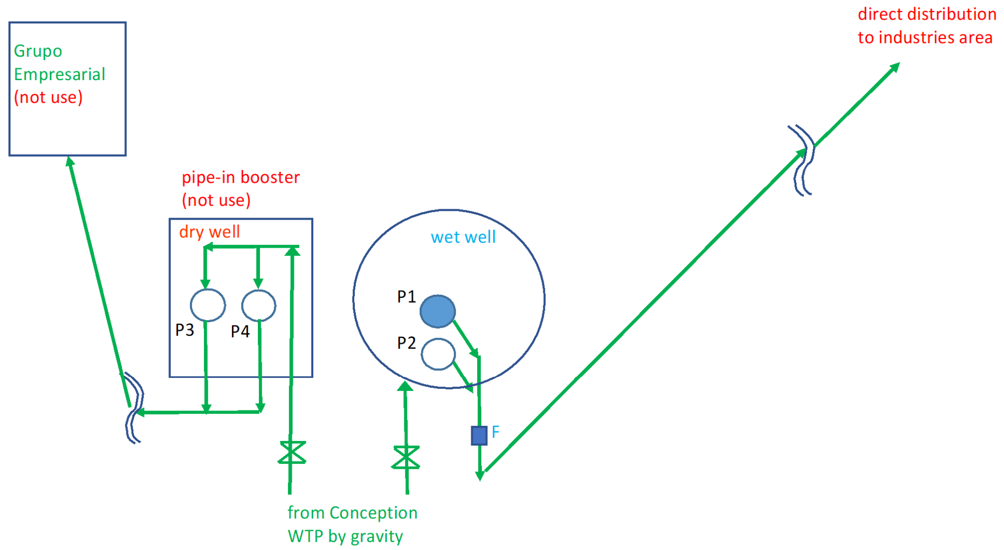
Figure 3.3.25 Current Situation of Altos del Trapiche PS

10) Grupo Empresarial PS

Both stations were constructed in 2010. Clear water is received from the Conception WTP through a gravity transmission main. The booster station for the Grupo Empresarial Tank shown in the left figure below is not used, but clear water is only distributed directly to the industrial area by another duty pump with one standby through a transmission main. The specifications are not clear since all are built and managed by the private industrial park on their own land. Therefore, UMAPS staff mentioned that these stations are not a priority. The current major issues are as follows:

- Both pumps for the Grupo Empresarial have not been used for 5 years due to pipe leaks. Therefore, no clear water is being transferred to this area.
- Pumps for the Grupo Empresarial are installed outdoors, so they seem to be deteriorating. Pumps for the industrial area seem to be in better condition due to installation with roof.
- Surge tank for the industrial area seems effective.
- No water level gauges. A flow meter and pressure gauges for the industrial area seem to work properly.

The schematic drawing and photos of this pump station are shown in Figure 3.3.26 and Figure 3.3.27, respectively.



Source: JICA Study Team

Figure 3.3.26 Current Flow Schematic of Grupo Empresarial PS

	
In-line Pumps	Vertical In-well Pump

JICA Study Team

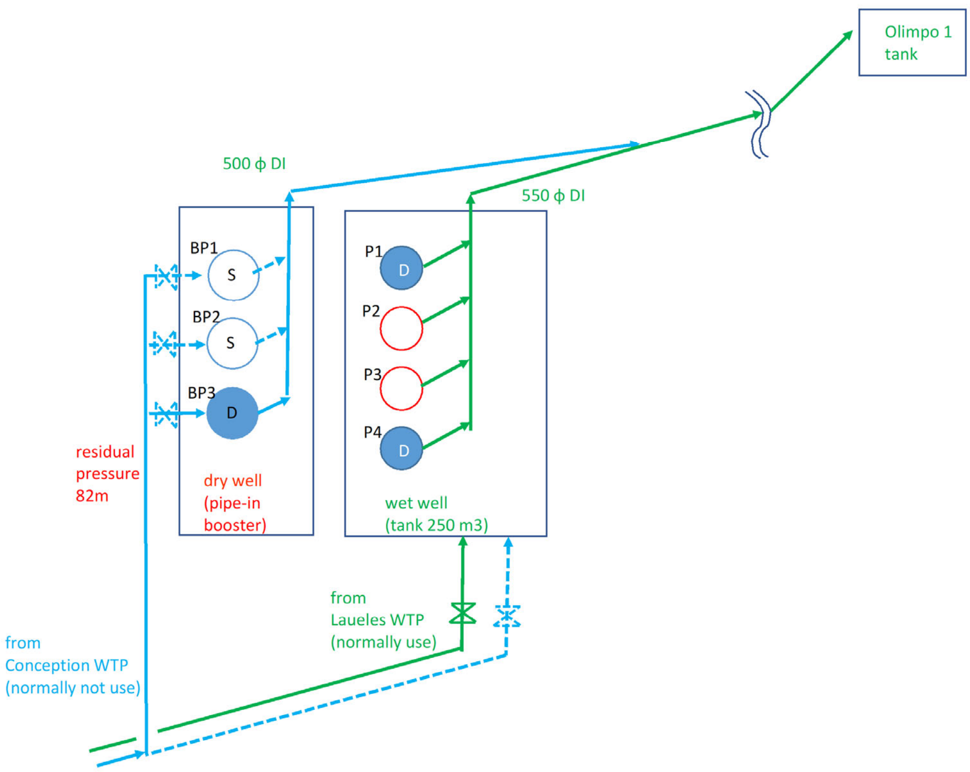
Figure 3.3.27 Current Situation of Grupo Empresarial PS

11) Canteras PS

The total flow of these stations with the clear water receiving tank is approximately 310 L/s. They were rebuilt in 1992. One has a wet well with vertical turbine submersible pumps and the other pumps have direct pipe-in booster pumps where the pumps are installed on the dry well. Normally, clear water is received only from the Laureles WTP by gravity flow to the wet well, but sometimes water from Conception WTP is also received through an additional gravity line, depending on the season or emergencies. Finally, clear water is transferred to the Olimpo 1 Tank through a 550 mm diameter transmission main. The current major issues are as follows:

- All pump equipment are aging.
- Water level gauges are not installed. Flow meters and pressure gauges are not working properly.
- Some standby pumps are completely damaged.
- Pumps are installed in the pump room, but bird droppings are found in the room.

The schematic drawing and photos of this pump station are shown in Figure 3.3.28 and Figure 3.3.29, respectively.



Source: JICA Study Team

Figure 3.3.28 Current Flow Schematic of Canteras PS

	
Booster Pumps	Vertical Turbine Submersible Pumps

Source: JICA Study Team

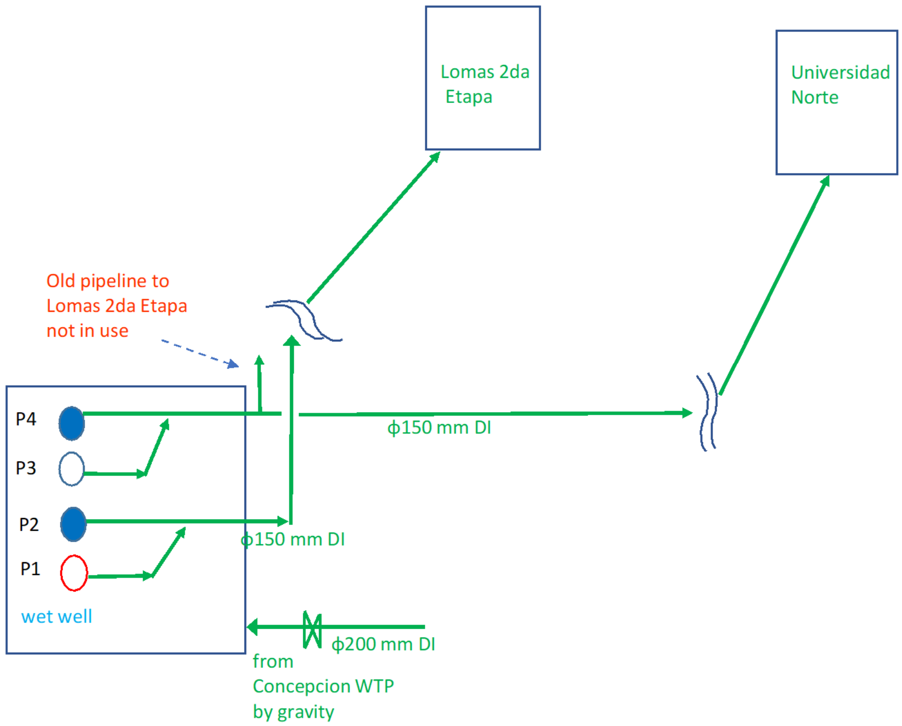
Figure 3.3.29 Current Situation of Canteras PS

12) Universidad Norte PS

This station was built prior to 2002. Clear water from the Conception WTP is received by gravity flow to the wet well and transferred to the Lomas 2da Etapa Tank through a 150 mm diameter transmission main by one pump with standby, and to the Universidad Norte tank through a 150 mm diameter transmission main by another one pump with standby, respectively. The current major issues are as follows:

- The motor of the duty pump for Lomas 2da Etapa was removed in 2021 and ready for repair for motor rewinding.
- Water level gauges are not installed. The flow meters and pressure gauges are not working properly.
- Pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.30 and Figure 3.3.31, respectively.



Source: JICA Study Team

Figure 3.3.30 Current Flow Schematic of Universidad Norte PS

	
Overall View	Vertical In-well Pumps

JICA Study Team

Figure 3.3.31 Current Situation of Universidad Norte PS

13) La Fuente PS

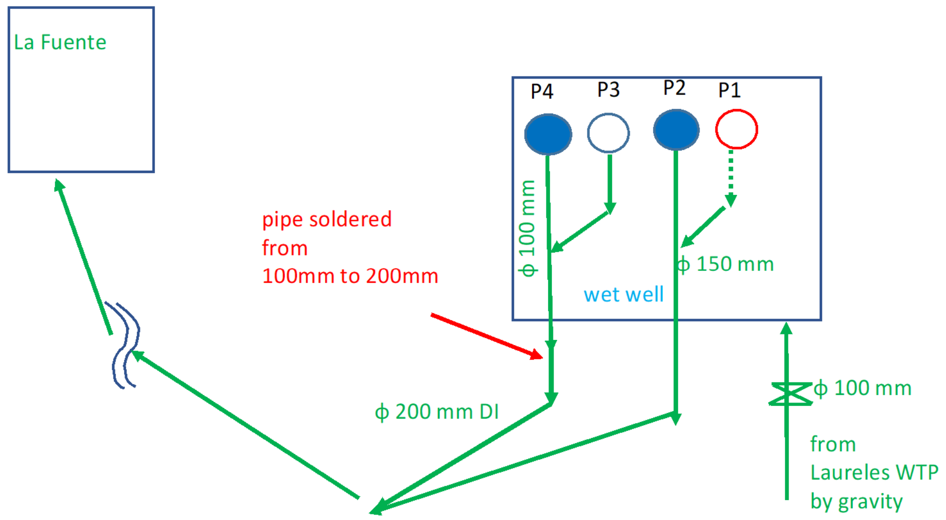
The year of construction and detailed specifications of this station are not clear. The pumps are deteriorated. Clear water from the Laureles WTP is received by gravity flow to the wet well, and transferred to the La Fuente Tank through a transmission main by one or two duty pumps with standby. The current major issues are as follows:

- A standby pump is not connected to the discharge pipe.
- Normally, only one pump operates, but sometimes, the second pump must operate as a booster

to increase flow when needed.

- Water level gauges and flow meters are not installed. Some pressure gauges do not seem to work.
- Pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.32 and Figure 3.3.33, respectively.



Source: JICA Study Team

Figure 3.3.32 Current Flow Schematic of La Fuente PS

	
Overall View	Vertical In-well Pumps

JICA Study Team

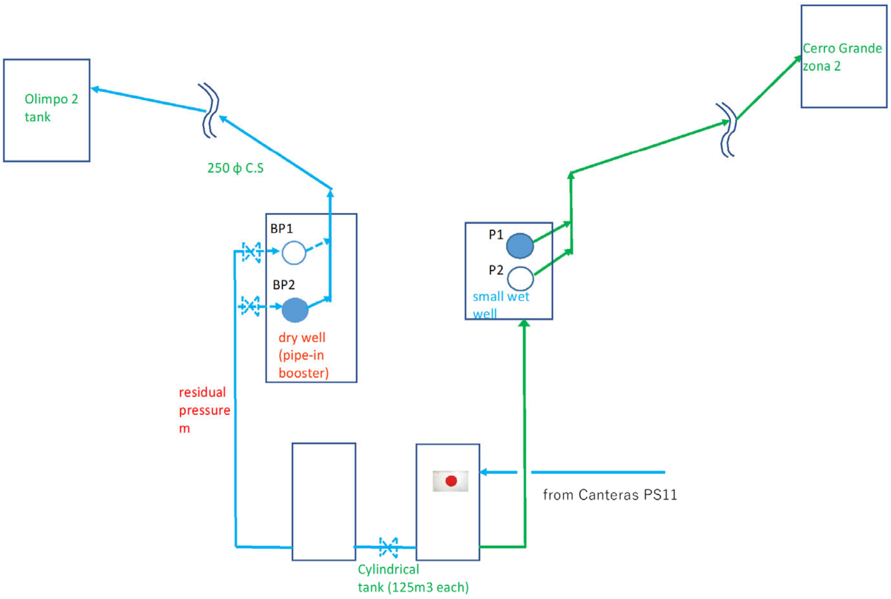
Figure 3.3.33 Current Situation of La Fuente PS

14) Olimpo say Cerro Grande 1 PS

The transmission flow of the direct pipe-in booster station, which was constructed in 2000, is approximately 90 L/s. Normally, clear water is transferred from the Canteras Pump Station to the two ground tanks constructed here by Japanese grant aid project completed in 2003, and transferred to the Olimpo 2 tank through a transmission main, and to the Cerro Grande Zona 2 Tank through another transmission main, respectively. The current major issues are as follows:

- All pump equipment are aging, with the exception of a complete 100 kW pump set that was replaced in 2019.
- No water level gauges, and no properly functioning flow meters and pressure gauges.
- One standby pump is completely broken and awaiting budget for replacement.
- Booster pumps are installed in the pump room, but bird droppings are found in the room.
- Turbine pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.34 and Figure 3.3.35, respectively.



Source: JICA Study Team

Figure 3.3.34 Current Flow Schematic of Olimpo say Cerro Grande 1 PS

	
In-line Pumps	Vertical In-well Pumps; the front pump is completely broken, the other was replaced in 2019.

Source: JICA Study Team

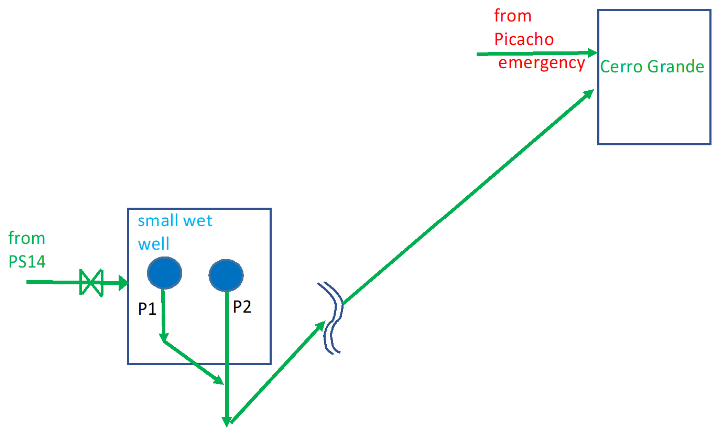
Figure 3.3.35 Current Situation of Olimpo say Cerro Grande 1 PS

15) Cerro Grande Zona II PS

This pump station with wet well was built about 30 years ago and receives clear water from PS 14. About 39 L/s of clear water is transferred to the Cerro Grande Tank through a transmission main by two pumps with no standby. In an emergency, clear water can be received in the Cerro Grande Tank from the Picacho WTP by gravity flow. The current major issues are as follows:

- Some minor repairs, such as replacement of the discharge base, are being made, but the efficiency of both pumps appears to be low.
- Although one duty pump should normally be operating, the standby pump is always operating to meet water demands for the above reason.
- Water level gauges, flow meters, and pressure gauges are not installed.
- Pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.36 and Figure 3.3.37, respectively.



Source: JICA Study Team

Figure 3.3.36 Current Flow Schematic of Cerro Grande Zona II PS

	
Overall View	Vertical Turbine Submersible Pumps

Source: JICA Study Team

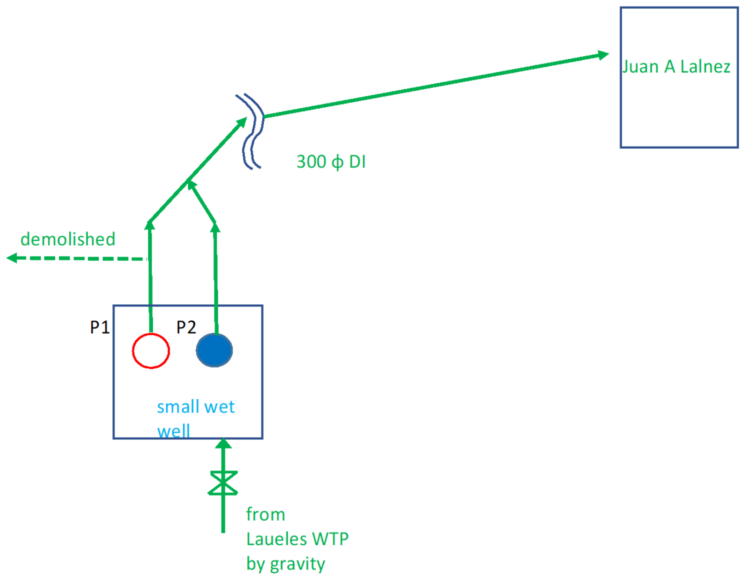
Figure 3.3.37 Current Situation of Cerro Grande Zona II PS

16) Juan A Lainez PS

The flow rate of this pump station, which was constructed around 1976, is approximately 33 L/s. Clear water is received from the Laureles WTP by gravity flow to the wet well, and clear water is transmitted to the Juan A Lalnez Tank through a 300 mm transmission main. Current major issues are as follows:

- The motors of the two pumps were replaced 15 years ago, but one pump is completely damaged.
- No water level gauges, and no properly functioning flow meters and pressure gauges.
- Turbine pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.38 and Figure 3.3.39, respectively.



Source: JICA Study Team

Figure 3.3.38 Current Flow Schematic of Juan A Lainez PS

	
Overall View	Vertical Turbine Submersible Pumps; only the front pump is operational.

Source: JICA Study Team

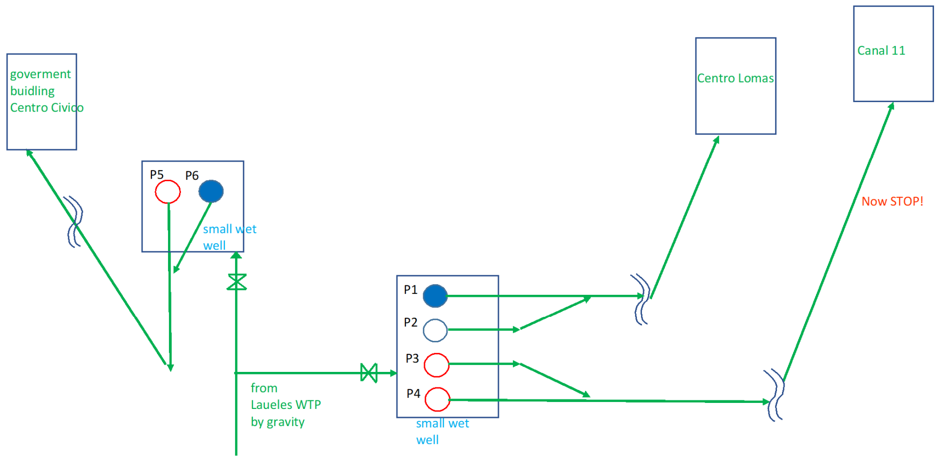
Figure 3.3.39 Current Situation of Juan A Lainez PS

17) Loma Linda PS

There are two stations, each with a clear water receiving well, where clear water from the Laureles WTP is received by gravity flow to the wet well. The first station was constructed in 1976, and 37 L/s of clear water is transferred to the Centro Lomas Tank through a transmission main by one duty pump with standby. The pump which send water to the Canal 11 tank through another transmission main is out of order. The second station was constructed in 2019, and 37 L/s of clear water is transferred to the Centro Civico Tank by another duty pump with standby. Current major issues are as follows:

- The first station is very old, except for two pumps for Centro Lomas that were replaced in 2019. Specially, clear water cannot be transferred to the Canal 11 Tank because both pumps are completely damaged and not working. Therefore, it is necessary to replace them.
- No water level gauges, and no properly functioning flow meters and pressure gauges.
- Pumps are installed outdoors in the first station, and therefore seem to have deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.40 and Figure 3.3.41, respectively.



Source: JICA Study Team

Figure 3.3.40 Current Flow Schematic of Loma Linda PS

	
First Pump Station (Vertical In-well Pumps)	Second Pump Station (Vertical In-well Pumps)

Source: JICA Study Team

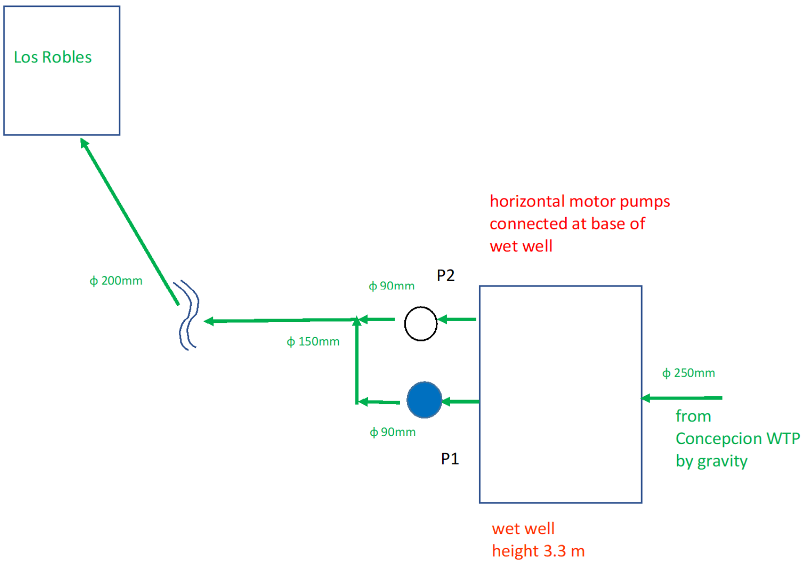
Figure 3.3.41 Current Situation of Loma Linda PS

18) Los Robles PS

There are two stations, each with a clear water receiving well, where clear water from the Conception WTP is received by gravity flow. The first station was renewed in 2011, and clear water is transferred to the Los Robles Tank through a 200 mm diameter transmission main. The second station was also renewed in 2011, and clear water is transferred to the Las Hadas Tank through a 150 mm diameter transmission main in case of emergency. Detailed specifications are not clear. Current major issues are as follows:

- ➢ Water level gauges, flow meters, and pressure gauges are not installed.
- ➢ Pumps are installed outside with roof.

The schematic drawing and photos of this pump station are shown in Figure 3.3.42, Figure 3.3.43, Figure 3.3.44, and Figure 3.3.45.



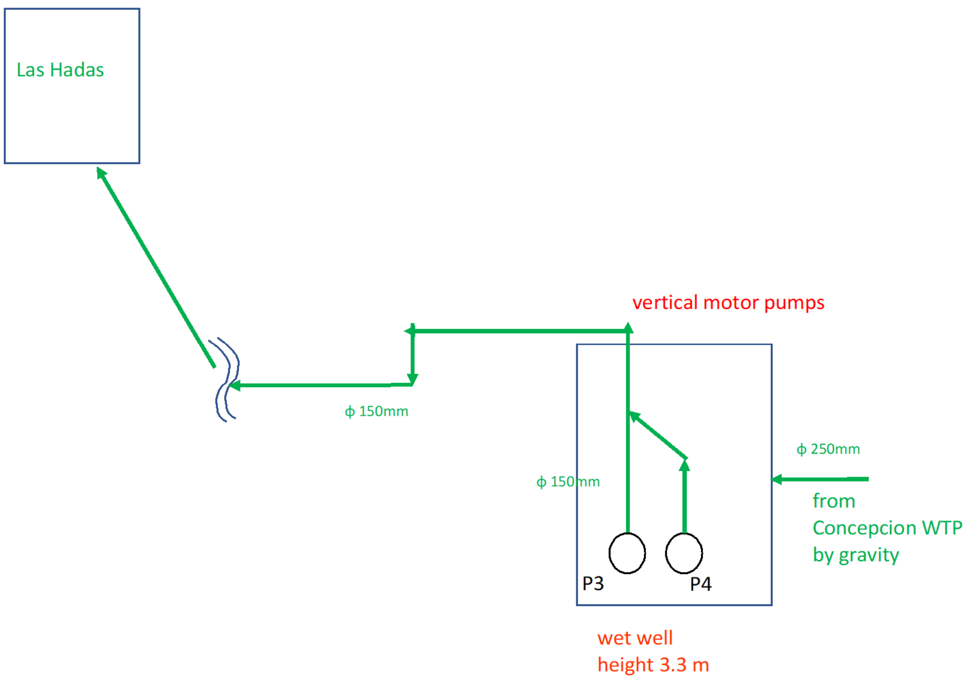
Source: JICA Study Team

Figure 3.3.42 Current Flow Schematic of Los Robles PS-1

	
Overall View	Horizontal Centrifuge Pumps

Source: JICA Study Team

Figure 3.3.43 Current Situation of Los Robles PS -1



Source: JICA Study Team

Figure 3.3.44 Current Flow Schematic of Los Robles PS -2

	
Overall View	Vertical In-well Pumps

Source: JICA Study Team

Figure 3.3.45 Current Situation of Los Robles PS -2

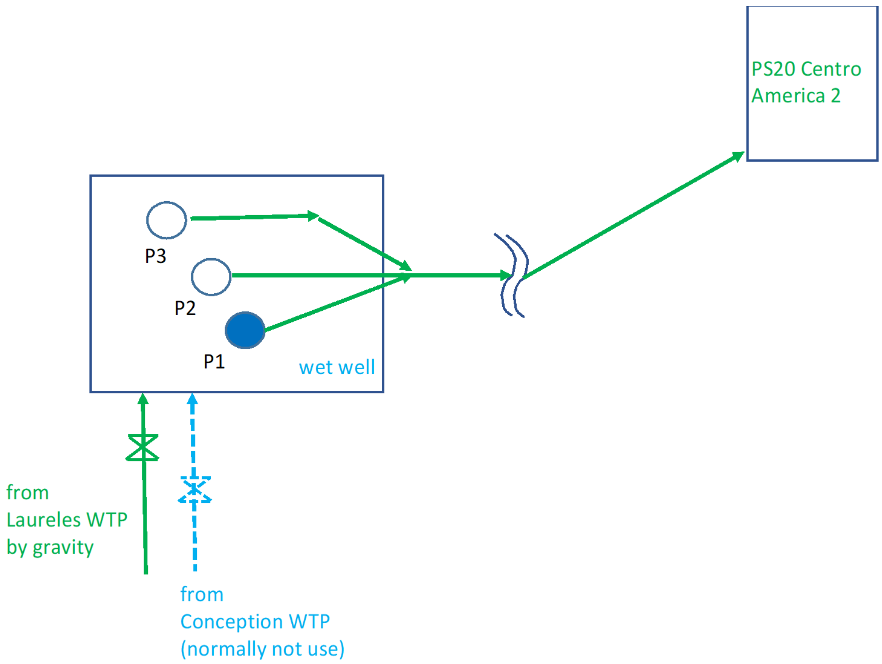
19) Centro America I PS

The flow rate of this pump station is approximately 95 L/s and it was constructed around 1980. Normally, only clear water from the Laureles WTP is received by gravity flow to the wet well, but water from the Conception WTP can also be received through an additional gravity line as a back-up. Clear water is also transferred to the Centro America II PS 20 through a transmission main. Current major issues are as follows:

- All pump equipment are aging although two 112 kW motors were replaced 25 years ago.
- Normally, one 55 kW duty pump is running, and sometimes the second pump must run to meet the water demand.

- No water level gauges; a flow meter and pressure gauges are installed.
- Pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.46 and Figure 3.3.47, respectively.



Source: JICA Study Team

Figure 3.3.46 Current Flow Schematic of Centro America I PS

	
Overall View	Vertical Turbine Submersible Pumps

Source: JICA Study Team

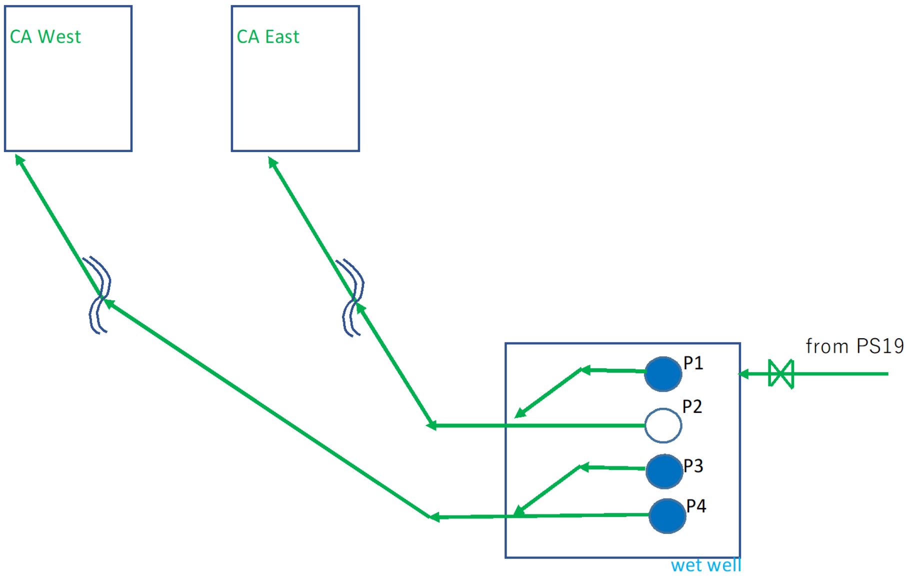
Figure 3.3.47 Current Situation of Centro America I PS

20) Centro America II PS

This pump station with a common wet well was constructed in 1996 and receives clear water from PS 19. Approximately 47 L/s of clear water is transferred to the CA East Tank through a transmission main by one duty pump with standby, and 47 L/s is transferred to the CA West Tank by two other pumps without standby. Current major issues are as follows:

- Some minor repairs, such as bearing replacement, are being made, but in particular, the efficiency of the pumps for CA West appears to be low.
- Although one duty pump should normally be running for CA West, the second pump is always running to meet the water demand for the above reason.
- No water level gauges, and no properly working flow meters and pressure gauges.
- Pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.48 and Figure 3.3.49, respectively.



Source: JICA Study Team

Figure 3.3.48 Current Flow Schematic of Centro America II PS

Overall View	Vertical Turbine Submersible Pumps

Source: JICA Study Team

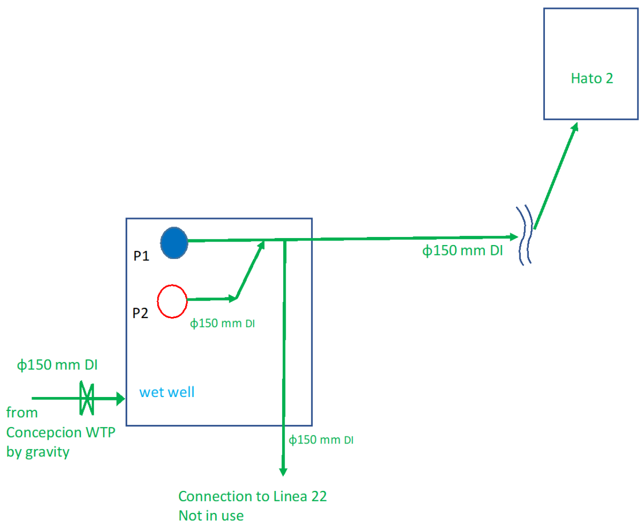
Figure 3.3.49 Current Situation of Centro America II PS

21) Hato PS

This pump station was constructed about 30 years ago, and clear water is delivered from the Conception WTP to the wet well here by gravity flow. Clear water is then pumped up to the Hato 2 Tank through a 150 mm diameter transmission main by one duty pump with standby. In case of emergency, clear water can be received in the Cerro Grande Tank from Picacho WTP by gravity flow. The current major issues are as follows:

- Pump No. 2 broke and was removed because the pump burned out from overuse and could not be shut down remotely.
- Pump No. 1 is also on the verge of failure according to UMAPS observation.
- No water level gauges, flow meters, and pressure gauges installed.
- Pumps are installed indoors but seem to have deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.50 and Figure 3.3.51, respectively.



Source: JICA Study Team

Figure 3.3.50 Current Flow Schematic of Hato PS

	
Overall View (Two Pumps in 2021)	No.2 (left) pump was broken. It is already removed.

Source: JICA Study Team

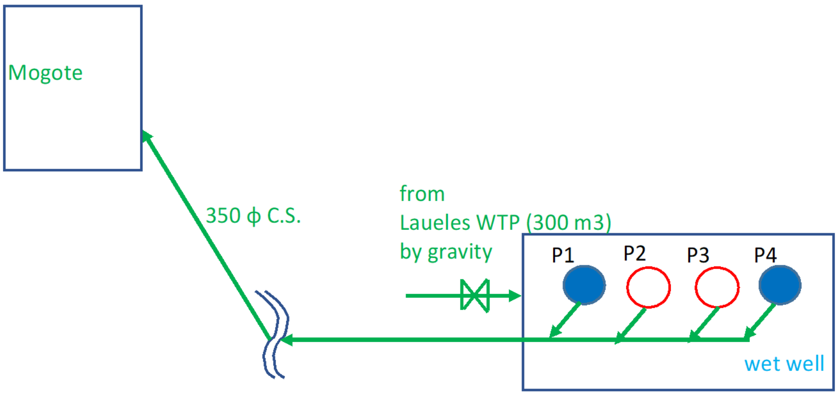
Figure 3.3.51 Current Situation of Hato PS

22) Mogote PS (inside of Laureles WTP)

The flow rate of this pump station is approximately 133 L/s. It was constructed in 1995. Clear water is received from the Laureles WTP by gravity flow to the wet well here and transmitted to the Mogote Tank through a 350 mm diameter transmission main. The current major issues are as follows:

- Two pumps were recently replaced but two other pumps are completely damaged.
- No water level gauges, and no properly functioning flow meter and pressure gauges.
- Pumps are installed outdoors with roof.

The schematic drawing and photos of this pump station are shown in Figure 3.3.52 and Figure 3.3.53, respectively.



Source: JICA Study Team

Figure 3.3.52 Current Flow Schematic of Mogote PS

	
Overall View (second and third pumps are damaged)	Vertical In-well Pumps; Only two pumps are operational.

JICA Study Team

Figure 3.3.53 Current Situation of Mogote PS

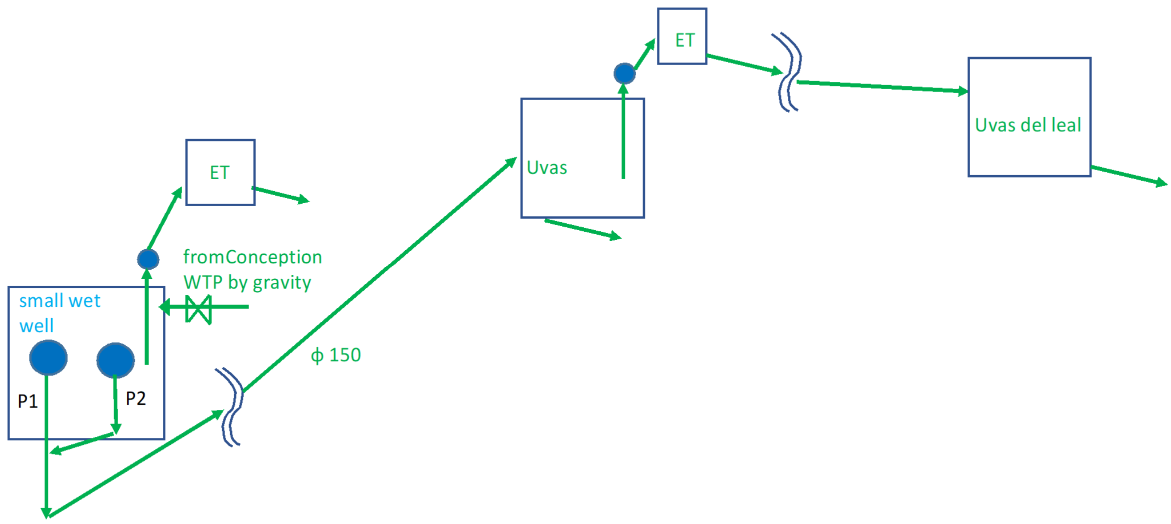
23) Las Uvas PS

The flow rate of this pump station is approximately 28 L/s. It was constructed in 2000. Clear water is received from the Conception WTP by gravity flow to the wet well here and transferred to the Uvas Tank through a 150 mm diameter transmission main. Another small elevated tank with a centrifugal pump was built next to this station around 2011 to serve nearby houses at request of the neighbors. UMAPS allowed the construction of the tank for additional supply. The current major issues are as follows:

- No water level gauges, flow meters, and pressure gauges installed.
- Pumps are installed outdoors with roof.
- Surge device does not work at all.

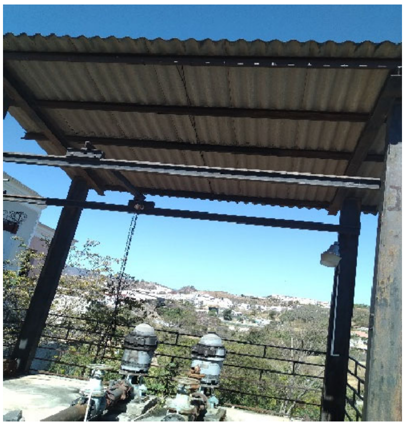
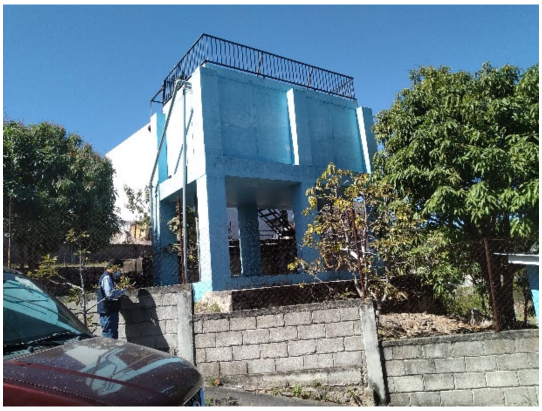
The schematic drawing and photos of this pump station are shown in Source: JICA Study Team

Figure 3.3.54 and Figure 3.3.55, respectively.



Source: JICA Study Team

Figure 3.3.54 Current Flow Schematic of Las Uvas PS

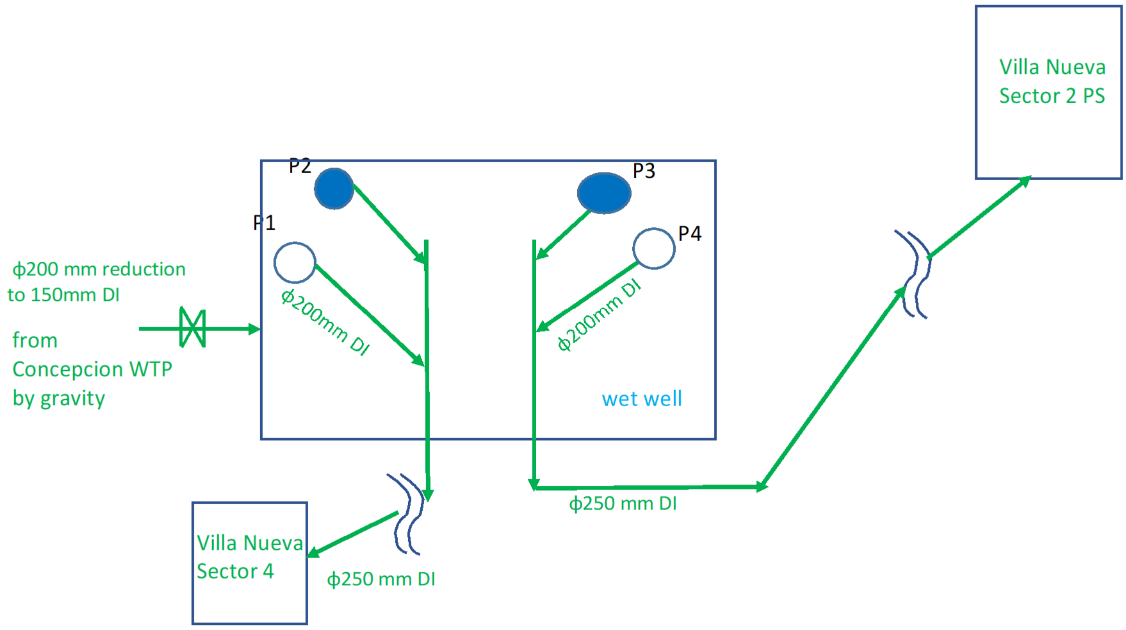
	
Overall View	Elevated Tank Constructed in 2011.

Source: JICA Study Team

Figure 3.3.55 Current Situation of Las Uvas PS

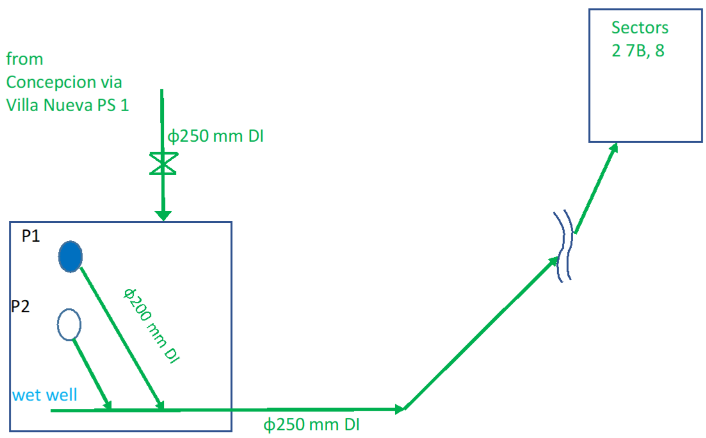
24) Villa Nueva PS

The first station has a common wet well that receives clear water from the Conception WTP by gravity flow. Clear water is transferred to the Villa Nueva Sector 4 Tank through a 250 mm diameter transmission main by one duty pump with standby, and to the second station (say Villa Nueva Sector 2) through a 250 mm diameter transmission main by another duty pump with standby. The second station in another location also has a wet well, and clear water is transferred to Sectors 2, 7B, 8 area. Some minor repairs, such as rewinding of the motors, are carried out. Safety level seems to be unstable around here. The schematic drawing and photos of this pump station are shown in Figure 3.3.56, Figure 3.3.57, and Figure 3.3.58.



Source: JICA Study Team

Figure 3.3.56 Current Flow Schematic of Villa Nueva PS -1



Source: JICA Study Team

Figure 3.3.57 Current Flow Schematic of Villa Nueva PS -2

Overall View (Main Pump Station)

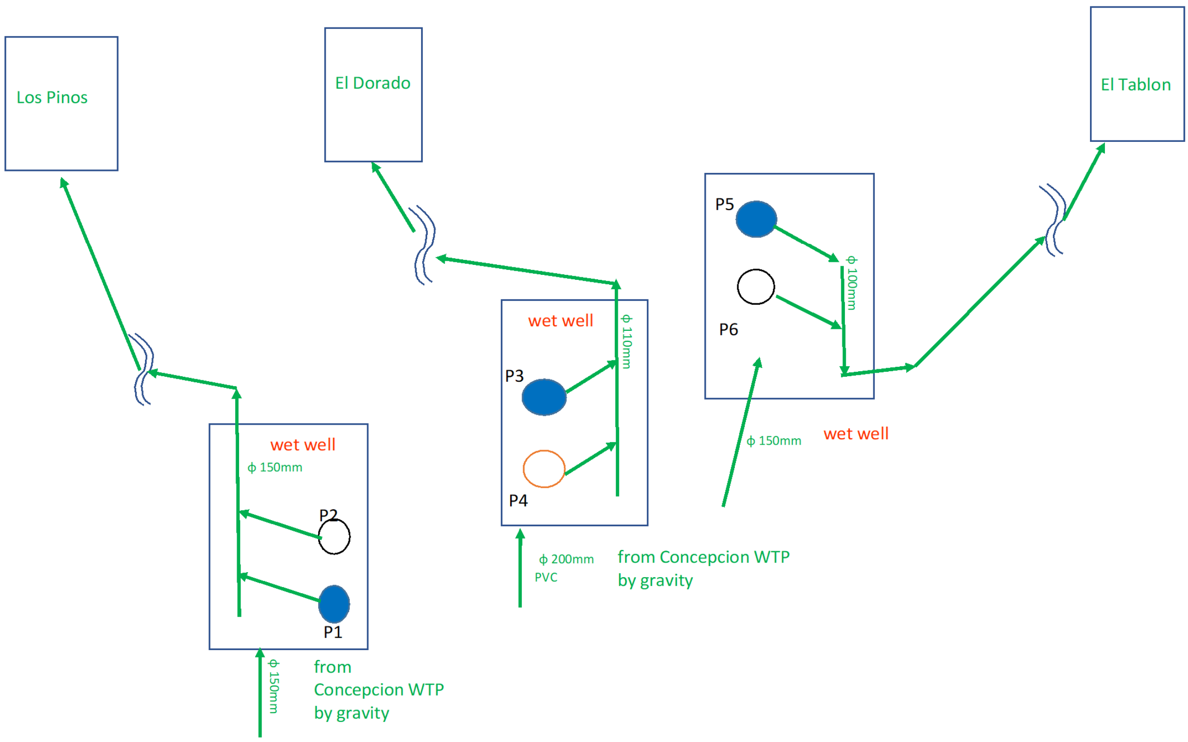
Overall View (Pump Station 2)

Source: JICA Study Team

Figure 3.3.58 Current Situation of Villa Nueva PS

25) Los Pinos PS

There are three stations each with a clear water receiving well where clear water is received from the Conception WTP by gravity flow. The first station was renewed in 1996 and clear water is transferred to the Los Pinos Tank through a transmission main by one duty pump with standby. The second and third stations are managed by the water committee although UMAPS is responsible for their operation. Clear water is transferred to these stations to the El Dorado Tank and El Tablon Tank, respectively. Therefore, detailed specifications are not clear. The schematic drawing and photos of this pump station are shown in Figure 3.3.59 and Figure 3.3.60, respectively.



Source: JICA Study Team

Figure 3.3.59 Current Flow Schematic of Los Pinos PS

	
Overall View for Los Pinos	Control Panel for Los Pinos
	
Overall View for El Dorado (one is broken)	Vertical In-well Pumps for El Tablon (one is broken)

Source: JICA Study Team

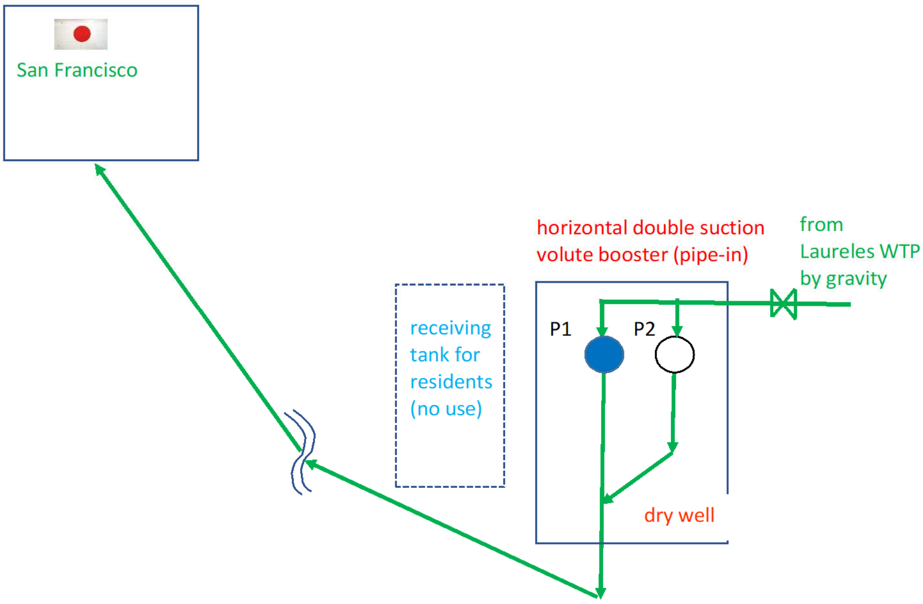
Figure 3.3.60 Current Situation of Los Pinos PS

26) San Francisco PS

The flow rate of the direct pipe-in booster station, which was constructed in 1980, is approximately 35 L/s. Clear water is received from the Laureles WTP by gravity flow to the wet well and transferred to the San Francisco Tank through a transmission main by one duty pump with standby, which was constructed by Japanese grant aid project completed in 2011. Current major issues are as follows:

- The duty pump was replaced in 2005. But the standby pump is aging, and especially not working due to electrical problems.
- No water level gauges installed, and no properly functioning flow meter and pressure gauges.
- Pumps are installed outdoors, and therefore seem deteriorated.

The schematic drawing and photos of this pump station are shown in Figure 3.3.61 and Figure 3.3.62, respectively.



Source: JICA Study Team

Figure 3.3.61 Current Flow Schematic of San Francisco PS

	
Overall View	In-line Pumps

JICA Study Team

Figure 3.3.62 Current Situation of San Francisco PS

3.3.7 Electrical Facility and Instrumentation

(1) Current Status of the Existing Pump Station

The electrical equipment is also getting old and it is recommended that when the pumps are renewed the electrical equipment, including the transformer, should also be renewed. The level switch that detects low water level is damaged or not installed in the pump well, and manual stop is done by visual check, which is thought to be the cause of the malfunctions. In addition, only mechanical flow meters are installed on the discharge side of the pumps, and most of them are broken. Half of the electrical panels are installed outdoors, causing them to age and raising safety issues.

(2) Current Status of the Existing Water Distribution Tank

The water distribution tank to which water is pumped is installed only with a mechanical water level gauge, and is run and stopped through verbal instruction by radio, which is thought to be one of the reasons for the leakage. The inlet flow meters to the water distribution tank are all unmeasurable, although insertion-type flow meters, which will be described later, have been installed. Most of the flow meters and transducers are installed outdoors, causing them to deteriorate.

(3) Current Status of the Existing SCADA System (Cause of Malfunction in Picacho SCADA)

With donation funds from Spain 2009-2013, the services of the AQUARUM Consortium were contracted for the execution of the Operational Optimization Project of Tegucigalpa. The telecontrol unit for the automation of Tegucigalpa's potable water supply network was created as part of this project, which is focused on the installation of a SCADA system for the remote control of the two large networks. These large networks, into which the water system of Tegucigalpa is divided, are commonly known as the Upper and Lower Networks. The works corresponding to the project and its start-up were carried out and completed in 2012, so called Picacho SCADA.

After the completion of this project and for different reasons, a series of problems began to arise in the implemented system and the telecontrol unit is not currently operational. The main causes of malfunction are shown below.

1) Data Communication Failure

For communication between the remote stations and the control room, microwave electromagnetic wave (2.4 GHz, 5 GHz) communication networks are used, based on point-to-point connections, where the antenna is installed at each station. It is necessary to keep the “line of sight” for good transmission of point-to-point connections. According to UMAPS, due to the development of the city, buildings have been built vertically, and the central station that was visible at the beginning of the project became invisible and the line of sight has been lost. It is true at some sites, but it seems that the installation location of antenna is not high to obtain the line of sight at some sites. Moreover, improper selection of construction material and improper installation work would be the reason for the data communication failure.

2) Influence of Voltage Fluctuation

Although not confirmed in the site survey, according to UMAPS, voltage fluctuation is one of the reasons for the malfunction of equipment, such as flow meter. Considering that motors and other power equipment are not affected, small noises or surges may be the cause of the malfunction. This effect may be suppressed by using a power supply via a rectifier such as a UPS, but it could also be caused by a grounding fault as described next.

3) Improper Installation

Throughout the site survey, basic construction work, such as cable connections, cable protection, equipment protection, rigid installation, and grounding work, was not done properly. In addition, as they are often installed outdoors, they appeared to be deteriorating because of ultraviolet rays, wind, and rain. Unknown malfunctions may be largely due to simple construction defects.

4) Type of Flow Meter

The existing flow meter was an insertion-type electromagnetic flow meter. The insertion type has the advantage of being able to be installed in existing piping, but it also has many disadvantages, such as difficult installation and unstable accuracy, and its adoption in water supply facilities is limited. None of the insertion-type flow meters were currently in good working condition. Not only that, but some were leaking from holes drilled in the piping for installation. In addition, the existing facility did not have a flow meter pit, which caused physical damage to the flow meters. A flange-mounted electromagnetic flow meter would be appropriate, although it would require piping work. The photos of each type of flow meter are shown in Figure 3.3.63.

Insertion Type

Flange-mounted Type

Source: JICA Study Team

Figure 3.3.63 Installation of Flow Meter

These four causes of failure can be prevented by taking countermeasures. Proposed measures to be taken are the use of cellular networks for communication and the use of flange-mounted flow meters, details of which are described in "6.2.2 Electrical Facility”.

3.3.8 Information System

The commercial sub-management is operating customer management system. The customer information (customer number, address, customer category, water usage, etc.) is registered in the system. This system is synchronized with Web-GIS so that information can be checked on Web-GIS. The repair and maintenance section of the potable water sub-management has developed the GIS database of the water leakage repair record.

Moreover, the technical cadastre section of the engineering and development sub-management has taken over the GIS database of the water supply system from SANAA. The technical cadastre section is going to verify and enhance the GIS database.

The current challenge is to develop a system to regularly update these information and to integrate these database.

3.4 Water Balance Analysis

The water balance analysis was conducted in accordance with the IWA definition shown in Table 3.4.1.

Table 3.4.1 Water Balance Sheet

Item				Detail	2021		2022	
					Volume(m^3)	%	Volume(m^3)	%
Input Volume	Authorized consumption	Billed Consumption	①Billed metered consumption	Water meter bill and AQUABLOQ bill(Water tanker)	13,340,698	18.2%	15,163,487	20.7%
			② Billed unmetered consumption	Flat rate bill	40,773,305	55.6%	39,099,763	53.4%
		Unbilled Authorized Consumption	③Unbilled Metered Consumption	Deduced consumption by settlement	261,001	0.36%	321,068	0.44%
			④Unbilled Unmetered Consumption	Water Tanker distribution for free of charge	140,120	0.19%	115,615	0.16%
	Water Losses	Commercial losses	⑤Unauthorized Consumption	Water theft	0	0%	0	0%
			⑥Metering Inaccuracies and Date handling Errors	⑥-1: Inaccurancies of water meter and flat rate bill	8,154,661	11.1%	7,819,953	10.7%
				⑥-2:Volume of water not detected by water meter	10,402		10,402	
		Physical Losses	⑦Leakage on Transmission or Distribution main	Assumition by watere lekage record from 2016-2020. Inculided in ⑨	10,492,588	14.3%	10,607,198	14.5%
			⑧Leakage and Overflows at Utility's storage tank	Result of Site survey	150,813	0.21%	150,813	0.21%
			⑨Leakage on Service Connections up to the mesurement point	It is inculided in ⑦	-		-	
				Total	73,323,589		73,288,300	
				NRW rate（Total of ③ to ⑨）/Total	26.2%		26.0%	

Source: JICA Study Team

The estimation process of each item indicated in the above table is described below.

(1) Input Volume

The input volume is based on the data from four WTPs: Picacho WTP, Laureles WTP, Concepcion WTP and Miraflores WTP.

(2) Billed Consumption

<u>① Billed Metered Consumption</u>

Total volume of water metered by the customer meter and the volume of water distributed by the private water truck called AQUABLOQ.

<u>② Billed Unmetered Consumption</u>

Total volume of water billed based on the average of the past three months due to malfunction of water meter and the water billed at flat rate.

(3) Unbilled Authorized Consumption

<u>③ Unbilled Metered Consumption</u>

This is the amount of excess water due to domestic water leakage, etc. This has been determined through the discussion between the customer and UMAPS.

<u>④ Unbilled Unmetered Consumption</u>

This is the amount of water that UMAPS provides using water tankers free of charge to the poor people and to the areas that cannot be served by the water supply system. Filling station of water tanker is located at Los Filtros, Picacho WTP, and Miraflores WTP. This volume has been calculated based on the driving record of water tanker.

(4) Commercial Loss

⑤ Unauthorized Consumption

Current situation of unauthorized connection is unknown. Thus, it was estimated to be zero at this moment. UMAPS estimation is approximately from 10 to 30%. However, it must be estimated by confirming the unauthorized connection in future.

⑥ Metering Inaccuracies and Data Handling Errors

This divided into two types：⑥-1 Inaccuracies of water meter and flat rate bill, and ⑥-2 : The amount of water not measured by the water meter

⑥-1 Inaccuracies of water meter and flat rate bill

In order to verify this amount, A total of 20 new water meters were installed during this study, which consists of two cases: Location of water meter installations were selected in consultation with UMAPS in the area where water meter theft did not highly occur and where customers were willing to cooperate.

Case 1 (11 sample) : Replacement of existing water meter with the new water meter

Case 2 (9 sample): Installation of new water meter where there is no water meter

The installation image is shown in Figure 3.4.1.

Residencia Palma Real	Centro America Oeste	Residencia La Hacienda
		

Source: JICA Study Team

Figure 3.4.1 Installation of Water Meter

Table 3.4.2 shows the comparison of water amount between before (2022) and after (2023) installation of new water meters.

Table 3.4.2 Result of Water Meter Installation

Case1 Compare with New water meter and current water meter (11 sample)

Year	Monthly average (m^3)			
-	May	June	July	Average
2022	22.7	22.3	29.7	24.9
2023	13.3	25.7	33.3	24.1
			Comparison to last year	-3%

Case 2 Compare with new water meter and flat rate(9 sample)

Year	Monthly average (m^3)			
-	May	June	July	Average
2022	28.8	29.7	29.2	29.2
2023	20.0	36.8	50.5	35.8
			Comparison to last year	22%

Source: JICA Study Team

It should be noted the condition in 2022 and 2023 is not necessary same, due to changes in family composition and other factors. It is likely that the hotter weather and small rainfall in July would result in more watering of residential gardens.

As shown in Case 1 of the above table, the difference between existing water meter (2022) and new water meter (2023) is low. Thus, inaccuracies of current water meters could not be evaluated at this moment. On the other hand, as shown in Case 2, the metered amount have increased by 22% compared with the amount with flat rate.

Although the results could change if more water meters were installed and compared. As a result of this comparative study, it is assumed that there is no significant difference between the existing aging water meters and the new water meters.

As a conclusion, ⑥-1 Inaccuracies of water meter and flat rate bill can be estimated at 20% of ② Billed Unmetered Consumption.

⑥-2 : The amount of water not measured by the water meter

Due to the intermittent water supply in Tegucigalpa, almost all customers have an underground tank in the house or building. During water distribution, water is supplied to the underground tank by gravity through a float valve. When the underground tank is full, the float valve automatically close and stop water supply. However, a small amount of water is still supplied. This kind of water cannot be detected by the water meter due to very small amount of flow rate. Since the water supply is currently intermittent, it is assumed that each customer's underground tank is filled once every four days and that low flows occur for approximately two hours.

(5) Physical Losses

Physical loss was calculated as input volume minus authorized consumption and commercial loss.

⑦: Leakage on water transmission and distribution system

It was calculated as total physical loss minus other item ⑧.

⑧: Leakage and overflow at the utility's storage tank

This calculated by site survey. Water leaks were found in 5 distribution tanks. The amount of leakage was visually estimated and assumed to be 24 hours a day, 7 days a week. t.

NRW rates in 2021 and 2022 were estimated to be 26.2% and 26.0%, respectively. It should be noted these figures were under the condition of intermittent water supply every 3 or 4 days and for 12 hours. NRW may increase under the condition of 24 hours water supply due to increase of physical loss, unless the water distribution network is improved.

3.5 Current Problem and Required Improvement

The problem of water supply in Tegucigalpa is that the water source is limited and thus the water supply to the residents is the intermittent supply. Moreover, the water is distributed unequally. There is a need to improve the water supply situation (water supply time and water pressure) by distributing the limited water equally to the residents as much as possible without wasting it.

This section presents the current problems and countermeasures to be taken for each process of the water supply: i) Water transmission, ii) Water distribution, and iii) Service connection. The countermeasures which should be implemented under the loan project are marked with (P), and those which should be implemented under the technical cooperation project are marked with (T). The countermeasures marked with (P) are described in Chapters 5 and 6, and those marked with (T) are described in Chapter 9.

3.5.1 Water Transmission Pipeline and Pump Station

(1) Current Problems

- There are deteriorated pipelines and pump facilities with a risk of accidents or malfunction, which will cause problems with water transmission.
- The amount of water delivered to each distribution tank is not quantitatively controlled. As a result, appropriate and equitable water distribution is not being achieved.
- Facility information (inventory information, operation records, and repair records) is not properly recorded and maintained.

(2) Countermeasures

- Renewal of deteriorated facilities **(P)**
- Installing the equipment for measuring and monitoring the volume of water delivered to each water distribution tanks (P)
- Making a water allocation plan based on actual data of water supply **(T)**
- Establishing a facility management system. **(T)**

3.5.2 Water Distribution Tank

(1) Current Problems

- There are deteriorated water distribution tanks with water leakage and water contamination. In addition, some of them are insufficient in capacity.
- Water levels and outflow volumes of the tanks are not recorded, and thus the water distribution is not properly managed.

(2) Countermeasures

- Renew the water distribution tanks **(P)**
- Install a measurement equipment of water level and outflow meter at the distribution tanks **(P)**

3.5.3 Water Distribution Pipeline Network

(1) Current Problems

- There are areas where water is easily distributed (low elevation areas) and areas where water is not easily distributed (high elevation areas). The water is distributed first to the former areas and not enough water is distributed to the latter areas, resulting in poor water supply in the latter area.
- In some areas, the maximum hydrostatic pressure exceeds 1 MPa, causing frequent water leakage. Pressure reducing valves have been installed in some areas, but some of them are malfunctioning.
- The GIS map of pipelines was created in 2021, but the information of some areas differ from the current status.
- The annual number of leaks per 100 km of distribution pipes is approximately 260 per 100 km/year, which is about 15 times higher than the IWA recommended allowable number of 13 per 100 km/year.
- The annual number of leaks per 1,000 connections of water supply pipes is about 30 leaks per 1,000 connections/year, which is about 10 times the IWA recommended allowable number of 3 leaks per 1,000 connections/year.

(2) Countermeasures

- Dividing the distribution area into high and low areas, and installing a pressure reducing valve at the boundary between high and low area. **(P)**
- Update GIS maps **(T)**
- Grasp the details of water distribution status (water supply time, distribution pressure) of each area. **(T)**
- Leakage investigation and evaluation **(T)**
- Study on leakage investigation and repair method under intermittent water supply **(T)**

3.5.4 Customer Connection and Customer Meter

(1) Current Problems

- Of the 124,732 total connections, 78,527 connections are equipped with customer meters. But only 35,019 (28% of all connections) customer meters are functioning. The remaining 72% of connections are charged a fixed rate based on estimated water consumption. Customers with fixed rates are not conscious of water conservation because the rate does not change no matter how much they use. In addition, even if there is water leakage on their premises, it is left unrepaired.

- The installation and maintenance of customer meters is to be performed by UMAPS according to the law, but in reality, customers procure the meters at hardware stores in the city and install the meters by themselves. UMAPS does not periodically replace customer meters.
- The intermittent water supply has led to over-metering and malfunctions of the meters due to intrusion of air and other contaminants into the meters. Customer's trust in meters is low. Approximately 70% of customer complaints are about excessive water readings.
- UMAPS sometimes calibrates meters at the request of customers, but because it is a single-point calibration, the calibration is not performed correctly.

(2) Countermeasures

- Setting of appropriate standards of design and construction of customer connections and specification of customer meter [(air valve + UFR + meter) or (smart meter)] **(T) and (P)**
- Planning and implementation of procurement, installation, and replacement of meters **(T) and (P)**
- Establishment of an appropriate meter calibration system **(T)**

3.5.5 Customer Management

(1) Current Problems

- UMAPS has a customer ledger system, and customer information (customer number, address, customer category, water usage, etc.) is registered in the system. This system is synchronized with Web-GIS so that information can be checked on Web-GIS. However, the system for regularly updating and correcting the registered information is not in place.
- The number of connections that are not registered as customers (so-called illegal connections) is estimated to be as high as 30% of the total number of registered connections.

(2) Countermeasures

- Checking of customer ledger information with actual customer information obtained by the meter reader **(T)**
- Implement a customer ledger updating system based on on-site information from meter readers **(T)**
- Identification of illegal connections **(T)**
- Develop and implement a plan to reduce illegal connections **(T)**

CHAPTER 4 WATER SUPPLY PLAN

4.1 Water Demand Projection

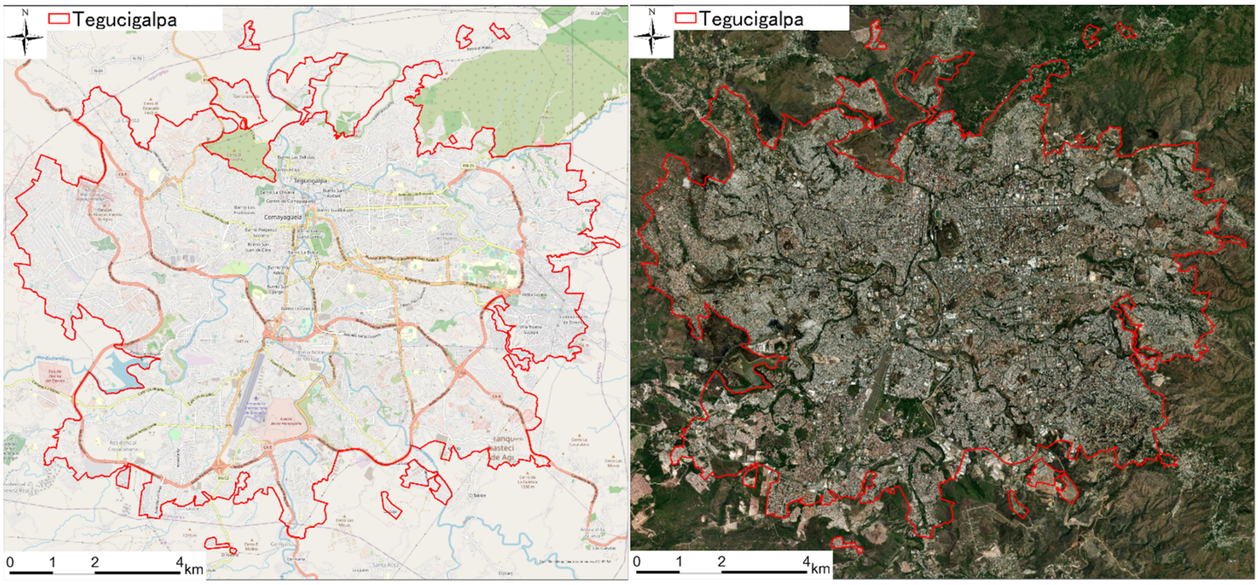
4.1.1 Basic Condition

(1) Target Year

The target year has been set as 2038, 15 years after 2023, in accordance with the SANAA's guideline (*Normas y Especificaciones, Normas SANAA DM 1 – 89, Distrito Metropolitano Departamento de Operación y Mantenimiento* 2001).

(2) Target Area

The target area is Tegucigalpa, as shown in Figure 4.1.1 .



Source: AMDC

Figure 4.1.1 Target Area for the Water Supply Plan

(3) Base Population

The population data by colonia for 2013, which was prepared by SANAA based on the latest INE (Instituto Nacional De Estadistica) census for 2013, is used as the base population for the population projection. The total population of Tegucigalpa in 2013 was 1,005,586. The population in each colonia is shown in the Appendix 4.1.1.

(4) Population Growth Ratio

1) Population Growth Ratio Until 2023

The population growth ratio until 2023 has been set as shown in Table 4.1.1, based on the INE's population projection of entire Distrito Central.

Table 4.1.1 Population and Its Annual Growth Ratio Until 2023 for Distrito Central

Item	2013	2021	2022	2023
Population	1,157,509	1,293,611	1,310,204	1,326,460
Growth Rate (%)	-	1.40	1.28	1.24

Source: INE

2) Population Growth Ratio After 2023

The population growth ratio after 2023 has been estimated as shown in Table 4.1.2, in proportion to the trend of United Nation's (UN) projection.

Table 4.1.2 Annual Population Growth Ratio After 2023

Unit: %/year

Growth Ratio	2023	2024	2025	2026	2027	2028	2029	2030
Honduras (UN's projection)	1.54	1.51	1.48	1.45	1.41	1.38	1.34	1.30
Distrito Central	1.24	1.22	1.19	1.17	1.14	1.11	1.08	1.05
	2031	2032	2033	2034	2035	2036	2037	2038
Honduras (UN's projection)	1.27	1.23	1.19	1.16	1.12	1.09	1.05	1.02
Distrito Central	1.02	0.99	0.96	0.93	0.90	0.88	0.85	0.82

Source: Population of Honduras based on UN (World Population Prospects 2019) (https://statisticstimes.com/demographics/country/honduras-population.php)

(5) Unit Water Demand (Not Including Water Leakage)

Unit water demand (not including water leakage) has been set as shown in Table 4.1.3, following the SANAA's guideline. The unit water demand in each colonia is shown in the Appendix 4.1.1.

Table 4.1.3 Unit Water Demand

Category	Unit Water Demand (L/capita/day)
Superior Very High Income	300
High Income	230
Medium Income	180
Low Income	100
Very low income	50

Source: JICA Study Team based on SANAA's guideline

(6) Ratio of Water Leakage

Ratio of water leakage has been set as 30%, based on the current data of Unidad Municipal de Agua Potable y Saneamiento (UMAPS).

(7) Ratio of Non-domestic Water

Ratio of non-domestic water has been set based on the billing data of UMAPS in 2021 and 2022, as shown in Table 4.1.4,

Table 4.1.4 Billed Water Amount by Customer Category

Category		Billed Amount in 2021 and 2022 (m^3/two years)
Domestic		71,989,006
Non-domestic		18,594,292
	Commercial	9,545,432
	Industrial	1,316,594
	Governmental	7,732,266
Water Union		16,777,675
	Total	107,360,973

Note: There may be a case where the customer currently categorized as domestic should be re-categorized as commercial.

Source: JICA Study Team based on the data from UMAPS

Thus, the ratio of non-domestic water to Domestic water is: 18,594,292/71,989,006 = 0.258

4.1.2 Population Projection

According to the 2013 census, the population of Tegucigalpa was 1,005,586. The population projection up to 2038 was made applying annual growth rate of Distrito Central from 2013 to 2023 shown in Table 4.1.1 and that from 2023 to 2038 shown in Table 4.1.2. The projection result is shown in Table 4.1.5. The population for each colonia is shown in the Appendix 4.1.1.

Table 4.1.5 Results of Population Projection in Tegucigalpa

2013	2023	2026	2029	2032	2035	2038
1,005,586	1,152,388	1,194,138	1,234,345	1,272,503	1,308,337	1,341,983

Source: JICA Study Team based on the data prepared by SANAA based on the latest INE's census for 2013

4.1.3 Water Demand Projection

The water demand for the whole Tegucigalpa in 2038 is 424,745 m^3/day and the water demand for piped water in Tegucigalpa in 2038 is 390,404 m^3/day.

The calculation process is shown below:

Water Demand of Colonia = Population of Colonia x Unit water demand of colonia x 1+0.258 (Ratio of Non-domestic water) x 1+0.3(Assumed water loss ratio in case of piped water)

The demand for each distribution tank is shown in Table 4.1.6. The demand of each colonia is shown in Appendix 4.1.1.

Table 4.1.6 Water Demand for Each Distribution Tank

No.	Name	Population in 2038	Water Demand in 2038 (m^3/day)
1	Japon	1,895	341
2	Saucique	865	155
3	Sagastume	4,947	1,600
4	El Porvenir	2,892	520
5	El Rincon	1,644	680
6	Guillen	5,741	1,032
7	Canaan	6,773	1,217
8	Estanzuela	1,440	259
9	El Molinon	2,520	1,211
10	La Sosa	53,903	15,649
11	La Travesia	39,099	12,673
12	Cerro Grande 1	25,508	11,962

No.	Name	Population in 2038	Water Demand in 2038 (m^3/day)
13	Olimpo 1	53,835	13,512
14	Olimpo 1 (Viejo)	49,008	9,380
15	Olimpo 2 (Nuevo 1)	34,841	6,922
16	Olimpo 2 (Nuevo 2)	15,037	3,166
17	Olimpo 2 (Viejo 2)	15,016	3,820
18	Olimpo 2 (Viejo)	10,022	2,449
19	La Flor	4,623	1,021
20	Juan A. Lainez 1	3,252	940
21	Juan A. Lainez 2	399	110
22	Canal 11	11,666	5,771
23	Canal 11 (Viejo)	5,442	2,839
24	La Leona 1	11,337	4,420
25	La Leona 2	15,821	5,422
26	La Leona 3	3,470	1,047
27	La Leona 4	8,708	3,055
28	Linderos 1	12,755	5,022
29	Linderos 2	14,305	3,997
30	Linderos 3	3,637	1,594
31	Lomas 2da. Etapa	9,741	3,917
32	Universidad Norte 1	7,300	3,538
33	Universidad Norte 2	475	256
34	Suyapita	12,203	5,543
35	Altos del Trapiche	4,258	2,296
36	Hato de Enmedio	24,813	9,704
37	Covespul/San Juan	2,114	1,140
38	Los Laureles 1	474	153
39	Los Laureles 2	1,401	252
40	Mogote 1	31,405	11,076
41	Mogote 2	19,465	4,050
42	Altos de los Laureles	3,080	554
43	Santa Cruz	834	450
44	Los Robles	4,476	2,413
45	Roble Oeste Etapa 1, 2 y 3	4,903	1,954
46	Roble Oeste 4ta. Etapa	551	297
47	Francisco Morazan	3,016	1,247
48	19 de Septiembre	1,401	252
49	San Francisco 1	21,413	4,371
50	San Francisco 2	8,791	2,543
51	La Fuente	2,178	967
52	Roble Alto 1ra. Etapa	259	140
53	Roble Alto 2da. Etapa	259	140
54	Las Hadas 1	7,185	3,682
55	Las Hadas 2	1,856	873
56	El Sauce	507	273
57	Estiquirin 1	45,750	15,552
58	Estiquirin 2	75,482	24,081
59	Estiquirin (Nuevo)	26,929	10,496
60	Carrizal	82,163	17,474
61	Centro America Este	13,620	6,528
62	Centro America Oeste	6,437	2,661
63	Centro America Oeste 2	6,437	2,661
64	Los Filtros 1	20,258	6,223
65	Los Filtros 2	12,936	3,850
66	Los Filtros (Nuevo)	16,630	3,718

No.	Name	Population in 2038	Water Demand in 2038 (m^3/day)
67	Altos de Primavera	248	44
68	Divanna	3,538	636
69	Centro Lomas	10,987	5,053
70	Centro Lomas (Nuevo)	14,550	7,715
71	Concepcion	0	0
72	Concepcion (Nuevo)	0	0
73	Res. Concepcion	830	447
74	Lomas Toncontin 1	1,065	440
75	Lomas Toncontin 2	5,014	2,703
76	Altos de Toncontin	883	455
77	Palma Real	2,848	1,535
78	Jardines de Loarque	1,806	974
79	Altos de Loarque	1,807	325
80	San Jose de Loarque	887	287
81	Loarque 1	15,149	6,877
82	Loarque 2	2,036	842
83	Yaguacire	0	0
84	La Cascada	1,405	757
85	Las Uvas	1,014	419
86	Villas del Real	1,262	418
87	14 de Marzo	16,060	3,578
88	14 de Marzo (Nuevo)	6,214	1,615
89	Calpules 1 (Alto)	3,374	1,395
90	Calpules 2 (Bajo)	2,367	665
91	Venecia	3,986	1,985
92	Monterrey	5,847	1,891
93	Los Llanos	3,749	1,550
94	Miraflores 1	11,267	4,790
95	Miraflores 2	2,115	906
96	Miraflores (Nuevo)	11,496	5,997
97	Grupo Empresarial	0	0
98	Las Mesitas	4,968	2,053
99	Kennedy 3	70,725	29,776
100	Los Pinos	19,634	3,814
101	Altos de los Pinos	0	0
102	Villa Nueva 5	8,027	1,443
103	Honduras Res. Alto	5,585	2,308
104	Honduras Res. (Bajo)	4,352	1,799
105	Villa Nueva 1	8,027	1,443
106	Villa Nueva 2	8,027	1,443
107	Villa Nueva 3	8,027	1,443
108	Villa Nueva 4	8,027	1,443
109	Villa Nueva 6	8,027	1,443
110	Aldea Suyapa	31,999	9,286
111	Nueva Suyapa	7,143	1,306
	Sub-Total	1,225,773	390,404
	Colonias without piped supply	116,211	34,341
	Total	1,341,983	424,745

Source: JICA Study Team based on the data prepared by SANAA based on the latest INE's census for 2013

4.2 Water Transmission Plan

4.2.1 Water Transmission System

There are four water treatment plants (WTPs) in Tegucigalpa: Picacho WTP, Laureles WTP, Concepcion WTP, and Miraflores WTP. The treated water from the WTPs are being transmitted to the distribution tanks via three transmission systems: 1) Picacho System, 2) Laureles System, and 3) Concepcion System. The Miraflores WTP supplies water only to the Miraflores Distribution Tank, which also receives water from the Concepcion System.

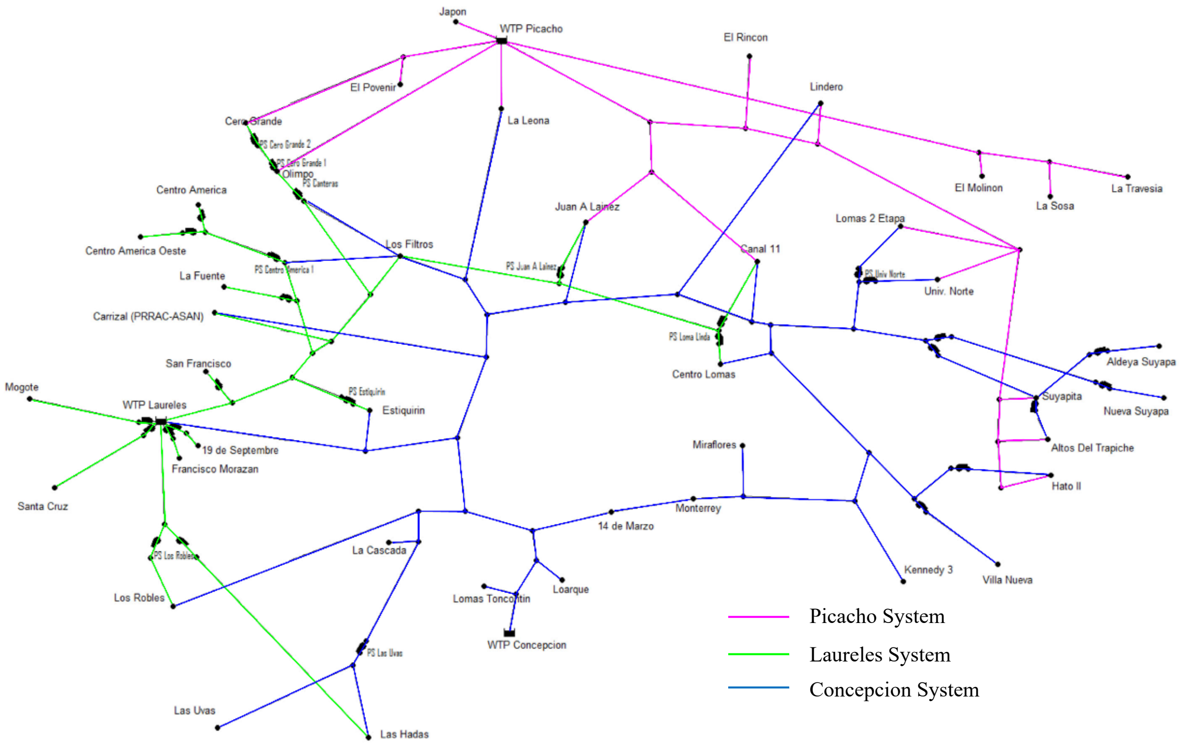
The 111 tanks as presented in Table 4.1.6 can be grouped into 42 tank groups as presented in Table 4.2.1. The grouping of the tank is presented in the Appendix 4.2.1.

Table 4.2.1 Tank Groups and Their Water Demand

Tank Group	Water Demand in 2038 (m3/d)	Tank Group	Water Demand in 2038 (m3/d)
Porvenir	520	Lomas de Toncontin	7,167
Japon	2,096	Loarque	7,718
Cerro Grande	11,962	14 de Marzo	7,252
Olimpo	40,270	Monterrey	3,441
El Rincon	3,187	Miraflores	11,694
Linderos	10,613	Centro Lomas	12,768
La Leona	13,944	Canal 11	8,609
Centro America Oeste	5,321	Juan A. Lainez	1,050
San Francisco	6,914	Lomas II Etapa	3,917
Centro America	6,528	Universidad Norte	3,794
La Fuente	967	El Molinon	1,211
Los Filtros	14,471	La Sosa	15,649
Mogote	16,084	La Travesia	12,673
Francisco Morazan	1,247	Aldea Suyapa	9,286
19 de Septiembre	252	Nueva Suyapa	1,306
Estiquirin	50,129	Suyapita	5,543
Santa Cruz	450	Kennedy 3	43,178
Los Robles	4,943	Hato 2	10,844
Las Cascadas	757	Altos del Trapiche	2,296
Las Uvas	837	Villa Nueva	7,213
Las Hadas	4,829	Carrizal	17,474
		Total	**390,404**

Source: JICA Study Team

Figure 4.2.1 shows the schematic drawings of the water transmission systems to each tank group.



Source: JICA Study Team

Figure 4.2.1 Schematic Drawings of Water Transmission Systems

As shown above, many distribution tanks can be supplied by two or three transmission systems. In general, the contribution ratio of Picacho system decreases in dry season, since the available water from Picacho WTP decreases. Thus, in dry season, water transmission from Picacho WTP to several distribution tank such as La Leona tank is stopped. Instead, such tanks are supplied water from Concepcion system.

4.2.2 Available Treated Water

The amount of water that can be supplied from each WTP varies seasonally. Table 4.2.2 (reprint of Table 3.3.2) shows the maximum daily production in the rainy season and the minimum daily production in the dry season, which are the averages from 2015 to 2022.

Table 4.2.2 Maximum and Minimum Daily Production of WTPs (Average of 2015-2022)

WTP	Picacho	Laureles	Concepcion	Miraflores	Total
Maximum (m^3/day)	63,892	54,614	121,545	3,857	243,908
Minimum (m^3/day)	37,450	36,257	104,957	2,898	181,562

Source: JICA Study Team based on the data from UMAPS

An ongoing water resources development project called "San Jose project" is building a dam and WTP 2 km southeast of the city. The main features of the project are as follows:

- Water source: Jacaleapa River
- Dam height: 63 m
- Dam storage: 9.2 million m^3
- WTP production Rainy season: 690 L/s (59,616 m^3/day)

Dry season : 430 L/s (37,152 m^3/day)

- The treated water will be directly transmitted to the existing tanks at the southeast area of the city via the newly constructed transmission pipeline; not through the Concepcion System.
- The newly constructed transmission pipeline will be connected to the southeast end of the Picacho System.

The San Jose project is supposed to be completed by 2028, five years after 2023. Thus, it shall be taken into account in the water transmission plan of the Project. Several water distribution tanks located in the southeast area of Tegucigalpa would be supplied mainly from the San Jose WTP.

There is also a plan for additional raw water to the Concepcion WTP by constructing a dam on the Jiniguare River, 1.5 km south of the Concepcion Dam. If this project is implemented, the production of the Concepcion WTP will be increased by around 30,000 m^3/day. This additional treated water will be transmitted to the southwest area of Tegucigalpa. However, this dam plan remains at the conceptual stage. Moreover, there is no plan for the expansion of the Concepcion WTP. It would be difficult to expand the capacity of the existing Concepcion WTP and it would be necessary to construct a separate WTP. Thus, the dam plan on the Jiniguare River shall not be taken into account in the water transmission plan of the Project.

4.2.3 Water Allocation Plan

The water transmission facility needs to be constructed and operated in line with the water allocation plan for equitable water delivery throughout the city.

Table 4.2.3 and Table 4.2.4 show the proposed water allocation plan in 2038, in which the water demand of each tank group can be fulfilled up to 77-79% in the rainy season and up to 56-57% in the dry season. The blue colored tank groups, which are currently supplied from the Picacho and Concepcion systems, are supposed to be supplied directly from the San Jose WTP.

Table 4.2.3 Proposed Water Allocation Plan in Rainy Season

WTP						Picacho WTP		Laureles WTP		Concepcion WTP		San Jose WTP	
Available Water in Rainy Season (m3/d)						63,892		54,614		125,402		59,616	
Tank / Tank Group	Demand in 2038 (m3/d)	Contribution ratio				Demand	Allocation	Demand	Allocation	Demand	Allocation	Demand	Allocation
		P	L	C	S								
Japon	2,096	1.00				2,096	1,633	0	0	0	0	0	0
Porvenir	520	1.00				520	405	0	0	0	0	0	0
El Rincon	3,187	1.00				3,187	2,483	0	0	0	0	0	0
El Molinon	1,211	1.00				1,211	944	0	0	0	0	0	0
La Sosa	15,649	1.00				15,649	12,193	0	0	0	0	0	0
La Travesia	12,673	1.00				12,673	9,875	0	0	0	0	0	0
Cerro Grande	11,962	0.40	0.10	0.50		4,785	3,728	1,196	932	5,981	4,602	0	0
Olimpo	40,270	0.40	0.10	0.50		16,108	12,551	4,027	3,138	20,135	15,493	0	0
Juan A. Lainez	1,050		0.20	0.80		0	0	210	164	840	646	0	0
Canal 11	8,609		0.20	0.80		0	0	1,722	1,342	6,887	5,300	0	0
La Leona	13,944	0.70		0.30		9,761	7,605	0	0	4,183	3,219	0	0
Linderos	10,613	1.00				10,613	8,269	0	0	0	0	0	0
Lomas II Etapa	3,917	0.70		0.30		2,742	2,137	0	0	1,175	904	0	0
Universidad Norte	3,794	0.70		0.30		2,656	2,069	0	0	1,138	876	0	0
Suyapita	5,543				*1.00*	0	0	0	0	0	0	5,543	4,386
Altos del Trapiche	2,296				*1.00*	0	0	0	0	0	0	2,296	1,816
Hato 2	10,844				*1.00*	0	0	0	0	0	0	10,844	8,580
Mogote	16,084		1.00			0	0	16,084	12,534	0	0	0	0
Santa Cruz	450		1.00			0	0	450	350	0	0	0	0
Francisco Morazan	1,247		1.00			0	0	1,247	971	0	0	0	0
19 de Septiembre	252		1.00			0	0	252	196	0	0	0	0
San Francisco	6,914		1.00			0	0	6,914	5,388	0	0	0	0
La Fuente	967		1.00			0	0	967	754	0	0	0	0
Los Robles	4,943		0.30	0.70		0	0	1,483	1,156	3,460	2,662	0	0
Las Hadas	4,829		0.30	0.70		0	0	1,449	1,129	3,380	2,601	0	0
Estiquirin	50,129		0.30	0.70		0	0	15,039	11,719	35,090	27,001	0	0
Carrizal	17,474		0.10	0.90		0	0	1,747	1,362	15,727	12,101	0	0
Centro America	6,528		1.00			0	0	6,528	5,087	0	0	0	0
Centro America Oeste	5,321		1.00			0	0	5,321	4,147	0	0	0	0
Los Filtros	14,471		0.20	0.80		0	0	2,894	2,255	11,576	8,908	0	0
Centro Lomas	12,768		0.20	0.80		0	0	2,554	1,990	10,214	7,860	0	0
Lomas de Toncontin	7,167			1.00		0	0			7,167	5,515	0	0
Loarque	7,718			1.00		0	0	0	0	7,718	5,939	0	0
Las Cascadas	757			1.00		0	0	0	0	757	583	0	0
Las Uvas	837			1.00		0	0	0	0	837	644	0	0
14 de Marzo	7,252			1.00		0	0	0	0	7,252	5,580	0	0
Monterrey	3,441			1.00		0	0	0	0	3,441	2,648	0	0
Miraflores	11,694			1.00		0	0	0	0	11,694	8,998	0	0
Kennedy 3	43,178			*0.10*	*0.90*	0	0	0	0	4,318	3,322	38,860	30,746
Villa Nueva	7,213				*1.00*	0	0	0	0	0	0	7,213	5,707
Aldea Suyapa	9,286				*1.00*	0	0	0	0	0	0	9,286	7,347
Nueva Suyapa	1,306				*1.00*	0	0	0	0	0	0	1,306	1,034
Total	390,404					82,000	63,892	70,082	54,614	162,973	125,402	75,349	59,616
Fulfilling ratio						0.78		0.78		0.77		0.79	

Note: P: Picacho system, L: Laureles system. C: Concepcion system, S: San Jose system

Note: Blue colored tanks would be separated from Picacho System and Concepcion System and would be supplied from San Jose WTP as mentioned in Section 4.2.2.

Source: JICA Study Team

Table 4.2.4 Proposed Water Allocation Plan in Dry Season

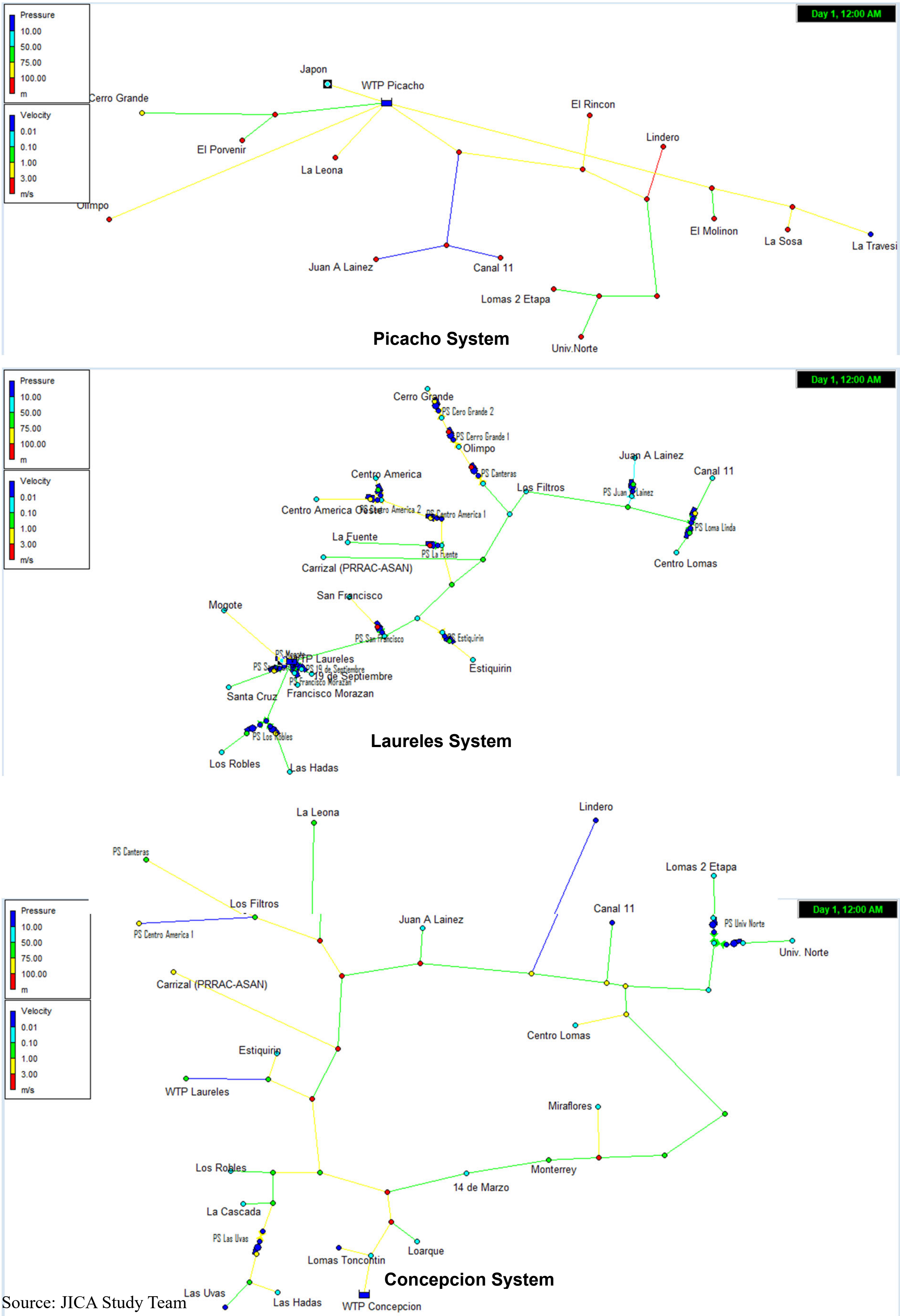
WTP						Picacho WTP		Laureles WTP		Concepcion WTP		San Jose WTP	
Available Water in Dry Season (m3/d)						37,450		36,257		107,856		37,152	
Tank / Tank Group	Demand in 2038 (m3/d)	Contribution ratio				Demand	Allocation	Demand	Allocation	Demand	Allocation	Demand	Allocation
		P	L	C	S								
Japon	2,096	1.00				2,096	1,175	0	0	0	0	0	0
Porvenir	520	1.00				520	291	0	0	0	0	0	0
El Rincon	3,187	1.00				3,187	1,786	0	0	0	0	0	0
El Molinon	1,211	1.00				1,211	679	0	0	0	0	0	0
La Sosa	15,649	1.00				15,649	8,768	0	0	0	0	0	0
La Travesia	12,673	1.00				12,673	7,101	0	0	0	0	0	0
Cerro Grande	11,962	0.40		0.60		4,785	2,681	0	0	7,177	4,012	0	0
Olimpo	40,270	0.40		0.60		16,108	9,025	0	0	24,162	13,505	0	0
Juan A. Lainez	1,050		0.20	0.80		0	0	210	119	840	469	0	0
Canal 11	8,609		0.20	0.80		0	0	1,722	977	6,887	3,850	0	0
La Leona	13,944			1.00		0	0	0	0	13,944	7,794	0	0
Linderos	10,613	1.00				10,613	5,946	0	0	0	0	0	0
Lomas II Etapa	3,917			1.00		0	0	0	0	3,917	2,190	0	0
Universidad Norte	3,794			1.00		0	0	0	0	3,794	2,120	0	0
Suyapita	5,543				1.00	0	0	0	0	0	0	5,543	3,087
Altos del Trapiche	2,296				1.00	0	0	0	0	0	0	2,296	1,278
Hato 2	10,844				1.00	0	0	0	0	0	0	10,844	6,039
Mogote	16,084		1.00			0	0	16,084	9,129	0	0	0	0
Santa Cruz	450		1.00			0	0	450	255	0	0	0	0
Francisco Morazan	1,247		1.00			0	0	1,247	708	0	0	0	0
19 de Septiembre	252		1.00			0	0	252	143	0	0	0	0
San Francisco	6,914		1.00			0	0	6,914	3,924	0	0	0	0
La Fuente	967		1.00			0	0	967	549	0	0	0	0
Los Robles	4,943		0.20	0.80		0	0	989	561	3,954	2,210	0	0
Las Hadas	4,829		0.20	0.80		0	0	966	548	3,863	2,159	0	0
Estiquirin	50,129		0.30	0.70		0	0	15,039	8,535	35,090	19,613	0	0
Carrizal	17,474		0.10	0.90		0	0	1,747	992	15,727	8,790	0	0
Centro America	6,528		1.00			0	0	6,528	3,705	0	0	0	0
Centro America Oeste	5,321		1.00			0	0	5,321	3,020	0	0	0	0
Los Filtros	14,471		0.20	0.80		0	0	2,894	1,643	11,576	6,470	0	0
Centro Lomas	12,768		0.20	0.80		0	0	2,554	1,449	10,214	5,709	0	0
Lomas de Toncontin	7,167			1.00		0	0			7,167	4,006	0	0
Loarque	7,718			1.00		0	0	0	0	7,718	4,314	0	0
Las Cascadas	757			1.00		0	0	0	0	757	423	0	0
Las Uvas	837			1.00		0	0	0	0	837	468	0	0
14 de Marzo	7,252			1.00		0	0	0	0	7,252	4,053	0	0
Monterrey	3,441			1.00		0	0	0	0	3,441	1,923	0	0
Miraflores	11,694			1.00		0	0	0	0	11,694	6,536	0	0
Kennedy 3	43,178			0.30	0.70	0	0	0	0	12,953	7,240	30,225	16,832
Villa Nueva	7,213				1.00	0	0	0	0	0	0	7,213	4,017
Aldea Suyapa	9,286				1.00	0	0	0	0	0	0	9,286	5,171
Nueva Suyapa	1,306				1.00	0	0	0	0	0	0	1,306	728
Total	390,404					66,842	37,450	63,882	36,257	192,967	107,856	66,713	37,152
					Fulfilling ratio	0.56		0.57		0.56		0.56	

Note: P: Picacho system, L: Laureles system. C: Concepcion system, S: San Jose system

Source: JICA Study Team

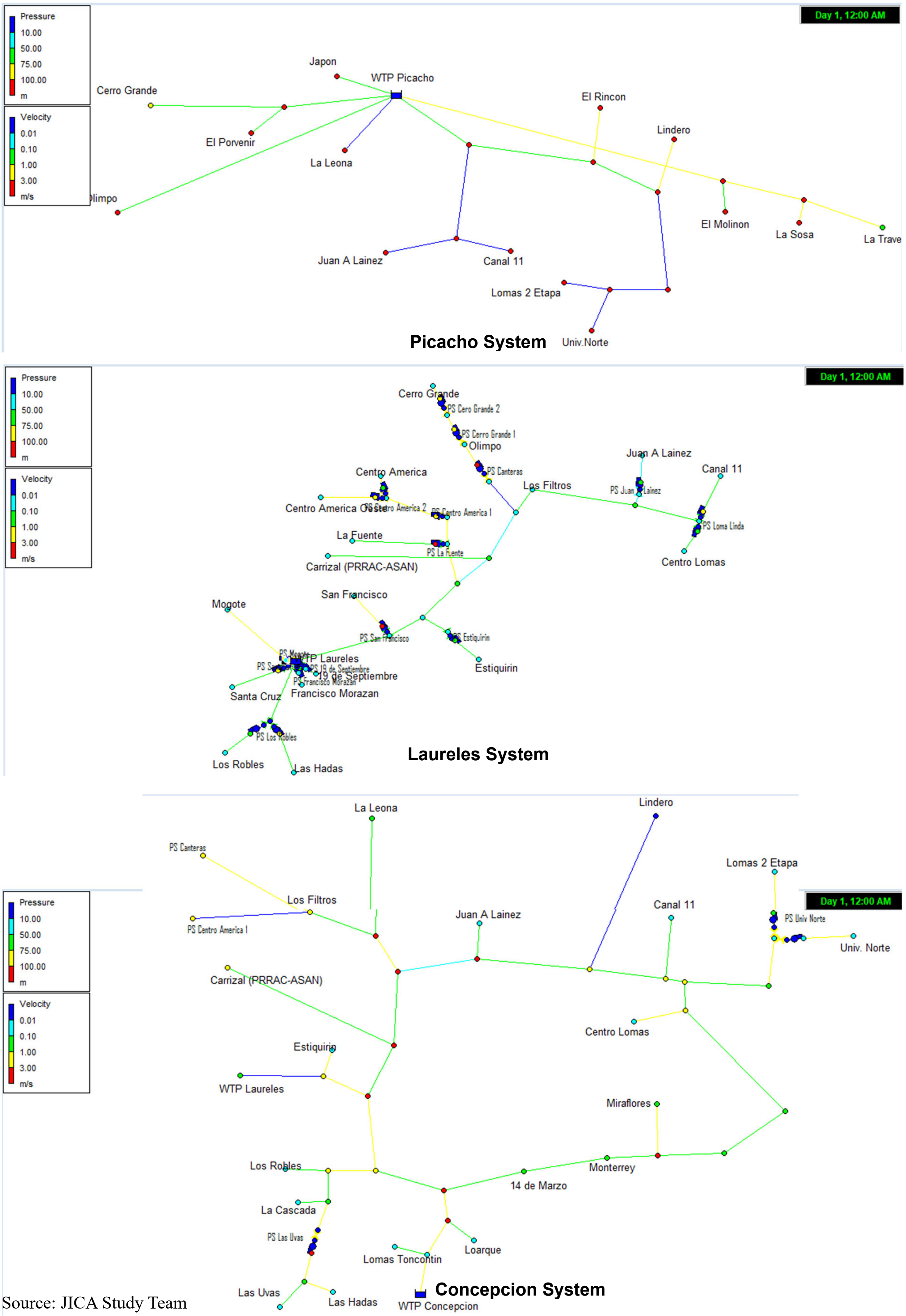
4.2.4 Evaluation of Water Transmission Facility

Figure 4.2.2 and Figure 4.2.3 show the results of the hydraulic analysis of the above allocation plan in the rainy season and dry season using EPANET software, which is widely used for hydraulic calculation of pipeline network. The hydraulic model excludes the tank groups which are supposed to be supplied directly from San Jose WTP. For the analysis, the input data (pipe diameter and pump capacity) has been adjusted so that the water pressure at each tank is more than 15 m, which is necessary to send the water to each distribution tank.



Source: JICA Study Team

Figure 4.2.2 Hydraulic Analysis Results in the Rainy Season



Source: JICA Study Team

Figure 4.2.3 Hydraulic Analysis Results in the Dry Season

Based on the hydraulic analysis, the following can be said:

- The transmission main pipeline of each system can accommodate the flow in 2038, which is the target year of the Project. Even if the Jiniguare Dam is completed, the transmission pipeline of the Concepcion System has sufficient diameter for transmitting additional 30,000 m^3/day of water from the Concepcion WTP.
- The diameter of the following transmission branch pipeline of the Laureles System needs to be increased for the flow in 2038:
  - Branch pipeline to Mogote Tank and San Francisco Tank
  - Branch pipeline from Centro America 1 Pump Station to Centro America 2 Pump Station
- Pump specification for pump renewal should be based on the flow in 2038.

CHAPTER 5 FORMULATION OF PROJECT COMPONENT

5.1 Viewpoints for the Selection of the Target Facility

The Project is to upgrade the water transmission and distribution facilities and thereby improve the water supply service in Tegucigalpa. The target facility to be upgraded in the Project were selected for each of the following facilities.

a) Transmission pipeline
b) Distribution tank
c) Distribution pipeline network
d) Mechanical and electrical facility
   - Transmission pump facility
   - Instrumentation and monitoring facility

In selecting the target facility, its necessity was evaluated from the following viewpoints.

1) Function/Performance
   Discrepancy between the required function/performance and those of the present facility.
2) Degradation
   Aging and deterioration.
3) Importance/Influence
   Number of beneficiaries and influence on the entire water supply system.
4) Urgency
   A problem or inconvenience is recognized, thus, urgent repair/replacement is required. The information from the Municipal Drinking Water and Sanitation Unit: *Unidad Municipal de Agua Potable y Saneamiento* (UMAPS) was also considered.

The priority of the target facility was determined based on an overall assessment of these viewpoints.

In addition, avoiding duplication with other projects, smooth project implementation (not dependence on the other project), and ease of quantification of project effects were taken into consideration.

5.2 Selection of Target Facility

5.2.1 Water Transmission Pipeline

The four viewpoints mentioned in Section 5.1 are described hereunder.

1) Function/Performance

The result of the hydraulic analysis described in Section 4.2.4 shows that the pipe diameter of the following branch pipelines of the Laureles system should be increased:

- Branch pipeline to Mogote Tank
- Branch pipeline to San Francisco Tank
- Branch pipeline to Centro America 1 and Centro America 2 pump stations

2) Degradation

The transmission pipeline of the Laureles System was installed 47 years ago. These pipelines may be deteriorated due to aging and site condition.

3) Importance/Influence

The outage of the transmission main pipeline will affect the entire transmission system. The affected population of each transmission system are as follows:

Picacho System:	20% of population
Laureles System:	17% of population
Concepcion System:	63% of population

On the other hand, the impact of branch pipeline failure only affects the limited area.

4) Urgency

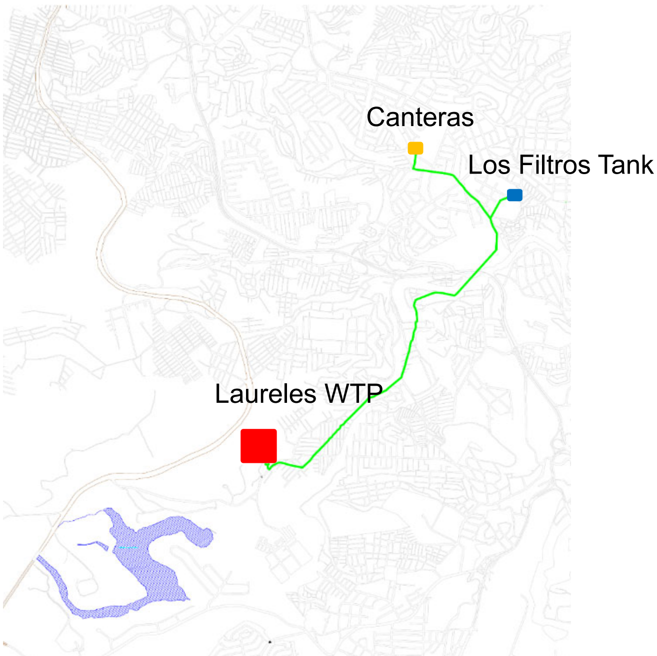
According to the UMAPS's information, the following facilities needs urgent repair/replacement.

a) Renewal of the transmission main pipeline between Laureles water treatment plant (WTP) to the Canteras pump station (PS).

D1000 L=3,210 m D600 L=230 m D400 L=910 m

These pipelines were installed 47 years ago.

Figure 5.2.1 shows the alignment of the pipeline.

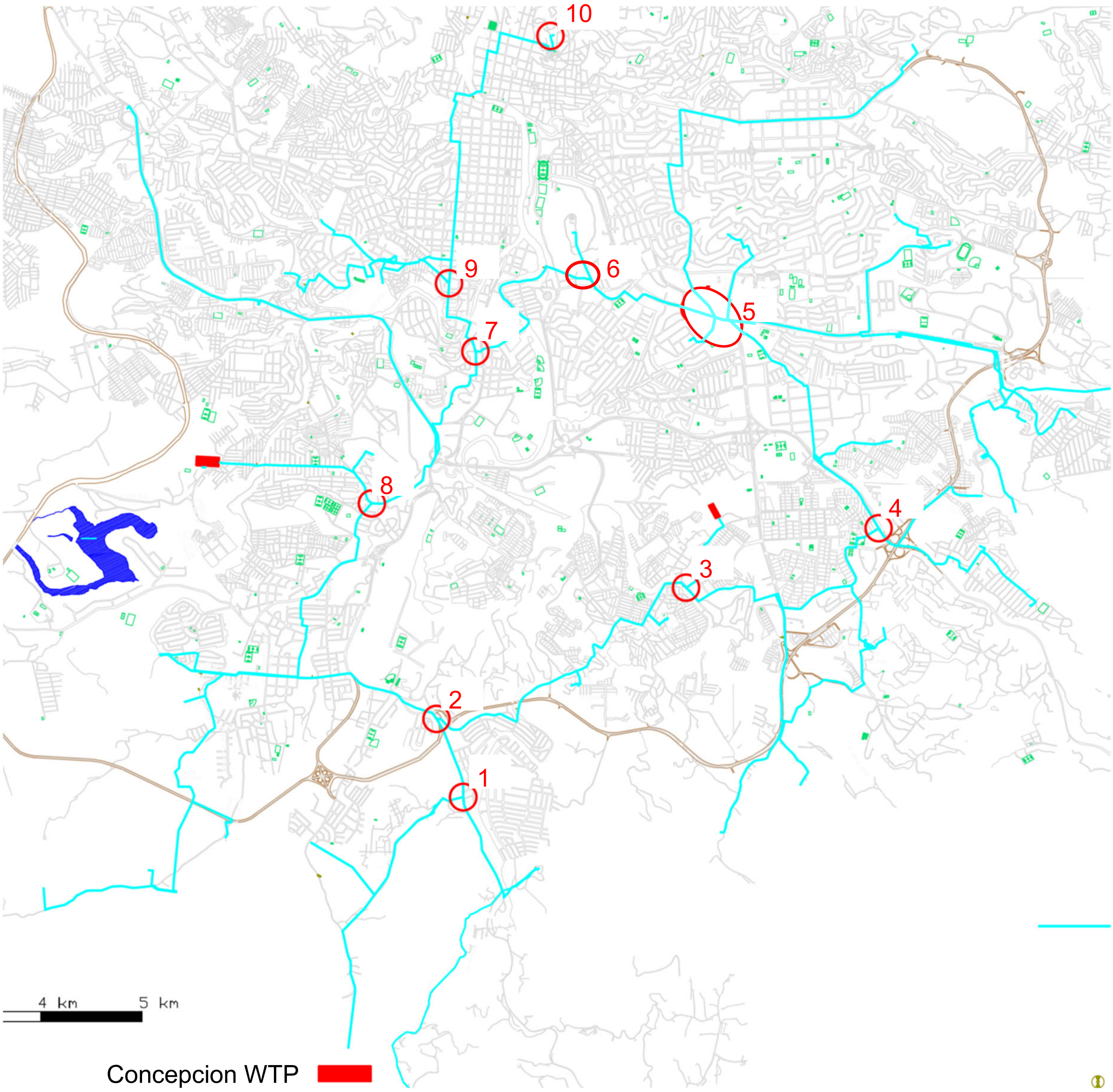


Source: JICA Study Team

Figure 5.2.1 Transmission Main Pipeline from Laureles WTP to Canteras PS

b) Renewal of valve facilities of the transmission main pipeline of the Concepcion System

Ten valve facilities have deteriorated and water leakage is occurring. The location is shown in Figure 5.2.2.



Source: JICA Study Team

Figure 5.2.2 Location of Valves in the Concepcion System that Needs Renewal

c) Increase the diameter of the pipelines between Laureles Dam and Laureles WTP

Change D250 to D400 L= 1.0 km

A transverse pipeline (D700 L=10 km) has been installed to pump raw water overflowing from the Laureles Dam to the Concepcion WTP during the rainy season. During the dry season, a portion of the water treated at the Concepción WTP is sent back by gravity to the Laureles WTP through this transverse pipeline and pipeline (D250 L= 1 km) from Laureles Dam to Laureles WTP to compensate for the lack of production at the Laureles WTP due to the shortage of raw water from the Laureles Dam. UMAPS is considering increasing the diameter from D250 to D400 to increase this gravity flow. In doing so, the flow capacity can be increased from 50 L/s to 125 L/s. It will enable UMAPS to have flexible water transmission operations.

Table 5.2.1 shows the overall evaluation results. The necessity of each item was rated on a three-point scale. The component with a total score of four or more were evaluated as high priority.

Table 5.2.1 Evaluation of the Project Component of Transmission Pipeline

Viewpoint / Component	1) Function	2) Degradation	3) Importance	4) Urgency	Overall Evaluation (Total Point)
I. Transmission main pipeline					
I.1 Laureles System					
Pipeline		1	2	1	4
I.2 Concepcion System					
Pipeline			3		3
Valves at the junctions	2	2	3	2	8
I.3 Picacho System					
Transmission main pipeline		1	2		3
II. Transmission branch pipeline					
II.1 Laureles System	1	1			2
II.2 Concepcion System			1		1
II.3 Picacho System		1			1
III. Transverse pipeline between Laureles Dam and Laureles WTP	2		1	1	4

Source: JICA Study Team

The explanation for the rating of each component is as below:

I. Transmission main pipeline

I.1 Laureles system

Viewpoint 2) Degradation [Rating 1]

The transmission pipeline of the Laureles System was installed 47 years ago. These pipelines may be deteriorated due to aging and site condition.

Viewpoint 3) Importance [Rating 2]

Laureles system covers 17 % of served population. The disruption of main pipeline leads to the stoppage of water supply for all these people.

Viewpoint 4) Urgency [Rating 1]

UMAPS informed that the renovation of this main pipeline is urgently needed, since the inside coating is heavily deteriorated.

I.2 Concepcion system (Pipeline)

Viewpoint 3) Importance [Rating 3]

Concepcion system covers 63 % of served population. The disruption of main pipeline leads to the stoppage of water supply for all these people.

I.2 Concepcion system (Valves at the junctions)

Viewpoint 1) Function [Rating 2]

Valves at the junctions of Concepcion system have an important role in regulating the flow to each direction and limiting the section of water shut off in the event of an accident of the system.

Viewpoint 2) Degradation [Rating 2]

These are valves are deteriorated and difficult to operate. Moreover, the water leakage occurs at several valves.

Viewpoint 3) Importance [Rating 3]

Concepcion system covers 63 % of served population. The disruption of main pipeline leads to the stoppage of water supply for all these people.

Viewpoint 4) Urgency [Rating 2]

UMAPS informed that the renovation of these valves is urgently needed, since it is difficult to regulate the water flow at present. Moreover, the water leakage occurs at several valves.

I.3 Picacho system

Viewpoint 2) Degradation [Rating 1]

Present transmission pipeline of the Picacho system was installed around 30 years ago. These pipelines may be deteriorated due to aging and site condition.

Viewpoint 3) Importance [Rating 2]

Picacho system covers 20 % of served population. The disruption of main pipeline leads to the stoppage of water supply for all these people.

II. Transmission branch pipeline

II.1 Laureles system

Viewpoint 1) Function [Rating 1]

The result of the hydraulic analysis described in Section 4.2.4 shows that the pipe diameter of several branch pipelines of the Laureles system should be increased.

Viewpoint 2) Degradation [Rating 1]

The transmission pipeline of the Laureles system was installed 47 years ago. These pipelines may be deteriorated due to aging and site condition.

II.2 Concepcion system

Viewpoint 3) Importance [Rating 1]

Concepcion system covers 63 % of served population. Even the branch line disruption has a significant impact.

II.3 Picacho system

Viewpoint 2) Degradation [Rating 1]

The existing transmission pipeline of the Picacho system was installed around 30 years ago. These pipelines may be deteriorated due to aging and site condition.

III. Transverse pipeline between Laureles Dam and Laureles WTP

Viewpoint 1) Function [Rating 2]

By increase the diameter of the transverse pipeline, the flexibility of water transmission during the dry season will be greatly improved.

Viewpoint 3) Importance [Rating 1]

In dry season, the water shortage frequently occurs in Laureles system due to the insufficient capacity of Laureles dam. It is necessary to supplement the water from Concepcion system.

Viewpoint 4) Urgency [Rating 1]

UMAPS informed that increasing the pipe diameter is urgently needed, since the water shortage in Laureles system frequently occurs.

As a result of the evaluation shown in Table 5.2.1, the prioritized components are:

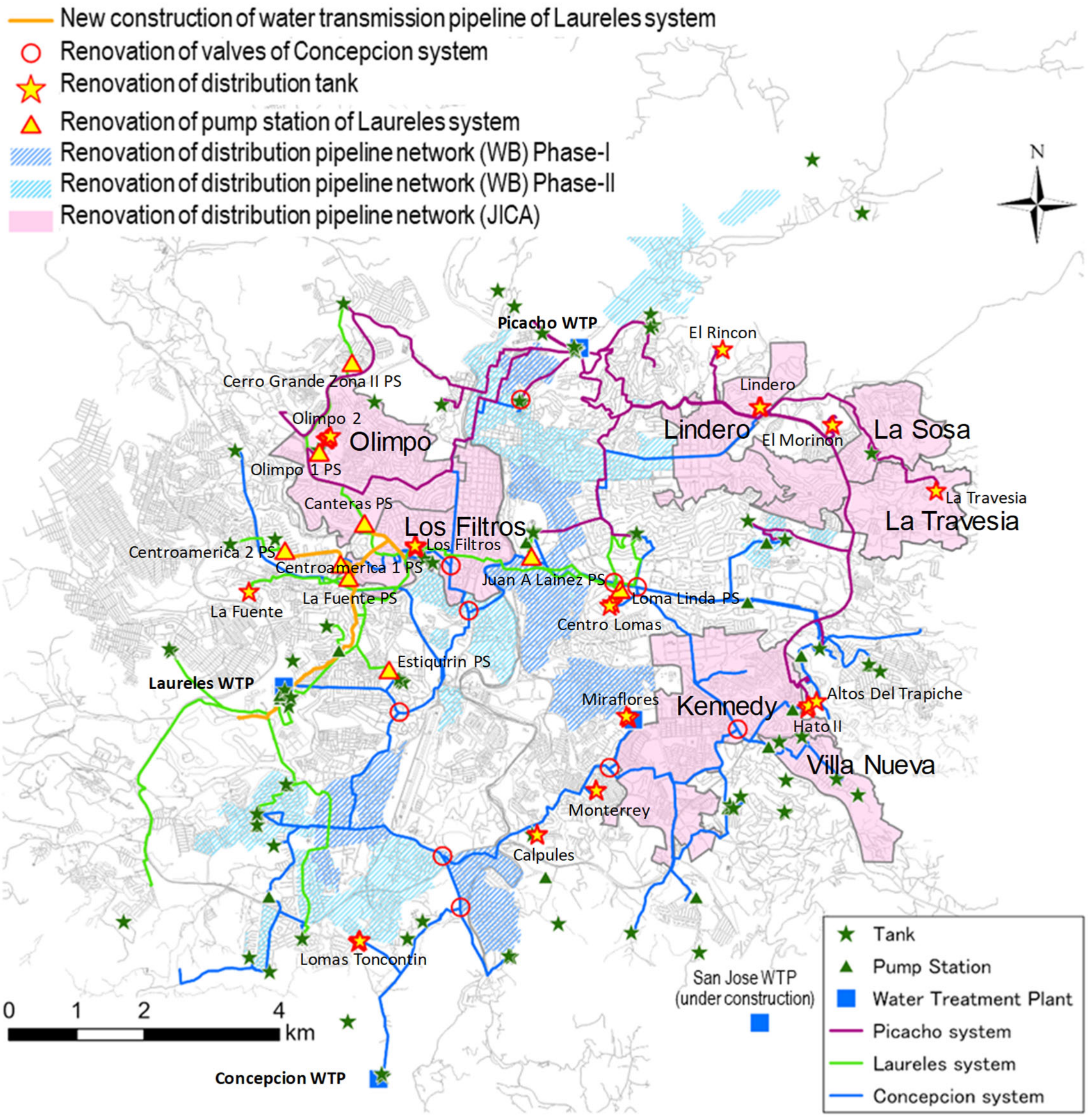
- Transmission main pipeline of Laureles system
- Renewal of valves on transmission main pipeline of Concepcion system

- Increase of diameter of the transverse pipeline between Laureles Dam and Laureles WTP for sending treated water from Concepcion WTP to Laureles WTP

5.2.2 Water Distribution Facility

The selection of water distribution tanks and the water distribution areas to be renovated were done from the four viewpoints mentioned in Section 5.1.

As a result of the evaluation, 14 tank groups (beneficiary population: about 303,164 in 2038) and seven water distribution blocks were selected. Figure 5.2.3 shows the location of facilities to be renovated.



Source: JICA Study Team

Figure 5.2.3 Location of Facilities to be Renovated

The four viewpoints mentioned in Section 5.1 are described hereunder. The necessity of each item was rated on a three-point scale.

(1) Water Distribution Tanks

1) Function/Performance

Based on the results of the 2038 water demand projection, the required capacity for each distribution tank was calculated. The capacity required by the UMAPS design criteria is 35% of the maximum daily water demand plus firefighting water. Based on the discussion with UMAPS, the amount of firefighting water is determined by the population of the water distribution tank. It is calculated as 100 m^3 for 10,000 people.

The ratio of existing capacity to required capacity in 2038 was calculated for each distribution tank. The necessity of each item was rated on a three-point scale. Since there is no extra tank capacity for the demand in 2038, the higher the point, the more priority. Each point is categorized as follows:

Point 1: From 50% to 100%
Point 2: from 20% to 50%
Point 3: less than 20%

2) Degradation

Concrete and brick water tanks more than 50 years old were found to be leaking due to concrete deterioration. In addition, steel water tanks more than 30 years old were found to have holes and collapsed ceilings due to oxidative deterioration. Therefore, the degradation was evaluated based on the number of years of age. Each point is categorized as follows:

Point 1: Concrete tank with more than 50 years old, steel tank with more than 30 years old
Point 2: Concrete tank with more than 60 years old, steel tank with more than 40 years old
Point 3: Concrete tank with more than 70 years old, steel tank with more than 50 years old

3) Importance/Influence

Evaluation is based on the size of the benefiting population. Priority was given to areas with large population that would benefit from the water distribution tank. Each point is categorized as follows:

Point 1: Population of 10,000 to 30,000
Point 2: Population of 30,000 to 50,000
Point 3: Population of more than 50,000

4) Urgency

Evaluation was based on water leakage from the tank, danger of collapse, and insufficient capacity. Each point is categorized as follows.

Point 1: Small leakage
Point 2: Large leakage
Point 3: Danger of collapse, insufficient capacity due to leakage

Table 5.2.2 shows the results of the above evaluation in terms of 1) function and performance, 2) degradation, 3) importance and impact, and 4) urgency. As a result of the evaluation, 14 water distribution tank groups were selected to be renovated.

Table 5.2.2 Results of the Evaluation of Water Distribution Tanks

No.	BLOCK Name	Tank Name	1) Function/ Performance	2) Degradation	3) Importance / Influence	4) Urgency	Total	Selection Candidates	Remark
1	Japon	Japon							
2	Saucique	Saucique	1				1		
3	Sagastume	Sagastume							
4	El Porvenir	El Porvenir	1				1		
5	El Rincon	El Rincon	2			3	5	○	
6	Guillen	Guillen							
7	Canaan	Canaan	1				1		
8	Estanzuela	Estanzuela	1				1		
9	El Molinon	El Molinon							
10	La Sosa	La Sosa	2		2		4	○	
11	La Travesia	La Travesia	2		1	1	4	○	
12	Cerro Grande	Cerro Grande	2		1		3		
13	Olimpo1	Olimpo 1	2		3		5	○	There is no space and tanks was constructed by JICA project in 2010
		Olimpo 1	2				4	○	
14	Olimpo 2	Olimpo 2	1		2		3		The water shortage in Olimpo 1 will be included in Olimpo 2.
		Olimpo 2 (Nuevo 2)	1				3		
		Olimpo 2 (Viejo 2)	1	2		3	8	○	
		Olimpo 2 (Viejo)	1	2		3	8	○	
15	La Flor	La Flor	3		1				
16	Juan A. Lainez	Juan A. Lainez 1		3					UMAPS will build ceiling protection.
		Juan A. Lainez 2		3					
17	Canal 11	Canal 11			1				
		Canal 11 (Viejo)		1					
18	La Leona	La Leona 1		1	2		3		
		La Leona 2		1			3		
		La Leona 3		1			3		
		La Leona 4					2		
19	Lindero	Linderos 1	2	3	2		7	○	
		Linderos 2	2	3			7	○	
		Linderos 3	2	3			7	○	

20	Lomas	Lomas 2da. Etapa	1						
21	Universidad Norte	Universidad Norte 1	1						
		Universidad Norte 2	1						
22	Suyapita	Suyapita	1						
23	Alto de Trapiche	Altos del Trapiche	1	1			4	○	
	Hato	Hato de Enmedio	1	2	2	3	7	○	
		Covespul/San Juan		1			1		
24	Los Laureles	Los Laureles 1		2			2		
		Los Laureles 2		2			2		
25	Mogote	Mogote 1	1		2		3		This area will be supplied by the Jiniguare project. UMAPS will renovate.
		Mogote 2	1	2		1	6		
26	Altos de los Laureles	Altos de los Laureles	1				1		
27	Santa Cruz	Santa Cruz							
28	Los Robles	Los Robles	1	1		1	3		
		Roble Oeste Etapa 1, 2 y 3	1	1			2		
		Roble Oeste 4ta. Etapa	1						
29	Francisco Morazan	Francisco Morazan	1						
30	19 de Septiembre	19 de Septiembre	2				2		
31	San Francisco	San Francisco 1	1		1		2		
		San Francisco 2	1						
32	La Fuente	La Fuente	1	3		3	7	○	
33	Roble Alto	Roble Alto 1ra. Etapa							
		Roble Alto 2da. Etapa							
34	Las Hadas	Las Hadas 1	1				1		
		Las Hadas 2	1	1			2		
35	El Sauce	El Sauce	1				1		
36	Estiquirin	Estiquirin 1	1				2		
		Estiquirin 2	1		1		3		
		Estiquirin (Nuevo)	1				3		
37	Carrizal	Carrizal	3		3		6		
38	Centro America Este	Centro America Este	2		1		3		
39	Centro America Oeste	Centro America Oeste	1		1		2		
		Centro America Oeste 2	1						
40	Los Filtros	Los Filtros 1	1	1			5	○	
		Los Filtros 2	1	1	3		5	○	
		Los Filtros (Nuevo)	1				4	○	

41	Altos de Primavera	Altos de Primavera							
42	Divanna	Divanna							
43	Centro Lomas	Centro Lomas		2	1	3	5	○	Many water leakages from tank were found
		Centro Lomas (Nuevo)		2			3		
44	Concepcion	Concepcion		2					
		Concepcion (Nuevo)							
45	Res. Concepcion	Res. Concepcion							
46	Toncontin	Lomas Toncontin 1	1				1		
		Lomas Toncontin 2	2				2		
		Altos de Toncontin	1	1		2	4	○	Many water leakages from tank were found
		Palma Real	1				1		
47	Jardines de Loarque	Jardines de Loarque	3				3		
48	Altos de Loarque	Altos de Loarque	2				2		
49	San Jose de Loarque	San Jose de Loarque	2				2		
50	Loarque	Loarque 1		1	1		2		
		Loarque 2		1			2		
51	Yaguacire	Yaguacire							
52	La Cascada	La Cascada							
53	Las Uvas	Las Uvas							
54	Villas del Real	Villas del Real							
55	14 de Marzo	14 de Marzo			1		1		
		14 de Marzo (Nuevo)					1		
56	Calpules	Calpules 1 (Alto)	1	2		3	6	○	
		Calpules 2 (Bajo)		2		3	6	○	
57	Venecia	Venecia	2				2		
58	Monterrey	Monterrey	2			3	5	○	
59	Los Llanos	Los Llanos	3	2			5	○	
60	Miraflores	Miraflores 1	1	1		3	5	○	
		Miraflores 2	1	1	1	3	6	○	
		Miraflores (Nuevo)	1				1		

61	**Grupo Empresarial**	**Grupo Empresarial**				**3**	**3**		
62	**Las Mesitas**	**Las Mesitas**	-	-	-	-			
63	**Kennedy 3**	**Kennedy 3**	-	-	-	-			
64	**Los Pinos**	**Los Pinos**	-	-	-	-			
65	**Altos de los Pinos**	**Altos de los Pinos**	-	-	-	-			
66	**Villa Nueva 5**	**Villa Nueva 5**	-	-	-	-			
67	**Honduras Res**	**Honduras Res. Alto**	-	-	-	-			
		Honduras Res. (Bajo)	-	-		-			
68	**Villa Nueva 1**	**Villa Nueva 1**	-	-	-	-			
69	**Villa Nueva 2**	**Villa Nueva 2**	-	-		-			
70	**Villa Nueva 3**	**Villa Nueva 3**	-	-		-			
71	**Villa Nueva 4**	**Villa Nueva 4**	-	-		-			
72	**Villa Nueva 6**	**Villa Nueva 6**	-	-		-			
73	**Aldea Suyapa**	**Aldea Suyapa**	-	-	-	-			
74	**Nueva Suyapa**	**Nueva Suyapa**	-	-	-	-			

Source: JICA Study Team

Table 5.2.3 shows the list of the above-mentioned 14 tank groups to be renovated and require additional capacity. In case there is a space in the tank site, the installation of a new tank was planned. In case there is no space in the tank site, removal of the existing tank and construction of a new tank was planned. Tanks should be consolidated as much as possible to simplify the operation and maintenance.

Table 5.2.3 List of Tanks to be Renovated

NO	BLOCK Name	Tank Name	Capacity(m3) Exsiting	Require Capacilty(m3) 2038	Shortage of capacity	Construction
1	El Rincon	El Rincon	79	238	159	Construct 300m^3
2	El Molinon	El Molinon	1,500	424	2301	Demolish 1 tank and construct 2500m3 tank for La sosa and distibution pipe
3	La Travesia	La Travesia	1,800	4,636	2836	Demolish exsiting tank and construct 4500m3 tank
4	Olimpo 2	Olimpo 2	3,697	6,125	8702	Demolish 2 tank of Olimpo2 and constrcut 9000m3 tank
		Olimpo 2 (Nuevo 2)				
		Olimpo 2 (Viejo 2)				
		Olimpo 2 (Viejo)				
5	Lindero	Linderos 1	1,809	3,814	3192	Demolish old 2 tanks and constrcut 3200m3tank
		Linderos 2				
		Linderos 3				
6	lto de Trapicl	Altos del Trapiche	600	803	203	Construct 300m3
7	Hato	Hato de Enmedio	880	3,597	2845	Demolish 2 tanks and construct 2800m3tank and elevated tank
		Covespul/San Juan	1,150	399		
8	La Fuente	La Fuente	539	338	-201	Demolish 1 tank and consturct 700m3
9	Los Filtros	Los Filtros 1	3,765	5,127	1627	Demolish 1 tanks and construct 1700m3tank and elevated tank
		Los Filtros 2				
		Los Filtros (Nuevo)				
10	Centro Lomas	Centro Lomas	1,923	4,669	3669	Construct 3700m3 tank and Demolish 1 tank
		Centro Lomas (Nuevo)				
11	Toncontin	Lomas Toncontin 1		154		
		Lomas Toncontin 2		946		
		Altos de Toncontin		159	413	Demolish and Construct 500m3 tank and elevated tank 32m3×15m
		Palma Real		537		
12	Calpules	Calpules 1 (Alto)	389	721	332	Demolish 2 tanks and construct 750m3 elevated tank(H=15m)
		Calpules 2 (Bajo)				
13	Monterrey	Monterrey	329	662	333	Construct 1000m3 tank and elevated tank 32m3×H15m and demolish
	Los Llanos	Los Llanos	35	543	508	
14	Miraflores	Miraflores 1	2,454	4,093	1639	Demolish 2 tank and constrcut 3000m3 tank
		Miraflores 2				
		Miraflores (Nuevo)				

Source: JICA Study Team

(2) Water Distribution Network

1) Function and performance

Aging pipelines and high water pressure are the causes of water leakage accidents in water distribution pipe networks. In particular, water leakage is considered to be caused by high water pressure and water hammer pressure due to the lack of air valves. Therefore, it is necessary to install appropriate air valves and pressure-reducing valves in terms of function.

The colonia, where more than ten water leakage accidents occurred in 2020, were leakage-prone areas. Therefore, functional and performance improvements are required in those areas.

Each point was categorized as follows.
Point 1: Less than 100 water leakage accidents
Point 2: 100 to 200 water leakage accidents
Point 3: More than 200 water leakage accidents

2) Degradation

Most of the water distribution pipe networks consist of ductile iron pipe (DIP), polyvinyl chloride (PVC), galvanized steel, and asbestos cement (AC) pipes and they are more than 20 to 30 years old. Although the installation year of each pipe network is not documented, the degradation is supposed to be at a significant level, especially for areas containing galvanized steel pipes and AC pipes. Galvanized steel pipes are prone to clogging due to corrosion on the inner surface of the pipe and are prone to leaking due to their thin walls. In addition, asbestos pipes are prone to leakage due to deterioration in the strength of the material and need to be completely replaced.

Each point was categorized as follows:
Point 1: Galvanized steel pipes and AC pipes account for 0-10 % of the total length
Point 2: Galvanized steel pipes and AC pipes account for 10-15 % of the total length
Point 3: Galvanized steel pipes and AC pipes account for more than 15 % of the total length

3) Importance/Influence

The evaluation was based on the size of the population served by the water distribution system. Priority was given to areas with large populations that would benefit from the water distribution tank.

Each point is categorized as follows:
Point 1: Population of 10,000 to 30,000
Point 2: Population of 30,000 to 50,000
Point 3: Population of more than 50,000

4) Urgency

Priority was given to those requested by UMAPS. JICA study team confirmed the requested areas to be of high leakage and are considered as important areas where pipe replacement is desired due to poor pipe installation. Therefore, all of the UMAPS' requests are given one point. In addition, Villa Nueva colonia was given high priority due to strong request from UMAPS.

5) Percentage of flat rate

At present, 29.1% of the total area served by the water distribution system is billed by water meters. On the other hand, 71.9% of customers are charged by flat rate. The flat rate system is not appropriate for water consumed. It is also more unequal than the water meter system. Therefore, when selecting water distribution areas, percentage of flat rate was calculated and evaluated as follows to give priority to water distribution areas that exceed the average of 70% or more of the water distribution areas.

Each point is categorized as follows:
Point 1: Percentage of flat rate is from 70 to 80%

Point 2: Percentage of flat rate is from 80 to 90%
Point 3: Percentage of flat rate is from 90 to 100%

6) Avoid duplication with the World Bank (WB) project

The distribution block where the WB project will be implemented were excluded from the target area.

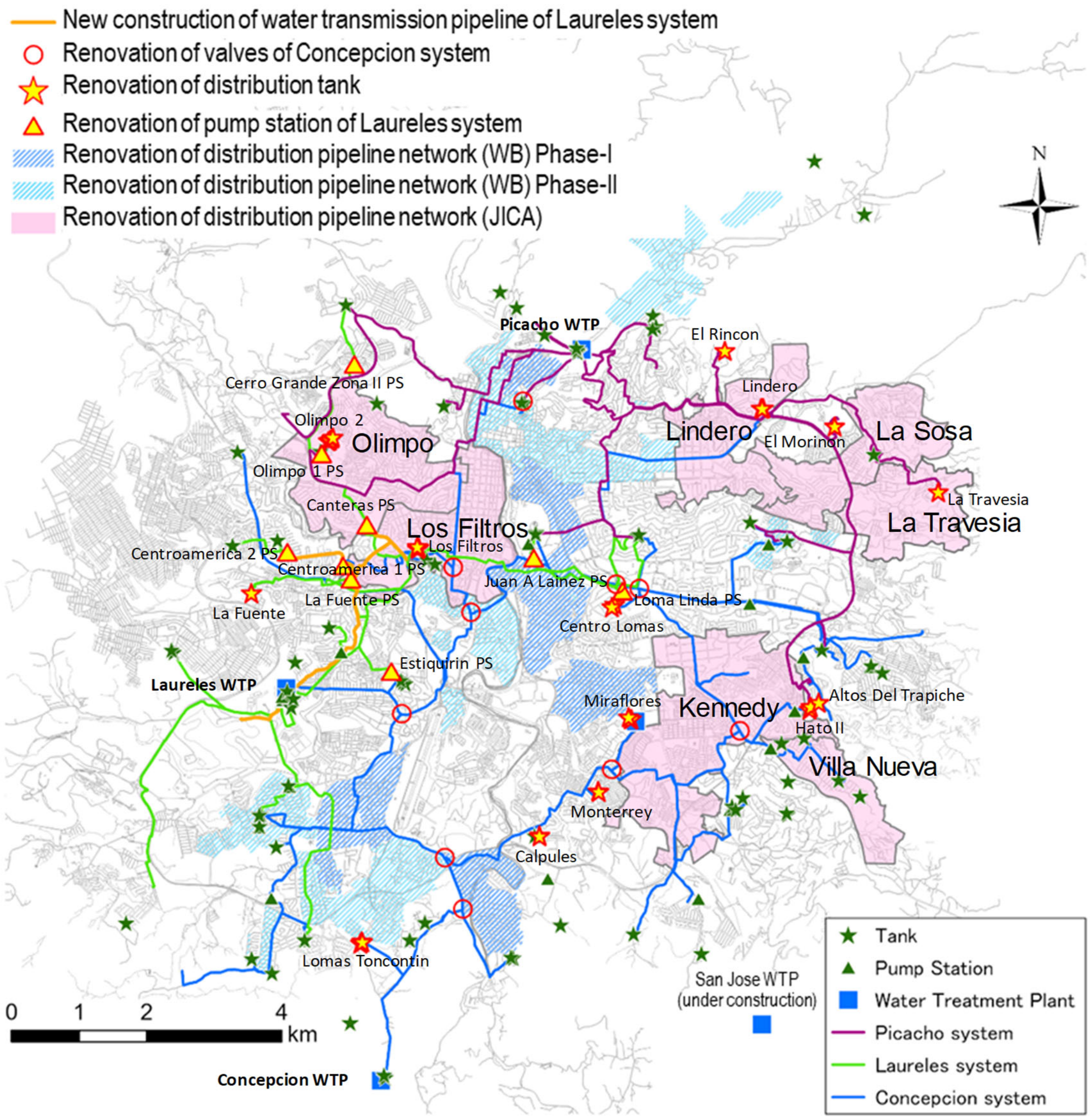
Table 5.2.4 shows the evaluation results based on the above viewpoints.

Table 5.2.4 Evaluation of the Distribution Network

Block	1)Function/ Performance	2) Degradation	3)Importance / Influence	4)Urgency	5)Persentage of Flat rate	6) WB Scope	Total	Selection
La Sosa	1	1	3	1	3	No	9	Selected
La Travesia	1	1	1	2	3	No	8	Selected
Cerro Grande	1	1	1		1	No	4	
Olimpo	3	2	3		3	No	11	Selected
Juan A. Lainez	1	1	1		2	WB Scope	5	
Canal 11	2	3	1	1		No	7	
La Leona	3	2	3	1	1	WB Scope	10	
Lindero	2	1	3	1	2	No	9	Selected
Suyapita	1	1	1			No	3	
Altos del Trapiche	1	1	1			No	3	
Hato de Enmedio	2	1	1	1		No	5	
Mogote	1	1	2		3	No	7	
Los Robles	1	1	1			WB Scope	3	
Roble Oeste Etapa 1, 2 y	1	1				WB Scope	3	
Francisco Morazan	1	1	1			No	3	
San Francisco	1	1	2		2	No	6	
Las Hadas	1	1	1			WB Scope	3	
Estiquirin	3	1	3			WB Scope	7	
Centro America Este	1	1	1		1	No	4	
Los Filtros	3	3	3		2	No	11	Selected
Centro Lomas	2	2	2	1		WB Scope	7	
Lomas Toncontin 1	1	1	1			WB Scope	3	
Loarque 1	1	1	1			WB Scope	3	
La Cascada	1	2	1			WB Scope	4	
Calpules 1 (Alto)	1	1	1		3	No	6	
Monterrey	1	1	1	1		No	4	
Miraflores	2	1	1		1	WB Scope	5	
Kennedy	2	3	3	1	3	No	12	Selected
Honduras Res. Alto	3	1	1	1		WB Scope	6	
Villa Nueva	1	1	3	1	3	No	9	Selected

Source: JICA Study Team

As a result, seven distribution blocks, La Sosa, La Travesia, Olimpo, Lindero, Los Filtros, Kennedy, and Villa Nueva, were selected for renovation.



Source: JICA Study Team

Figure 5.2.4 Location of the Distiribution Network to be Renovated
(Same figure as Figure 5.2.3)

Table 5.2.5 shows the pipe length, number of connections, and number of water meters in each colonia. The total pipe length is 515.76 km. Most of the pipes are PVC pipes with two-inch diameter.

The number of customers in the targeted colonia is 42,260 in 2023. Of those customers, 11.7 percent have installed water meters and are billed according to their readings; 28.0 percent have broken water meters and are billed according to the average of the last three months; and the remaining 60.3 percent are billed at a flat rate.

The planned served population of the seven blocks is 470,551, which is 38% of the total served planned population of 1,225,773.

Table 5.2.5 Number of Water Meters in the Selected Distribution Block (2023)

	Block	No.	Colonia	Meter	Billed On average	Flat Rate	Total length(km)
1	La Sosa (Planned population in 2038: 53,903)	1	ESTADOS UNIDOS	0	4	271	38.9
		2	EL SITIO	0	16	940	
		3	SANTA MARIA	1	11	446	
		4	OJO DE AGUA	0	1	0	
		5	LA SOSA	1	387	729	
		6	LA TRINIDAD	0	4	272	
		7	LA UNION	0	0	104	
		8	SEMPE	0	4	170	
		9	30 DE NOVIEMBRE	0	1	348	
		10	LA AURORA	39	34	7	
		11	EL JAZMIN	0	0	0	
		12	SAN MIGUEL	96	656	917	
		13	13 DE JULIO	0	0	1	
		14	NUEVA EDEN	0	6	67	
		15	SANTA ANITA	0	0	0	
		16	28 DE MARZO	2	62	547	
2	La Travesia (Planned population in 2038: 39,099)	1	LA TRAVESIA	104	445	963	32.7
		2	LA ERA	2	15	66	
		3	VILLA AURORA	0	0	0	
		4	EL ZAPOTE	0	1	0	
		5	LA MOLOLOA				
		6	LOS QUEBRACHOS	0	0	0	
		7	MIRADOR DE LA	0	0	0	
		8	BUENOS AIRES	101	356	601	
		9	NUEVA ERA	57	163	77	
3	Olimpo (Planned population in 2038: 182,382)	1	COFRADIA	0	0	0	107.36
		2	3 DE MAYO	0	6	1475	
		3	GRANADA	30	200	53	
		4	AYESTAS	0	48	673	
		5	OBRERA	0	0	1	
		6	BARRIO LOS	0	38	17	
		7	GUAMILITO	0	28	56	
		8	LAS CRUCITAS	10	246	290	
		9	BELLA VISTA	11	237	480	
		10	SIPILE	0	62	54	
		11	EL ROSARIO	0	12	35	
		12	GRACIAS A DIOS	0	1	0	
		13	SANTA CECILIA	15	17	8	
		14	SANTA CECILIA NO. 2	0	0	0	
		15	LA ESPERANZA	6	19	15	
		16	RAFAEL CALLEJAS	0	0	1	
		17	SAN ANOTNIO	0	0	0	
		18	1 DE DICIEMBRE	0	0	1	
		19	TOROCAGUA	171	356	412	
		20	INDEPENDENCIA	0	4	772	
		21	SAN CRISTOBAL	6	80	100	
		22	SANTA FE	45	227	193	
		23	COLINAS LA	0	0	0	
		24	EL PEDREGALITO	44	183	171	
		25	ALTOS DEL	0	0	0	
		26	ZONA CLINICA	0	0	0	
		27	OBRERO	0	2	78	
		28	LA LAGUNA	0	75	125	
		29	14 DE ENERO	0	1	0	
		30	ESPIRITU SANTO	0	0	0	

	Block	No.	Colonia	Meter	Billed On average	Flat Rate	Total length(km)
		31	INTERCONTINENTAL	0	0	0	
		32	LIVERPOOL	0	0	0	
		33	EL PEDREGAL	44	183	171	
		34	EL CARRIZAL	36	23	1029	
		35	ROSARIO	0	12	35	
		36	COL ADIOS IDEPEND	3	65	44	
		39	SMITH NO. 1	0	0	1	
		40	POLICARPO PAZ	1	3	358	
		41	VILLA FRANCA	0	0	0	
		42	VILLA CRISTINA	1	0	0	
		43	VILLA UNION	0	0	1	
		44	CANADA	0	0	1	
		45	FUERZAS ARMADAS	0	1	0	
		46	COL. ZAPOTE NORTE	0	132	193	
		47	BRISAS DE OLANCHO	0	1	0	
		48	COL ZAPOTE CENTRO	0	237	142	
		49	FLOR Nª 1	0	5	485	
		50	CAMPO CIELO	0	0	578	
		51	FLOR Nª 2	0	0	265	
		52	BARRIO SAN MARTIN	0	1	216	
		53	BARRIO EL PASTEL	0	1	211	
		54	14 DE FEBRERO	0	1	0	
4	Linderos (Planned Population in 2038: 30,697)	1	21 DE OCTUBRE	0	545	303	50.5
		2	CALDERON	0	0	0	
		3	EL JARDIN	13	17	9	
		4	LARA	92	61	34	
		5	BOLIVAR	18	47	8	
		6	LAS JOYAS	0	0	0	
		7	VILLAS DEL RIO	33	52	17	
		8	VILLA SANTA	0	0	1	
		9	EL CERRITO	0	1	5	
		10	MODESTO RODAS	0	131	8	
		11	LOMA LAS MINITAS	0	0	0	
		12	LOS PROCERES	9	12	15	
		13	LOS GIRASOLES	128	152	78	
		14	IZAGUIRRE	0	1	0	
		15	LA ESPERANZA	6	19	15	
		16	SANTA ISABEL	8	1	0	
		17	SANTA ANA	0	0	0	
		18	LOS ALMENDROS	90	97	21	
		19	SABANAGRANDE	0	0	0	
		20	PARCALTAGUA	24	23	8	
		21	MONTE CARLO	51	49	12	
		22	PUEBLO NUEVO	111	109	63	
		23	EL CASTAÑO	0	0	0	
		24	INDEPENDIENTE	0	0	0	
		25	LA FRATERNIDAD	3	76	102	
		26	PARCALTAGUA	24	23	8	
		27	PUEBLO NUEVO	111	109	63	
		28	SANTA ISABEL	8	1	0	
		29	PLANES DEL GUIJA	0	0	0	
5	Los Filtros (Planned population in 2038: 53,609)	1	DIVANNA	23	194	222	113.7
		2	BELEN	40	265	200	
		3	SAN JUAN DE DIOS	0	46	38	
		4	BENDECK	0	54	55	
		5	CONCEPCION	133	69	26	
		6	CENTRO AMERICANA	189	104	72	
		7	EL COUNTRY	53	54	40	
		8	HOLLYWOOD	14	11	7	
		9	INTERAMERICANA	37	34	32	

	Block	No.	Colonia	Meter	Billed On average	Flat Rate	Total length(km)
		10	LOMAS DEL	34	46	26	
		11	COL ALTOS DE LA	15	24	22	
		12	MONSEÑOR FIALLOS	17	193	249	
		13	CRISTOBAL DIAZ	0	14	24	
		14	EL CALVARIO	0	0	0	
		15	EL PROGRESO	14	21	27	
		16	LA SOLEDAD	3	1	78	
		17	VEGAS DEL COUNTRY	0	0	0	
		18	GUACERIQUE	14	39	22	
		19	BARRIO LA BOLSA	24	44	21	
		20	LEMPIRA	166	244	133	
		21	SEPILE	0	0	0	
		22	CENTRO DE	0	0	0	
		23	CAMAGUARA	0	0	0	
		24	LA HAYA	31	123	168	
		25	LAS MERCEDES	8	187	471	
6	Kennedy (Planned population in 2038: 70,725)	1	RESIDENCIAL PLAZA	530	751	223	131.6
		2	BERNARDO DAZZI	70	165	43	
		3	LAS PALMAS	9	202	446	
		4	LOMAS DE SAN JOSE	19	13	265	
		5	LOMAS DE	7	6	14	
		6	RESIDENCIAL VICTOR	50	107	180	
		7	COL KENNEDY	557	936	2712	
		8	SAN ANGEL	144	444	301	
		9	GUAYMURAS	31	102	132	
		10	BELLA ORIENTE	262	109	51	
		11	VALENCIA	29	16	17	
		12	RES. GLORIA ADIOS	2	17	9	
		13	HATO DE ENMEDIO	395	774	2742	
		14	MAYANGLE	61	61	86	
		15	JARDINES DE SAN	0	33	26	
		16	SANTA MARTHA	0	5	6	
		17	VILLA NUEVA	10	23	209	
		18	LOMAS DEL NAUVOO	41	12	2	
		19	LOMAS DEL NAUVOO	22	14	5	
		20	LOMAS DEL NAUVOO	61	35	2	
		21	LOMAS DEL NAUVOO	17	3	1	
		22	JESUS AGUILAR PAZ	48	22	9	
		23	VILLA COLONIAL	59	15	2	
		24	CUIDAD JARDIN	46	10	1	
		25	VILLAS COLONIAL	20	5	0	
		26	EL TABLON	58	17	9	
		27	VEGAS DE LA	12	3	2	
7	Villa Nueva (Planned population in 2038:	1	Villa Nueva	0	0	0	41.0
TOTAL				4,930	11,866	25,464	515.76

Source: JICA Study Team

5.2.3 Service Facility

Table 5.2.7 shows the number of water meters in the distribution blocks selected in Section 5.2.2.

Table 5.2.7 Number of Water Meters in the Selected Distribution Block (2023)

Condition of Water Meter	Number
Water meter (working)	4,930
Water meter (mal function)	11,866
No water meter	25,464
Total	42,260

Source: JICA Study Team

Approximately 11.7% of customer connection is equipped with functioning water meters. The mal functioning water meter need to be replaced. In addition, it is necessary to install water meters in houses where water meters are not installed so that water consumption in the distribution area can be measured.

5.2.4 Mechanical Facility

(1) Necessity of replacement

Pump equipment is generally replaced every 15-20 years. Thus, pumps that are more than 15 years old are considered to be a high priority for replacement. In this regard, most of the transmission pumps of UMAPS would be eligible for replacement, as shown in Table 3.3.6, except for some pumps that were replaced by UMAPS funds.

(2) Request from UMAPS for the improvement of pump stations

UMAPS suggested to prioritize 12 pumping stations for the rehabilitation or replacement of facilities as listed below:

- Highest priority: Estiquirin PS, Juan A. Lainez PS, and Loma Linda PS
- Second priority: Canteras PS, Centroamerica I PS, and Centroamerica II PS
- Third priority: La Fuente PS, Olimpo I PS, Cerro Grande Zona II PS, Hato PS, Mogote PS, and San Francisco PS

After several discussions, it was confirmed that Hato PS, Mogote PS, and San Francisco PS, shall not be included because of the possibility that a water transmission pipeline may be constructed in the future by the development of the water source in San Jose and Jinigale.

Table 5.2.8 Selected Pump Stations

Pump Station Name	Priority	Selection
Estiquirin PS	First	Selected
Juan A. Lainez PS	First	Selected
Loma Linda PS	First	Selected
Canteras PS	Second	Selected
Centroamerica I PS	Second	Selected
Centroamerica II PS	Second	Selected
La Fuente PS	Third	Selected
Olimpo I PS	Third	Selected
Cerro Grande Zona II PS	Third	Selected

Hato PS	Third	-
Mogote PS	Third	-
San Francisco PS	Third	-

Source: JICA Study Team

The selected nine pump stations are of the Laureles transmission system.

5.2.5 Electrical Facility and Instrumentation

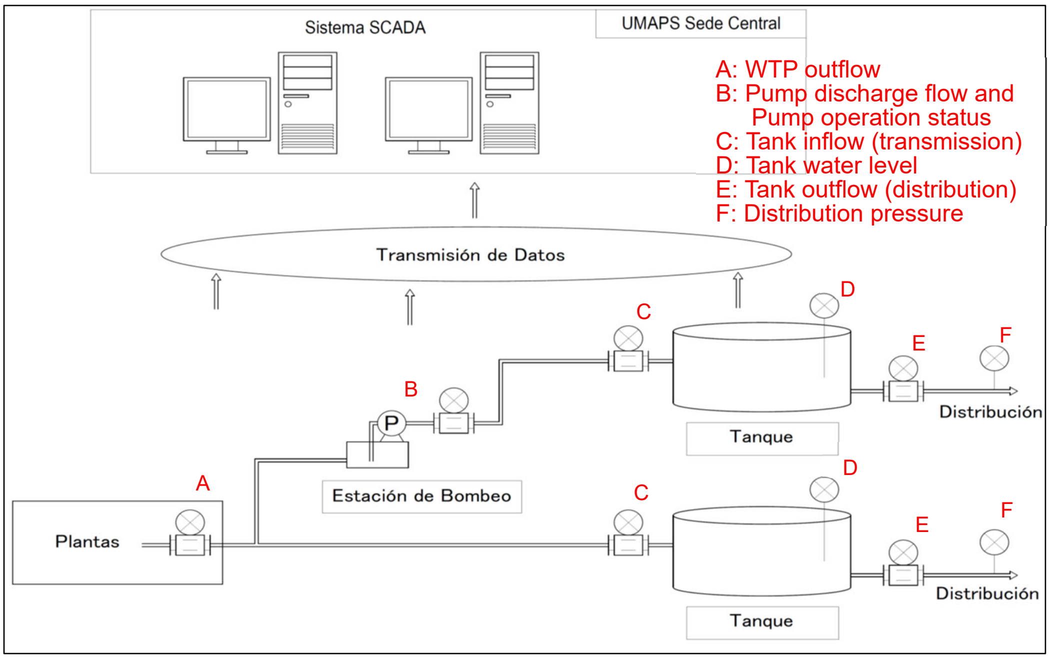
(1) Power Receiving Facilities in the Pump Station

When pumps are renewed at a pump station, the power receiving and transforming facilities shall be renewed as well. Since there are no major changes in electrical capacity, the same specifications as the existing facilities are used: 13.8 kV power receiving, oil-filled outdoor transformer, and secondary voltage of 460 V. A low-voltage receiving panel is installed in the electrical room to distribute power to each pump panel. In some existing facilities, the power receiving panels and pump panels are installed outdoors, but in principle, they should be installed indoors because of concerns about safety as well as reduced durability. In addition, since the frequency of power failure is not so high and the water is supplied on a timed basis, a standby generator is not considered.

(2) Instrumentation Equipment and its Prioritization

In order to efficiently distribute the insufficient amount of water, a system that can continuously monitor the inflow rates to each distribution tank, water level of distribution tanks, and distribution flow rates from the tanks should be installed. Typical water supply systems and necessary instruments (A~F) are shown in Figure 5.2.5.

The top priority is to monitor the water transmission flow since it is indispensable for securing equitable water allocation throughout the service area. The flow meters (A), (B), and (C) are related to the water transmission flow. Monitoring of tank level (D) and water distribution flow (E) should also be conducted for securing the equitable water supply, as well as for developing the leakage and NRW management system in future. Water distribution pressure (F) shall not be adapted for this project, since all water distribution will be by gravity.



Source: JICA Study Team

Figure 5.2.5 Typical Water Supply System and Instrumentation

5.3 Proposed Project Component

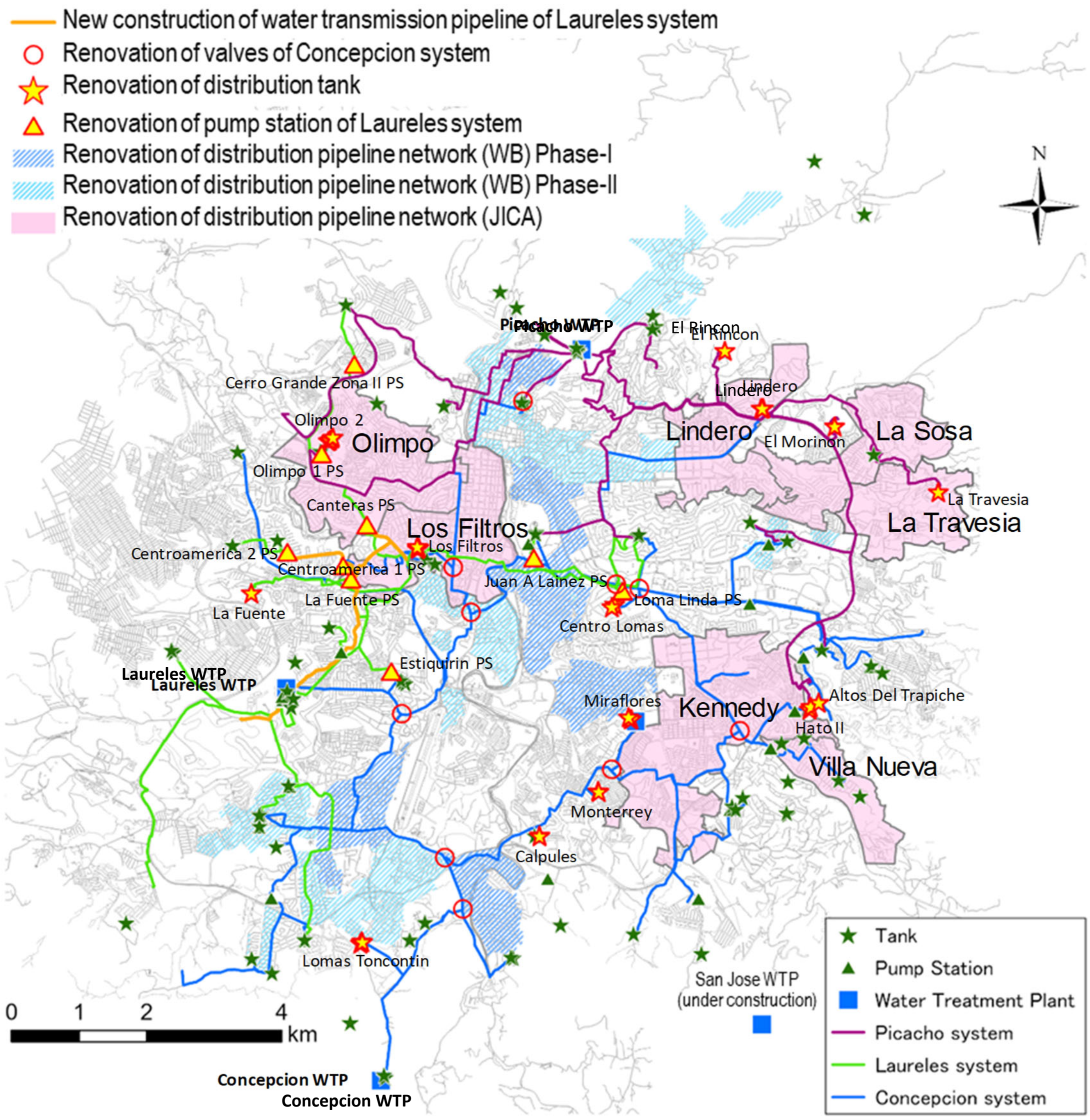
Based on Section 5.2, following six components are proposed for the Project.

Table 5.3.1 Proposed Project Component

Component	Contents
1. Water transmission pipeline	- Renovation of transmission pipeline of the Laureles System. D150 – D1000 L= 6.5 km - Renovation of valves of the Concepcion system.
2. Water transmission pump station	- Replacement of transmission pump and renovation of associated facilities at nine pump stations.
3. Instrumentation and SCADA	- Monitoring system of inflow rate and water level of distribution reservoirs. Monitoring point: 43 points - Monitoring system of outlet flow rate of the distribution tanks
4. Water distribution tank	- Demolish existing distribution tanks and construct new tanks at 14 tank sites.
5. Water distribution network	Renovation of distribution pipe network at seven distribution blocks - Installation of additional distribution main pipeline, pressure reducing valve, and air valve, for establishing distribution sub-block. - Replacement of distribution pipe and replacement/installation of associated customer meter.
6. Procurement of customer meter	- Procurement of customer meters to be installed at the above-mentioned seven distribution blocks.

Source: JICA Study Team

Figure 5.3.1 shows the location of the project component.



Source: JICA Study Team

Figure 5.3.1 Location of the Proposed Project Component

(Same Figure as Figure 5.2.3)

CHAPTER 6 CONCEPTUAL DESIGN OF PROJECT FACILITY

6.1 Renovation of Water Transmission Pipeline

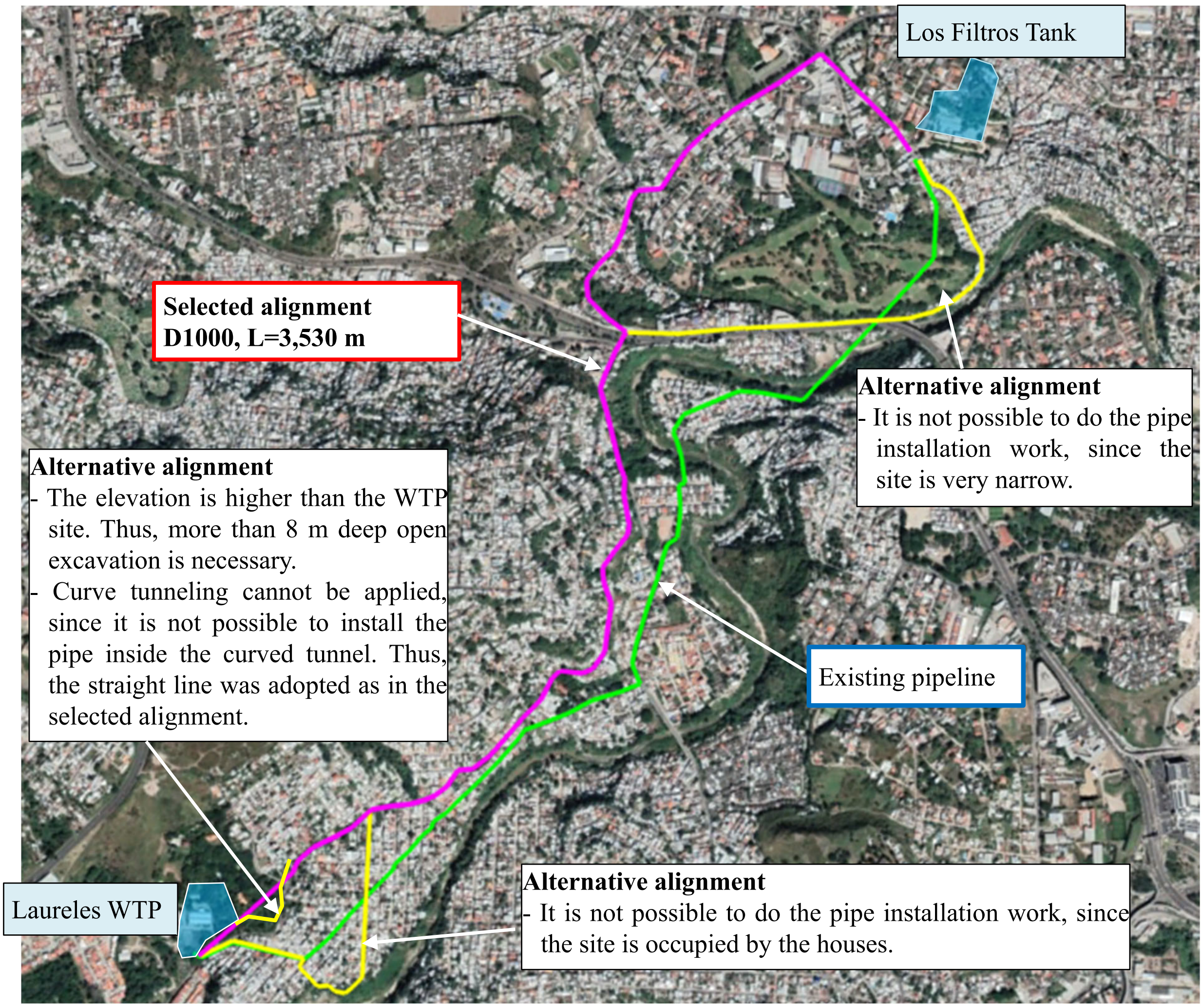
6.1.1 Laureles System

(1) Outline of Renovation

The existing main pipeline from WTP Laureles to Los Filtros Tank was installed more than 47 years ago and the inner surface of the pipe has deteriorated. However, it is not possible to repair the damaged pipe due to the site conditions. Thus, a new pipeline shall be installed in a separate alignment from the existing pipeline. The existing pipe will be filled with the concrete after once ensuring the new pipeline is in use. Several branch pipelines to the pumping stations along the way shall also be renewed. A plan and profile drawing for this pipeline is as shown in Appendix 6.1.1.

(2) Pipe Alignment

The pipe alignment has been determined considering the site conditions as shown in Figure 6.1.1.



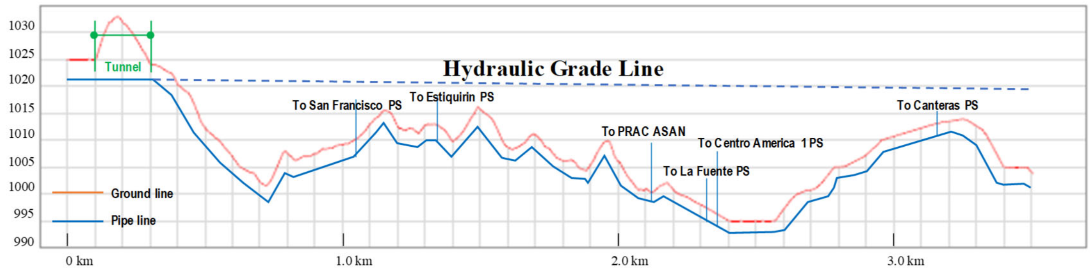
Source: JICA Study Team, Esri, Maxer, Earthstar Geographics, and the GIS user Community

Figure 6.1.1 Alignment of New Pipeline

As shown above, the selected alignment is basically under the existing road, except for the starting point which is under the private land where construction of a tunnel is required as described below.

(3) Profile and Hydraulic Examination

Figure 6.1.2 shows the profile and hydraulic grade line. As shown in the figure, a tunnel under the private land needs to be constructed at the starting point.



Source: JICA Study Team

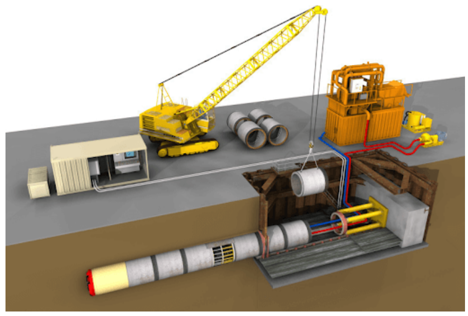
Figure 6.1.2 Profile and Hydraulic Grade Line

(4) Examination of the Tunnel Section

1) Tunnelling method

The pipe jacking method has been selected as shown in Table 6.1.1.

Table 6.1.1 Comparison of Tunneling Methods

	Mountain Tunnelling Method	Pipe Jacking Method
Outline	 - Construct the tunnel with a diameter of around 2.5 m. Then, bring in the D1000 DCI pipe and install it inside the tunnel. - Use of explosives is not possible since the residents on the upper ground does not approve. Thus, only manual digging using hand held rock drill can be applied. - Special protection measures at the tunnel entrance and exit are required.	  - Construct D1500 concrete culvert by pipe jacking method - Then insert the D1000 DCI pipe from the tunnel entrance.
Impact on the ground	Even though manual digging is applied, there is a risk on the upper ground.	There is no risk since the earth coverage is eight times of the pipe diameter (1.5 m).

Construction cost	Approx. JPY 360 million	Approx. JPY 350 million (including transport of equipment and material from abroad)
Construction period	Approx. 250 days (11 months)	Approx. 90 days (4 months)
Evaluation	Not selected	**Selected**

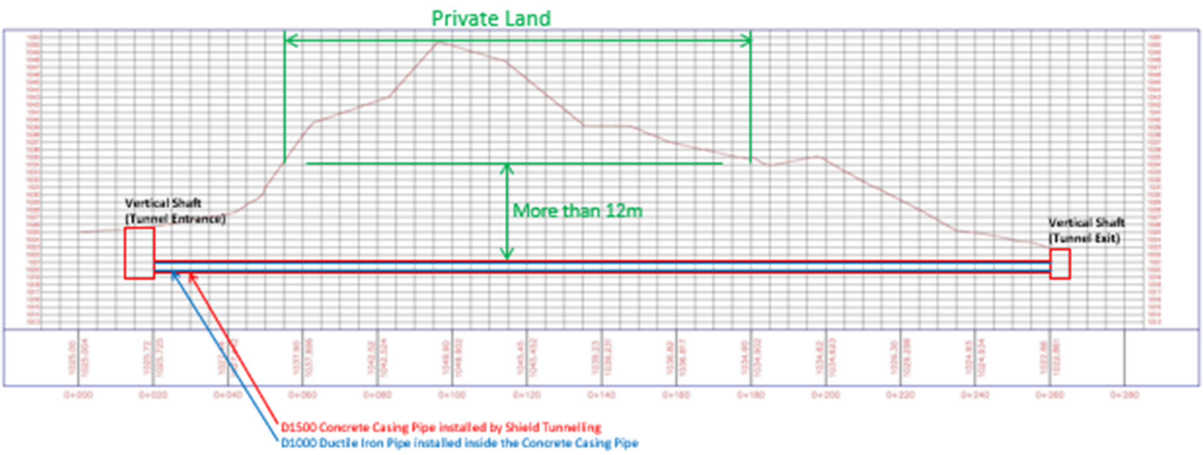
Source: JICA Study Team

2) Impact on the ground

Figure 6.1.3 to Figure 6.1.5 shows the plan, profile, and cross section of the tunnelling section.

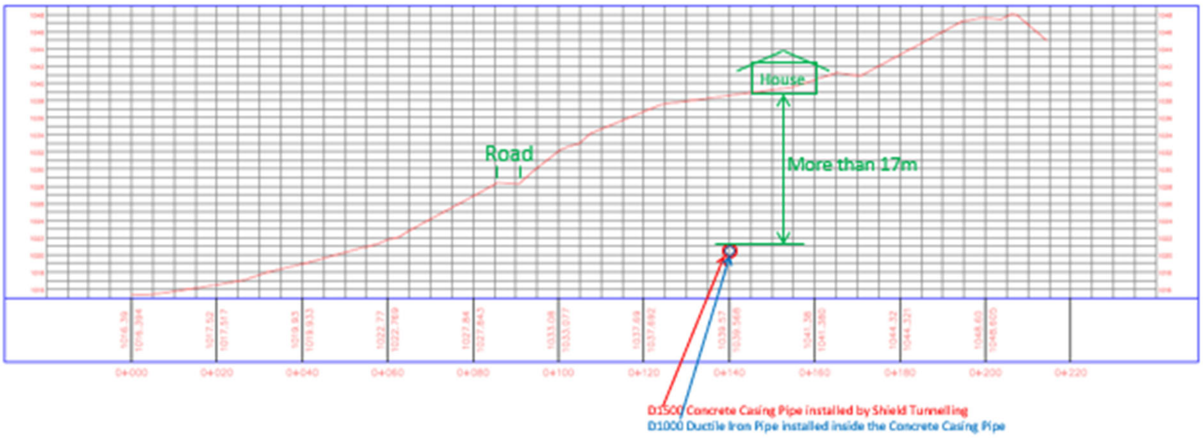
Source: JICA Study Team

Figure 6.1.3 Plan of Tunneling Section



Source: JICA Study Team

Figure 6.1.4 Profile of Tunneling Section



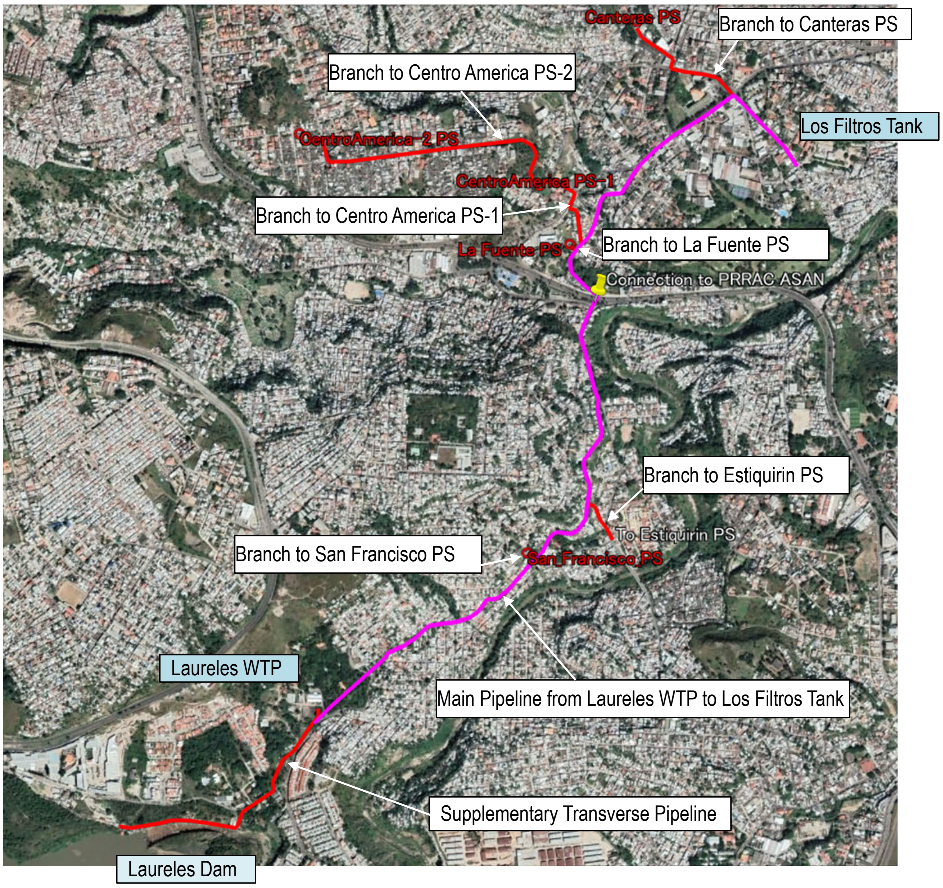
Source: JICA Study Team

Figure 6.1.5 Cross Section of Tunneling Section

As shown above, the earth coverage of the tunnel in the private land is more than 12 m and the vertical distance is more than 17 m, which are more than eight times of the pipe diameter. Thus, the tunnelling is not expected to affect the upper ground.

(5) Branch Pipeline and Supplemental Transverse Pipeline

Figure 6.1.6 shows the locations of the branch pipelines and supplemental transverse pipelines.



Source: JICA Study Team, Esri, Maxer, Earthstar Geographics, and the GIS user Community

Figure 6.1.6 Branch Pipelines and Supplemental Transverse Pipelines

Table 6.1.2 shows the diameters and lengths of the pipelines. The diameter has been determined based on the hydraulic analysis described in Section 4.2.

Table 6.1.2 Specifications of the Branch Pipelines and Supplemental Transverse Pipelines

Pipeline	Specification
Branch pipeline to San Fransisco PS	D300 L=40 m
Branch pipeline to Estiquirin PS	D400 L=170 m
Branch pipeline to La Fuente PS	D150 L=30 m
Branch pipeline to Centro America I PS	D300 L=350 m
Branch pipeline to Canteras PS	D400 L=480 m
Branch pipeline from Centro America PS-1 to Centro America PS-2	D300 L=1,000 m
Supplementary transverse pipeline to the treated water tank in Laureles WTP	D400 L=980 m

Source: JICA Study Team

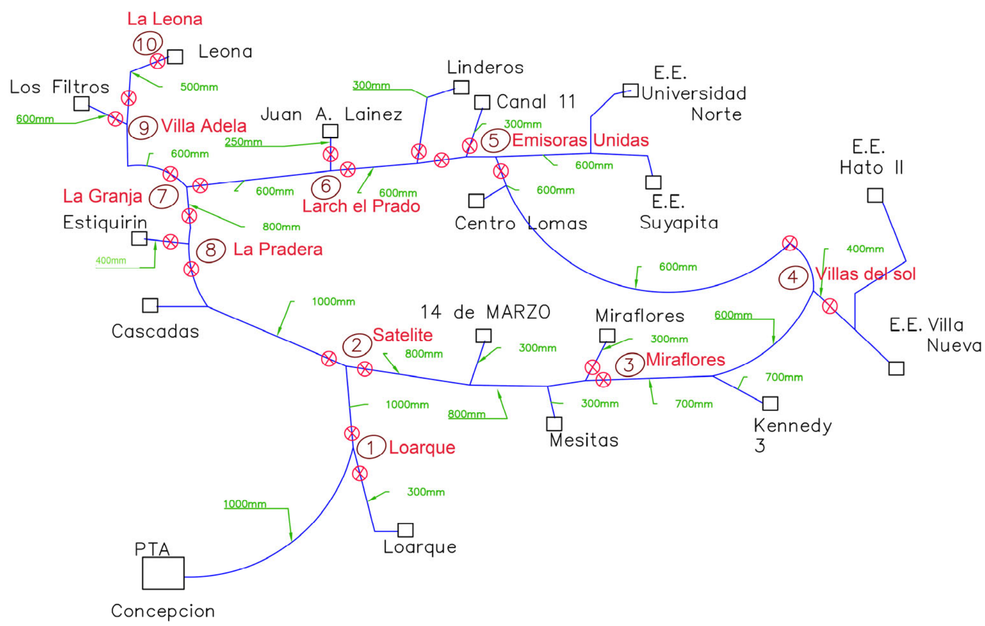
6.1.2 Concepcion System

(1) Outline of Renovation

The Concepcion System is an important system that covers more than 60% of the water demand in Tegucigalpa. In maintenance of the system, it is necessary to limit the water cutoff section by valves. Thus, the aging or deteriorated valves shall be replaced so that the proper operation of the valves can be secured.

(2) Location and Diameter of the Valves to be Renovated

Figure 6.1.7 shows the locations of the valves to be renovated.



Source: JICA Study Team

Figure 6.1.7 Locations of Valve Renovation

The Table 6.1.3 shows the list of the valves with its diameter.

Table 6.1.3 List of Valves to be Renovated

No.	Place Name	Valve Diameter (mm)								Total
		1,000	800	700	600	500	400	300	250	
1	Loarque	1						1		2
2	Satelite	1	1							2
3	Miraflores			1				1		2
4	Villas del sol				1		1			2
5	Emisoras Unidas				2			2		4
6	Larach el Prado				1				1	2
7	La Granja				2					2
8	La Pradera		2				1			3
9	Villa Adela				1	1				2
10	La Leona					1				1
	Total	2	3	1	7	2	2	4	1	22

Source: JICA Study Team

6.2 Renovation of Pump Station

6.2.1 Mechanical Facility

(1) Design Considerations for the Replacement

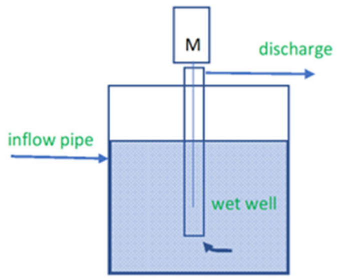
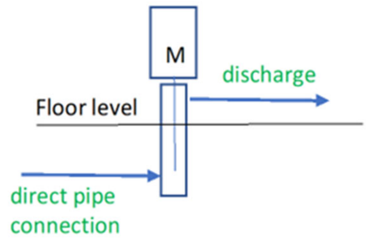
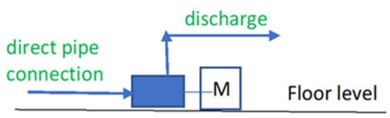
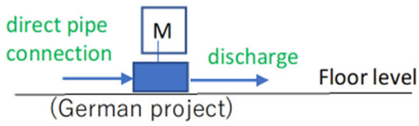
1) Pump type

Most of the existing pumps are vertical in-well type (Type I) as shown in the Table 6.5.1. This type has been used for more than 40 years in UMAPS, and the civil structures including pump wells, have been adapted to this type. The general advantages are space saving and good pump efficiency. But maintenance management is a bit difficult because the pump body and impeller are located in the wet well under the floor. When the JICA study team interviewed the mechanical staff of UMAPS, they suggested that the pump type should be the same as the existing one because the electro-mechanical technicians are accustomed to maintaining this type of equipment.

Some pump stations use an in-line type (Type II-1 to 3) as shown in Table 6.2.1. The advantage of the in-line pump is to utilize the remaining water pressure of the pipeline, which leads to energy savings.

Since the maintenance of the pump itself is particularly difficult for Type II-1, when considering replacement, Types II-2 to 3 are recommended. But, UMAPS also suggested that the pump type should be the same as the existing one, because it is necessary to expand the pump room if the pump type is changed. The expansion of the pump room is difficult since the land area are limited. A comparison of these types is shown in Table 6.2.2.

Table 6.2.1 Type of Transmission Pump

<table>
<tr><td>Type I: Vertical in-well type</td><td>Type II-1: Vertical in-line type</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Type II-2: Horizontal in-line type</td><td>Type II-3: Vertical in-line type</td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Source: JICA Study Team

Table 6.2.2 Comparison of Pump Types

	Type I	Type II-1	Type II-2, II-3
Features	Pump body and multi-impellers are submerged in the water tank.	Suction pipe is directly connected to the pump under the floor	Suction pipe is directly connected to the pump on the floor.
Advantages	Pump efficiency is relatively high. Saves installation space.	The remaining water pressure can be utilized.	The remaining water pressure can be utilized.
Dis-advantages	Maintenance is not easy.	Fluctuation of suction pressure will affect pump performance. Therefore, its lifetime is shorter. Difficult installation and maintenance, since the pump body is in the underfloor.	Fluctuation of suction pressure will affect pump performance. Therefore, its lifetime is shorter. Space for suction pipe is larger compared to Type II-1.
Equipment cost (ratio)	100	110	95
UMAPS preference	Electro-mechanical technicians know this type well during its more than 40 years of operation.	Utilizing remaining water pressure should be continued. Electro-mechanical technicians know this type well during its more than 40 years of operation.	It is necessary to re-construct the pump house for replacing Type-II-1 to this type, requiring additional cost for building the pump house.

Source: JICA Study Team

Based on the above consideration, the same type as the existing pump (Type I and Type II-1) were selected for the new pumps.

2) Pump capacity

The pump capacity of each transmission pump station for future demand has been determined to meet the hydraulic analysis mentioned in Section 4.2.4. The unit capacity for pump replacement is shown in Table 6.2.3.

Table 6.2.3 Design Capacity of Pump Station

Pump Station Name	Capacity and Head	Motor (kW)	Duty	Standby
Estiquirin PS	Q= 136 L/s H=54 m	110	1	1
Juan A. Lainez PS	Q= 33 L/s H= 72 m	37	1	1
Loma Linda PS	Q= 21 L/s H=79 m	30	1	1
	Q= 38 L/s H=50 m	30	1	1
Canteras PS	Q= 93 L/s H=147 m	200	3	1
	Q= 140 L/s H=76 m (Booster)	160	2	1
Centroamerica I PS	Q= 107 L/s H=78 m	120	1	1
Centroamerica II PS	Q= 59 L/s H=68 m	75	1	1
	Q= 48 L/s H=97 m	75	1	1
La Fuente PS	Q= 24 L/s L=151 m	55	1	1
Olimpo I PS	Q= 64 L/s H=109 m	100	1	1
	Q= 93 L/s H=27 m (Booster)	37	1	1
Cerro Grande Zona II PS	Q= 64 L/s H=86 m	90	1	1

Source: JICA Study Team

3) Ancillary facility

Flowmeter

An electro-magnetic flowmeter or mechanical turbine with a signal is more recommendable than the existing insert type. However, because of the length of straight pipes required, if they cannot be installed at the main discharge header, they must be installed outside in the basement, which requires extensive construction work.

Pressure gauge and water level meter

It is necessary to install pressure gauges for each pump discharge pipe and water level meter in each tank.

Piping work

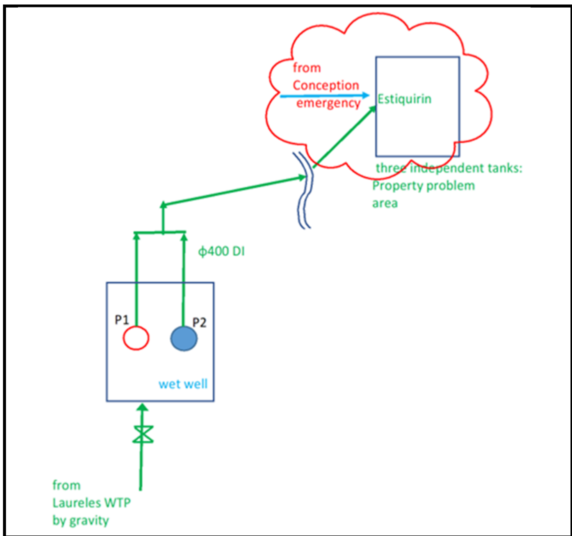
When pumps are replaced, all the piping work including valves in the building and related electrical works shall also be replaced.

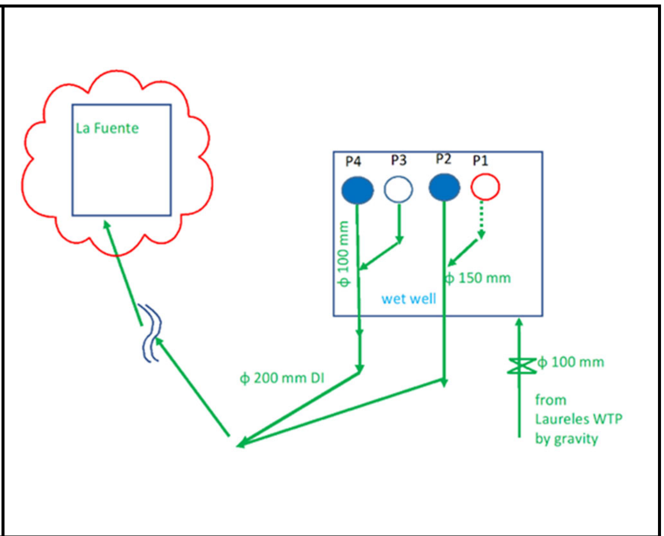
4) Considerations during the construction period of pump stations (PSs)

In addition to the pumps, the pipes and electrical facilities will also have to be replaced, which means that water will not be able to be transferred to the reservoir during the construction period. Therefore, the construction period shall be minimized. During the rehabilitation or re-construction period of PSs, temporary water supply interruption will occur. Water transmission should be continued using alternative transmission system, if possible, to minimize the water outage. Otherwise, it will be necessary to use water trucks to supply water temporarily during the period.

As an example, Estiquirin PS has an alternative water supply line from the Conception WTP, but La Fuente PS does not have it, as shown in Table 6.2.4.

Table 6.2.4 Configuration of Two PSs





In case that the distribution tank has an alternative water supply source	In case of not having any alternative water source

Source: JICA Study Team

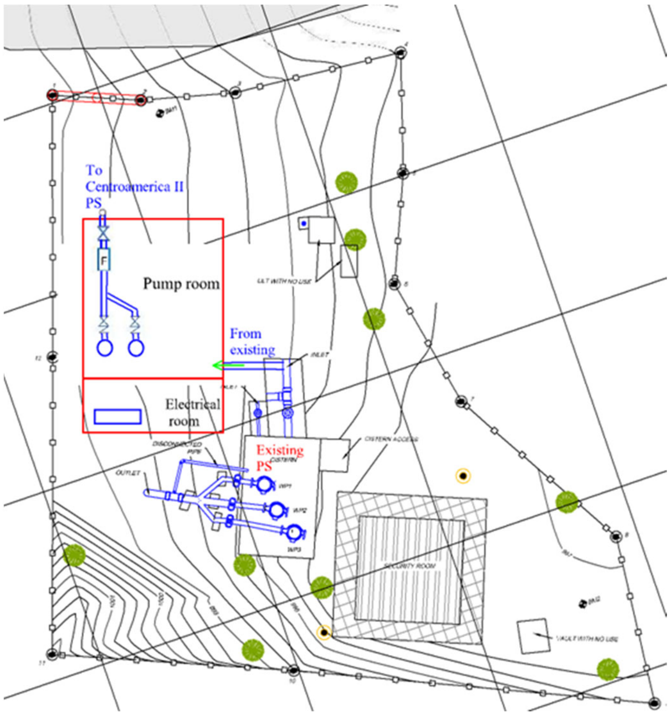
Further, Centroamerica I PS and II PS are the same situation of the La Fuente PS, as shown in the Table 6.2.5. Therefore, construction procedure for these three PSs shall be carefully considered.

Table 6.2.5 Effect of Water Interruption

PS	To the (Tank name)	Alternative water source	Affection to the water interruption
2-1 Estiquirin PS	Estiquirin	✓Gravity from Conception	Low
2-2 Juan A. Lainez PS	Juna A.Lalnez	✓Gravity from Conception & Picacho	Low
2-3 Loma Linda PS	Centro Lomas & Canal 11	✓Gravity from Conception	Low
2-4 Canteras PS & BP	Olimpo 1	✓Gravity from Picacho (but not enough)	Low
2-5 Centroamerica I PS	Centroamerica II PS	None	high
2-6 Centroamerica II PS	CA West & CA East	None	high
2-7 La Fuente PS	La Fuente	None	high
2-8 Olimpo I PS & B	Olipmpo II Cerro Grande II	✓Gravity from Picacho ✓Gravity from Picacho through Cerro grande tank of PS 2.9	Low
2-9 Cerro Grande II PS		✓Gravity from Picacho	Low

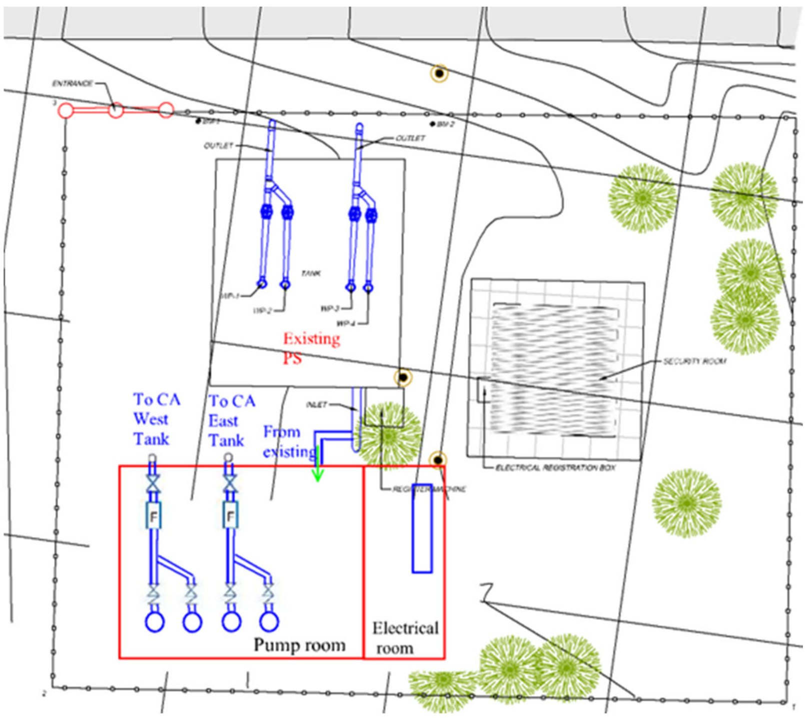
Source: JICA Study Team

Regarding Centroamerica I PS and II PS, there are enough land space for new construction. Therefore, to minimize the water interruption period, the new PS will be first constructed, and switched from the existing PS after the completion of the performance test of the new PS.



Source: JICA Study Team

Figure 6.2.1 Layout of Centroamerica I PS



Source: JICA Study Team

Figure 6.2.2 Layout of Centroamerica II PS

Regarding La Fuente PS, there is not enough land space for new construction. Therefore, only the mechanical and electrical facility will be renovated. During construction period, water shall be delivered by water tankers to the La Fuente Distribution Tank or could be supplied from the Centro America Oeste Tank.

Source: JICA Study Team

Figure 6.2.3 The Existing Layout of La Fuente PS

Topographical plan drawing for each PS is as shown in Appendix 6.2.1 – 6.2.9.

6.2.2 Electrical Facility

(1) Pump Starting Methods

Recently, electronic voltage reduction starting methods such as soft starters have been the popular method for starting motors exceeding 30 kW. The starting methods based on motor capacity are generally as follows:

Table 6.2.6 Starting Method of Pumps

Motor Capacity	Starting Method	Remarks
7.5 kW or less	DOL	
7.5 kW to 30 kW	Star-Delta	
30 kW to 55 kW	Star-Delta or Soft Starter	
55 kW or more	Soft Starter	

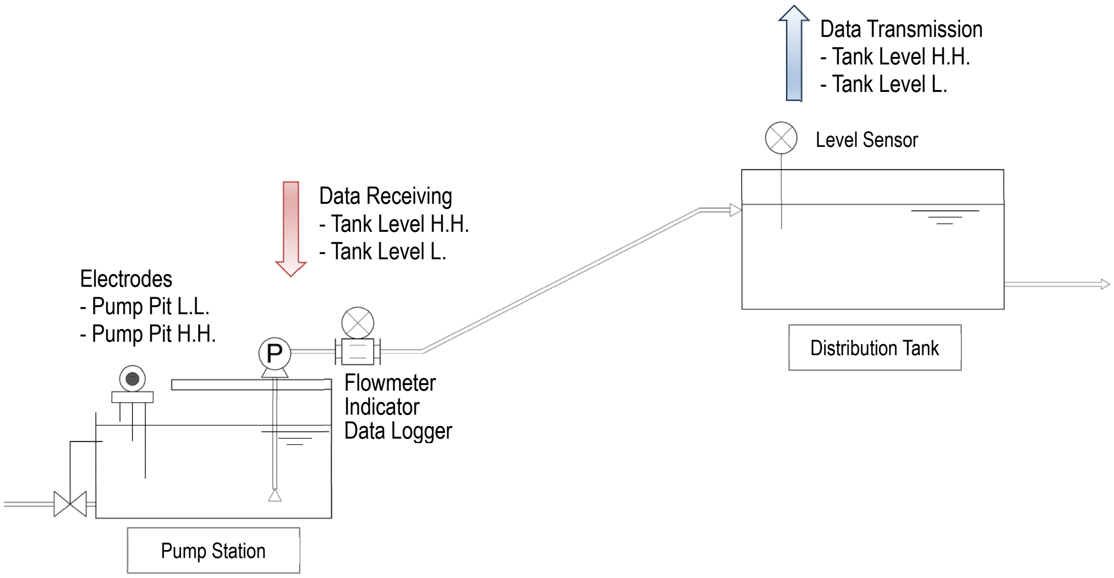
Source: JICA Study Team

(2) Automatic Pump Control

At the nine pumping stations planned for renewal, electrodes are installed in the pump pits to prevent the pumps from dry running and automatically stop pumps at Level L.L. In addition, mechanical valves are automatically closed at high water levels, but electrodes also detect Level H.H. and alarm in case of failure of mechanical valves.

Pressure-type water level meters are installed on the water distribution tanks' side, which transmits an alarm and automatically stops the pumps when the water distribution tank level H.H. is reached. When the water level drops, only an alarm is transmitted, and in principle, the pump is restarted manually.

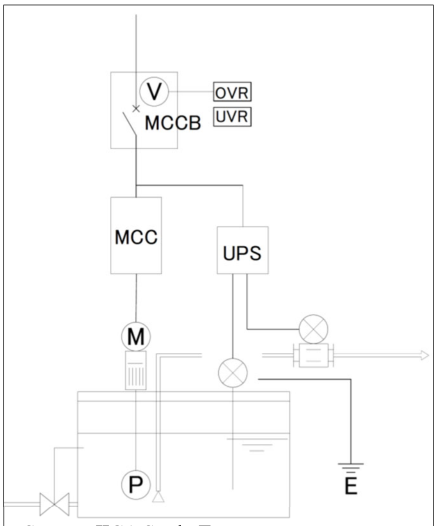
As for SCADA system applications, the pump operation status can be monitored, but remote operation of the pump is not provided in principle. A flowmeter will be installed on the outlet side of the pump, and an indicator and data logger will be installed on site, but signals will not be taken into the SCADA system.



Source: JICA Study Team

Figure 6.2.4 Pump Operation

(3) Voltage Fluctuation Prevention Measures



Source: JICA Study Team

Figure 6.2.5 Measuer for Voltage Fluctiation

The project area is subject to frequent voltage fluctuations that is considered to be caused by the imbalance between the supply and demand of electric power, which frequently damage equipment. In particular, flowmeters and other instrumentation equipment are often fatally damaged, rendering them unusable. As a countermeasure, an over voltage relay (OVR) and an under voltage relay (UVR) are installed at the main breaker to automatically disconnect the circuit in the event of abnormal voltage. In addition, instrumentation and soft starter control circuits that are easily affected by voltage fluctuations should be powered via an uninterruptible power supply (UPS); since the UPS has a rectification function, constant power supply from the UPS will ensure a stable power supply and protection against external power supply problems. In addition, the grounding should be securely applied, and arresters should be installed on the power and signal lines respectively for instrumentation equipment as a measure against surge voltages. In addition, the Project area has a lot of bedrock geology, and if the site has bedrock geology, it may be extremely difficult to obtain good grounding, which may have been one of the reasons for past instrumentation failures. It is recommended that soil resistance be confirmed based on the geological survey during detailed design, and that appropriate grounding methods and grounding resistance values be specified in the bidding documents.

6.3 Renovation of Instrumentation and SCADA System

6.3.1 Selection of Flowmeter Type

In principle, a flange-mounted electromagnetic flowmeter with high measurement accuracy and few failures should be used as the flowmeter type. An ultrasonic flowmeter is also considered for the case where long-time interruption of water supply is unavoidable, such as at the outlet of a water treatment plant. But currently, there is no such case because the signal can be taken in from the existing flowmeter. Most flowmeters have a diameter of around 300 mm, and there is almost no price difference between the electromagnetic flowmeter and the ultrasonic flowmeters when replacing piping. Note that although the insertion-type flowmeter is easy to install on existing piping, it is not used in the Project due to problems with the Picacho System as mentioned in Section 3.3.7 (3) 4).

It is recommended that flowmeter transducers be installed indoors to prevent lightning and physical damage, but if indoor installation is difficult, a firm storage panel will be provided. In the Project, the flowmeters for the tanks will be installed in a dedicated concrete pit, and the flowmeters for the pumping stations will be installed in the pump room building. Each site will also have an instrumentation panel to accommodate power supply equipment, indicator meters, lightning arrestors, etc.

6.3.2 Selection of Water Level Meters

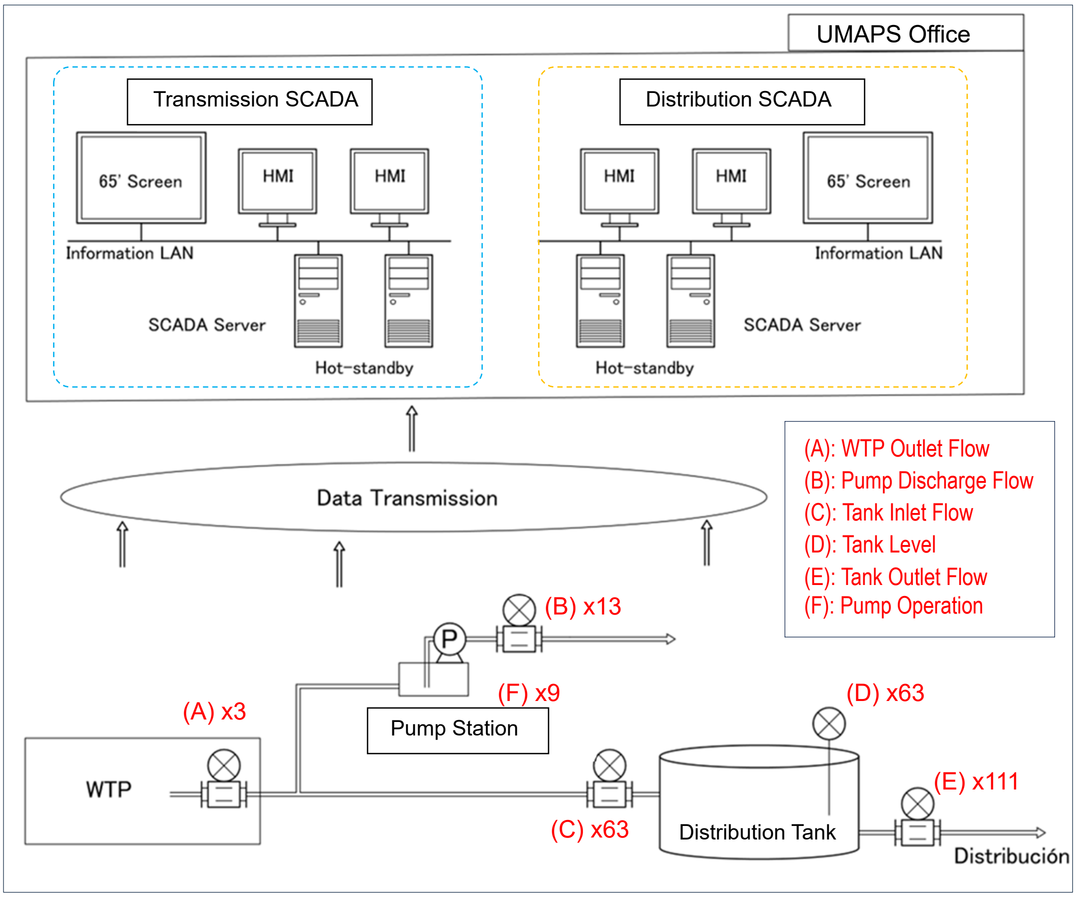
In principle, pressure-type water level meters, which can be easily sealed after installation and do not require maintenance, will be adopted as water level meters to be installed in the water distribution tanks. Some pressure-type water level meters are less influenced by lightning and can transmit signals through optical cables. Its adoption will be determined after confirming its operational track record and ease of maintenance.

6.3.3 Communication Method

For the communication method between each site and the SCADA monitoring room to be constructed at UMAPS headquarter, considering the problems with Picacho, gigahertz-band wireless devices will not be used, and data communication using the highly popular cellular phone network will be applied as a standard data communication. In Tegucigalpa, 3G or 4G networks are available at all sites. One of the disadvantages of using general-purpose lines is the cost of communication fees. According to our research, the minimum flat-rate communication fee is USD 22 (30 GB/month), and assuming that there are 50 target sites, the minimum monthly running cost will be USD 1100. If the flow rate and water level information is to be monitored in real time, the amount of information will increase, and the burden may become much higher. In the Project, UMAPS needs to provide SIMs for data communication and bear the telecommunication costs. (Communication charges are for private subscriptions, and may be reduced by limiting the amount of communication through corporate subscriptions, etc.) In addition, UMAPS has experience in data communications using UHF frequency band radios, and will utilize these as much as possible, but in principle only where there is current communications performance, and will not consider constructing new high antennas to secure line-of-sight in the Project. The site to adopt this wireless communication should be decided at the time of detailed design after having UMAPS check the communication status again.

6.3.4 SCADA System Overview

Figure 6.3.1 shows the overview of SCADA system.



Source: JICA Study Team

Figure 6.3.1 SCADA System Overview

The measurement items to be monitored by SCADA are (A): WTP outlet flow [three sets/three locations], (B): Pump Discharge Flow [13 sets /9 locations], (C): tank inlet flow [63 sets/41 locations] , (D): tank level [63 sets/41 locations] and (E): Tank Outlet Flow (Distribution Flow) [111 set /67 locations]. These items shall be monitored in near real-time with SCADA, and data such as trends stored in SCADA can be utilized retrospectively. For the nine pumping stations to be renewed in the Project, the pump operation status (Stop, Run, and Alarm) shall be monitored by SCADA.

The hardware of SCADA monitoring room consists of two hot-standby servers, two HMIs for operator interface, a large 65" screen, and a printer. All power for the hardware is supplied by a UPS. The hardware will be installed in a newly constructed building on the UMAPS head office site.

All sites where flowmeters and water level meters are installed will have instrument panels so that the indicated values can be checked on-site and alarms such as water level HH can also be checked. The instrument panels will also be equipped with hardware recorders (data logger). This recorder will be able to check trends and historical data based on accumulated measurement information, and will also serve as a backup in the event that data cannot be sent to SCADA due to communication failures or other problems.

Transmission SCADA & Instruments system diagram is as shown in Appendix 6.3.1.

6.3.5 Data Transmission

As mentioned in the previous chapter, data communication using cellular networks incurs a large monthly cost. If a continuous connection is used to monitor changes in flow rates and water levels in real time, the monthly communication volume can be expected to exceed 30 GB. On the other hand, the water flow rate and distribution tank level information are not necessarily required to be monitored in real time, and the communication volume can be greatly reduced by sending the totalized flow rate in batches at regular intervals and sending only set values such as water level alarms. In the Project, the frequency of data transmission and reception is assumed to be as follows, considering the balance between necessary information and communication volume. Table 6.3.1 shows the proposed monitoring frequency of each monitoring item.

Table 6.3.1 Frequency of Data Transmission

Equipment	Monitoring Item	Frequency
Transmission Flow	Hourly Average Flow	/Hour
	Daily Max Flow, Daily Min Flow, Trend, Hourly Totalized Flow	/Day
Distribution Tank Level	Setting in Six Levels	/Setting
	Trend	/Day
Distribution Flow	Hourly Average Flow	/Hour
	Daily Max Flow, Daily Min Flow, Trend, Hourly Totalized Flow	/Day
Pump Station	Stop, Run, Failure, Pump pit HH、LL	/Alarm, /Event
	Running Hour, Wh	/Day

Source: JICA Study Team

These communication frequencies and monitoring items can be easily changed by SCADA settings. Details will be determined at the time of construction, taking into account communication conditions and convenience of data utilization.

6.3.6 Selection of the Contactor for SCADA System

The contractor for SCADA system need to take total responsibility not only for the SCADA equipment but also for the selection and installation of field instruments as a total system. Thus, it is necessary to select a contractor with a sufficient experience in manufacturing and constructing in similar projects.

In addition, following factors need to be considered for selection of the Contractor. The detail will be determined in the bid documents at the time of detailed design.

Table 6.3.2 Factors for Selecting SCADA System Contractor

System Integration	Manufacturing and contracting experience in the water supply works should be specified and should be a condition for review at the time of bidding.
Expandability	Open systems, future capacity, etc. should be specified in the specifications. Software and equipment experience should also be evaluated at the time of bidding.
Service Bases	One of the conditions for selecting a system integrator is the base for supplying maintenance services and spare parts. Remote support can also be considered.
Training	Training in the manufacturer's proprietary technologies, such as programming, should be included in the Project.

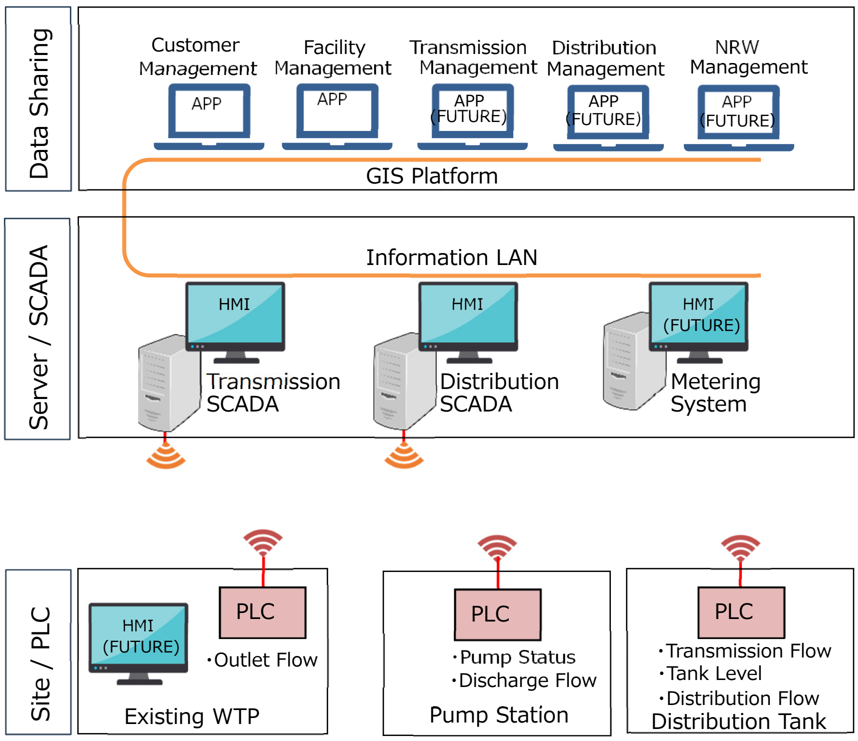
Source: JICA Study Team

6.3.7 Proposed Expansion Plan of SCADA System

In the Project, SCADA for the water transmission and distribution systems will be installed and a monitoring room will be set up at the UMAPS headquarters.

In the future, it is proposed the data of SCADA system be shared with metering system, customer management, facility management, transmission management, distribution management, and NRW management on the GIS platform.

Figure 6.3.2 shows an image of data transmission of SCADA system and proposed future expansion.



Source: JICA Study Team

Figure 6.3.2 Data Transmission of SCADA System and Proposed Expansion Plan

The system configuration assumes that each Application Software (APP) will share the data from SCADA system using standard protocols such as Ethernet. The details will be decided at the time of the detailed design.

6.3.8 Proposed Development of Information System

As mentioned in Section 3.3.8, UMAPS is operating several information systems. It is proposed that the introduction of SCADA by the Project will be an initiation to develop the information system of UMAPS. That is, it is proposed to rationalize and upgrade the water supply management by integrating each data, and to establish a rational water operation planning system and NWR management system using the SCADA system developed by the Project. Figure 6.3.3 shows an image of proposed development of information system of UMAPS. The blue-colored item is to be done during the Project implementation and the green-colored item is to be done after the Project.

Present

Customer Management System
- Registration of customer information synchronized with Web-GIS — System in Operation
- Recording of billing data — System in Operation

Facility Management System
- GIS database on leakage repair record — System in Operation
- GIS database on facility inventory data — Under development

Water distributoin planning (manual operation) — Manual operation

During Project Implementation

Customer Management System
- Registration of customer information synchronized with Web-GIS
- Recording of billing data

Facility Management System
- GIS database on leakage repair record
- GIS database on facility inventory data

Proposed to be assisted by JICA techincal cooperation scheme (refer to Section 9.3.4)
- Launch data update system
- Data integratoin on GIS platform

Project Scope

Transmission SCADA
- **Monitoring and recording of water transmission volume to distribution tanks**
- **Monitoring and recording of nine pump station of Laureles system**

Distribution SCADA
- **Monitoring and recording of water level of major Distiribution tanks**
- **Monitoring and recording of water level of major Distiribution tanks**

- Installation by the Project

- Training on transmission and distribuion monitoring by the Project

Water distributoin planning (manual operation)

After Project Completion

Customer Management System
- Registration of customer information synchronized with Web-GIS
- Recording of billing data

Metrering System

Facility Management System
- GIS database on leakage repair record
- GIS database on facility inventory data

Transmission SCADA
- Monitoring and recording of water transmission volume to distribution tanks
- Monitoring and recording of nine pump station of Laureles system

Distribution SCADA
- Monitoring and recording of water level of major Distiribution tanks
- Monitoring and recording of water level of major Distiribution tanks

Water distributoin management using Distribution SCADA data

Proposed to be assisted by JICA techincal cooperation scheme (refer to Section 9.3.4)
- Launch metering system and integration with customer management system
- Data integration on GIS platform
- Update the inventory data with the newly constucted facility by the Project
- Launch water distribution planning system using Distribution SCADA data

- Launch water transmission management system

- Launch NRW management system

Source: JICA Study Team

Figure 6.3.3 Proposed Development of Information System of UMAPS

6.4 Renovation of Distribution Tank

(1) Design Criteria

The design of a distribution tank is based on UMAPS design standards and considers functionality (durability, watertightness, and maintainability), workability (construction time and space), and economy (construction and maintenance costs).

The existing distribution tanks are made of reinforced concrete (RC), steel, concrete block, and glass fused steel. In the case of the steel tank, which is 30 years old or more, there are cases of holes due to oxidative deterioration and cases of collapsed ceilings, and in the case of the concrete block, there are cases of water leakage due to aging deterioration. After discussions with UMAPS, it was decided to apply RC. However, in places where it is difficult to access due to land constraints and steep slopes, circular glass fused steel type shall be applied.

The construction site for the distribution tank will generally be on the site of the existing tank, as it is difficult to acquire new land. In case it is necessary to demolish the existing tank, the water shall be distributed through by-pass pipe.

(2) Design Considerations

Based on the above design criteria, design considerations of each tank are shown in Table 6.4.1. The site plan for each tank is presented in Appendix 6.4.1.

Table 6.4.1 Design Considerations for the Water Distibution Tank

No.	Tank Name	Design Considerations
1	El Rincon	The capacity of the existing reservoir is approximately 80 m^3 and the required capacity in 2038 is 238 m^3. During the construction period, the existing water distribution tank will be used for water distribution. For the new water distribution tank, a 300 m^3 RC distribution tank will be constructed on the site, as there is space available on the existing site.
2	El Molinon	The water distribution tank in La Sosa has a required capacity of 5,877 m^3 in 2038. A 2,500 m^3 steel water distribution tank was constructed in La Sosa in 2010 with the aid of the Japanese government, which is of good quality and can be used for a long time. There is no space left in the La Sosa Tank. On the other hand, space is available on the site of the nearby El Molinon Tank, which will have a water demand of 424 m^3 in 2038, which is far below the existing three 500 m^3 tanks. Therefore, a new tank will be built and connected to the existing tank at El Molinon to distribute water to Colonia 13 de Julio, San Miguel, and Izaguirre, the water distribution area south of El Sosa. One of the existing 500 m^3 tanks at El Molinon will be removed and a new 2,400 m^3 tank will be built. Water from the La Sosa Tank will be distributed to Colonia La Sosa, Aurora, 30 de Noviembre, Sempre, and La Trinidad, which is located north of the existing water distribution area.
3	La Travesia	La Travesia's capacity requirement for 2038 is 4,636 m^3. Although the existing water distribution tank is made of reinforced concrete, it is about 30 years old and there are signs of leakage from the wall. Therefore, the existing tank will be removed and a new tank will be constructed. Due to space limitations, the maximum size of the tank will be 4500 m^3.
4	Olimpo2	The required capacities for Olimpo 1 and 2 in 2038 are 8,362 m^3 and 6,125 m^3, respectively. Two of the four Olimpo 1 and 2 tanks were rebuilt in 2004 with Japanese grant aid and are made of steel. The quality of the newly constructed tanks is good, so they can be used for a long time. On the other hand, the rooftop of the two Olimpo 2 tanks have collapsed due to age-related deterioration, making them extremely dangerous. Olimpo 1 does not have enough space for a water distribution tank, but Olimpo 2 does. Therefore, the two old distribution tanks in Olimpo 2 will be removed and a new 9,000 m^3 RC distribution tank will be constructed to meet the insufficient water demand in Olimpo 1 and 2. During construction, water will be partially distributed from the water pipe bypass. Pressure reducing valves will be installed due to the high-water supply pressure.

No.	Tank Name	Design Considerations
5	Lindero	Lindero's 2038 capacity requirement is 3,814 m^3. There are three existing water distribution tanks and there is not enough space to build a new one. Even if the three tanks are removed, there is not enough room on the part of the steep slope for the 3,800 m^3 tank, so one tank(640m^3) that is in relatively good condition will be kept and the other two will be removed. Therefore, 3150m^3 tank will be constructed.
6	Alto de Trapiche	The required tank capacity in 2038 is 803 m^3. The existing water distribution system consists of two RC 300 m^3 distribution tanks with a total capacity of 600 m^3. The tanks are already 30 years, but there are no leakages, and the system is still fully functional. There is little space in the existing distribution tank and considering the landscape, a 300 m^3 water distribution tank equivalent to the existing one will be constructed to ensure the required amount of water.
7	Hato de Enmedio	A total of 3,995 m^3 of water will be needed in 2038. In this water distribution area, there is a coverspul/San Juan of RC, which is about 30 years old, but it is of good quality and can be in use for a long time without water leakage. On the other hand, Hato de Enmedio has a steel tank and an elevated tank that have holes due to oxidative deterioration. The elevated tank has significant water leakage. There is concern that it may collapse or leak in the future. The insufficient capacity of 2,845 m^3 needs to be secured. There is no space for the existing water distribution tank, and even if the existing distribution tank and the elevated water tank are removed, it is difficult to secure sufficient space with an RC distribution tank. Therefore, a 25.6 m diameter x 6.08 m high glass fused steel water distribution tank will be constructed. The elevated water tank will be made of RC. During the construction period, water will be distributed from the water main to the distribution main by bypassing the water main.
8	La Fuente	The capacity needed in 2038 is 693 m^3. The existing water distribution tank is made of steel and has holes due to oxidative deterioration. Although it has a capacity of 539 m^3, it cannot be used due to the possibility of collapse in the future. Due to lack of space, the existing tank will be removed, and a new RC tank will be constructed. A new 750 m^3 water distribution tank will be constructed to maximize the use of space. The demand is 338 m^3, but a 750 m^3 tank will be built with room to spare by using the same space as the existing tank.
9	Los Filtros	The required capacity in 2038 is 5,127 m^3. The existing facilities include RC and concrete block water distribution tanks, as well as an elevated water tank constructed in 2009 with Japanese assistance. However, due to limited space in the facility, the two RC (3500m^3) tanks that can continue to be used will be retained, the concrete block tank will be removed, and a new RC tank of 1,800 m^3 will be constructed to meet demand.

No.	Tank Name	Design Considerations
10	Centro Loma	UMAPS has led to the decision to distribute part of the Canal 11 water distribution area from Centro Loma. The capacity required for this is 1,500 m^3. Thus, a capacity of 6,169 m^3 is required. On the other hand, there are two existing RC distribution tanks, one of which was built in 2004 with Japanese aid. The other is made of RC, but 40 years have passed since its construction, and water leakage from the basement of the tank has been confirmed due to poor construction. Repair is difficult and the tank needs to be replaced. Since there is plenty of room in the existing space, a new 5,400 m^3 distribution tank will be constructed after the existing RC distribution tank is removed.
11	Toncontin	The existing one has four distribution tanks with a total required capacity of 1,797 m^3. Alto de Toncontin is a steel elevated water tank. It has holes due to oxidation and deterioration over time, and there is constant leakage from the elevated water tank. The other three distribution tanks are made of reinforced concrete and concrete blocks and can be used in the future. Therefore, the Alto de Toncontin will be removed and a 500 m^3 RC tank above the ground water distribution tank will be constructed to meet the overall capacity requirements, and an elevated RC water tank (32 m^3 x H 15 m) will be constructed next to the above ground tank.
12	Calpules	There are two existing steel elevated water tanks. Both have holes due to age-related deterioration. There is a risk of water leakage and collapse in the future, so they need to be replaced. There is not enough space on the site. In order to ensure the required water volume, a circular 750m3 RC elevated water tank will be constructed.
13	Monterry/ Los llano	The existing water distribution tanks are a 329 m^3 RC tank at Monterry and a 35 m^3 steel elevated tank at Los llano. Both are deteriorating with age. Los Llano has holes due to age-related deterioration and is in need of replacement. Therefore, the two were integrated and a 1,000 m^3 above-ground water distribution tank and an elevated RC water tank (32 m^3 x H 15 m) will be constructed adjacent to each other to meet the demand and distribute water to the Los Llano water distribution area.
14	Miraflores	There are three existing water distribution tanks. One was constructed in 2004 with Japanese grant aid and can be used for a long time to come. The remaining two tanks are 40 years old that have no leakages. Since there is not enough space on the site, the two tanks will be demolished and a RC 3,000 m^3 aboveground water distribution tank will be constructed to provide the necessary capacity by 2038.

Source: JICA Study Team

(3) Basic Specifications

The determined basic specifications of the water distribution tanks to be constructed are shown in Table 6.4.2. The standard drawing is attached in Appendix 6.4.2.

Table 6.4.2 Specification of the Water Distibution Tank

No.	Tank Site	Specification of New Tank	Remarks
1	El Rincon	Type: RC rectangle 300 m^3 Dimensions: W:5.0 m, L:10.0 m, D:6.0 m	Construction on existing tank site
2	El Molinon	Type: RC rectangle 2,400 m^3 Dimensions: W:20.0 m, L:20.0 m, D:6.0 m	Distribute to the south of Sosa distribution area
3	La Travesia	Type: RC rectangle 4,500 m^3 Dimensions: W:30.0 m, L:25.0 m, D:6.0 m	Demolish the existing tank and construct a new tank
4	Olimpo 2	Type: RC rectangle 9,000 m^3 Dimensions: W:50.0 m, L:30.0 m, D:6.0 m	Demolish the existing two tanks and construct a new tank
5	Lindero	Type: RC rectangle 3,150 m^3 Dimensions: W:35.0 m, L:15.0 m, D:6.0 m	Demolish the existing two tanks and construct a new tank
6	Alto de Trapiche	Type: RC rectangle 300 m^3 Dimensions: W:5.0 m, L:10 m, D:6.0 m	Construction on the existing tank site
7	Hato	Type: Glass fused steel tank (Cylindrical type) 2700m^3 Dimensions: ϕ25.6 m×6.08 m Type: RC elevated tank 32 m^3×15 m	Construction on the existing tank site
8	La Fuente	Type: RC rectangle 750 m^3 Dimensions: W:15.0 m, L:10.0 m, D:5.0 m	Construction on the existing tank site
9	Los Filtros	Type: RC rectangle 1,800 m^3 Dimensions: W:15.0 m, L:20.0 m, D:6.0 m	Demolish the existing tank and construct a new tank
10	Centro Loma	Type: RC rectangle 5,400 m^3 Dimensions: W:30.0 m, L:30.0 m, D:6.0 m	Demolish the existing tank and construct a new tank
11	Alto de Toncontin	Type: RC rectangle 500 m^3 Dimensions: W:10.0 m, L:10.0 m, D:5.0 m Type: RC elevated tank 32 m^3×15 m	Demolish the existing tank and construct a new tank
12	Calpules	Type: RC Circular Elevated tank 750 m^3 Dimensions: ϕ15.0 m×4.1 m	Demolish the two existing tanks and construct a new tank
13	Monterrey/ Los llanos	Type: RC rectangle 1,000 m^3 Dimensions: W:10.0 m, L:20.0 m, D:6.0 m Type: RC elevated tank 32 m^3×15 m	Demolish the two existing tanks and construct a new tank
14	MiraFlores	Type: RC rectangle 3,000 m^3 Dimensions: W:20.0 m, L:25.0 m, D:6.0 m	Demolish the two existing tanks and construct a new tank

Source: JICA Study Team

6.5 Improvement of the Water Distribution Network

(1) Design Guidelines

The water distribution network shall be designed according to the UMAPS design standards. Each water distribution network consists of distribution main pipeline and branch pipeline. The water is distributed from the distribution tank throughout the network via the distribution main pipe. The branch pipeline is the pipelines branched from the main pipeline. The water is distributed from the branch pipeline to each house through the customer connections. The gate valves and discharge facilities will be installed at appropriate locations for proper functioning and maintenance of the pipeline.

The distribution network should be divided into sub-block according to the ground elevation to equalize the water pressure throughout the entire distribution block. Pressure-reducing valves should be installed between high elevation block and low elevation block, while booster pumps and elevated water tanks should be installed for the areas with low water pressure. The elevation data was obtained from the AMDC DEM data with a 10 m mesh. The design criteria of water distribution pipe network are shown in Table 6.5.1.

Table 6.5.1 Design Criteria for the Water Distibution Pipe Network

Item	Design Criteria
Pipe type	Pipes less than 300 mm in diameter should be PVC/HDPE and pipes over 300 mm in diameter should be DCIP. PVC/HDPE pipe should be adequate pressure resistant pipe. Galvanized steel pipe (GSP) and asbestos cement (AC) pipes should be replaced as they are a reason for leakage.
Water pressure	Hydrodynamic pressure shall be more than 10m. Hydrostatic pressure shall be less than 60m.
Hydraulic calculation	Factor for maximum hourly flow rate: 1.92 Flow coefficient C value for Hazen-Williams formula: 110 Software of hydraulic calculation: EPANET
Valves	- Air valve: to be installed to prevent air accumulation in pipeline - Gate valve: to be installed for maintenance - Pressure reducing valve: to be installed to limit the maximum pressure of the pipeline. Especially in the distribution block where the hydrodynamic pressure exceeds 60m, the distribution block shall be divided into high elevation sub-block and low elevation sub-block. A pressure reducing valve shall be installed at the entrance to the low elevation sub-block to reduce the water pressure in the sub-block.

Source: JICA Study Team

(2) Design Conditions

The design conditions for the water distribution pipe network is shown in Table 6.5.2.

Table 6.5.2 Design Conditions for the Water Distibution Network

No.	Block	Overview of present condition	Design condition
1	La Sosa	・Water is distributed from the La Sosa Tank to two areas (north and south) ・Total length: 38.9 km (PVC 91.3%, GSP 7.4%, DCIP1.2%) ・Diameter : ϕ 50～150 mm	・ South area will be distributed from Molinon Tank. ・Design flow: 626 m^3/h. ・Several pipe information in existing GIS data was revised

No.	Block	Overview of present condition	Design condition
		・12 hours of water distribution every four days ・Installed in the 1980s ・70 water leakage accidents in 2020	based on the CAD data from UMAPS.
2	La Travesia	・Total length: 32.69 km (PVC 96%, GSP 4%) ・Diameter： φ 50～200 mm ・12 hours of water distribution every four days ・Installed in the 1990s ・20 water leakage accidents in 2020	・Design flow: 1,014 m^3/h.
3	Olimpo	・Total length: 108.36 km (no pipe material data) ・Diameter： φ 50～600 mm ・12 hours of water distribution every three or four days ・Installed in the 1990s ・323 water leakage accidents in 2020	・Design flow: 1,831 m^3/h. ・There is no GIS data. The pipeline length was estimated by road length.
4	Lindero	・Total length: 50.5 km (PVC 91.3%, GSP 3.2%, DCIP 5.6%) ・Diameter： φ 50～150 mm ・12 hours of water distribution every four days ・Installed in the 1970s ・112 water leakage accidents in 2020	・Design flow: 849 m^3/h.
5	Los Filtros	・Total length: 113.70 km (PVC 58.9%, GSP 28.2%, DCIP 12.1%, AC 0.8%) ・Diameter： φ 50～400 mm ・12 hours of water distribution every three days ・Installed in the 1960s ・203 water leakage accidents in 2020	・Design flow: 1,103 m^3/h.
6	Kennedy	・Total length: 131.58 km (PVC 94.5%, GSP 1.6%) ・Diameter： φ 50-400 mm ・12 hours of water distribution every three days ・Installed in the 1970s and rehabilitated in 2000. ・149 water leakage accidents in 2020	・Design flow: 2,382 m^3/h. ・Several pipe information in existing GIS data was revised based on the data from UMAPS.

No.	Block	Overview of present condition	Design condition
7	Villa Nueva	・Total length: 41 km (PVC 94.5%, GSP 1.6%) ・Diameter : ϕ 50 mm ・12 hours of water distribution every three days ・Installed in 1990. ・No water leakage accident data	・Designed maximum daily supply is 346 m^3/h. ・There is no GIS data. The total distance is from the CAD data from UMAPS and it is estimated by the total road length.

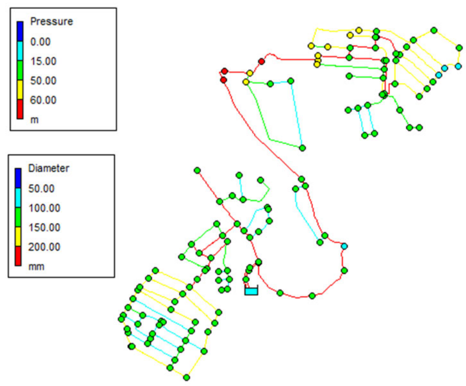
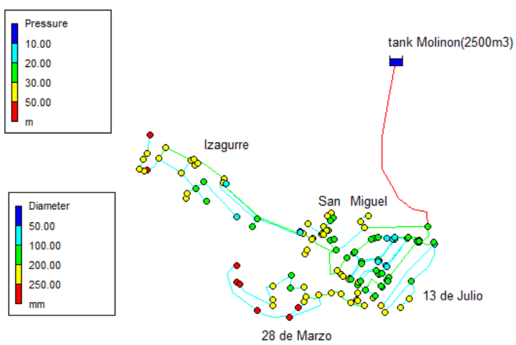
Source: JICA Study Team

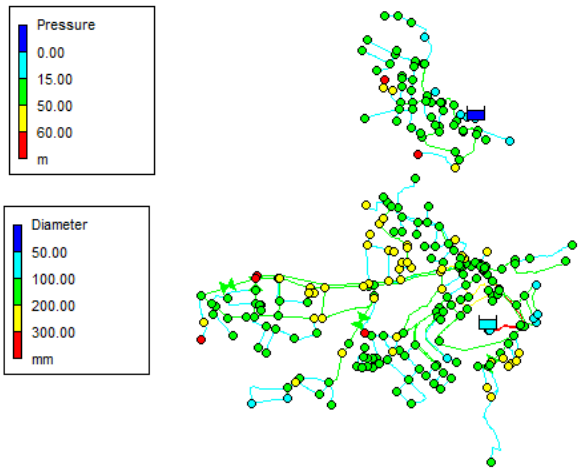
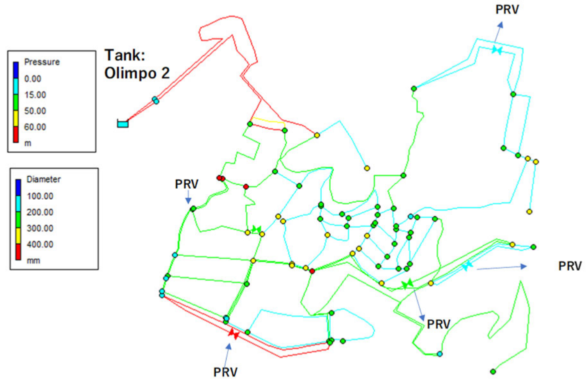
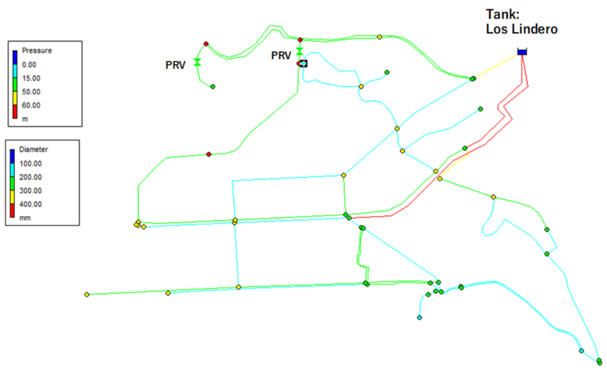
Existing conditions of distribution pipeline are as shown in Appendix 6.5.1 - 6.5.7.

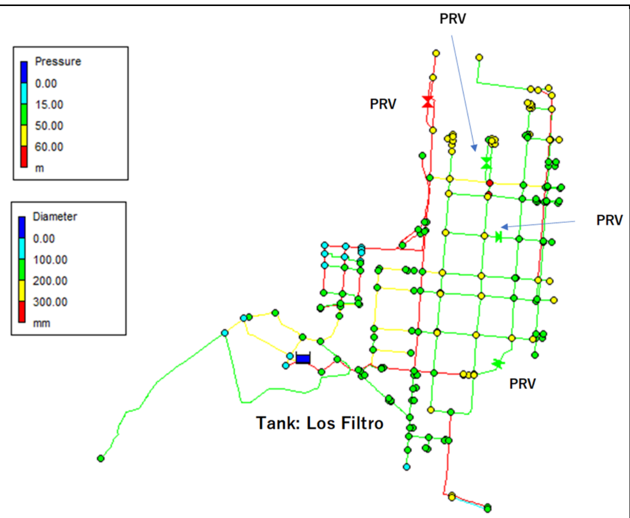
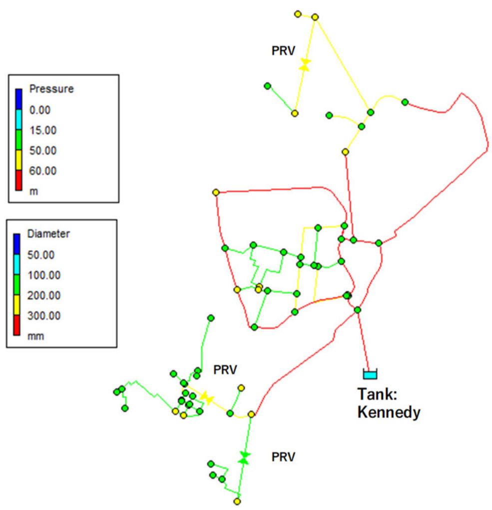
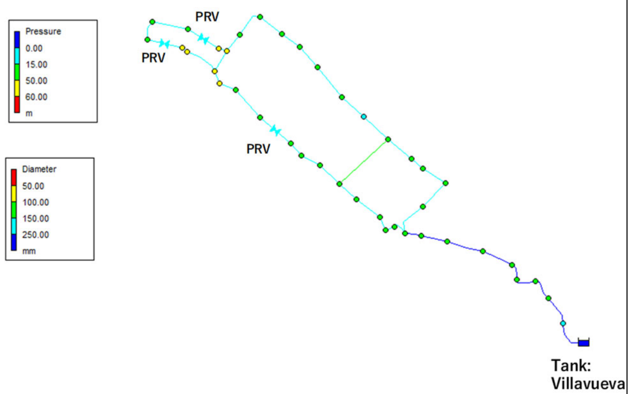
(3) Result of Pipe Network Analysis

The result of pipe network analysis is shown in Table 6.5.3. More detailed information of the results is as shown in Appendix 6.5.8.

Table 6.5.3 Result of Pipe Network Analysis

Bolock	Result of Pipe Network Analysis	Remarks
La Sosa (north area)		・65.5% of the pipe is replaced. ・7.6% galvanized steel pipe will be replaced. ・To prevent air accumulation and water hammer pressure even with intermittent water supply, an air valve is installed. ・Installing a dividing valve improves pipeline maintenance.
La Sosa (south area)		・66.0% of the piping should be replaced. ・Dynamic water pressure is between 10-60 m at all points.

La Travesia		・26.0% of the piping should be replaced. ・Dynamic water pressure will be maintained between 10-60 m at all points by installation of pressure reduction valve.
Olimpo		・8.0% of the pipe should be replaced. ・Galvanized steel pipe is to be replaced. ・Dynamic water pressure will be maintained between 10-60 m at all points by installation of pressure reduction valve.
Lindero		・32.0% of the piping should be replaced. ・Dynamic water pressure will be maintained between 10-60 m at all points by installation of pressure reduction valve.

<table>
<tr>
<td>Los Filtros</td>
<td>
</td>
<td>・18 % of the piping should be replaced.
・Dynamic water pressure will be maintained between 10-60 m at all points by installation of pressure reduction valve.</td>
</tr>
<tr>
<td>Kennedy</td>
<td>
</td>
<td>・8.4% of the piping should be replaced.
・Dynamic water pressure will be maintained between 10-60 m at all points by installation of pressure reduction valve.</td>
</tr>
<tr>
<td>Villa Nueva</td>
<td>
</td>
<td>・27.3% of the piping is replaced.
・Dynamic water pressure will be maintained between 10-60 m at all points by installation of pressure reduction valve.</td>
</tr>
</table>

Source: JICA Study Team

(4) Work Quantity

Based on the above hydraulic analysis, the recommended replacement/installation of pipes and valves are presented in Table 6.5.4

Table 6.5.4 Recommended Replacement of pipes and valves

Block Name	Diameter	Pipe Installation (m)	Pipe Removal (m)	PRV (pcs)	Air Valve (pcs)	Gate Valve (pcs)
La Sosa	φ50	1,762	21,317	-	-	26
	φ75	-	-	-	-	-
	φ100	5,075	2,177	-	6	6
	φ150	6,534	2,026	-	7	7
	φ200	4,323	-	-	6	6
	φ250	209	-	-	1	1
	φ300	6,881	-	-	8	8
	φ400	2,954	-	-	3	3
	φ600	456	-	-	1	1
La Travesia	φ50	1,027	6,095	-	-	-
	φ75	309	-	-	-	-
	φ100	3,150	365	4	4	4
	φ150	4,762	1,470	-	4	4
	φ200	710	567	-	1	1
	φ250	-	-	-	-	-
	φ300	418	0	-	1	1
	φ400	50	0	-	1	1
	φ600		-	-	-	-
Olimpo	φ50	3,143	3,143	-	0	16
	φ75	1,070	1,070	-	0	0
	φ100	267	4,069	-	3	3
	φ150	609	0	2	1	1
	φ200	2,419	357	2	5	5
	φ250	1,131	-	-	1	1
	φ300	-	-	-	0	0
	φ400	-	-	1	3	3
Lindero	φ50	708	708	-	-	4
	φ75	125	125	-	-	0
	φ100	647	410	-	4	4
	φ150	5,571	5,685	-	6	6
	φ200	7,688	6,490	2	8	8
	φ250	811	811	-	1	1
	φ300	417	1,955	-	0	0
	φ400	1,754	-	-	2	2
	φ600	-	0	-	0	0
Los Filtros	φ50	9,533	9,553	-	0	48
	φ75	1,698	1,698	-	0	0
	φ100	17,743	17,606	-	18	18
	φ150	3,509	2,425	3	4	4
	φ200	746	418	-	1	1
	φ250	875	926	-	1	1
	φ300	0	0	-	0	0
	φ400	332	0	1	0	0
Kennedy	φ50	0	141	-	-	1

Block Name	Diameter	Pipe Installation (m)	Pipe Removal (m)	PRV (pcs)	Air Valve (pcs)	Gate Valve (pcs)
	φ75	0	-	-	-	-
	φ100	141	10,896		1	1
	φ150	2,551	0	1	3	3
	φ200	3,291	0	2	4	4
	φ250	209	0	-	1	1
	φ300	4,109	0	-	5	5
	φ400	2,954	7	-	3	3
	φ600	7	0	-	1	1
Villa Nueva	φ50	-	11,199	-	-	0
	φ75	-	-	-	-	-
	φ100	0	-	-	-	-
	φ150	8,437	-	3	9	9
	φ200	0	-	-	-	-
	φ250	2,762	-	-	3	3

Source: JICA Study Team

The customer meter shall be replaced along with replacement of the distribution pipeline with diameter of D100 or less. The replacement number has been estimated at 10% to 20% of the existing customer connections. Table 6.5.5 shows the number of customer meter to be replaced.

Table 6.5.5 Number of Replacement of Customer Meter

Block	La Sosa	La Travesia	Olimpo	Lindero	Los Filtros	Kennedy	Villa Nueva	Total
Replacement Number	615	296	1,142	331	1,806	1,396	4,153	9,739

Source: JICA Study Team

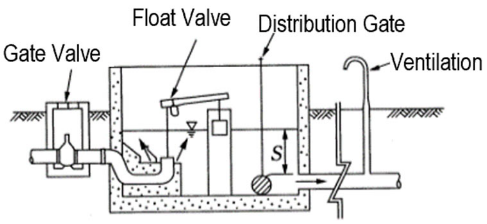
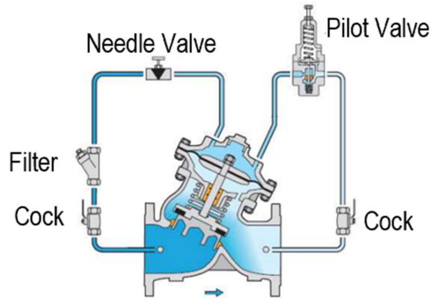
(5) Consideration on Application of Alternative Equipment/Material

1) Application of pressure reducing tank

The water distribution network is distributed from the distribution tank by gravity, and the water pressure varies depending on the altitude in the areas. To reduce leaks occurring in high water pressure areas, the UMAPS standard prescribes the water pressure shall be 60 m or less. Hydraulic analysis shows that a pressure-reducing device is required to reduce the water pressure to 60 m or less.

Pressure reducing valves are currently installed at existing distribution pipeline, but some are inadequately maintained. Instead, pressure reducing tank can be an alternative option. Table 6.5.6 shows the comparison of the pressure reducing device.

Table 6.5.6 Comparison of Pressure Reducing Device

	Pressure Reducing Tank	Pressure Reducing Valve
Overview	A tank is installed in the water distribution system to release water pressure. The pressure on the secondary side cannot be adjusted.	A pressure reducing valve is a valve that reduces the pressure of a high-pressure fluid to a pressure suitable for use. It's possible to change the set pressure. However, there are several conditions that must be considered.
Mechanism	 Maintain a constant high-water level in the tank through the use of a float valve or other appropriate means.	 The valve opening is adjusted by detecting the pressure on the secondary side using the pressure reducing pilot valve in order to maintain the set pressure and to reduce the pressure.
O&M	・A more reliable system that is less prone to failure due to fewer components. ・Easily visible for inspection.	・If the pilot valve malfunctions, it must be replaced. ・Check primary and secondary pressures during inspections. ・A leakage accident may occur unless proper maintance is conducted
Required space for installation	Large space for construction of concrete structures is required.	Only the space for valve chamber is required.
Cost	Approximately from 55,000 to 67,000USD	Approximatley 33,000USD（Including valve chamber）
Applicability	It may be applicable in areas where the space is available such as Villa Nueva block.	Suitable in urban areas and other areas where space is limited.

Source: JICA study team

Basically, pressure reducing valve shall be applied in the Project. Application of the pressure reducing tank shall be examined in detail in the detailed design stage of the Project.

2) Application of HDPE pipe

Currently, UMAPS uses PVC pipe for the pipeline with diameter up to 300mm. However, UMAPS have begun to consider the application of HDPE pipe. Comparison of PVC pipe and HDPE pipe is shown in Table 6.5.7.

Table 6.5.7 Comparison of PVC pipe and HDPE pipe

	PVC pipe	HDPE pipe
Track record	SDR 13.5 (Pressure class: 2.0 Mpa) is utilized for a diameter of φ13 mm. SDR 26 (Pressure class: 1.1 Mpa) is utilized for other diameters	Not commonly used in Honduras. It needs to be imported.
O&M	・Excellent corrosion resistance, but susceptible to heat and ultraviolet rays. ・It also has low shock resistance.	・Excellent corrosion resistance, but susceptible to heat and ultraviolet rays. ・The flexibility of the pipe body

		allows it to adapt to settlement of the ground.
Constructability	・Easy to fit, lightweight item. ・Leaks may occur if installed with poor techniques.	・Easy to fit, lightweight item. ・A special tool is necessary to join fusion connections, but they can be reliably installed without any installation skills.
Cost (Supply & Installation) (PVC pipe =100)	100	117（1.17time of PVC）
Remarks	Standardization of installation techniques for PVC joints is necessary to avoid leaks.	It is necessary to introduce the special tool and fusion technology.

Source: JICA Study Team

Application of HDPE pipe shall be examined in detail in the detailed design stage of the Project. The construction cost shall be estimated assuming HDPE pipe is used.

6.6 Procurement of Customer Meter

(1) Type and Equipment Arrangement of Customer Meter

For the accurate measurement of the water inflow to the customer connection, the customer meter shall be equipped with an air valve and Unmeasured-Flow Reducer (UFR).

The reason for the installation of these equipment is as follows:

Air Valve

In water utilities that provide intermittent water supply, air enters the distribution pipes when the water supply is stopped, and when the water supply is resumed, some of the air passes through the customer's meter, causing the meter to measure more water than is actually used. In addition, the amount of air that exceeds the meter's specified speed causes the meter to rotate at a high speed, resulting in meter failure. To reduce these problems, it is necessary to install an air valve upstream of the meter.

UFR

Some customers have private tanks installed on their residential property as a measure against intermittent water supply. The ball valve that controls the inflow of this private tank has been known to cause the customer meter to under-record. To reduce this problem, it is effective to install a UFR that closes during low flow rates and does not allow water to pass through. The installation of UFRs can also effectively exclude air in the distribution pipes from the air valves.

(2) Procurement Quantity

As mentioned in Section 5.2.2 the total number of customer connections in the seven distribution block of Component 5 is approximately 42,000. Of these, 9,739 connections will be equipped with new customer meters. In addition, 10,000 customer meters shall be procured by the Project, in order to increase the reliable customer meters. The installation of or replacement of the aged customer meter with these meters shall be conducted by UMAPS.

CHAPTER 7 PROJECT IMPLEMENTATION PLAN

7.1 Demarcation of Project Component between JICA and IDB

The Project consists of six components as shown in Table 7.1.1

Table 7.1.1 Proposed Project Component (same as Table 5.3.1)

Component	Contents
1. Water transmission pipeline	- Renovation of transmission pipeline of the Laureles System. D150 – D1000 L= 6.5 km - Renovation of valves of the Concepcion system.
2. Water transmission pump station	- Replacement of transmission pump and renovation of associated facilities at nine pump stations.
3. Instrumentation and SCADA	- Monitoring system of inflow rate and water level of distribution reservoirs. Monitoring point: 43 points - Monitoring system of outlet flow rate of the distribution tanks
4. Water distribution tank	- Demolish existing distribution tanks and construct new tanks at 14 tank sites.
5. Water distribution network	Renovation of distribution pipe network at seven distribution blocks - Installation of additional distribution main pipeline, pressure reducing valve, and air valve, for establishing distribution sub-block. - Replacement of distribution pipe and replacement/installation of associated customer meter.
6. Procurement of customer meter	- Procurement of customer meters to be installed at the above-mentioned seven distribution blocks.

Source: JICA Study Team

IDB is considering financing a part of this Project. The demarcation of the components to be financed by JICA and IDB was determined considering the following:

- Components 1, 2 and 3 work integrally for improvement of the water transmission system of Tegucigalpa. It is not desirable to be conducted separately. They should be “JICA portion”.
- The item in Component 4 and 5 can be conducted separately, since each item functions independently.
- Components 1, and 2 deal with the Laureles transmission system. Thus, it is desirable that the tanks and distribution networks which are supplied from Laureles transmission system are JICA portion, in view of evaluation of the project effect.

As a result, the demarcation of project component was determined as shown in Table 7.1.2.

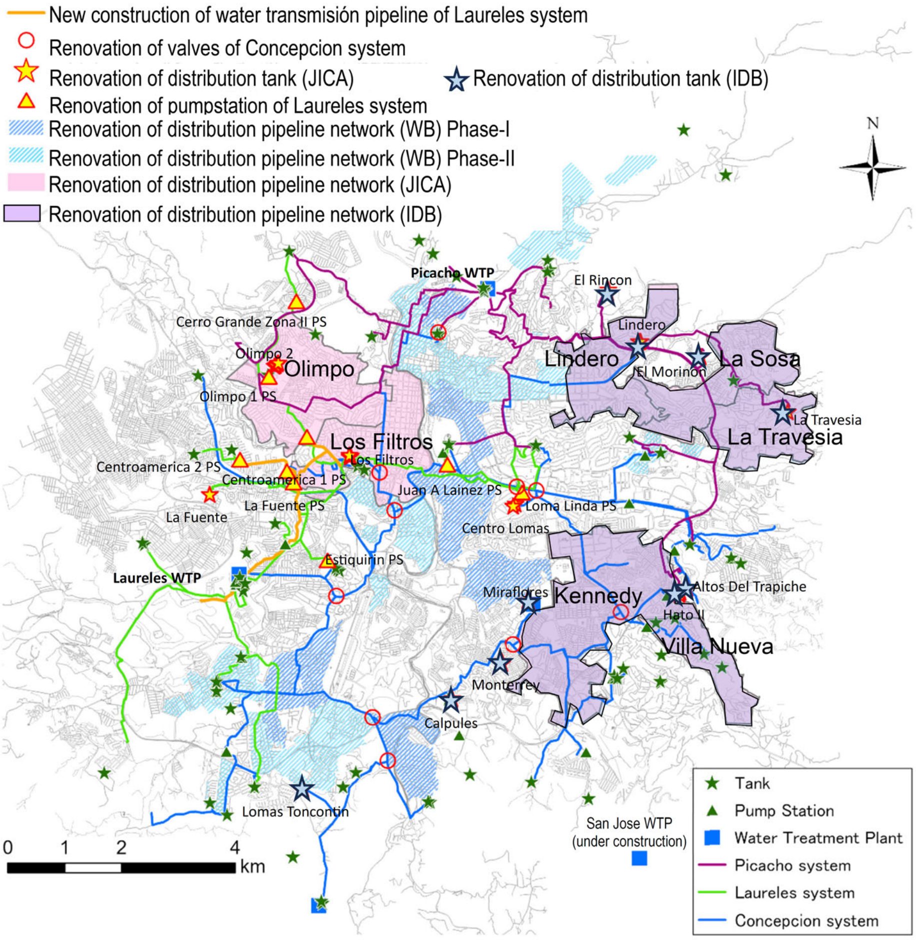
It should be noted that Component 3 of JICA portion includes the installation of the flowmeters and level sensors to the distribution tanks which belong to IDB portion. Thus, the coordination with JICA portion and IDB portion for detailed work demarcation and work scheduling of Component 3.

Table 7.1.2 Demarcation of Project Component between JICA and IDB

JICA Portion	IDB Portion
Component 1: Water transmission pipeline	
Component 2: Water transmission pump station	
Component 3: Instrumentation and SCADA	
Component 4: Water distribution tank <u>Supplied from Laureles system</u> La Fuente <u>Supplied from Laureles and Concepcion system</u> Los Filtros, Centro Lomas <u>Supplied from Laureles, Concepcion, and Picacho system</u> Olimpo 2	Component 4: Water distribution tank <u>Supplied from Concepcion system</u> Lomas Toncontin, Calpules, Monterrey, Miraflores <u>Supplied from Concepcion and Picacho system</u> Lindero, Altos del Trapiche, Hato II <u>Supplied from Picacho system</u> La Travesia, El Molinon, El Rincon
Component 5: Distribution network <u>Supplied from Laureles and Concepcion system</u> Los Filtros block <u>Supplied from Laureles, Concepcion, and Picacho system</u> Olimpo block	Component 5: Distribution network <u>Supplied from Concepcion system</u> Kennedy block, Villa Nueva block <u>Supplied from Concepcion, and Picacho system</u> Lindero block <u>Supplied Picacho system</u> La Sosa block, La Travesia block
Component 6: Procurement of customer meter 5,000 nos.	Component 6: Procurement of customer meter 5,000 nos.

Source: JICA Study Team

Figure 7.1.1 shows the location and demarcation of the project components.



Source: JICA Study Team

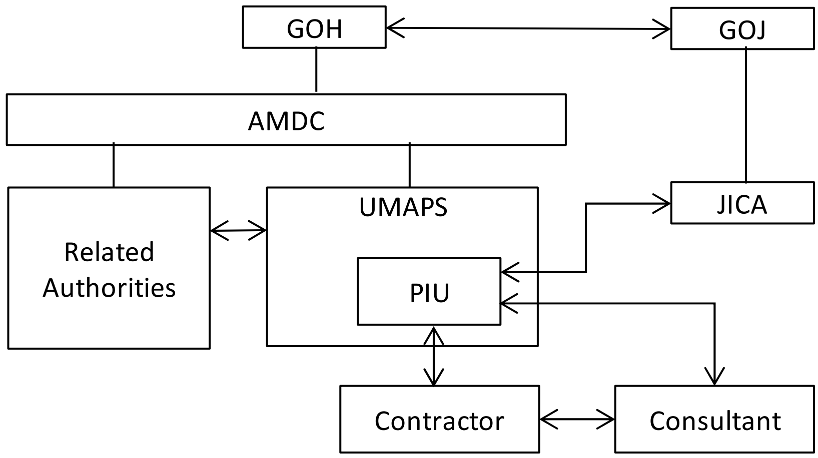
Figure 7.1.1 Location and Demarcation of Project Component

Subsequent sections describe the project implementation plan for the JICA portion.

7.2 Project Implementation System

7.2.1 Overall Implementation Structure

Figure 7.2.1 shows the proposed overall implementation structure of the Project.



Source: JICA Study Team

Figure 7.2.1 Overall Implementation Structure of the Project

The Municipal Drinking Water and Sanitation Unit: *Unidad Municipal de Agua Potable y Saneamiento* (UMAPS) is supposed to be an executing agency of the Project. It is proposed that a project implementation unit (PIU) be established in UMAPS. UMAPS will employ a consultant who will assist the PIU in project management and communication with the Japan International Cooperation Agency (JICA). UMAPS is expected to coordinate with related authorities of AMDC such as the public road maintenance unit to obtain permission for the construction work.

7.2.2 Implementation Process and Roles of Each Organization

The implementation process of the JICA loan project is as follows:

1) Loan Agreement

   A loan agreement is signed between the borrower (Government of Honduras or GOH) and JICA.

2) Procurement of Consultant:

   The procurement of the consultant shall be in accordance with the "Guideline for the Employment of Consultants under Japanese ODA Loans".

3) Detailed Design

   The Consultant will prepare the detailed design and assist the executing agency in preparation for the pre-qualification and tender document.

4) Procurement of Contractor

The procurement of the contractor shall be in accordance with the "Guideline for Procurement under Japanese ODA Loans".

5) Construction

The construction will be conducted under the supervision of the Consultant.

Table 7.2.1 shows the roles of the organizations for project implementation.

Table 7.2.1 Roles of Organizations for Project Implementation

<table>
<tr><th colspan="2" rowspan="2">Implementation Process</th><th rowspan="2">AMDC/Related Authorities</th><th colspan="2">UMAPS</th><th rowspan="2">Consultant</th><th rowspan="2">Contractor</th><th rowspan="2">JICA</th></tr>
<tr><th>Managers</th><th>PIU</th></tr>
<tr><td rowspan="3">Procurement of Consultant</td><td>RFP</td><td colspan="3">Preparation of RFP</td><td></td><td></td><td>Concurrence</td></tr>
<tr><td rowspan="2">Contract</td><td colspan="3">Evaluation of Proposal</td><td>Submission of Proposal</td><td></td><td>Concurrence</td></tr>
<tr><td>Approval</td><td colspan="2">Negotiatio and Signature of Contract</td><td>Signature of Contract</td><td></td><td>Concurrence</td></tr>
<tr><td rowspan="3">Consulting Service</td><td>Detailed Design</td><td>Approval</td><td>Approval</td><td>Supervision</td><td>Preparation</td><td></td><td></td></tr>
<tr><td>Bidding Document</td><td>Approval</td><td>Approval</td><td>Preparation</td><td>Preparation</td><td></td><td>Concurrence</td></tr>
<tr><td>Construction Supervision</td><td></td><td>Approval</td><td>Supervision</td><td>Execution</td><td></td><td></td></tr>
<tr><td rowspan="2">Procurement of Contractor</td><td>Bidding</td><td>Approval</td><td>Approval</td><td>Evaluation of Bid</td><td>Assist PIU</td><td>Bid submission</td><td>Concurrence</td></tr>
<tr><td>Contract</td><td>Approval</td><td colspan="2">Negotiatio and Signature of Contract</td><td>Assist PIU</td><td>Signature of Contract</td><td>Concurrence</td></tr>
<tr><td rowspan="3">Construction</td><td>Permission for Construction Work</td><td>Approval</td><td></td><td>Application</td><td>Assist PIU</td><td>Preparation of application document</td><td></td></tr>
<tr><td>Construction</td><td></td><td></td><td>Approval</td><td>Supervision</td><td>Execution</td><td></td></tr>
<tr><td>Commissioning</td><td>Approval</td><td>Approval</td><td>Approval</td><td>Supervision</td><td>Execution</td><td></td></tr>
<tr><td colspan="2">Progress Report to JICA</td><td></td><td></td><td>Submission to JICA</td><td>Assist PIU</td><td></td><td>Monitoring</td></tr>
</table>

Source: JICA Study Team

7.2.3 Proposed Staffing of PIU

The role of PIU is to conduct/supervise the entire activities of the Project:

- Supervision of the detailed design;
- Finalizing the bidding document;
- Evaluation of the bid and negotiation and signature of the contract.
- Supervise the consultant's activities
- Application for the permission for the construction work
- Commissioning of the project facility
- Construction supervision;
- Progress reporting to JICA, as well as the related authorities of GOH

To fulfil these roles, the PIU should at least be staffed as shown in Table 7.2.2.

Table 7.2.2 Proposed Staffing of PIU

Position	Nos. of Staff	Remarks	
Project Director	1	May be held concurrently with regular position	
Deputy Project Director	1	Should be full-time	
Secretary	1	Should be full-time	
Technical Manager	5	- Transmission pipeline - Pump station - Instrumentation - Distribution tank - Distribution pipeline network	May be held concurrently with regular position
Supporting staff	2	- Transmission system - Distribution system	Should be full time
Chief account officer	1	May be held concurrently with regular position	
Accountant	2 *	Should be full time Depend on nos. of contract package	

Source: JICA Study Team

7.3 Procurement Plan

7.3.1 Procurement Process

7.3.2 Contract Packaging

Table 7.3.1 Proposed Contract Packages of JICA Portion

7.4 Required Activity of UMAPS

For smooth implementation of the Project as well as realization of the effects of the Project, UMAPS is required to perform the following activities.

<u>Activities before employment of the Consultant</u>

- Establishing PIU (Project Management Unit)
- Organize and update facility inventory information (drawings, GIS data, etc.)
- Agreement between the landowner of the tunnelling section of the transmission pipeline
- Clarification of tax exemption procedure

<u>Activities during detailed design and construction</u>

- Coordination with the Potable Water Sub-Management regarding the detailed design
- Obtaining permission from related authorities including environment authorities for construction works
- Coordination with customers regarding installation of customer meter
- Coordination with customers regarding water outages
- Coordination with project implementation unit of IDB portion for detailed work demarcation and work scheduling of Component 3.

<u>Activities after construction</u>

- Incorporation of the as-built drawings into the facility inventory
- Establishing design and construction standard of house connection
- Establishing facility inventory management system
- Establishing facility operation and maintenance system
- Establishing water transmission control system
- Establishing water distribution volume analysis system

- Establishing water leakage reduction system
- Establishing water meter management system
- Establishing financial management system including water tariff setting
- Implementation of the customer survey for post-evaluation of the Project

7.5 Project Implementation Schedule

7.5.1 Construction Period

Figure 7.5.1 Proposed Construction Schedule

7.5.2 Overall Implementation Schedule

Figure 7.5.2 Proposed Overall Implementation Schedule

CHAPTER 8 PROJECT COST

8.1 Condition of Cost Estimate

8.1.1 Composition of the Project Cost

8.1.2 Conditions of Cost Estimate

8.1.3 Method of Cost Estimate

8.2 Construction Cost Estimate

8.2.1 Construction Cost by Project Component

Table 8.2.1 Construction Cost by Project Component

Table 8.2.2 Construction Cost by Sub-Component

8.2.2 Construction Cost by Contract Package

Table 8.2.3 Construction Cost by Contract Package

8.3 Project Cost and Disbursement Schedule

Table 8.3.1 Total Project Cost

Table 8.3.2 Disbursement Schedule

CHAPTER 9 OPERATION MANAGEMENT PLAN

9.1 Financial Status of the Executing Agency

9.1.1 Financial Status of UMAPS

Table 9.1.1 Income Statement of UMAPS - Year 2022

Table 9.1.2 Notes to Income Statement of UMAPS

Table 9.1.3 Income Statement of UMAPS – May 2022 to April 2023

Table 9.1.4 Balance Sheet of UMAPS - End of Year 2022

Table 9.1.5 Notes to Balance Sheet of UMAPS

Table 9.1.6 Segment Expenditures of UMAPS

Table 9.1.7 Segment Revenues of UMAPS

Table 9.1.8 Income Statement of SANAA

Table 9.1.9 Balance Sheet of SANAA

Table 9.1.10 UMAPS Financial Performance

9.1.2 Financial Status of Tegucigalpa

Table 9.1.11 Income Statement of AMDC

Table 9.1.12 Balance Sheet of AMDC

9.1.3 Financial Status of Honduras

Table 9.1.13 Operation Statement of Central Government

Table 9.1.14 Public Debt by Central Government

9.2 Operation Management System

9.2.1 UMAPS' Performance in Operating and Maintaining Water Supply Facilities

UMAPS is responsible for the operation and maintenance of the water supply facilities taken over from SANAA starting in 2021. Since the Project is the renovation of existing aging facilities, UMAPS can conduct operation and maintenance of the similar facilities.

Table 9.2.1 Quantity of Facilities Operated and Maintained by UMAPS and Facilities to be Renovated

Name of Facility	Existing Facility	Facilities to be renovated
Water treatment plant	4 WTPs	
Transmission pipeline	D150 - D1000; L= 132 km	Renovation of existing pipes D150-D1000 L = 6.6km
Pump station	26 nos.	Renovation of existing pump stations: 9 nos.
Distribution tank	30 m^3 - 5,850 m^3; 111 nos. (74 Locations)	Renovation of existing distribution tanks: 4 nos.
Distribution pipeline	D15 - D600; Total length is approximately 1,500 km	Renovation of existing distribution pipeline in two water distribution blocks L = 43 km

Source: JICA Study Team

9.2.2 UMAPS's Operation and Maintenance System for Water Supply Facilities

There are three main departments responsible for the operation and maintenance of water supply facilities, which account for approximately 62% of the total staff.

Table 9.2.2 UMAPS's Department in Operation and Maintenance for Water Supply Facilities

Department	Role	Number of Staff as of July 2023
Potable Water Sub-management	Responsible for water management from collection, purification, and drinking water distribution network: composed of the primary distribution network, secondary and tertiary network, distribution tanks, and pump system.	437
Commercial Sub-management	Responsible for customer meter readings, billing, collections, customer registration, and customer education.	140

Engineering and Development Sub-management	Responsible for setting technical and supervisory standards for water supply facilities, water source management, and GIS development and management.	11

Source: JICA Study Team

Engineers account for about 6% of the UMAPS staff, with civil engineers making up the largest percentage at about 3%, followed by industrial engineers at about 1%.

At present, UMAPS has not established its own technical standards, but follows SANAA design standards and other standards.

The only training available to employees is general mechanical, electrical, civil, and business training provided by the National Institute of Professional Training (INFOP). Other than that, only on-the-job training (OJT) is available, and no systematic independent training program has been established.

9.3 Planning for Technical Cooperation

In considering technical cooperation, the current capacity of UMAPS was assessed. Based on the results, critical issues for operation and maintenance were identified, and planned the technical cooperation needed to address those identified issues.

9.3.1 Capacity Assessment of UMAPS

Table 9.3.1 Explanation of 5-step Evaluation

Figure 9.3.1 Results of Capacity Assessment of UMAPS

Table 9.3.2 Results of Capacity Assessment of UMAPS

9.3.2 Consideration of Critical Issues in Operational and Maintenance

Based on the abovementioned assessment, seven critical issues which are hindering the growth of UMAPS were identified as shown in Table 9.3.3.

Table 9.3.3 Critical Issues in Operation and Maintenance

Critical Issues	Assessment No.	Description
1. Customer meter malfunctions due to intermittent water supply and cannot meter correctly.	Q8 Q14 Q15 Q22	➢ Of the about 124,300 customers, about 62% have meters installed, of which around 35% have faulty meters. ➢ Almost 73% of the customers are on estimated rates, which means that the actual amount of water used is unknown, and therefore, UMAPS cannot collect charges based on the amount of water used. The remaining 27% of customers are on a measured rate, but UMAPS does not know whether the amount of water used is accurately metered. (In the meter verification test conducted in this survey, new meters were installed and measured for both estimated and metered customers, and the

Critical Issues	Assessment No.	Description
-		results showed that both customers were using approximately twice the amount of water they had been billed for.) ➢ Because of the intermittent water supply, air mixed in the piping leads to over-reading and malfunctions of the meter. ➢ The float valves on the customers' water tanks installed in each customer are causing the actual amount of water used to be under-metered. ➢ About 80% of customers' complaints (March 2021) were about meters, and about 73% of complaints were about excessive water usage, indicating that customers have low trust in their meters. ➢ Need to increase the number of customers on the measured rate system, but even if new meters are installed, the meters will fail due to air and other factors, and will not meter correctly, reverting back to the estimated rate system. ➢ Even if an air valve was installed upstream of the meter, the air valve sold at the hardware store in Tegucigalpa does not exclude much air, and the meter would rotate with air.
2. Illegal connections are rampant and there is inaccurate customer information -	Q14 Q21 Q22	➢ The UMAPS Amended Business Plan in 2018 states that there are residents who are not registered as customers but use tap water (so-called illegal connections), which account for about 30% of all customers. ➢ Customers who should be classified as commercial or industrial may be incorrectly registered as residential. ➢ This is due to unethical behavior on the part of the customers, construction companies, and UMAPS staff. ➢ When a resident builds a new home, it is common for the construction companies to make the water service connection without obtaining permission from UMAPS (or its predecessor, SANAA) to connect the water distribution pipeline. ➢ The residents of the new house continue to use the water supply without notifying UMAPS and without paying for it. The residents who move into a house classified as non-residential do not report to UMAPS that they have started using the water system. ➢ The customer registration department needs a month at the earliest to install a meter after receiving a request for water service from a resident, and it usually takes much longer. ➢ The meter readers do not check with the customer registration section during or after construction of a new house to see if the house is registered for water service. ➢ The meter reader does not know or confirm that a resident has moved into a house that is classified as non-residential, and the customer registration section is not aware that usage has resumed. ➢ The customer land registry section conducts a survey twice a year to check for illegal connections. This report is paper-based.

Critical Issues	Assessment No.	Description
		➢ The customer registration section does not have a system in place to regularly review and update current customer information and is either unaware of incorrect information or does not attempt to correct the information.
3. Inequitable water distribution	Q12 Q13 Q22	➢ The status of water distribution after the water treatment plant is not known, and water is not being distributed equitably. ➢ Even in areas with the same water distribution schedule, there are areas where water is easily distributed and areas where water is less likely to be distributed, resulting in differences in the actual time of water supply. ➢ Customers who live in areas where water is easily distributed and have an estimated rate often use a lot of water, resulting in water taking longer to reach areas where water is less likely to be distributed.
4. Many leaks from distribution pipes and service pipes, shortening water supply hours -	Q2 Q7 Q8 Q11 Q12 Q13 Q14 Q16 Q18 Q22.	➢ NRW rate is about 33% (average water supply hours of about 3 hours/day) (2016-2020). If water is supplied 24 hours a day under the current condition of the distribution pipes, the NRW rate could be more than 50%. ➢ The maximum hydrostatic pressure standard is 50 mca (70 psi) to 60 mca (85 psi), but in some areas the hydrostatic pressure is 100 mca (140 psi), and water pressure management is not properly implemented. In addition, leakage increases proportionally in areas of high pressure. ➢ Leakage accidents involving service and distribution pipes with diameters of 2 inches or less accounted for about 77% of the total (2022), and damage caused by excessive water pressure accounted for 86% (2020). PVC was the pipe type with 94% of the leakage incidents. ➢ The annual number of leaks per 100 km of distribution pipes is from 250 to 300 leaks per 100 km per year(IWA recommendation of 13 leaks per 100 km per year), which is a very high number of leaks. ➢ The annual number of leaks per 1,000 connections of service pipes is about 40 leaks per 1,000 connections per year(IWA recommendation of 3 leaks per 1,000 connections per year)which is a very high number of leaks. ➢ Intermittent water supply makes it difficult to detect leaks from distribution pipes and service pipes. ➢ Even if there is a visible leak from a water service pipe on the customer's premises, approximately 73% of customers are on estimated rates and left unaddressed. ➢ GIS data has not been updated since 2011, and some of the pipe locations and diameters are not correct, making it not very useful for pipe renewal planning and leakage surveys.
5. O&M of mechanical and electrical	Q9 Q10 Q22	➢ The mechanical and electrical equipment is aging, and many water pump stations do not have spare equipment, increasing the

Critical Issues	Assessment No.	Description
equipment is not properly implemented		risk that water cannot be delivered in the event of equipment failure. ➢ There are no operation or repair records for the pump. ➢ Many of the water level gauges, pressure gauges, and flow meters in the water tanks at the pump stations are missing or not functioning properly. ➢ Drawings and specifications for mechanical and electrical equipment are not properly maintained. ➢ There are no O&M manuals or standard operating procedures for mechanical and electrical equipment. ➢ Since there are no O&M manuals for pumps, electrical equipment, transmission pipelines, distribution pipelines, and various valves, O&M techniques are being passed on only through on-the-job training. In addition, some facilities have lost their maintenance and management methods due to a breakdown in the transfer of O&M methods. ➢ Some experienced people who were with the SANAA Metropolitan Division in the operation and maintenance of the facility have been fired as a result of the transfer of operations to UMAPS or a change in administration. Some experienced staff members who have been with the SANAA Metropolitan Division but managed to be hired by UMAPS may be laid off in the future in the event of attrition or a change in administration. In order to ensure that O&M methods for mechanical and electrical facilities do not cease to exist, it is urgently necessary to document O&M methods and standard operating procedures for existing facilities while experienced staff is still available, and to establish a system that allows even inexperienced staff to perform O&M appropriately.
6. Customers are not aware of water conservation due to the estimated rate system	Q14 Q22 Q23 Q24.	➢ Even if there is a visible leak from a service pipe on the customer's premises, about 73% of customers have estimated rate, which are not addressed and left unattended. ➢ Since the fee is estimated no matter how much is used, it does not create awareness of water conservation. ➢ Customers prefer the estimated rate system because they believe that metering by customer meter is incorrect.
7. Most customers are on estimated rates and not billed based on actual water use	Q19 Q20 Q22.	➢ About 73% of customers are on an estimated rate system and should be transitioned to a measured rate system, but the air presence in the pipes of intermittent water supply has forced the installation of new meters to fail again and revert to an estimated rate system.

Source: JICA Study Team

9.3.3 Measures for Critical Issues

Conceivable measures to address each of above critical issues are presented in Table 9.3.4.

Table 9.3.4 Critical Issues and Measures to Address Them

Current critical issues	Measures	To be addressed by Loan Project	To be addressed by Technical Cooperation
1. Customer meter malfunctions due to intermittent water supply and cannot meter correctly	Improved water supply reliability and revenues by achieving metering based on actual water use, eliminating air. A method should be established to correctly measure water volume by installing an air valve between the distribution pipe and the meter which do not meter air. ・ Air valve(Combination air valve) and UFR(Unmeasured flow reducer)+Ordinary water meter ・Smart meter (Ultra sonic type)	・Procurement of customer meters to be properly metering. ・ Installation of air valves on distribution pipes	【Before construction】 ・ Study of accurate metering methods for customer water usage ・ Establishment of design construction and maintenance standards for water meter ・ Development of Water meter calibration method ・Development of customer meter installation and replacement plans
2. Illegal connections are rampant and there is inaccurate customer information	Improved revenues through the introduction of a mechanism to identify illegal connections and update customer information. A cross-departmental illegal connection reduction team will be established to clarify UMAPS policies for reducing illegal connections, and to implement illegal connection reduction activities collaborated with AMDC.		【Before construction】 ・Establish a team to reduce illegal connections ・ Strengthen collaboration with external organizations to reduce illegal connections ・ Develop a policy and plan to reduce illegal connections ・ Implement activities to detect illegal connections and to update customer information
3. Inequitable water distribution	Improved water supply reliability by achieving equitable water distribution unaffected by regional characteristics	・ Install flow meters and monitoring systems (SCADA) at transmission and distribution facilities to monitor and record	【Before construction】 ・Analyze current water distribution status (Pressure, Volume,

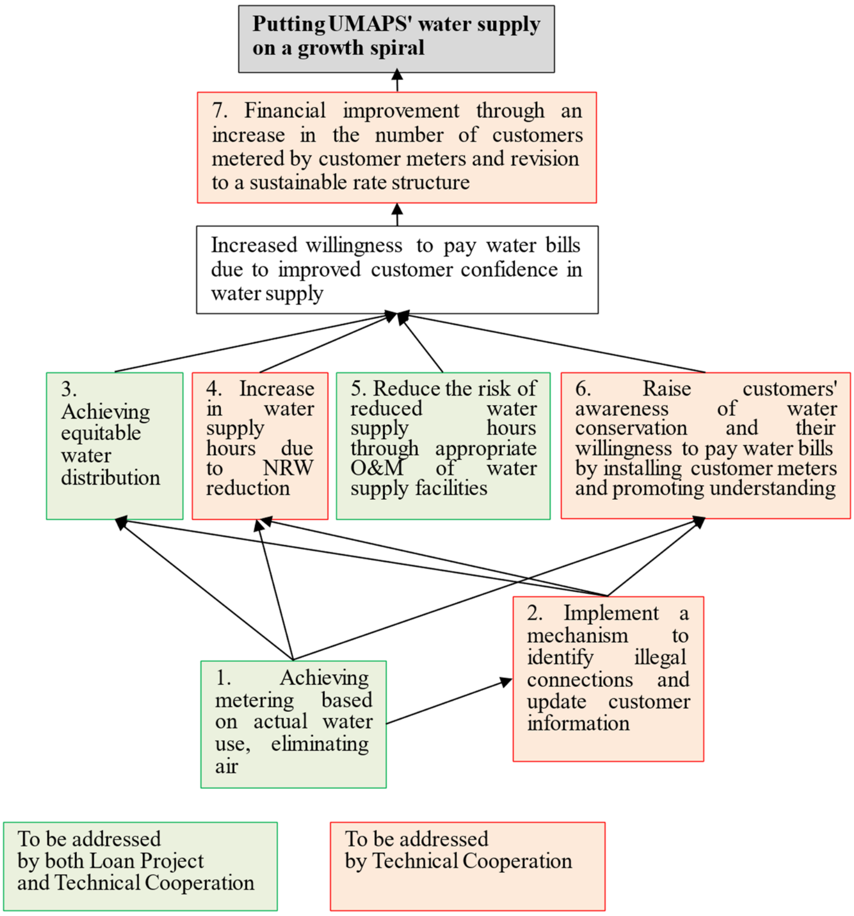
Current critical issues	Measures	To be addressed by Loan Project	To be addressed by Technical Cooperation
	It is necessary to study the current water distribution situation in low, medium, and high areas in each of the water distribution areas, identify areas with excessive water supply and areas with little water supply, and correct the imbalance. To this end, the first step is to measure and evaluate the current water distribution situation so that equitable water distribution can be monitored, planned, and implemented through facility development and capacity building.	water transmission amount to each distribution tank and water distribution amount from the distribution tank to each distribution block ・Divide the distribution block into high elevation sub-block and low elevation sub-block and install a pressure reducing device at the entrance of low elevation sub-block, so that the water distribution pressures are equalized.	Number)in the target distribution area ・Planning and implementation of equitable water distribution plan for the target water distribution area 【After construction】 ・Monitoring of water distribution status in the water transmission system using SCADA ・ Ensure equitable water distribution in the water transmission system based on SCADA data
4. Many leaks from distribution pipes and service pipes, shortening water supply hours	Improved water supply reliability and customer satisfaction through increased water supply hours due to NRW reduction Water supply hours was shorten by many leaks from pipes, illegal connection and excessive water use by customers. Therefore, it is necessary to take measures such as measuring water distribution flow, identifying and repairing leakage points, and identifying illegally connected customers. Measures that can be taken even under intermittent water supply (Direct measurement of NRW and leakage location identification using tracer gas) will be conducted.	・Installation of pressure reduce valve at water distribution pipeline to equalize water distribution pressure ・ Renewal of old water distribution pipes. ・Guidance on management of GIS data for pipeline to be installed	【Before construction】 ・ Accurate GIS data for transmission and distribution pipelines ・Analysis of status of water distribution in target water distribution areas ・Selection of pilot areas ・ Installation of Balk meter, pressure gauges, customer meters in the pilot areas ・Leakage survey, leakage repair, and illegal connection identification survey under intermittent water supply in the pilot areas

Current critical issues	Measures	To be addressed by Loan Project	To be addressed by Technical Cooperation
	If it is 24hours water supply, NRW will be further reduced by identifying and repairing leakage points. At the same time, water pressure equalization and replacement of old pipes will be carried out to address problems that cannot be dealt with by remedial measures.		・Planning and Implementation of NRW reduction activities under intermittent water supply 【After construction】 ・Verification of NRW reduction effect in pipeline renewal areas ・Selection of 24-hour water supply model areas ・NRW measurement in the 24-hour water supply model areas ・Verification of the effectiveness of a 24-hour water supply system
5. O&M of mechanical and electrical equipment is not properly implemented	Improved water supply reliability and customer satisfaction by reducing the risk of reduced water supply hours through appropriate O&M of water supply facilities. Updating aging and inefficient pump equipment in the loan project and standard operating procedures (SOPs) for operation and daily maintenance of mechanical and electrical equipment will be developed, and adequate O&M system will be established.	・Renewal of pump facilities ・Technical guidance for O&M of pump facilities ・SCADA System Installation ・SCADA system initial training	【Before construction】 ・Training of basic knowledge of O&M method of mechanical and electric equipment. 【After construction】 ・Preparation of SOPs for operation and daily maintenance of mechanical and electrical equipment included in SCADA ・Conduct periodic diagnosis of mechanical and electrical equipment ・Strengthen management system for spare parts of mechanical and electrical equipment
6. Customers are not aware of water conservation due to	Raise customers' awareness of water conservation and their willingness to pay water bills by installing customer meters and promoting understanding of payment based on the actual water usages.		【Before construction】 ・Conduct customer satisfaction surveys in the target areas

Current critical issues	Measures	To be addressed by Loan Project	To be addressed by Technical Cooperation
the estimated rate system	Customers do not trust the accuracy of the current customer meters nor are they satisfied with the inequitable water distribution situation. Therefore, trustable water meter system will be analyzed. And, UMAPS explained improved water meter system and promote customer understanding for water metering system. In addition, UMAPS will raise customer awareness of water conservation and conduct public awareness activities, such as reporting leakage, illegal connections.		・ Promote understanding of installation of customer meters and payment of charges based on actual water usages in the target areas, and conduct educational activities for customers regarding reporting of water leakage and illegal connections. 【After construction】 ・ Conduct customer satisfaction surveys in 24-hour water supply model areas ・ Conduct customer satisfaction survey after 24-hour water supply and survey on water tariff for 24-hour water supply areas
7. Most customers are on flat rates and not billed based on actual water use	Financial improvement through an increase in the number of customers metered by customer meters and revision to a sustainable water tariff structure. Introduce trustable water metering system to customer and encourage flat rate customers to install water meters. In addition, the cost of water will be analyzed and consideration of new water tariff		【After construction】 ・Conduct cost analysis ・Planning a sustainable water tariff

Source: JICA Study Team

Figure 9.3.2 shows the overall picture of how UMAPS can put its water services on a growth path.

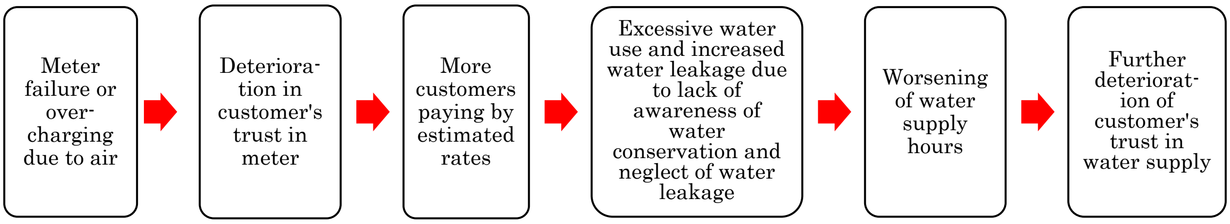


Source: JICA Study Team

Figure 9.3.2 Overall Picture of UMAPS's Water Supply on a Growth Path

In particular, the increase in the number of customers who pay based on the amount of water used through "1. Achieving metering based on actual water use, eliminating air" is an important measure that can put UMAPS's water supply on a growth spiral. In addition, UMAPS, as a leader in the Honduran water utility industry, can set an example for local urban water utilities, which also is facing the problem of incorrect metering due to intermittent water supply, by establishing an appropriate metering method under intermittent water supply, and this will lead to the improvement of the water sector in Honduras as a whole.

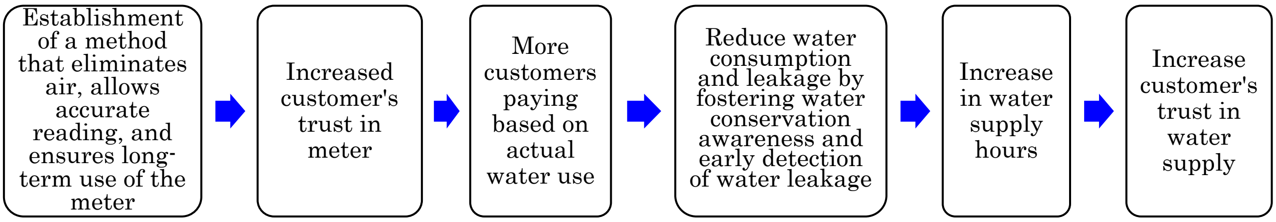
Figure 9.3.3 shows the current negative chain of events due to malfunction of customer meter by air intrusion to the customer connection.



Source: JICA Study Team

Figure 9.3.3 Deterioration in Water Supply Hours and Reliability to the Water Supply Due to Meter Rotation by Air

Figure 9.3.4 shows the desirable chain of events for achieving customer's trust in water supply



Source: JICA Study Team

Figure 9.3.4 Achieving Metering Based on Actual Water Use, Eliminating Air, to Improve Water Supply Hours and Reliability to the Water Supply

9.3.4 Consideration of Necessary Technical Cooperation

The proposed technical cooperation necessary to implement the above measures was considered. The following are the results of the consideration.

UMAPS began their operations in January 2021, and although the transfer of operations to UMAPS from its predecessor, the SANAA Metropolitan Division, was completed in May 2022, personnel transferred from SANAA accounted for only about 40% of UMAPS's total staff. As a result of hastily reducing and replacing personnel in 2022, manuals, maintenance methods, and GIS data have not been properly transferred. In addition, intermittent water supply has been the norm for many years, and new technology is needed to improve this situation, but the personnel who have been with SANAA are not knowledgeable about these technologies. Under these circumstances, capacity building of the organization and human resources is essential for UMAPS to properly implement its water supply services.

The detailed design of the Japanese loan project is scheduled to be implemented from 2025 to 2026, and the construction is scheduled to be implemented from 2027 to 2030. Considering that, it is proposed that the technical cooperation be implemented in two phases during the period as follows:

Phase 1: From the detailed design stage and until the beginning of the construction stage

Phase 2: From the construction stage to two years after completion of the construction

Proposed contents of each phase are shown in Table 9.3.5.

Table 9.3.5 Proposed Contents of Technical Cooperation

Phase	Period	Contents
Technical Cooperation Phase 1	3 years from 2025-2027	The first step to NRW management and will include the following. (1) Raising awareness of NRW Training will be conducted to UMAPS staff included in management staff ・Introduction of successfully improved non-revenue water ratio in JICA project and experience in Japan ・Water distribution volume analysis(Water Balance Sheet) (2) Pilot activities for customer meter installation ・Establishment of design and construction standards for water supply facilities (model selection) * It will be analyzed before the detailed design of construction, and the project will support the development of design and construction standards. ・ Establishment of design construction and maintenance standards for water meter ・Development of Water meter calibration method ・Development of customer meter installation and replacement plans (3) NRW reduction activity ・Analysis of status of water distribution in target water distribution areas ・Selection of pilot areas and installation of Balk meter, pressure gauges, customer meters in the pilot areas ・Leakage survey, leakage repair, and illegal connection identification survey under intermittent water supply in the pilot areas ・Planning and Implementation of NRW reduction activities under intermittent water supply (4) Development of customer information Activities related to updating customer information. Reduction of illegal connections (5) Activities related to updating GIS Establishment of rules for updating GIS and field survey methods
Technical Cooperation Phase 2	Tentative 5 years from 2028-2032	The detailed contents will be determined based on the evaluation of the activity in Phase 1.If UMAPS request phase 2, the project will be considered. Tentative contents are as follows: - Water supply management (water quantity and water pressure control) - Facility maintenance management - Non-revenue water management - Financial improvement

Source: JICA Study Team

Since the World Bank (WB) is currently planning to provide technical cooperation and equipment for water distribution pipe network improvement and leakage reduction from September 2023 to October 2024, it is necessary to take the implementation status of the WB into consideration when planning Phase 1 of JICA's technical cooperation project.

Figure 9.3.5 shows the schedule of the loan project and technical cooperations.

Figure 9.3.5 Schedule of the Loan Project and Technical Cooperations

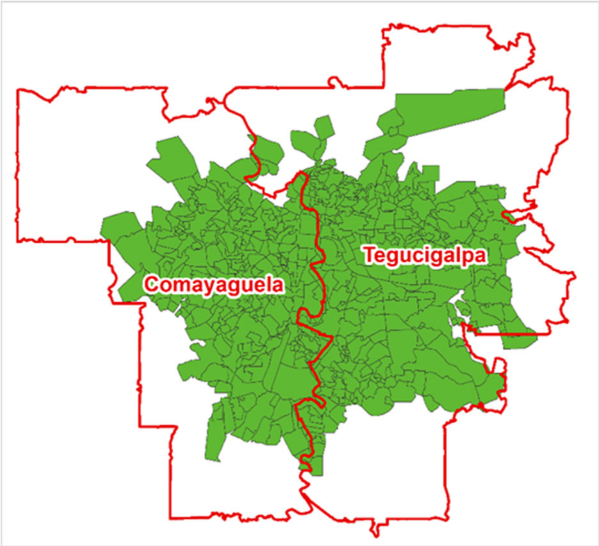
CHAPTER 10 ENVIRONMENTAL AND SOCIAL CONSIDERATION

10.1 Current Status of Environment and Society

10.1.1 Demographic Distribution and Dynamics

(1) Map of Central District

The Central District is composed of two large cities. These are Tegucigalpa and Comayaguela, composed of 746 zones (*barrios*) and colonies (*colonias*), according to (*Instituto Nacional De Estadiaticas* (INE), 2013). See Figure 10.1.1.

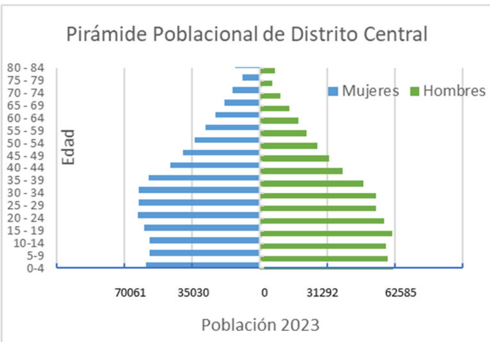


Source: Elaborated with the urban zone layer of SIMET.

Figure 10.1.1 Map of the Central District

(2) Population by Gender and Age

Based on INE projections, it is estimated that by 2023, the total population of the Central District will reach 1,326,460 inhabitants. Of these, 625,846 are men and 700,614 are women, representing 47.2% and 52.8%, respectively. Of this population, 90% live in the urban area of he Central District. According to the distribution by age groups, it is estimated that the population of children represents 26.5%, adults 66.8%, and the elderly 6.7%, as shown in Figure 10.1.2.

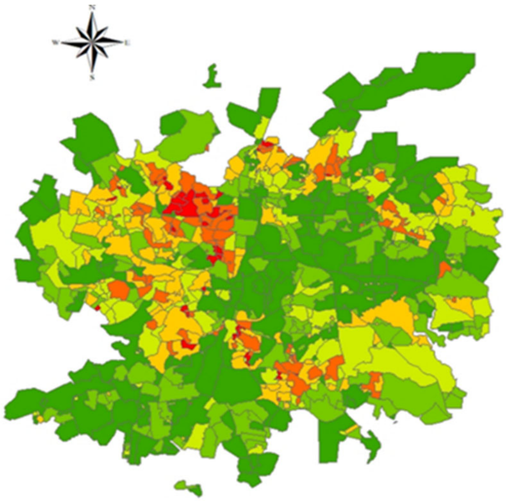


Source: Based on population projection data of INE

Figure 10.1.2 Population Pyramid of the Central District

(3) Population Density

Figure 10.1.3 shows a map of the distribution of population density in the Central District, which gives an adequate reference of the zones with the highest density, mostly located in Comayaguela and the outskirts of Tegucigalpa.



Source: Obtained from the drinking water diagnosis for the San José Project (HyH, 2018).

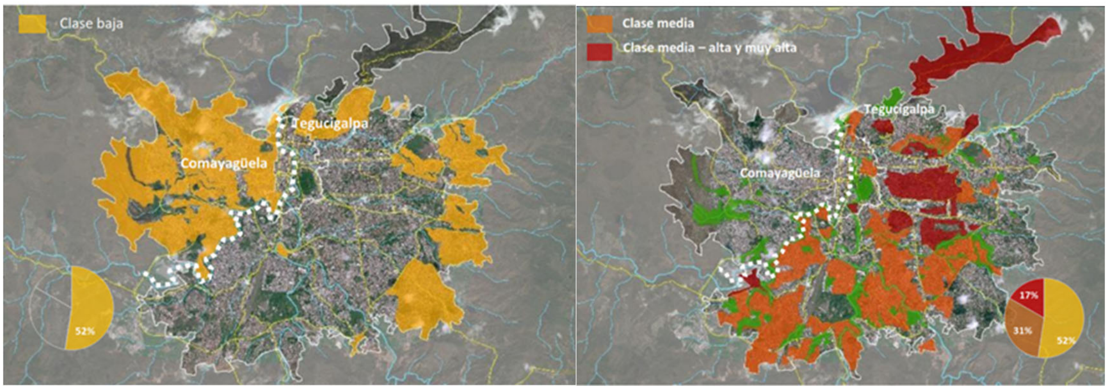
Figure 10.1.3 Population Density per Colony in the Central District

(4) Population Growth and Projection

According to the 2013 census, the Central District had a population of 1,157,509 inhabitants, 850,227 in 2001 and 585,686 in 1988. The projected population growth of the Central District corresponds to 2.33%.

(5) Economic Status

Figure 10.1.4 shows a thematic map that gives an adequate reference of the economic condition of the Central District. The lower class is located in the peri-urban areas of the Central District.



Source: Retrieved from IDB, Prefeasibility study of sanitation and drainage of the city of Tegucigalpa, Honduras, 2016.

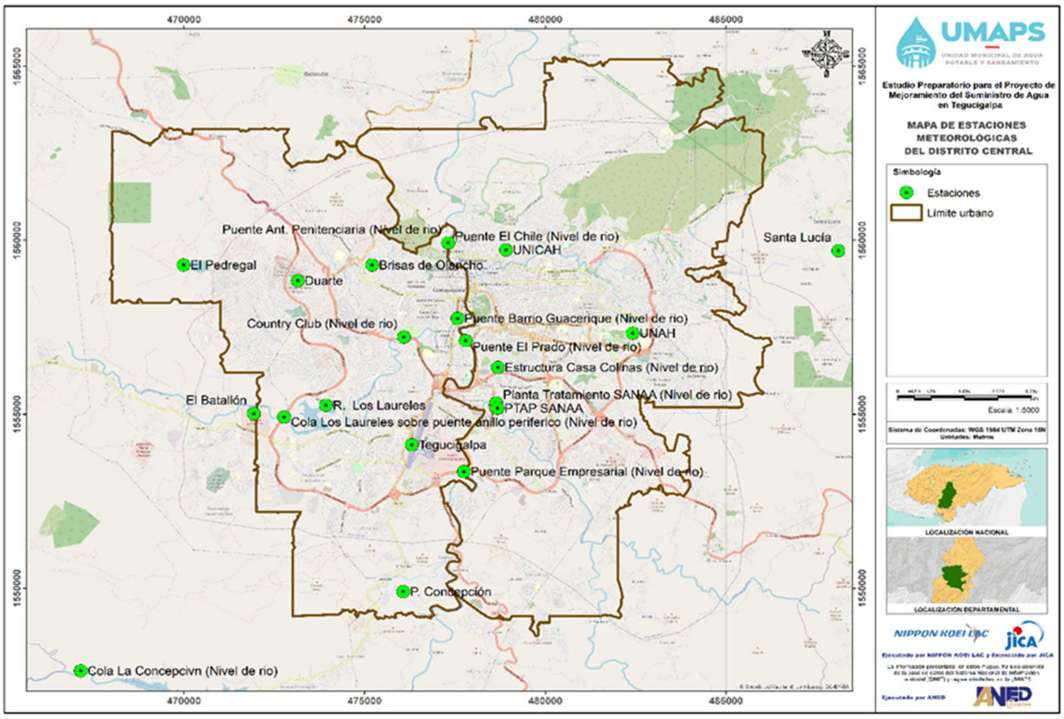
Figure 10.1.4 Distribution by Social Class in the Central District

10.1.2 Climate

According to the climate classification (SERNA, 1999), most of the urban area of the Central District has a rainy climate with a very dry winter, and the highlands have a high-altitude rainy climate.

(1) Meteorological Stations in the Central District

In the Central District, there is a series of meteorological stations located in different areas, as shown in the following Figure 10.1.5. These stations are managed by different entities, including the Municipal Mayor's Office of the Central District (AMDC), the Permanent Contingency Commission (COPECO), the National Autonomous University of Honduras (UNAH), the National Aqueduct and Sewer Service (SANAA), and the National Meteorological Service (SMN).

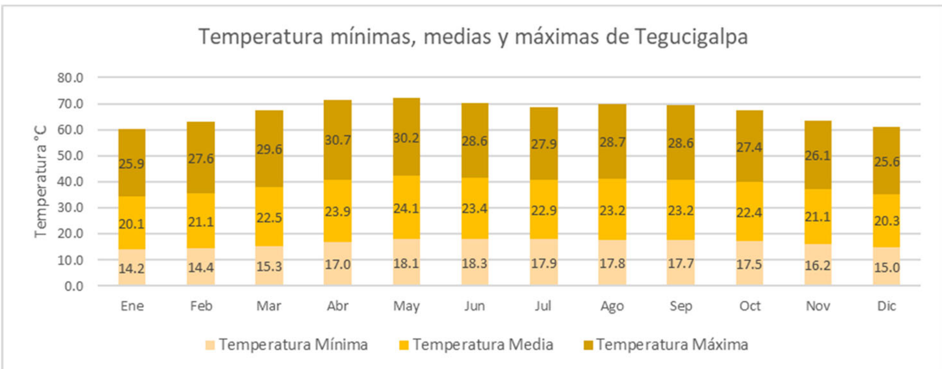


Source: The map shows the geographic location of the different meteorological stations and river level gauging stations managed by the different institutions. The map is elaborated, based on data taken from http://mapas.simet.amdc.hn/ and sinit.hn.

Figure 10.1.5 Map of Meteorological Stations Available for the Central District

(2) Minimum, Average, and Maximum Temperatures

According to the data measured at the Tegucigalpa Station, the average annual temperature for the Central District is 22.3 °C, with the hottest months from April to September, as shown in Figure 10.1.6.

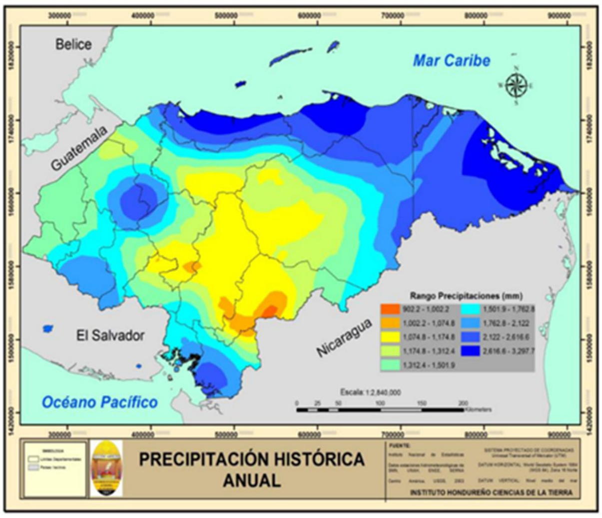


Source: Based on data from the Tegucigalpa meteorological station located at the Toncontín Airport, managed by SMN.

Figure 10.1.6 Minimum, Average, and Maximum Temperatures in Tegucigalpa

(3) Average Precipitation

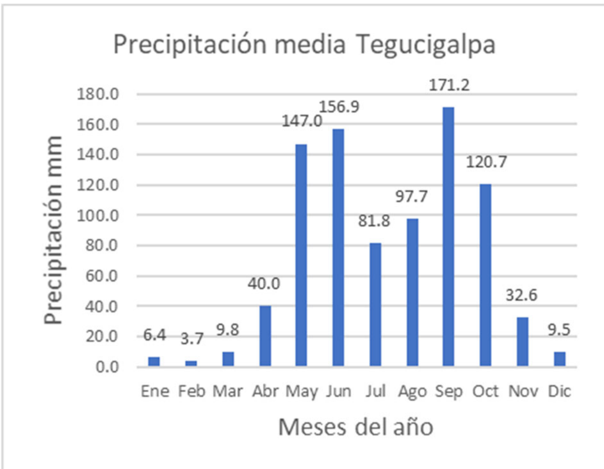
The average annual rainfall of the Central District is in the lower ranges compared to the rest of the country. Figure 10.1.7 shows the historical precipitation map of Honduras.



Source: Climate Atlas of Honduras (UNAH, 2012)

Figure 10.1.7 Historical Precipitation Map of Honduras

According to Figure 10.1.8, the rainy period of the year begins in May with rainfall averages of 147 mm and is diminished by heat wave (*veranillo/canícula*)[1], which occurs between the months of July and August, closing the year with the months with the highest rainfall, September and October, with rainfall greater than 171 mm. The annual average precipitation for Tegucigalpa reaches 877 mm.



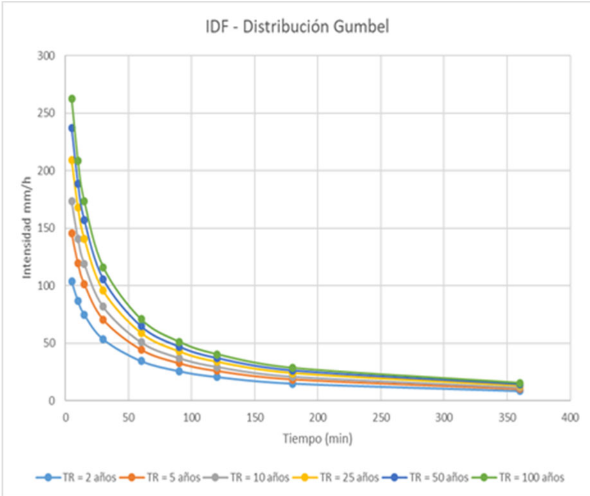
Source: The graph shows rainfall in mm per month according to the Tegucigalpa meteorological station located at the Toncontín Airport with data from 1953-2007 managed by SMN.

Figure 10.1.8 Average Precipitation in Tegucigalpa

(4) Rainfall Intensities

Regarding rainfall intensities, the intensity-duration-frequency curve of Tegucigalpa for the UNAH Station is shown in the following Figure 10.1.9.

[1] It is the middle of the rainy season, when the rain stops for several weeks in July and August, and the air is dry and parched.

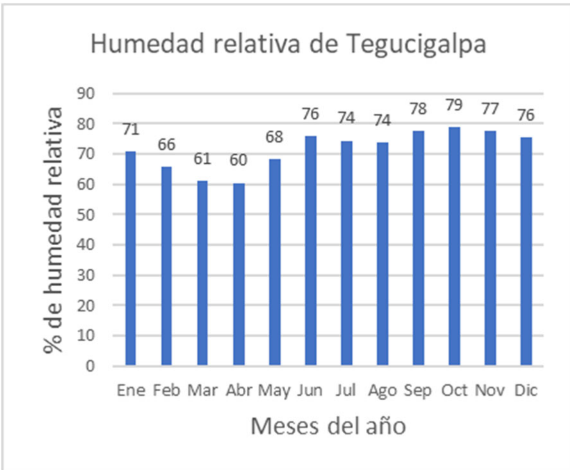


Source: The graph shows the IDF curves for different return periods at UNAH Station, taken from Granados (2016).

Figure 10.1.9 Rainfall Intensity-Duration-Frequency for Tegucigalpa

(5) Relative Humidity

The relative humidity in Tegucigalpa is 60-80%, with the highest relative humidity from September to November.



Source: The graph shows the relative humidity in % per month according to the Tegucigalpa weather station located at the Toncontín Airport with data from 1953-2007 managed by SMN.

Figure 10.1.10 Relative Humidity in Tegucigalpa

10.1.3 Natural Disasters

(1) Historical Events of Storm, Flood, and Torrential Rainfall Since 2000

The historical events of hurricanes, tropical storms, and tropical depressions that have directly and indirectly affected the Central District are presented in Table 10.1.1.

Table 10.1.1 Historical Events of Storm, Flood, and Torrential Rainfall Since the Year 2000

Year	Date	Event	Category	Year	Date	Event	Category
2000	28 Sept -06 Oct	Hurricane Keith	4	**2008**	05-10 Nov	Hurricane Paloma	4
2001	15-22 Aug	Tropical Storm Chantal		**2008**	14-16 Oct	Tropical Depression Dieciséis	
2001	19-20 Sept	Tropical Depression Nine		**2009**	04-10 Nov	Hurricane Ida	2
2001	04-09 Oct	Hurricane Iris	4	**2010**	27-30 May	Tropical Storms Agatha	
2001	28 Oct-06 Nov	Hurricane Michelle	4	**2010**	21 Sept	Lluvia	

Year	Date	Event	Cate-gory		Year	Date	Event	Cate-gory
2002	14-16 Oct	Tropical Depression Catorce			**2010**	22-30 Sept	Tropical Storms Matthew	
2003	08-16 July	Hurricane Claudette	1		**2011**	04 Oct	Lluvia	
2005	08-13 June	Tropical Storms Arlene			**2011**	08 Oct	Lluvia	
2005	18-21 Nov	Tropical Storms Gamma			**2011**	21 May	Lluvia	
2005	11-21 July	Hurricane Emily	4		**2012**	23 May	Lluvia	
2005	27-31 Oct	Hurricane Beta	3		**2013**	25 Mar	Lluvia	
2005	15-25 Oct	Hurricane Wilma	5		**2015**	11 June	Lluvia	
2007	13-23 Aug	Hurricane Dean	5		**2020**	03 Nov	Tropical Storm Eta	4
2007	31 Aug-05 Sept	Hurricane Felix	5		**2020**	16 Nov	Tropical Storm Iota	4

Source: Adjusted from the Study Report on the Characterization of Historical Events and Statistics of Hydrometeorological Variables and Progress on Technical Assistance for the Operationalization of the SAT-SIMET 2022 (UMGIR, 2022).

(2) Impact of Events on the Water Supply and Sewerage Facilities

Table 10.1.2 shows the events that have had an impact on the Central District, possibly affecting the water supply and especially the network of main sewerage collectors; however, there is no specific study on the subject.

Table 10.1.2 Impact of Hydrometeorological Events on Drinking Water and Sewage Systems in the Central District

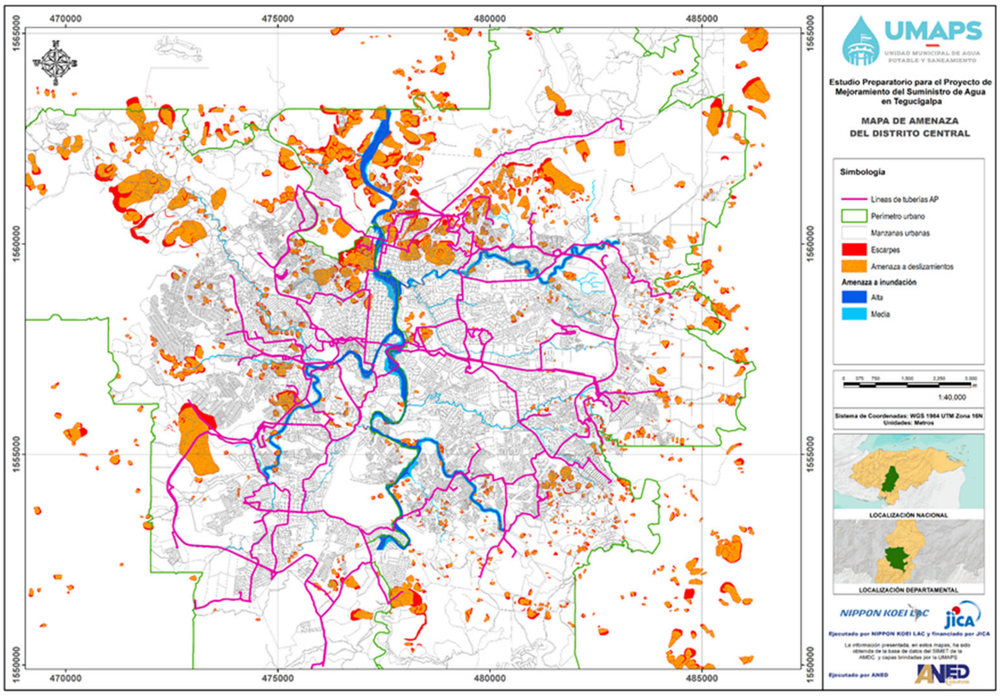
Event	Date (date/month/year)	Comments	Cause	Source
Landslide	10/10/2015	-	River overflowed its banks.	*La Prensa* (newspaper)
Rainfall	21/2/2011	The main access road to Reparto area collapsed, leaving the houses in this barrio and the surrounding areas cut off. 2500 families affected.	-	*El Heraldo* (newspaper)
Tropical Storm	25/8/2010	Flooding caused by accumulation of garbage. Damage to three automobiles and flooding in several houses.	Tropical Wave No. 25	*La Tribuna* (newspaper)
Tropical Storm	21/8/2010	Danger of collapse of in the Kassandra residence.	-	*La Tribuna*
Tropical Storm	17/8/2010	Amount of rainfall in the order of 40-80 mm. Damage to drinking water and aqueduct systems.	Tropical Waves Nos. 24 and 25	*La Tribuna*
Flood	17/8/2010	Sewage water flows through the streets.	Overflows of sewage systems	*La Tribuna*
Flood	17/8/2010	Overflowing of the El Sapo creek due to the accumulation of garbage carried by the river as a result of the rains.	Tropical Waves	*La Tribuna*
Tropical Storm	17/8/2010	Collapse of Retaining Wall at the Conservation Institute	Tropical Wave No. 24	*La Tribuna*
Tropical Storm	15/8/2010	Damage of the road section entering the Metromall up to the bridge	Tropical Waves Nos. 24 and 25.	*La Tribuna*
Structural damages	24/5/2010	Damaged sewage pipes and rainwater pipes	-	Municipal Emergency Committee (CODEM). SMMF
Tropical Storm	20/8/2010	Damage to potable water supply systems	-	*La Tribuna*
Landslide	17/10/2008	All residents are harmed by real estate insecurity.	Rainfall caused by Tropical Depression 16	*El Heraldo*
Landslide	9/9/2008	The strong water pressure of the creek has caused the wall to collapse. The pavement of the street in front of the Baptist church in Colonia La Reforma is sinking. Because of the humidity, this street has a large hole in it. The mother valve is susceptible to bursting.	Rainfall caused by Tropical Depression 16	*El Heraldo*
Rainfall	27/9/2005	One family evacuated, Colonia la Mololoa was cut off. The mayor's office declares a green alert.	Moderate to heavy rains, according to weather service	*La Tribuna*

Structural damages	16/12/2002	Cruz del Manchen Avenue is practically closed due to the sinking of the asphalt and repair works. Hundreds of residents of this barrio are worried because the drinking water pipes are damaged and generating a water crisis.	-	*El Heraldo*
Flood	5/6/2002	Overflowing of almost all streams and damages have not been calculated for the moment. There are missing persons, streets flooded, and water and sanitation systems affected.	Heavy rains at the beginning of Hurricane season	*El Heraldo*

Source: JICA Study Team

(3) Hazard Map of the Central District

The following Figure 10.1.11 shows the flood and landslide hazard map of the Central District, noting that much of the area is under threat, including the drinking water network.



Source: Based on landslide hazard layers from JICA, and flood hazard from JICA and IDOM.

Figure 10.1.11 Map of Landslide and Flood Hazards

10.1.4 Status of Drinking Water Supply in Central District

(1) Coverage and Status of Drinking Water Service

Table 10.13 summarizes the results of the LXXIV Permanent Multipurpose Household Survey (INE, 2022), referring to the type of drinking water supply that households in the Central District have. It is observed that 92.5% of the households are supplied with drinking water through a distribution network. But the coverage of the drinking water system is not an indicative index of the quality of the service, since the coverage with house connection does not guarantee the actual supply and quality of drinking water received by the population. One of the problems of the sector is the lack of concordance of data on drinking water and sanitation services. In the case of the UMAPS, it defines that only 70% of households in the Central District have a connection to the drinking water distribution network. According to the UMAPS user registry, there is a record of more than 130,000 users as direct customers; however, there is a group of barrios and colonies served by water boards (Junta de Agua) that are registered as macro users, so it is estimated that it reaches more than 185,000 users, including the houses of these barrios and colonies[2]. It should be clarified that the 286,263 houses with connections in data by INE include those in barrios and colonies administered by water boards that are *not direct users* of UMAPS, those that are *not UMAPS users,* and those that are *illegally connected*, which is a greater number of house connections compared to the data of UMAPS users.

Table 10.1.3 Main Sources of Drinking Water Supply in the Central District by Household

TOTAL N°	HOUSE CONNECTION		WELL WITH PUMP		WATER TANKER		PUBLIC COMMUNITY TAP		PICK-UP WITH DRONE OR BARREL		FROM NEIGHBORS / OTHER HOUSE		NOT DEFINED	
	N°	%	N°	%	N°	%	N°	%	N°	%	N°	%	N°	%
309,516	286,263	92.5	697	*0.2*	16,568	5.4	697	0.2	2138	0.7	2,954	1.0	199	0.1

Note: N° means number of household.
Source: LXXIV Permanent Multipurpose Household Survey (INE, 2022)

(2) Frequency and Hours of Water Supply Service

Water supply in the Central District is very limited and varied depending on the sectors. In recent years, supplies have been from 8 to 12 hours once every 2 days for some sectors and up to 6 days for other sectors. This situation is aggravated in the dry season, from April to June, where the supply has been once every 9 days. Currently, supplies are regulated with a general frequency of 6 to 12 hours every 2 days. This situation has generated the need to build water storage at homes, generating inequality in access to water since only high-income users can afford to build cisterns (tanks).

(3) Water Supply by Private Companies in the Central District

The supply of drinking water by private companies in the Central District is categorized in two ways: one is a group of AquaBlock water tankers whose water is supplied by UMAPS from the Los Laureles System. The total number of registered water tankers belonging to private companies and private owners is 223. Another is a group of private water tankers that are supplied water from unregulated private wells.

For 16 years, the water tankers have been buying water from AquaBlock (currently, the cost per 2,500 gallon water tanker is HNL 125 (USD 5.0)) and the owners sell water throughout the Central District at a cost of approximately HNL 1500 (USD 61.0), either by total volume or per barrel (1 cistern tank has 40 barrels) especially in poor barrios and colonies. This means that the user who buys water from water tankers pays 12 times higher price than those who receive water from the public system directly. Approximately, a household in the high consumption segment of the Central District pays HNL 12.80 per cubic meter or HNL 0.04838 per gallon.

According to data from the Secretary of Health, there are records of 58 private wells that are used for direct supply, bottled water, and water tankers. This registry has data recorded from 2017 to 2022 with information on the owner's name, well location, and water quality analysis. According to reports from the Secretary of Health technicians, some of the wells do not meet the water quality standards for the country; however, they did not have access to these quality results. Since 2022, this responsibility was

[2] Interviews with local consultants in the water sector (31st March, 2023)

transferred to the Drinking Water and Sewage Services Regulatory Entity (ERSAPS) responsible for the control and regulation of these services. In addition, there is another group of wells that does not have any type of record or information and is part of the private water supply, which puts human health at risk due to the lack of water quality control.

10.1.5 Access to Public Health Services

(1) Coverage and Number of Healthcare Facilities

According to the Secretary of Health (Annual Statistics 2021 and 2021), the Metropolitan Health Region of the Central District has a total of 96 health facilities. Of these facilities, 7 are specialty hospitals, 1 is an institute (IHSS), 35 are Primary Health Care Units (UAPS), 28 are Comprehensive Health Centers (CIS), 2 are Student Dental Centers (CEO), 3 are Polyclinic (POL), 3 are Peripheral Clinics (CLIPER), and 17 are other health facilities.

(2) Principal Diseases Associated with Water and Air Pollution

The following Table 10.1.4 shows a list of the main diseases associated with water or air pollution problems for the Central District.

Table 10.1.4 Principal Diseases Associated with Water and Air Pollution

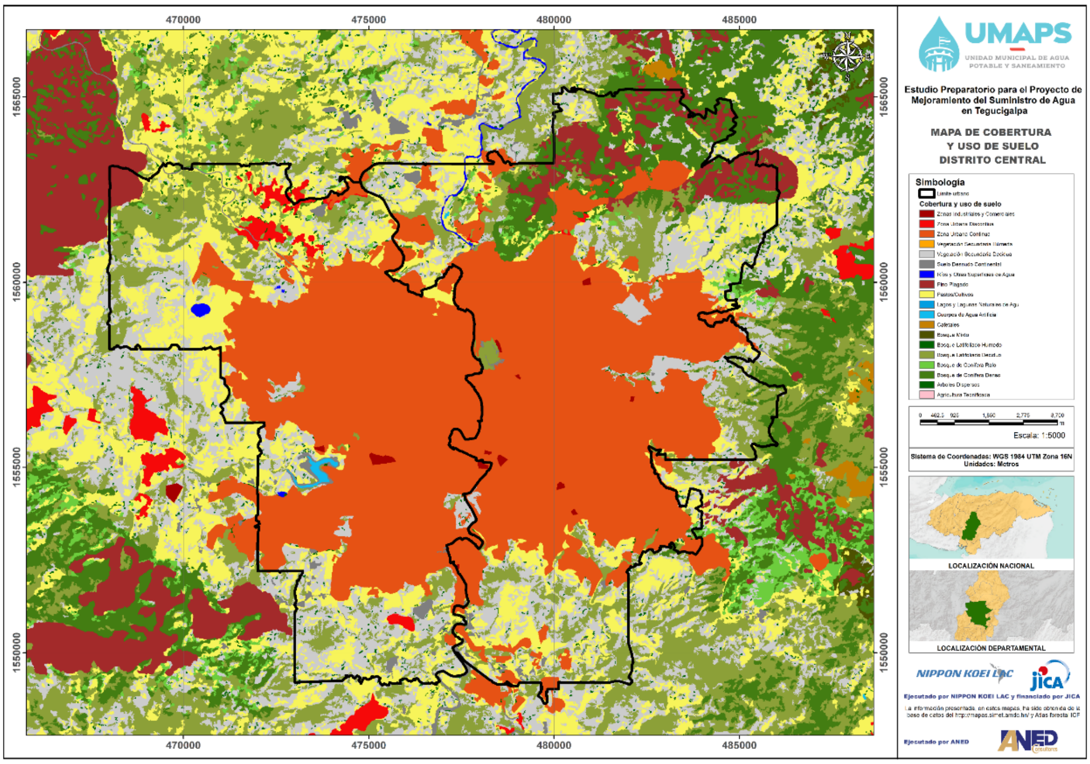
Disease	Preventable Diseases			Other Preventable Diseases	Intestinal Diseases				Respiratory Diseases		
	Polio	Pertussis	Diphtheria	Hepatitis A (Infectious Hepatitis)	Diarrhea	Dysentery	Cholera	Typhoid and Paratyphoid Fever	Bronchitis and Asthma	Pneumonia/ Bronchopneumonia	Pulmonary Tuberculosis
Cases in the Central District	0	2	0	380	27,439	356	0	8	17,386	7,845	268
Percentage with respect to National total (%)	0	9.52	0	45	23.2	10	0	36.4	16.9	16.9	15.3

Source: Annual Statistics (2021&2022), Secretary of Health

10.1.6 Land Use

(1) Land Cover and Land Use Map of the Central District

The latest land use map of the Project area corresponds to the Municipal Forest and Land Cover Atlas (2018) by Forest Conservation Institute (ICF), as shown in Figure 10.1.12.



Source: The map shows the polygons of the 5 macro categories: Forest, Agroforestry, Agricultural, Water Bodies, and Other Uses (Non-forest) for the Central District. Elaborated from ICF layers.

Figure 10.1.12 Coverage and Land Use in the Central District

(2) Land Use Regulations

The Regulation on Zoning, Works, and Land Use in the Central District, which establishes the zoning parameters applicable to the Central District for the execution of works and land use, as well as the procedures and requirements to issue municipal authorizations, was approved in 2018 and is currently still in force.

For the purpose of updating the zoning in the Central District, the following zones are established:

a) Distribution Zones, which are further divided into distribution zones D-1, D-2, D-3, and D-4.

b) Residential Zones, which are further divided into residential zones R-1, R-2, R-3, R-4, R-5, and R-E.

c) Zones classified as industrial (Z-I) and/or urban-rural (U-R).

d) Special Zones, which are further divided into Ecological Conservation (C-E), Historical Conservation (C-H), Cultural Projects (P-C), Conservation by Risk Areas (CAR), Suburban Zones (Z-SU).

The particular characteristics and regulations applicable to each of the zones described in paragraphs c) and d) in the regulation are developed by means of specific regulations that are issued by the Construction Control Management with the approval of the Land Use and Zoning Department.

In addition, the regulation defines undevelopable areas as all those areas of land that are considered non-viable as a result of the risk assessment report of the risk assessment management office (GER) or whoever takes its place in the application of the Regulation for the Reduction of Disaster Risks of the Central District.

10.1.7 Basic Sanitation

(1) Types of Sanitation Technology and Coverage in the Central District

More than half of the households of the most disadvantaged classes dispose of gray water in backyards, streets, or neighboring hillsides, representing a major problem affecting this segment of the population. A high percentage of poor households have no sanitary facilities at home (75%) and most use latrines (69%). In contrast, 100% of wealthy households have a toilet inside the house (IDB, 2007). On the other hand, the expansion of the city, especially to the south and west, has meant that private developers are responsible for providing sanitation solutions, by septic tanks, treatment plants, or discharging directly into streams and creeks.

According to the data (INE, 2022) shown in Table 10.1.5, 82.3% of the dwellings in the Central District are connected to sanitary sewerage; latrines occupy the second most used type of sanitation technology and cover 10.5% of the households. Third most common are on-site toilet-type solutions, which cover 3.8%, and fourth are other types of technology, which are used by 0.7% of the households. Meanwhile, 2.6% of the households do not have any sanitation means and are forced to defecate in the open air.

Table 10.1.5 Main Means of Excreta Disposal in Households

Sewer-connected toilet		Toilet connected to septic tank		Toilet with drainage to river, lagoon or sea		Latrine with discharge to river, lagoon or sea		Latrine with water seal		Toilet with septic tank		Latrine with cesspool		Other type		Does not have	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
254,762	82.3	8,017	2.6	3,720	1.2	511	0.2	9,478	3.1	7,490	2.4	15,089	4.9	2,277	0.7	8,173	2.6

Source: INE (2022)

(2) Quality Control of Effluents

The Technical Standards for Wastewater Discharges to Receiving Bodies and Sanitary Sewers 1996 No. 58-1996 must be applied. The parameters and permissible values/ maximum permissible concentrations are shown in Table 10.1.6 below.

Table 10.1.6 Quality Standards for Wastewater Discharge Into Receiving Water Bodies

Parameter	Permissible Value/ Maximum Permissible Concentration	Parameter	Permissible Value/ Maximum Permissible Concentration
Temperature	< 25 degrees Centigrade	Lead	0.5 mg/L
Color	< 200 UC	Mercury	0.01 mg/L
pH	6 a 9	Cadmium	0.05 mg/L
Volume Discharged	<10% of the average flow or volume of the receiving body	Total Chromium	1 mg/L
Solid Sediments	1 ml/L/hr	Hexavalent Chromium	0.1 mg/L
Suspended Solids	100 mg/L	Cobalt	0.5 mg/L
Floating Material and Foam	Absent	Arsenic	0.1 mg/L
BOD	50 mg/L	Cyanide	0.5 mg/L
COD	200 mg/L	Fluorides	10 mg/L
Fats and Oils	10 mg/L	Selenium	0.2 mg/L
Total Kjeldahl Nitrogen	30 mg/L	Polychlorinated Biphenyls	Absent
Ammonia Nitrogen	20 mg/L	Trichloroethylene	0.3 mg/L

Parameter	Permissible Value/ Maximum Permissible Concentration	Parameter	Permissible Value/ Maximum Permissible Concentration
Total Phosphorus	5 mg/L	Tetrachloroethane	0.1 mg/L
Sulfides	0.25 mg/L	Carbon Tetrachloride	1 mg/L
Sulfates	400 mg/L	Dichloroethylene	1 mg/L
Aluminum	2 mg/L	Chloroform	0.03 mg/L
Barium	5 mg/L	Carbon Sulfide	1 mg/L
Iron	1 mg/L	Chlorinated Organo Pesticides	0.05 mg/L
Manganese	2 mg/L	Organo-Phosphorus Pesticides	0.1 mg/L
Zinc	2 mg/L	Hydrocarbons	0.5 mg/L
Copper	0.5 mg/L	Phenols	0.5 mg/L
Tin	2 mg/L	Detergents	2 mg/L
Nickel	2 mg/L	Fecal Coliforms	5000 MPN/ 100ml
Silver	0.1 mg/L	Radioactive Isotopes	Absent

Source: Technical Standards for Wastewater Discharges to Receiving Bodies and Sanitary Sewers 1996 No. 58-1996

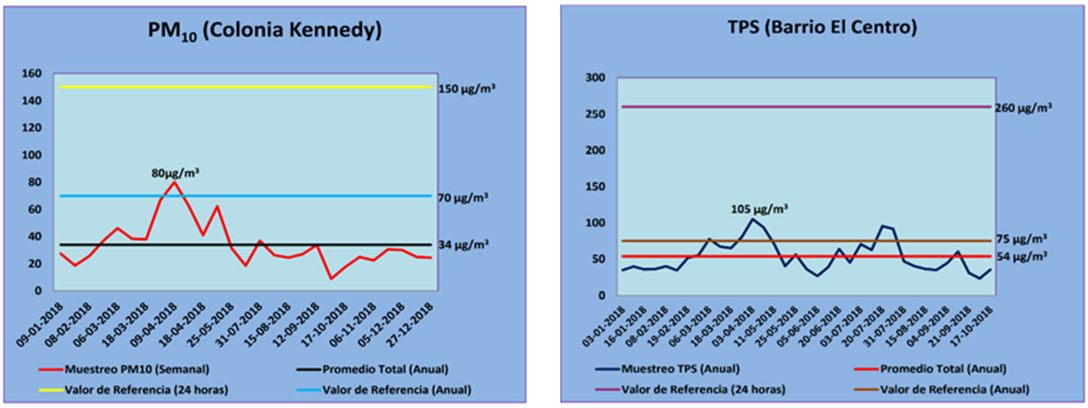
10.1.8 Air Quality

(1) Air Quality Data

Since 2012, the Secretary of Natural Resources and Environment, through the Center for Studies and Control of Pollutants (CESCCO), generates data on particulate matter suspended in the air such as total suspended particulate matter (TSP), particulate matter less than or equal to 10 micrometers (PM10), and particulate matter less than or equal to 2.5 micrometers (PM2.5) measured in a 24-hour period, in two points of the Central District, namely, Barrio El Centro (HONDUCOR) and Colonia Kennedy (HOSPIMED).

In 2018, TSP and PM10 were measured in HONDUCOR. But in HOSPIMED, only PM10 was measured. In Figure 10.1.13 below, it can be observed that the data obtained for PM10 (Colonia Kennedy) and TPS (Barrio El Centro) are below the reference value (24 hours and annual) according to and the Regulation for the Control of Emissions Generated by Stationary Sources (2011) for PM10 in sensitive areas and USEPA Standard for TSP respectively.

The WHO Air Quality Guidelines set the recommended annual mean AQG level of PM10 at 15 $\mu g/m^3$ and that of the recommended short-term (24-hour) AQG level at 45$\mu g/m^3$. In comparison to the guideline values, those of Colonia Kennedy generally exceed the recommended annual mean AQG level, but is lower than the recommended short-term (24-hour) AQG level.



Source: Concentration of particles smaller than 10 microns at Colonia Kennedy and TSP at Barrio El Centro, Year 2018. (CESSCO, 2018)

Figure 10.1.13 Results of CESCCO's Air Quality Measurement in the Central District

(2) Air Quality Regulations

The purpose of the Regulation for the Control of Emissions from Stationary Sources (2011) is to prevent, control, and reduce air pollution from stationary sources. Article 35 defines the criteria for gases emitted from stationary sources in sensitive zones, i.e., occupational areas such as housing and working areas which can be directly affected by atmospheric emissions from the stationary source through deteriorating air quality. In the water and sanitation construction project, air quality may be adversely affected due to the use of vehicles and machinery that emit gases and dust. Table 10.1.7 shows the criteria in the regulation of Honduras.

Table 10.1.7 Air Quality Standard Parameters

POLLUTANT	SAMPLING PERIOD	LIMIT VALUE (micrograms/cubic meter)
Sulfur dioxide SO_2	24 hours	125
	10 minutes	500
Particulate matter (PM_{10}, particles smaller than 10 micrometers)	1 year	70
	24 hours	150
Particulate matter ($PM_{2.5}$, particles smaller than 2.5 microns)	1 year	15
	24 hours	65
Nitrogen dioxide NO_2	1 year	40
	1 hour	400

Source: Regulation for the Control of Emissions from Stationary Sources (2011)

10.1.9 Water Quality

(1) Drinking Water Quality Standard Parameters

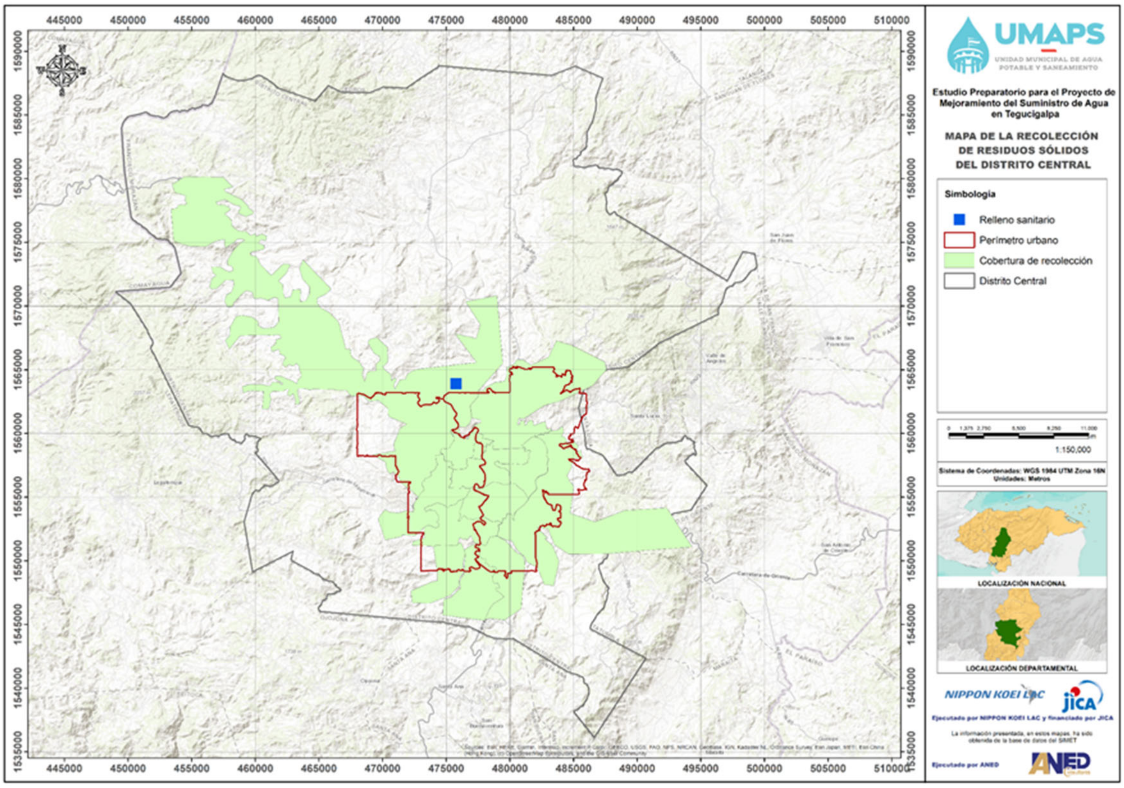
The parameters are set by the National Technical Standard for Drinking Water Quality (1995).

10.1.10 Solid Waste Treatment and Disposal

(1) Coverage for Solid Waste Treatment and Disposal

Currently, the Central District generates 1,175 tons of solid waste and in the future, it is expected to receive between 2,500 and 3,000 tons of garbage daily in the open-air cell. The AMDC has outsourced solid waste collection services to two companies: AMAHSA and COSEMSA. Currently, coverage is

99% of the urban area and 50% of the rural area (see Figure 10.1.14). It is important to note that there are no environmental monitoring programs for the handling, collection, transportation, and final disposal of solid waste.



Source: Based on information provided by the Municipal Waste Management Department of AMDC.

Figure 10.1.14 Coverage of Solid Waste Collection in the Central District

(2) Waste Collection System

Waste collection in the Central District is carried out three days a week, except in the central area, which is done daily by using the following methods. It is depending on the topographical conditions or access to the colonias.

Containers: located in areas of high generation and limited access.

Corner or fixed stop: vehicles going to certain predetermined points where users place their waste at the permitted times.

Door-to-door pickup: vehicles driving through all the streets in the area and collecting solid waste in front of houses.

(3) Final Disposal of Wastes

Waste disposal is carried out at a landfill of 72.79 hectares which is located at Km 6.5 of the road to Olancho in Tusquerique Village of El Guanábano Sector. At the time of daily operation with cell method, a 15 cm thick layer is applied. The placement is done with a bulldozer in 60 cm layers on 3:1 slope, and there is also a network of leachate collection pipes with exploration wells.

10.1.11 Noise

As for noise, although CESSCO has taken measurements in some projects, there is no noise measurement unit in the Central District and there are no public records on the subject. Therefore, it is important to refer to the Guidelines for Community Noise (1999) by the WHO (See Table 10.1.8).

Table 10.1.8 Acceptable Noise Levels in Residential Areas According to WHO Guidelines

Specific Environment	Critical Health Effect	LAeq (dB)	LAmax (dB)
Outdoor Living Area	Serious annoyance	55	–
	Moderate annoyance	50	–

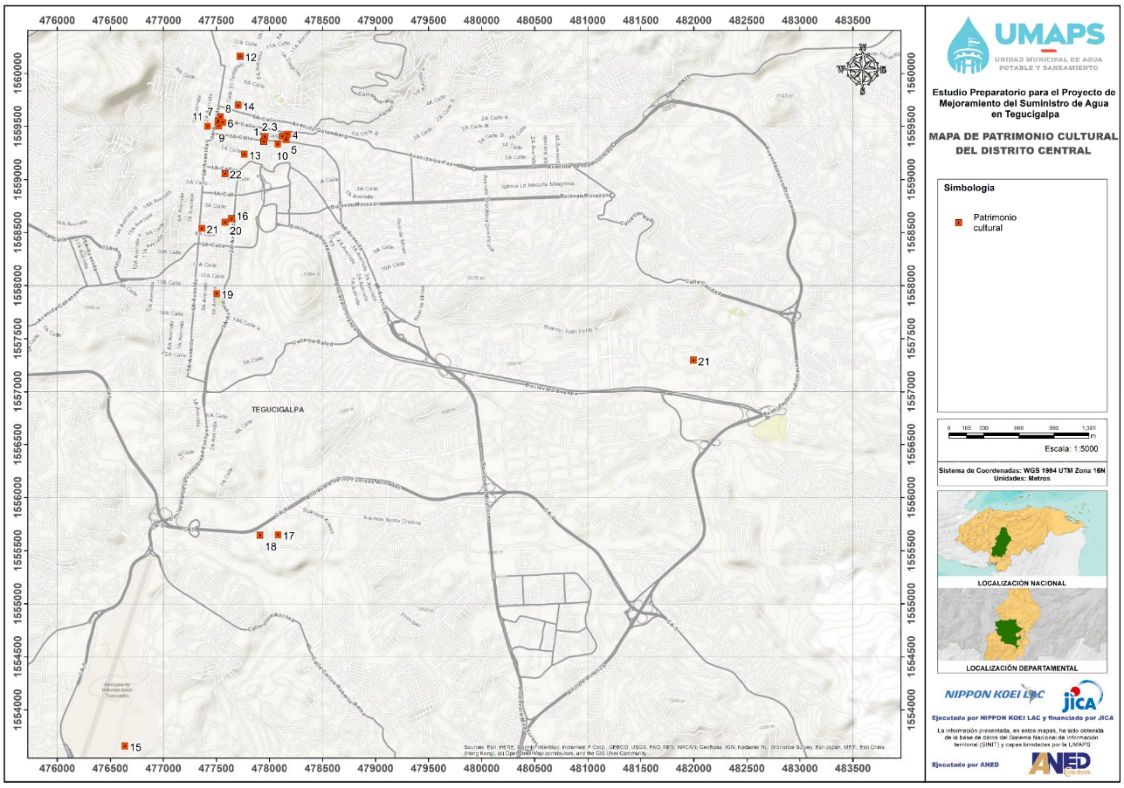
Source: WHO (1999), Guidelines for Community Noise

10.1.12 Cultural Heritage

(1) Map of Cultural Heritage of the Central District

The Honduran Institute of Anthropology and History made an inventory of properties, which are considered historical heritage of the nation, given their historical, anthropological, and architectural characteristics, collected in the document titled "Brief Overview of the Historic Center (AMDC)". In addition, the ILAM Foundation presents a list of cultural heritage of Latin American countries. This information is presented in Figure 10.1.15 and Table 10.1.9.

It is important to mention that in the event that a material classified as cultural heritage is found, it will be the responsibility of the Honduran Institute of Anthropology and History (IHAH) to specify how it will be treated.



Source: Prepared with information from AMDC, etc.

Figure 10.1.15 Location of Cultural Heritage of the Central District

Table 10.1.9 Cultural Heritage of the Central District

ID	Name of Heritage	ID	Name of Heritage
1	Municipal Palace	13	Former Presidential House
2	San Miguel Arcángel Metropolitan Cathedral	14	Los Dolores Church
3	San Francisco Church	15	Air Museum of Honduras
4	Military Historical Museum	16	National Fine Arts School
5	Museum of Mankind	17	Museum of Children (CHIMINIKE)
6	National Art Gallery of Honduras	18	Rigoberto Borjas BCH Numismatic Museum
7	National Identity Museum	19	Armed Forces General Staff
8	Telecommunications Museum	20	Inmaculada Concepción Church
9	Honduras National Post Office	21	Museum of Natural History & Entomology
10	National Library and Archives	21	Lempira School
11	National Theater	22	Hibueras Institute
12	Villa Roy Republican History Museum		

Source: AMDC and ILAM Foundation

10.1.13 Ecosystem

(1) Types of Ecosystems in the Central District

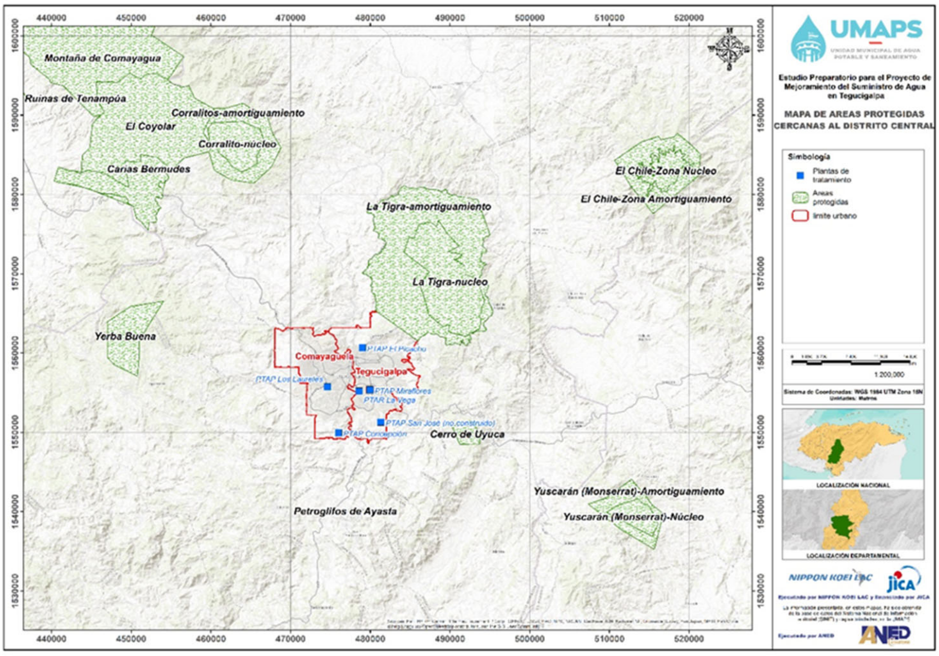
According to the country's ecosystem map, the urban area of the Central District is composed of an urban zone, an agricultural ecosystem in the north-western zone, a seasonal tropical evergreen forest in the north-western zone, a pine forest in the southern zone, and well-drained lowland deciduous microlatifoliated shrub land in some small areas.

In Honduras, there are 253 species of flora and 387 species of fauna of special concern (MIAMBIENTE, 2018). For new projects, the presence of species of special concern in the Central District should be studied, as no study detailing the presence of these species has been found.

10.1.14 Protected Areas

(1) Map of Protected Areas

There are no protected areas within the urban area of the Central District; however, the following thematic map, Figure 10.1.16, shows the closest protected areas, with La Tigra being the closest and within the Project's possible influence.



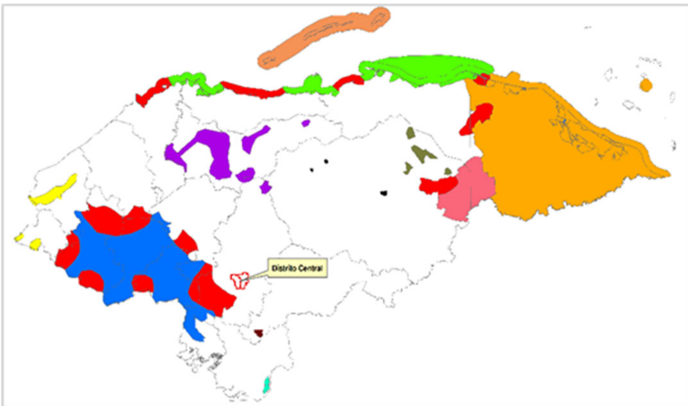
Source: Elaborated with ICF's protected areas layer (2011), also includes the location of the drinking water treatment plants of the Central District.

Figure 10.1.16 Protected Areas Near the Central District

10.1.15 Indigenous Minority Ethnic Groups

(1) Ethnic Groups in Central District

As shown in Figure 10.1.17, there is no record of ethnicities in the urban area of the Central District, although the multi-ethnic and Lenca area is located as the closest one in the south of Francisco Morazán Department. It is also important to mention that the Special Prosecutor's Office for the Protection of Ethnic Groups and Cultural Heritage is located in the Central District.



Source: Elaborated based on the ethnic groups layer of Honduras from https://territoriosenriesgo.unah.edu.hn/

Figure 10.1.17 Map of Ethnicities in Honduras

10.1.16 Gender

(1) Gender in the Central District

According to the labor market analysis of the National Institute of Statistics (INE, LXXIV Permanent Multipurpose Household Survey, 2022), the unemployment rate in the working-age population is significantly higher for women than for men, with a rate of 12.9% for women at the national level, compared to a rate of 6.2% for men. In the Central District, this gender gap in the unemployment rate is maintained, with a rate of 14.2% for women and a rate of 9.7% for men.

Despite the fact that the labor participation rate for women in the Central District is 15.4%, compared to the labor participation rate for men of 11.3%, there are notable differences in the distribution of jobs according to occupational category and domain of activity between men and women.

Women employed in the Central District have a higher participation in the occupational category of "Unpaid family work" (9.9%) and "Apprentices" (44.1%) compared to men who represent 8% and 39.3% respectively, indicating a significant gender gap in access to quality jobs with labor rights.

In addition, women have lower participation in the public sector (23.4%) compared to men (30.7%). Women have higher participation in self-employment (13.6%) compared to men (11.6%), which suggests that they have fewer opportunities to access jobs in the public sector, i.e., jobs with greater guarantees of labor rights.

When analyzing the data by gender, it is observed that the average income of employed women (HNL/month/person) is lower than that of men in general. In the case of men, the average income is HNL 10,342/month/person, while for women, it is HNL 7,770/month/person. In terms of employment domains, the average income in the public sector is higher than in the private sector, domestic work, and self-employment.

(2) Gender in the Construction Sector and in the Water and Sanitation Sector

1) Presence in the Water Sector of Community Level

According to the research entitled "Community and Social Participation of Women in Water Management as a Common Good in Honduras", women have greater participation in activities related to water management in the community, such as water collection, caring for men during the construction of drinking water systems, and education on sustainable practices. However, it was also found that there is a marked gender segregation in decision-making in water management, as men have a greater presence in leadership positions and make the key decisions in water management despite the high participation in events and meetings by women (Suarez, 2018).

In the Central District, it is estimated that there are around 300 water boards (*junta de agua*), of which 160 are registered in the Association of Similar Water and Sanitation Management Boards of Francisco Morazan (AJAASSFRAM). According to the diagnostic survey conducted at the end of 2022, the number of men is 568 and that of women is 375, representing 60% and 40%, respectively (AJAASSFRAM, 2022).

2) Labor Market

With the data provided by INE (LXXIV Permanent Multipurpose Household Survey, 2022), at the national level, a clear gender gap can be observed in the labor sector. In construction, a great disparity is observed in the number of men and women employed, with men being much more represented than women. In this case, men outnumber women by more than 150 times.

In the water supply, sewage disposal, and waste management sector, the gender gap is also notable, although the disparity is much smaller in absolute terms. Even so, the number of men employed in this sector is significantly higher than that of women, with a ratio of almost eight men for every woman.

3) Income Level

At the national level, the average income of men in construction is HNL 6,740 per month, while that of women is HNL 7,241 per month. In the water supply, wastewater disposal, and waste management sector, the average monthly income for men is HNL 6,829, while for women, it is only HNL 887.

4) Schooling Level

Men have an average of 10.3 years of schooling, while women have 11 years of schooling on average. As for the difference by occupational category, it is observed that women working in construction have an average of 11.9 years of study, while men in the same category have an average of 7 years.

On the other hand, in the category of water supply, wastewater disposal and waste management, women have an average of 4.3 years of study, while men have an average of 7.3 years.

These data reflect the existence of significant gender inequality in the Honduran labor market, especially in these two sectors. The gender gap is not only reflected in the number of employees, but also in other aspects such as remuneration, representation in management positions, and equity in labor treatment.

The above statistics show that women in the construction sector are relatively higher earning and better educated than men, but they are a very small minority in the construction sector as a whole.

10.1.17 Poverty

(1) Poverty Rates

At the national level, INE conducted a survey to analyze poverty. As shown in Table 10.1.10, 37.3% of households in the Central District have an income of less than HNL 1914.6, which is barely enough to meet the nutritional requirements necessary to develop an average level of activity.

Table 10.1.10 Households by Poverty Level for Central District [1]

Total	Number of Poor Households	Poor[2]		
		Total	Relative [3]	Extreme[4]
261,517	95,953 (36.7%)	165,563 (63.3%)	68,120 (26%)	97,443 (37.3%)

Source: LXXII Permanent Multipurpose Household Survey (INE, 2021)

Note:

1. Poverty measured by the Poverty Line Method, defined as the cost of the Basic Food Basket
2. Poor: Households whose per capita income is below the Poverty Line
3. Relative poverty: Households whose income is less than the cost of the Basic Basket, HNL 3829.1/month/person and greater than the cost of the Basic Food Basket, HNL 1914.6
4. Extreme poverty: Households that have a per capita income below the cost of the Basic Food Basket, HNL 1914.6

(2) Unemployment Rate

The Central District has an unemployment rate of 14.2%, which means that a significant portion of the population is unemployed. In addition, of the 86% of employed people, 23% are underemployed due to lack of sufficient working time, while 31% are underemployed due to insufficient income. These data suggest that although a portion of the population is employed, many of them are not working enough or are not earning enough to cover their basic needs (INE, 2022).

10.1.18 HIV/AIDS and Prevention Measures

(1) Population with HIV/AIDS in the Central District

The statistical report on the HIV Epidemic in Honduras, corresponding to the period 1985 to December 2022, reveals that in Tegucigalpa, 88 cases of asymptomatic HIV infection were registered in 2020, 86 cases in 2021, and 96 cases in 2022, with a cumulative total since 1985 of 2,735 people affected by this condition. In the country, it is known that the ratio of cases in men is 1.3 times higher than in women. Regarding the advanced HIV diseases (AHD), the report states that in Tegucigalpa, 34 cases were registered in 2020, 60 cases in 2021, and 40 cases in 2022, with a cumulative total since 1985 of 5,106 people.

(2) HIV/AIDS Care Offered in the Central District

The Ministry of Health offers HIV and sexually transmitted infection (STI) promotion, prevention, and care services throughout its network (CESAR, CESAMO, CMI, and hospitals), but these services are not systematized. The Honduran Social Security Institute (IHSS) provides promotion and prevention services only to its affiliates, through its network of services.

In the health sub-sector, represented by local governments, non-governmental for-profit and non-profit organizations, and community-based organizations provide promotion, prevention and support services, but with little coordination among themselves and without any regulation by developing actions according to their organizational criteria.

10.1.19 Environmental Protection Activities

In the Central District, there are governmental and non-governmental actors, private companies, and international cooperation agencies that have carried out or are carrying out environmental protection activities.

(1) Actors for Environmental Protection

1) Government Institutions:

- Secretary of Natural Resources and Environment
- Forest Conservation Institute (ICF)
- Environmental Management Office of the Central District Municipal Mayor's Office
- Environmental Prosecutor's Office
- Secretary of National Defense
- Fire Department

- Secretary of Education
- Permanent Contingency Commission (COPECO)
- National Autonomous University of Honduras

2) Non-governmental Organizations:

- AMITIGRA
- Honduran Association for the Protection of Animals and their Environment (AHPRA)
- Sustainable Development Network of Honduras (RDS)
- National Observatory of Climate Change for Sustainable Development (ONCC-DS)
- Honduran Foundation for the Environment and Development (Life Foundation)
- Integral Foundation for the Development of Honduras (FIPADEH)
- The Water for All Foundation (FUNAPAT)
- Association of Protected Area Management Organizations of Honduras (MOCAPH)
- Women's Business Development Organization (ODEF ONGD)

3) International Organizations:

- USAID
- JICA
- UNDP
- IDB
- CASM
- Goal
- Birdlife International
- IUCN
- Greenpeace International
- Nature Conservancy
- World Resources Institute
- WWF International

4) Private companies that have implemented actions in the last few years:

- Ficohsa Bank
- Larach & Cia
- Terra Group

(2) Activities Carried Out by the Central District/NGOs for Environmental Protection

Government institutions, the mayor's office of the Central District, and several NGOs are working to protect the environment and natural resources of the Central District. For example, ICF works in forest planning and management, forest protection and conservation, restoration of degraded areas, education and training, and research and monitoring. The mayor's office is currently carrying out reforestation campaigns, implementing green walls, and taking care of the capital's protected areas. It also attends to and processes complaints related to poor waste disposal, noise pollution, occupation of green areas, vacant lots, environmental contamination, illegal tree cutting, and other environmental problems. The

Secretary of Defense and the Fire Department are implementing activities to create clean and safe environments to prevent diseases and reduce the impact of climate change. The Secretary of Education and the UNAH carry out training activities on environmental issues and non-formal education such as diploma courses.

Most NGOs focus on the fight against climate change, environmental protection, and biodiversity, with special attention to forests. Among the organizations working on environmental protection in the Central District, AMITIGRA focuses on monitoring and protection of areas affected by the bark beetle, production of native plants for the recovery of areas damaged by pests or fires, and monitoring the quantity and quality of water in La Tigra National Park.

10.2 Identification of Environmental and Social Consideration Systems and Organizations in Honduras

10.2.1 Relevant Environmental Policies, Social Laws, Regulations and Standards

(1) National Plan and Environmental and Social Policies in Honduras

1) Summary of the Country Vision 2038, National Plan (2010-2022 and 2022-2034)

In conceptual terms, the national objectives and goals of national priority (from the point of view of the Country Vision) will be concretized under the progressive execution of the National Plans (2010-2022 and 2022-2034).

Legislative Decree No. 286-2009, "Law for the Establishment of a Country Vision and the Adoption of a Nation Plan for Honduras", has a conceptual framework oriented to the conformation of the following instruments:

- A national plan contains the strategic guidelines, objectives, and indicators that address the challenges faced by the nation and around which public and private action must be executed in order to achieve the intermediate objectives of the Country Vision. The National Plans are formulated for successive 12-year periods.
- A matrix of 65 indicators, which contains quantitative criteria to be achieved and which allow us to measure progress in the fulfillment of the goals of the National Plan, in accordance with each of the strategic guidelines.

The objectives of the Country Vision are:

- A Honduras without extreme poverty, educated and healthy, with consolidated social welfare systems.
- A Honduras that develops in democracy, with security, and without violence.
- A productive Honduras that generates opportunities and dignified employment that takes advantage of its resources in a sustainable way and reduces environmental vulnerability.
- A modern, transparent, responsible, efficient, and competitive state.

The regional development approach is the most appropriate management model for achieving the country's economic and social growth, considering an environmentally sustainable development process. In this context, regional development plans become the regulatory and normative element for productive investment, social development, and infrastructure investment.

But land tenure and property rights problems are also a cause of conflicts over the use of natural resources. Forests on public lands are auctioned without the participation of the communities and without the benefits of such exploitation being fully reverted to the communities and the municipalities.

As a conclusion, regarding social policies, the plan seeks gender equity, health promotion, access to education, and the strengthening of food and nutritional security. It also seeks to guarantee access to basic services such as drinking water and sanitation, and to promote the development of rural and urban communities. To carry out these policies, citizen participation and collaboration between different sectors, including the public, private, and civil society, are promoted. It also emphasizes the importance of international cooperation and regional integration to achieve sustainable environmental and social management at the national and global levels.

2) Environmental and Social Policies

National Biodiversity Policy of Honduras:

The National Biodiversity Policy of Honduras is created taking into account measures to respect, preserve, and maintain the knowledge, innovations, and practices of the indigenous peoples and local communities and to promote a broad use of traditional knowledge for the conservation of biological diversity.

MIAMBIENTE institutionalizes and monitors the National Biodiversity Policy and its measures and use the sustainable development goals accepted for Honduras considering the linkage of the policy and its alignment with the third objective of the Country Vision: A productive Honduras, generator of opportunities and decent employment that takes advantage of its resources in a sustainable manner and reduces environmental vulnerability.

National Climate Change Adaptation Plan:

This plan aims to strengthen multisectoral (interinstitutional and intersectoral) and multilevel coordination (at multiple levels of government from local to national) for the formulation and implementation of adequate community and citizen adaptation to climate change. It also promotes adaptation actions and measures that contribute to the fulfillment of the progressiveness and universality of human rights, the effective participation of communities, the sustainable development goals, and national policies for low-carbon and resilient development.

In addition, it has the following five cross-cutting pillars:

- Human Rights and Adaptive Governance
- Knowledge Management
- Gender and Vulnerable Groups
- Territorial Planning
- Disaster Risk Management

(2) Legal System Relevant to the Environmental and Social Considerations in Honduras

1) Constitution of the Republic

The following are relevant articles of the Constitution of the Republic:

Art. 107. State lands may only be acquired or owned or held in any title by Hondurans by birth, by companies composed entirely of Honduran partners and by State institutions, under penalty of nullity of the respective act or contract.

Art. 145. The State shall preserve an adequate environment to protect the health of the people. Consequently, access to water and sanitation shall be declared a human right.

Art. 172. All anthropological, archaeological, historical, and artistic wealth of Honduras is part of the cultural heritage of the Nation.

Art. 340. The technical and rational exploitation of the natural resources of the Nation is declared to be of public utility and necessity. The State shall regulate their exploitation, in accordance with the social interest, and shall establish the conditions under which they may be granted to private individuals.

2) General Environmental Law: (Decree 104-93 of May 2, 1993, and its amendments, Decree 181-2007 of July 16, 2010)

The following are among the most relevant articles of this law to be considered in the environmental impact assessment process:

Art. 5. Projects, industrial facilities or any other public or private activity, susceptible of polluting or degrading the environment, natural resources or the historical and cultural heritage of the nation, shall be compulsorily preceded by an environmental impact assessment (EIA)....

Art. 78. Natural or juridical persons, public or private, who wish to carry out any work or activity likely to seriously alter or deteriorate the environment, including natural resources, are obliged to inform the competent authority of the same and to prepare an environmental impact assessment (EIA), as amended by the Law of Administrative Simplification Article (Decree No. 255-2002).

Art. 85. The State shall require the mass media of their free contribution in the dissemination of education programs, legislation, and environmental information in general.

3) Regulations of the General Environmental Law (Agreement 109-93 of December 20, 1993, as amended by Executive Agreement 016-2017 of January 29, 2018)

This regulation shall be of mandatory application in any activity that is potentially harmful or that currently contaminates or degrades the environment, natural resources, or the historical and cultural heritage of the nation, carried out by any State organ, decentralized entities, and private persons, natural or juridical, national, or foreign.

4) Regulation of the National System of Environmental Impact Assessment SINEIA (Updated Executive Agreement 008-2015, amendments by Executive Agreement 011-2016)

The National System of Environmental Impact Assessment is the process which gives a sustainable development to the country by seeking a balance between the development of projects, works and activities and the care and preservation of the environment.

Its main objective is to ensure that plans, policies, programs and projects, industrial facilities or any other public or private activity likely to pollute or degrade the environment, are subject to an environmental impact assessment in order to avoid significant, reversible, and irreversible damage to the environment.

The General Directorate of Environmental Evaluation and Control (DECA) is set in the MIAMBIENTE, responsible for coordinating the SINEIA; its attributions are:

- To issue reports and technical opinions on environmental matters, within the framework of environmental licensing, to control and monitor them.
- To coordinate the preparation and review of technical standards, measures, terms of reference, and designs, and the review of good environmental practices guides, studies in accordance with the conditions established in this regulation.

5) Environmental Categorization (Ministerial Agreement No. 705-2021)

The main purpose of the environmental categorization is to categorize the projects by sector, sub-sector, and activity, works, or projects subject to the environmental impact assessment process, as well as to classify them according to their potential environmental impact. It also serves as a technical basis to establish the environmental risk category of the activities, works, or projects in operation, in order to guide the different authorities gathered in the SINEIA, with respect to the actions of environmental administrative procedures related to permits, authorizations, and control. There are four categories in which different necessary procedures are prescribed.

6) Regulations for the Integral Solid Waste Management (Executive Agreement No. 1567-2010)

The objective of this regulation is to ensure the proper and responsible management of solid waste generated in the country in order to minimize its environmental impact and protect public health.

7) Forestry, Protected Areas, and Wildlife Law (Decree 98-2007, as amended by Decree 365-2013 of July 24, 2014)

This law aims to conserve, manage, and sustainably use the country's natural resources. The law establishes the creation and demarcation of protected areas for biodiversity conservation, watershed protection, soil regeneration, and erosion prevention.

Relevant aspects to be considered in this law are stipulated in the following articles:

Art. 45. Forest areas may be public or private due to their ownership regime.... The right over forest areas is recognized in favor of the indigenous and Afro-Honduran peoples who locate in the lands they traditionally own, in accordance with the International Labor Organization (ILO).

Art. 133. Regulation of the Population in Protected Areas. New settlements are prohibited in protected areas... Resettlements must be carried out after a scientific technical study of the limits corresponding to the core or buffer area according to the reality of the same. Indigenous and Afro-Honduran peoples living in protected areas are exempted from the above provision. The content of this provision must be of obligatory compliance otherwise it will result in relocation.

8) Regulation of the Forestry, Protected Areas, and Wildlife Law (Executive Agreement 031-2010)

Relevant aspects to be considered in this regulation are stipulated in the following article:

Art 4. Forest resources, protected areas, and wildlife shall be managed and harvested in a rational and sustainable manner. In accordance with the above, forest harvesting shall be carried out under forestry techniques that allow the perpetuity of the resources and efficiency in their use, preventing losses due to inadequate use, or their destruction or degradation due to incorrect practices or contrary to the technical norms issued by the ICF.

9) Environmental Permit for AMDC

When this Project was first planned 40 years ago, an environmental permit at that time was required, and it was obtained in 1983. On the other hand, since the environment-related legal system has been improved and revised since then, the necessity of obtaining Environmental License in the SINEIA was reviewed during this survey, then it was confirmed that there is no need to obtain it again.

The reason why there is no need to obtain the above License is that the Project does not fall under the aforementioned environmental categories in the SINEIA due to its content, size, or character, etc. However, instead of the Environmental License in SINEIA it will be required to apply for an Environmental Permit to the Environment Management Unit UGA in AMDC. This is a simpler procedure than that of SINEIA, and in the case of this Project, the following documents are required to be submitted[3].

- Sketch of the location of the site with respect to the area
- Copy of ownership document duly authenticated and/or checked against the original
- Copy of deed of sole trader or partnership or legal personality when applicable, duly authenticated and/or checked against the original
- Environmental Compatibility Certificate issued by the Management of Construction Control and the Directorate of Land Management of the AMDC (original) or, in its absence, the business operation permit of the previous year
- Descriptive technical report (reflecting the total area, land use area, construction area, activities to be developed on the land with its materials) signed and sealed by the person in charge or owner. Steps to follow on the back of the page.

10) Tree Cutting and/or Trimming Permit for AMDC

If tree cutting and/or trimming is required for construction work, a permit application will be submitted to UGA in AMDC. Applications are divided into the following seven categories, and this Project is

[3] Confirmed in the interview with a UGC manager at the AMDC Office (12 July 2023)

considered to fall under the category of "Cutting and/or trimming for urban or infrastructure development projects".[4]

- Cutting and/or trimming on private property for damages
- Cutting and/or pruning in green areas
- Cutting and/or trimming due to damage to infrastructure requested by institutions
- Cutting for construction
- Cutting near the areas of El Hatillo, El Picacho, La Tigra National Park, United Nations Park or Central District Sub-basin
- Cutting of trees at risk (all those trees that due to their poor vegetative state or poor root anchorage may fall or let their branches fall, putting lives and property at risk), according to the technical criteria of the UGA.
- Cutting and/or trimming for urban or community infrastructure development projects

In addition, the required documents to submit for the category "Cutting and/or trimming for urban or community infrastructure development projects" are as follows:

- Application from the contractor, governmental or municipal institutions that will carry out the work.
- Copy of the applicant's identity card
- Construction and architectural plans of the project, showing the location of the trees duly signed, stamped and sealed by the corresponding professional
- Copy of its environmental authorization or request for it to the UGA or MIAMBIENTE
- Letter of Control and Follow-up Manager

11) Health Code (Decree No. 65-91)

Relevant aspects to be considered in this regulation are stipulated in the following articles:

Art. 9. Every person has the right to live in a healthy environment, and the correlative duty to protect and improve the environment that surrounds him.

Art. 25. The environment shall be understood as the set of natural resources whose preservation and renovation, in charge of the State and all the inhabitants, are necessary to ensure health and general welfare.

Art. 46. Pollution of the atmosphere is understood as the deterioration of its purity, due to the presence in concentrations higher than those allowed, of agents such as: solid particles, dust, smoke, radioactive materials, sound waves in diffusion and others that the Secretary of Health defines as pollutants, as well as the presence or emanation of odors that impair the well-being of the people.

10.2.2 Organizations and Institutions with Competence in Environmental and Social Considerations

Within this environmental management system, Honduras has different institutions and organizations with the competence to regulate aspects of environmental and social considerations, such as the following:

(1) Secretary of Natural Resources and Environment

This is the government agency responsible for public and private institutional coordination in environmental matters to promote the protection, conservation, restoration, and sustainable management

[4] Ditto.

of the environment and natural resources by formulating and coordinating environmental policies and legislation, and ensuring that they are complied with.

Some of its attributions include creating and managing the National System of Environmental Impact Assessment (SINEIA), which refers to environmental impact assessments (EIAs), permits or licenses, and the control of the activities of the public and private sectors potentially polluting or degrading.

In the operation of the SINEIA, the MIAMBIENTE intervenes through the DECA, which has functions such as: Issuance of reports and technical opinions on environmental matters within the framework of environmental licensing, control and monitoring; Coordination for the preparation, review of technical standards, measures, terms of reference, and designs; and Review of good environmental practices guides and studies in accordance with the regulations established in the SINEIA regulations and other applicable laws.

(2) National Institute for Forest Conservation and Development, Protected Areas, and Wildlife (ICF)

The ICF shall act as the executor of the national policy for forest conservation and development, protected areas, and wildlife with the authority to develop programs, projects, and plans and to create the technical and operational administrative units necessary to comply with the objectives and purposes of the laws. The ICF is also in charge of approving internal regulations and management plans for forest and protected areas, cancelling permits in case of non-compliance, and hearing administrative complaints. Other functions include maintaining up-to-date records, promoting citizen participation and scientific research, and designing strategies to control illegal logging and transport of forest products. It is responsible to lead the processes to develop and implement integrated management plans for river basins, micro-basins, and sub-basins, with emphasis on the conservation of resources, soils, forests, and water.

(3) Municipalities

The municipality is the governing and administrative body of the local government and exists to achieve the welfare of the inhabitants, promote their integral development and the preservation of the environment, with the authority granted by the Constitution of the Republic and other laws described in the preceding sections.

Within the framework of their attributions related to environmental and social considerations in Honduras, municipalities have responsibilities to protect the ecology of the environment and promote reforestation. By signing agreements with the central government and with other decentralized entities, municipalities cooperate in the exploitation of the resources, including exploitation areas, reforestation systems, environmental protection, and corresponding payments.

10.2.3 Procedures of Application and Approval of Environmental License

(1) Requirement of Environmental Applications and Permits

All projects or works of public or private activities must have an environmental license for operation and/or functioning. The general steps to be followed are developed virtually through the webpage of MIAMBIENTE and are described according to the environmental impact assessment regulations as follows:

<u>Steps to obtain an environmental license:</u>

1. The proposer and/or Environmental Service Provider can access the Consultation and Technical Pre-Decision Platform through the webpage of the MIAMBIENTE Environmental Licensing Consultation, where general information about the company, proposer, and the project will be entered, and based on this information, the system will categorize, determine the environmental pre-feasibility, and define the technical and legal requirements according to the category, which are the responsibility of the proposer and/or Environmental Service Provider.
2. In the event that the system does not provide pre-feasibility and sends the user to consultation, it must be referred to the Advisory Committee of MIAMBIENTE, so that in the period of ten working days, it defines the procedure to follow, as established in the Environmental Evaluation and Control Manual.
3. In the event that the system does not provide pre-feasibility and the proposer decides to continue with the environmental licensing process, it must enter the consultation platform and access the information folders for each of the requirements requested; likewise, it must submit to the General Secretary of Environmental Licensing two copies of printed documents of the requirements described above, leaving the record of the document submitted and the accompanying documents (Articles 50 and 51 LPA). Technical documents will be reviewed by a representative of DECA and legal documents will be reviewed by a representative of the Legal Services Unit. For Category 4 projects, five copies of the technical report or document prepared by the PES must be submitted.
4. If the submitted document is accepted by the General Secretary of Environmental Licensing, a contract of compliance with environmental control measures will be signed, followed by the issuance and signing of the operational environmental license.
5. The General Secretary of Environmental Licensing will forward the file to the DECA in order to carry out a control and follow-up inspection of the authorized project.
6. Based on the control and follow-up inspection, DECA will issue a report and technical opinion establishing whether or not to grant the operational environmental license.
7. Based on the control and follow-up inspection, the Legal Services Unit of MIAMBIENTE will elaborate the legal opinion pronouncing the granting or not of the operational environmental license and sanctions when they correspond; and

8. The General Secretariat of MIAMBIENTE will issue the resolution including the updated environmental control measures and the issuance of the operational environmental license. The points to consider in the process are the following:
   - As a requirement to carry out the process, an Environmental Services Provider (PSA) must be hired, who will visit the project site and elaborate a report called Report and Measures. According to this report, the system will provide a licensing payment rate calculated based on the amount of investment and the sector involved. This payment is called TGR-1 and can be paid at any banking institution.
   - Another payment must be made for a visit by inspectors of the DECA. This payment is made at the National Bank of Agricultural Development.
   - For the issuance of the environmental license, the project proposer must submit to MIAMBIENTE an economic guarantee of compliance with the environmental mitigation measures established for this purpose by MIAMBIENTE in accordance with the regulations in force (Executive Agreement No. 011-2016).

(2) Information Disclosure and Public Consultation Process

In the case of projects, works, or activities of all categories, the proposer must submit the environmental license application together with the publication of the Notice of Entry in an eighth page of a newspaper of major national circulation, within five working days after its publication.

In the case of Category 4 projects, in addition to the publication of the Notice of Entry of the environmental license application, another publication shall be made, and the provisions of Article 26 and Article 28 of the regulations shall be followed.

Art. 59. The Project Proposer shall involve the neighboring population of the project area at the earliest possible stage in the process of preparing the Environmental Impact Assessment Study (EIA) or Environmental Audit Study (EAS). Likewise, the Proposer and its Environmental Consultant or Consulting Team must record all activities carried out to involve and/or consult the population during the preparation of the EIA or EAS and also propose the communication, conflict resolution, and consultation mechanisms to be developed during the document review stage.

Art. 60. In the projects of high risk, the Proposer shall be requested to socialize and/or consult the results of the EIA through open meetings, public forums, and all means that allow a discussion and exchange of ideas with the communities within the area of influence of the project, and accredit to Secretary of State the Certification(s) of the Minutes of the Open Meeting of the Municipality(ies) with their respective means of verification (attendance lists, photographs, etc.), and copies of the agreements subscribed for such purpose.

(3) Categorization

Art. 29. The projects, works, or activities are ordered in an Environmental Categorization Table that takes as a reference the International Standard of the UIIC (Uniform International Industrial Code)

System of all productive activities. The following Table 10.2.1 shows the category and its condition in the Environmental Categorization.

Table 10.2.1 Environmental Categorization

Category	Condition
Category 1	Activities, works, or projects below Category 1 correspond to activities classified as having Very Low Potential Environmental Impact or Very Low Environmental Risk and therefore are not subject to the Environmental Impact Assessment process.
Category 2	Moderate Potential Environmental Impact or Moderate Environmental Risk
Category 3	High Potential Environmental Impact or High Environmental Risk
Category 4	High Potential Environmental Impact or Very High Environmental Risk. Mega development projects are considered as part of this Category

Source: Regulation of the National System of Environmental Impact Assessment SINEIA

In the event that a specific activity, work, or project cannot be located in the Environmental Categorization Table, the proposer must consult to DECA in writing.

As a result of this survey, it is confirmed that the Project does not fall into the above categories due to the nature of the project, which consists of construction and renovation of facilities in UMAPS own property and piping work on existing public roads. Therefore, no environmental license under SINEIA is required.

10.2.4 Other Environmental and Social Permits

These permits are required as necessary in Honduras, but since the conditions in the Project area do not apply to these ones because there are no protected areas or cultural heritage sites in and around the Project sites, so there will be no need to apply for them.

(1) Protection in Forestry Development, Protected Areas, and Wildlife[5]

In no case will permits or licenses be granted for the exploitation of resources in the core zones of protected areas and wildlife areas. In the buffer zones, only economic activities that are in accordance with the Management Plans or Operational Plans previously approved by the National Institute for Forest Conservation and Development, Protected Areas and Wildlife (ICF) may be authorized.

(2) Protection of the Cultural Heritage[6]

Art. 15. Owners of any kind who intend to demolish real property designated as cultural property, alleging ruinous, or any other cause, as well as those who intend to make alterations or additions to the building thereof, must request the opinion and authorization of the Honduran Institute of Anthropology and History.

Art. 16. The owners of real estate adjacent to a cultural property subject to protection who intend to carry out excavation, foundation, demolition, or construction works, which may affect its archaeological, historical, artistic, or traditional characteristics must obtain the permission of the Honduran Institute of Anthropology and History, which is authorized to exercise the necessary functions and to suspend any

[5] See the General Regulation of Forestry Conservation and Development Protected Areas and Wildlife Law (Executive Agreement 031-2010, 2010)
[6] See Law for the Protection of the Cultural Heritage of the Nation (Decree No.220-97, 1997)

work of this nature that is carried out in violation of the Law. In case of being an owner, it is necessary to present the following requirements:

- Application submitted by legal representative or legal representative of the company, to the General Secretary.
- Power of attorney or public instrument of general power of attorney
- Deed of incorporation of the company
- Deeded testimony of the company

10.2.5 Comparison of JICA Guidelines and Honduran EIA System

The requirements of the JICA Guidelines (2022) were compared with the institutional and project status in Honduras in order to identify any gaps, and the response policy in the Project was summarized in Table 10.2.2.

Table 10.2.2 Comparison of JICA Guidelines and Honduran EIA System

Main Items	JICA Guideline	EIA in Honduras	Gaps between Them and Coping Strategy
Basic Principles	▪ Early assessment of environmental and social impacts, reflecting results of the reviews in the project plan. ▪ Include quantitative and qualitative environmental and social cost-benefit analyses in harmony with economic, social, and technical aspects. ▪ Preparation of environmental and social assessment reports, as well as reports on potential significant impacts. ▪ Formation of a committee of experts to resolve controversial cases and those of significant impact.	▪ All projects, works or activities must have an environmental license or permit before starting operations, and the project must be categorized in order to initiate the licensing procedure. ▪ According to the manual, a cost-benefit analysis should be established for projects where the economic factor is a determining factor in deciding on environmental viability. ▪ Preparation of an environmental impact assessment report on cases with a high potential environmental impact category. ▪ DECA request the Technical Advisory Committee as a consultative body in conflictive cases that, due to their magnitude, affect the national interest.	▪ **No gaps**: the Basic Principles are completely similar in their wording, recognizing the importance of early assessments of the environmental and social impacts of the project.
Examination of Measures	▪ Examine alternatives to avoid adverse impacts, prioritize the prevention of environmental impacts, otherwise minimize, reduce, and then mitigate impacts. ▪ Prepare monitoring and environmental management plans and determine their costs and methods of financing.	▪ The technical instrument of the EIA must include the environmental diagnosis with the identification of impacts, environmental measures, contingency plan, environmental management plan, and its economic impact. MIAMBIENTE will include the environmental control measures to be considered in	▪ It is established to identify the impacts for the implementation of similar measures, as well as the preparation of Management Plans. However, Honduran legislation does not specify the determination of costs and methods for financing. Therefore, these factors must be specified in this

		its resolution. ▪ According to the Manual, the Management Plan must be presented, including the environmental impact identified, such as: water and air pollution and the environmental measures to be complied with.	Preparatory Survey.
Scope of Impacts to be Assessed	▪ Assess impacts on human health and safety, natural environment, water use, transboundary impacts such as: migration, livelihoods, social institutions, vulnerable communities such as: population in poverty and indigenous peoples. ▪ Also consider secondary or derivative impacts.	▪ Environmental impacts are assessed according to a standardized procedure established by MIAMBIENTE, including cumulative impacts. The environmental factors that could be affected by the development of the project are air, soil, surface water, groundwater, flora and fauna, socioeconomic and cultural condition, and landscapes are considered.	▪ In Honduras, environmental impacts are generalized determines, so the more specific aspects offered by JICA (for example, estimating and disclosing the total amount of greenhouse gas emissions) should be considered in order to achieve a holistic coverage of the scope of the impacts, especially in the factors that are not considered in Honduras.
Compliance with Laws, Standards, and Plans	▪ Comply with laws, ordinances, and regulations related to environmental and social considerations of the local and host government, in accordance with their policies and plans. Respect nature conservation areas or cultural heritage, avoiding causing significant adverse impacts.	▪ When evaluating impacts, take as a reference the stipulations of the Technical Standards and Good Environmental Practices Guidelines. ▪ Consider all legal provisions, ordinances, decrees, agreements and environmental quality standards at the municipal, national, regional and local levels, as well as competent institutional provisions for implementation.	▪ **No gaps**: compliance with laws, regulations and plans is consistent, since any legal provision that helps to conserve the areas and avoid adverse impacts should be considered for enforcement.
Social Acceptability	▪ In projects with significant environmental impacts, conduct consultations with local stakeholders, residents, through the dissemination of information and thus, examine alternatives for project plans. Consider vulnerable social groups such as: women, children, the elderly, indigenous peoples, refugees, internally displaced persons, people with disabilities.	▪ Regardless of the category in EIA, the notice of entry shall be published in a newspaper of major national circulation, and in the case of indigenous territory, it shall be socialized in the community. For category 4, there will be two publications, in addition, in a radio station and signs in the area. ▪ As for public consultation, any natural or legal person may make known their considerations in relation to the EIA study, considering that no significant impacts have been foreseen, nor lack of mitigation measures. ▪ The neighboring population of the project area must be involved in the earliest EIA	▪ **No gaps**: in this case, Honduran legislation clearly determines the importance and procedure for public consultation in general.

		stage, the proponent must record the activities carried out, communication mechanisms, and conflict resolution to involve the population. In projects of environmental significance, the results of the EIA study will be socialized through open meetings, public forums, and any other means that allows for discussion and exchange of ideas.	
Climate Change	▪ The total amount of greenhouse gas emissions will be estimated and disclosed.	▪ Honduras has a National Greenhouse Gas Inventory (INGEI) S/2005-2015, however, in the case of environmental impact projects, the procedure to be followed is not specified.	▪ Consider the importance of estimating and disclosing the total amount of greenhouse gas emissions in the implementation of the project.
Biodiversity	▪ Avoid significant forest conversion or degradation, obtain certifications for forestry projects and prevent illegal logging.	▪ The ICF is responsible for designing and implementing a national strategy to control illegal logging and the illegal transport of forest products. In addition, there is a list of Species of Special Concern in Honduras.	▪ **No gaps**: there is no contradiction, so permits must be requested to prevent illegal logging and guarantee that species of special concern are not affected.
Involuntary Resettlement and Loss of Livelihood	▪ Aspects to be avoided, carrying out analysis of viable alternatives, if not possible, minimize impacts and compensate for losses. ▪ People affected, involuntarily resettled or who lose their livelihoods should be compensated with full replacement costs. ▪ Inform the compensation standards, so that affected people can confirm the content of the same. ▪ Promote the participation of affected people in the process of establishing measures against involuntary resettlement and loss of livelihoods. ▪ For large-scale involuntary resettlement, a Resettlement Action Plan will be available in advance of action. It includes elements of World Bank Environmental and Social Standards ESS.	▪ Honduran legislation provides for forced expropriation after fair compensation, when negotiation has failed in cases of habitation in protected areas. ▪ However, it does not establish specific criteria for voluntary resettlement and loss of livelihoods. ▪ The environmental and social policies of the World Bank established in the ESS are adopted.	▪ **No gaps**: consider the issues proposed by JICA, and adopt the World Bank's environmental and social policies set forth in the ESS in case that involuntary resettlement and /or loss of livelihood may be predicted in the Preparatory Survey.
Indigenous Peoples	▪ Avoid adverse impacts on indigenous peoples by analyzing viable alternatives	▪ It is important to directly inform them of the impacts involved, and if the project is	▪ **No gaps**: It is considered the breadth of aspects established by JICA,

	and, if not possible, minimize impacts and compensate for losses. ▪ In case of adverse aspects, their land and resource rights must be respected in accordance with international treaties including the United Nations Declaration, trying to obtain the Free, Prior and Informed Consent of the indigenous peoples. ▪ Prepare Indigenous Peoples Plan, including elements of ESS 7 of the World Bank's Environmental and Social Policies.	located on land titled in favor of indigenous peoples. ▪ Honduran legislation recognizes the right to forest areas in favor of indigenous peoples, located on the lands they traditionally own, in accordance with national laws and Convention 169 of the International Labor Organization (ILO) as well as the United Nations Declaration on Indigenous Peoples.	considering the aspects established by the United Nations Declaration related to this aspect.
Monitoring	▪ Project proponents will monitor the effectiveness of mitigation measures as well as ensure that project plans include feasible monitoring plans. ▪ The results of monitoring shall be available to interested parties. ▪ When it is pointed out that environmental and social considerations are not considered, the stakeholder meetings shall be held for discussion and examination of countermeasures for problem solving.	▪ The environmental license system requires responsibility for complying with the environmental measures. For the internal actions of the project, the control and follow-up of the environmental measures will be carried out by the proponent of project. If during the control and follow-up process impacts (new or potential) are detected, the DECA must carry out the environmental control measures.	▪ **No gaps**: the proponent of project is in charge of control and monitoring; in the event of new impacts that were not considered of non-conformity, DECA will carry out control actions.
Grievance Redress Mechanism	▪ There should be a mechanism for handling complaints from people affected by environmental and social impacts, which should be easily accessible and its procedure publicized. Complaints should be responded to promptly.	▪ Any person, natural or legal, can make known their considerations in relation to the EIA Study document, whether they consider that adequate mitigation measures have not been proposed, and have doubts, complaints or objections. It is at the discretion of MIAMBIENTE to resolve the observations.	▪ Establish the mechanism for this purpose according to JICA's proposal because the process for complaints to MIAMBIENTE is not clear.
Information Disclosure	▪ Promoters in project disseminate information on environmental and social considerations, and JICA assists through cooperative projects. ▪ JICA encourages the dissemination of information on environmental and social considerations and promoters make it well in advance, and JICA assists in the preparation of documentation in various	▪ Information on the EIA process for any project is public matter. Any person may request information on projects if it does not contravene Articles 16, 17, 18 and 19 of the "Transparency and Access to Public Information Law" and the "Secrecy of Data and Processes Law" and the confidentiality of personal data and information provided	▪ **No gaps**: Information is made available to the public at all stages of the project, and confidentiality of information is also respected.

	languages, and provides reports through the JICA library.	by individuals to the State. ▪ The proponent of project must keep a copy of the EIA Study document in the places established by DECA for public consultation. MIAMBIENTE will encourage public participation of civil society during the environmental assessment process at all stages of the project.	

Source: JICA Study Team

10.3 Relevant Organizations for Environmental and Social Consideration

10.3.1 Functions of the Project Executing Organization (AMDC and UMAPS)

(1) Experience in the Preparation of EIAs

The Municipal Environmental Management Unit (UGAM) of the AMDC supports the management of permits and authorizations. Functions performed by UGAM for EIAs are the following:

- With the data and information provided by the project management unit, supports through the legal representative for the management of environmental licenses for projects.
- Supports with the participation of its technicians in the conformation of the SINEIA.
- Provides pruning, transplanting, and tree cutting permits.
- Verifies the compensation and/or reforestation carried out by each contractor.
- Submits to the Secretary of Natural and Environmental Resources the technical documentation required for the validation of environmental licenses.

(2) Land Acquisition and Resettlement Experience

In 1982, the Guacerique Dam Project was prepared, but it could not be executed due to the resettlement process. It is important to note that to date, an effective resettlement strategy has not been implemented due to the lack of political decision on the part of the authorities, who are afraid of assuming the social cost and confronting the population. In addition, it has been suggested that there are major politicians with interests in the area that would be affected by the flooding, which could be influencing the situation[7].

In the San Jose Dam Project, it has not been possible to obtain the land for the construction of the project after two years of starting the work; however, this is due to the time taken to carry out the administrative and legal review of the work[8].

It is emphasized that involuntary resettlement in projects should be avoided or minimized, and if unavoidable, adverse impacts should be mitigated by providing compensation and assistance to displaced persons to improve or restore their livelihoods and standard of living. In addition, the living conditions of poor or vulnerable displaced persons should be improved by formulating and

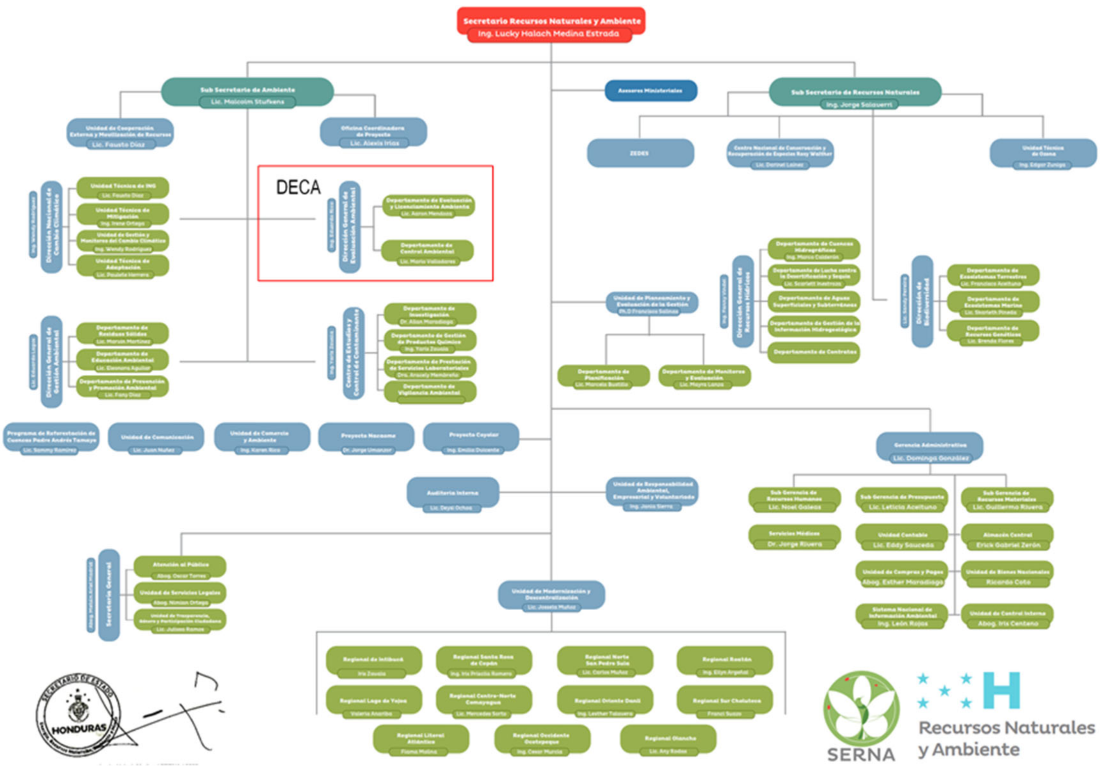
[7] Based on the interview with the coordinator of the technical secretary of the National Drinking Water and Sanitation Council (CONASA). 17th March, 2023
[8] Based on the interview with the constructor of the Project. 15th March, 2023

implementing sustainable resettlement programs. It is important to plan and implement these activities with adequate information dissemination, meaningful consultation, and informed participation of those affected.

10.3.2 Functions and Composition of the Secretariat of Natural Resources and Environment (MIAMBIENTE)

(1) Functions of the General Directorate of Environmental Assessment and Control (DECA)

DECA is under the Sub-Secretary of Environment in the MIAMBIENTE (See Figure 10.3.1) and has two departments, the department of environmental evaluation and licensing and the department of environmental control. DECA is responsible for the National Environmental Impact Assessment System (SINEIA), as well as the issuance and control of environmental licenses and the practice of environmental audits. Its specific functions are shown in Table 10.3.1:



Source: MIAMBIENTE

Figure 10.3.1 Organizational Chart of MIAMBIENTE

Table 10.3.1 Specific Functions of DECA

Functions
a) To organize, coordinate, manage, and regulate the SINEIA, with the objective of ensuring the mandatory application of environmental impact
b) To adopt the necessary measures to prevent, mitigate, or correct environmental pollution
c) Implement the EIA for the execution of potentially degrading public or private projects
d) Promote and encourage the improvement of the environment in the surroundings of human settlements through inspections and technical evaluations that help control the generation of pollutants
e) Exercise inspection, control, and surveillance actions in environmental matters
f) Collaborate technically with all state or private organizations in the development of activities aimed at preserving, conserving, and restoring the environment and natural resources

g) Issue technical opinions on environmental matters, prior to the authorization, concession, and issuance of operating permits for industrial or commercial enterprises and for the execution of public and private projects
h) Dictate measures necessary to preserve, conserve, and restore the environment and natural resources in specific cases
i) Conduct environmental pre-audits
j) Administer and regulate all pollutant control research and support services
k) Coordinate and follow up on the activities carried out by the Center for Studies and Control of Pollutants (CESSCO)
l) Attend, coordinate, evaluate, and technically rule on complaints that generate an impact on the environment at a national level
m) Any others assigned to it

Source: Art.10 in the Regulation of the SINEIA (Agreement No.189-2009)

10.4 Comparison of Alternatives Options

10.4.1 Water Distribution Tank and Pump House Construction

These works are the reconstruction of existing infrastructure (water distribution tanks) and new construction (pump houses) on UMAPS-owned property, and no social impacts are expected as a result of these works. The surrounding area is also far from the protected areas (see Table 1 and Figure 1 in Appendix-10) and the presence of rare species of flora and fauna has not been confirmed. If these construction works are not implemented, 1) further deterioration of water supply service due to insufficient capacity and leakage of water distribution tanks, and 2) loss of electric energy due to use of old pumps, and 3) associated additional GHG emissions will continue.

10.4.2 Pipe Installation Works

Since the need for laying new transmission pipeline outside the route of the existing pipeline was considered in some sections, alternatives were considered as shown in Table 10.4.1. In the end, Option 1 was considered appropriate in terms of technology, environment, society, and economy.

Table 10.4.1 Comparison of Alternative Options

	Option 1	Option 2	Option 3	Without-Project Option
Pipeline Replacement Method	Installation of new pipes by excavating the shortest tunnel distance using Japanese technology	Tunnel is excavated along the road, bypassing private properties, and new pipeline is laid.	Installation of new pipeline near existing pipeline locations.	NA
Construction Cost	High	Very High	Low	NA
Construction Period	Short	Long	Very Long	NA
Key Diversity Area	The construction site is away from the protected areas. No rare species are identified in the construction site.			NA
Housing	Permission to excavate from one family's private property is required for excavating underground. No need to purchase land.	There is no impact on surrounding residences due to construction along a one-lane road.	Because of the high density of residences in the surrounding area, it is extremely difficult to secure a construction site for the pipeline installation, including relocation of the residences. Safety measures for pedestrians, noise,	NA

			and dust are essential.	
Road	During the construction period, lane restrictions and safety measures on some road sections are required.	During the construction period, lane control of the road must be restricted in each direction with safety measures, etc.	During the construction period, all roads must be closed to traffic, and safety measures must be taken for residents and residences nearby.	NA
Evaluation and Reason	**Recommended** Construction time and cost can be minimized using Japanese technology. Social impacts are limited and can be handled with normal construction supervision. UMAPS and the land owner already agreed and gave permission regarding the excavation.	The construction period and cost are significant. In addition, lane restrictions on the road inevitably affects traffic.	Although construction costs are relatively low, the construction period increases and the possibility of compensation to the surrounding residents (land expropriation, construction permits, and temporary livelihood security against restrictions on commercial activities) arises.	If the pipeline is not renewed, the amount of water delivered will not be sufficient for future needs, and continued leakage will result in water resource loss and a negative impact on UMAPS management.

Source: JICA Study Team

10.5 Scoping of Survey in Environmental Social Consideration

10.5.1 Scoping Matrix

Scoping was done to determine methodologies and coverage of significant or potentially significant environmental and social impacts that will be assessed in this Project. The scoping in the environmental social consideration was carried out in three categories by type of components in the construction: 1) water distribution tank construction at 13 sites, 2) pump house construction and new pump installation at 9 sites, and 3) pipeline installation, as shown in the following Table 10.5.1 to Table 10.5.3.

Table 10.5.1 Scoping Matrix for Water Distribution Tank Construction

Field	Item	Evaluation		Reason for Evaluation
		Before/During Construction	During Operation	
Pollution control measures	Air quality	✓	–	**During construction:** The operation of construction machinery/equipment and the demolition of existing tanks are expected to have a temporary negative impact on air quality. **During operation:** Operation of the water storage tank does not affect air quality due to manual operations.
	Water quality	✓	–	**During construction:** Possible generation of muddy water during site preparation. If waste is left as it is on the site, there is a possibility of contamination. **During operation:** Water to be delivered from the water storage tank is a treated one at the treatment plant, so there is no possibility of water pollution even if the water is discharged due to overflow, etc.
	Waste	✓	–	**During construction:** Construction waste such as surplus soil, concrete and steel scraps after demolition of existing tanks, and logged trees would likely be generated. General waste and excreta may be

				generated from the base camp. **During operation:** Operation of the water storage tank does not generate any waste due to manual operations.
	Soil pollution	✓	–	**During construction:** Minor soil contamination is possible due to oil leakage from construction machinery/equipment and transport vehicles. There is potential for soil contamination if waste is left as it is on the site. **During operation:** Operation of the water storage tank does not generate any waste due to manual operations. And water to be delivered from the storage tank is a treated one at the treatment plant, so there is no possibility of water pollution even if it is discharged due to overflow, etc.
	Noise and vibration	✓	–	**During construction:** Noise and vibration are expected to occur due to the demolition of existing tanks and operation of construction machinery/equipment. **During operation:** Operation of the water storage tank does not generate any noise and vibration due to manual operations.
	Land subsidence	–	–	**During construction/operation:** The construction site is in a bedrock area and there is no potential for ground subsidence due to the operation of vehicles and equipment in construction work or water storage tank operations.
Natural environment	Sanctuary	–	–	**During construction/operation:** No protected areas exist in and around the planned project area.
	Biodiversity	✓	–	**During construction:** No rare species of flora or fauna have been identified in or around the construction site, and there is very limited tree cutting and pruning associated with the construction. **During operation:** No impact on flora and fauna is expected from the operation of the water storage tank.
	Hydrological phenomena	–	–	**During construction/operation:** No activities (large-scale drilling or water pumping) are planned that would significantly lower groundwater levels.
Social environment	Resettlement and site acquisition	–	–	**During construction/operation:** No activities are expected to induce land acquisition and resettlement.
	Livelihoods	–	–	**During construction/operation:** No impact on livelihoods is expected.
	Socially vulnerable people	–	–	**During construction:** It has been confirmed that there are no socially vulnerable people living in or around the construction area for new water storage tank. **During operation:** No activities that would have a negative impact on vulnerable groups in society are expected.
	Cultural heritage	–	–	**During construction/operation:** There is no cultural heritage (tangible or intangible), etc., in the area subject to construction and nearby.

	Landscape	–	–	**During construction/operation:** No landscape impact is expected because this work is a reconstruction of the existing water storage tank.
	Ethnic minorities and indigenous peoples	–	–	**During construction:** It has been confirmed that there are no ethnic minorities or indigenous peoples living in the construction area for new water storage tank. **During operation:** No activities that would adversely affect ethnic minorities or indigenous peoples are expected.
	Work environment	✓	✓	**During construction:** In accordance with relevant laws and regulations, it is necessary to ensure that the construction working environment, especially for female workers, is taken into consideration (rest rooms and separate toilets for men and women). **During operation:** The working environment for UMAPS staff must be ensured in accordance with relevant laws and regulations.
	Community health, safety and security	✓	–	**During construction:** Infectious diseases such as Sexually Transmitted Disease (STD) and COVID-19 may spread due to the influx of construction workers. Traffic accidents may increase due to the use of surrounding roads by construction vehicles. **During operation:** No activities that would adversely affect the local community are expected.
Other	Transboundary impacts and climate change	–	–	**During construction:** No climate change impacts are expected, such as large-scale deforestation or increased greenhouse gas (GHG) emissions. **During operation:** No impact activities are expected.

Source: JICA Study Team

Table 10.5.2 Scoping Matrix for Pump House Construction and New Pump Installation

Field	Item	Evaluation		Reason for Evaluation
		Before/During Construction	During Operation	
Pollution control measures	Air quality	✓	–	**During construction:** The operation of construction machinery/equipment and the demolition of existing pump houses are expected to have a temporary negative impact on air quality. **During operation:** Pump operation does not affect air quality due to its use of commercial electric power.
	Water quality	✓	–	**During construction:** Possible generation of muddy water during site preparation. If waste is left as it is on the site, there is a possibility of contamination. **During operation:** No impact on water quality is expected from the operation of water pumps.
	Waste	✓	–	**During construction:** Construction waste such as surplus soil, concrete debris, steel scraps and old pumps after demolition of existing pump houses, and logged trees would likely be generated. General waste and excreta may be generated from the base camp. **During operation:** Pump operation does not generate waste due to its use of commercial electric power.

	Soil pollution	✓	—	**During construction:** Minor soil contamination is possible due to oil leakage from construction machinery/equipment and transport vehicles. There is a potential for soil contamination if waste is left as it is on the site. **During operation:** Pump operation does not generate waste due to its use of commercial electric power. And the water to be delivered has already been treated at the treatment plant, so there is no possibility of soil contamination if it is discharged when the pumps are repaired.
	Noise and vibration	✓	✓	**During construction:** Noise and vibration are expected to occur due to the demolition of existing pump houses and operation of construction machinery/equipment. **During operation:** Noise and vibration due to operation of water pumps may occur.
	Land subsidence	—	—	**During construction/operation:** The construction site is in a bedrock area and there is no potential for ground subsidence due to the operation of vehicles and equipment in construction work or water pump operations.
Natural environment	Sanctuary	—	—	**During construction/operation:** No protected areas exist in and around the planned project area for new pump houses.
	Biodiversity	✓	—	**During construction:** No rare species of flora or fauna have been identified on/around the construction site for new pump houses, and there is very limited tree cutting and pruning associated with construction. **During operation:** No impact on flora and fauna is expected from the operation of the water pump.
	Hydrological phenomena	—	—	**During construction/operation:** No activities (large-scale drilling or water pumping from underground) are planned that would significantly lower groundwater levels.
Social environment	Resettlement and site acquisition	—	—	**During construction/operation:** No activities are expected to induce land acquisition and resettlement.
	Livelihoods	—	—	**During construction/operation:** No impact on livelihoods is expected.
	Socially vulnerable people	—	—	**During construction:** It has been confirmed that there are no socially vulnerable people living in or around the construction area for new pump houses. **During operation:** No activities that would have a negative impact on vulnerable groups in society are expected.
	Cultural heritage	—	—	**During construction/operation:** There is no cultural heritage (tangible or intangible), etc. in the area subject to construction and nearby.
	Landscape	—	—	**During construction/operation:** No landscape impact is expected because this work is a reconstruction of the existing water pump houses and installment of new pumps.

	Ethnic minorities and indigenous peoples	—	—	**During construction:** It has been confirmed that there are no ethnic minorities or indigenous peoples living in the construction area for new pump houses. **During operation:** No activities that would adversely affect ethnic minorities or indigenous peoples are expected.
	Work environment	✓	✓	**During construction:** In accordance with relevant laws and regulations, it is necessary to ensure that the construction working environment, especially for female workers, is taken into consideration (rest rooms and separate toilets for men and women). **During operation:** The working environment for UMAPS staff must be ensured in accordance with relevant laws and regulations.
	Community health, safety and security	✓	—	**During construction:** Infectious diseases such as Sexually Transmitted Disease (STD) and COVID-19 may spread due to the influx of construction workers. Traffic accidents may increase due to the use of surrounding roads by construction vehicles. **During operation:** No activities that would adversely affect the local community are expected.
Other	Transboundary impacts and climate change	—	✓	**During construction:** No climate change impacts are expected, such as large-scale deforestation or increased greenhouse gas (GHG) emissions. **During operation:** The reduction in electricity consumption associated with the operation of the new pumps is expected to contribute to climate change mitigation through reduced GHG.

Source: JICA Study Team

Table 10.5.3 Scoping Matrix for Pipeline Installation

Field	Item	Evaluation		Reason for Evaluation
		Before/During Construction	During Operation	
Pollution control measures	Air quality	✓	—	**During construction:** The operation of construction machinery/equipment and the demolition of existing pipeline are expected to have a temporary negative impact on air quality. **During operation:** No impact on air quality is expected.
	Water quality	✓	—	**During construction:** Turbid water may be generated during tunnel excavation and pipe laying work. If waste is left as it is on the site, there is a possibility of contamination. **During operation:** No impact on water quality is expected.
	Waste	✓	—	**During construction:** Construction waste is expected to be generated, such as surplus soil, removed road surfaces (asphalt and concrete), existing pipeline (including asbestos cement AC pipes), and logged trees. General waste and excreta may be generated from the base camp. **During operation:** No waste is expected to be generated.
	Soil pollution	✓	—	**During construction:** Minor soil contamination is possible due to oil leakage from construction machinery/equipment and transport vehicles. There is potential for soil contamination if waste is left as it is on the site. **During operation:** No soil contamination is expected to occur.
	Noise and vibration	✓	—	**During construction:** Noise and vibration are expected to occur due to pipeline renewal work and operation of construction machinery/equipment. **During operation:** No noise or vibration is expected to occur.

	Land subsidence	✓	✓	**During construction:** If the ground is soft at pipe replacement points and/or tunnel excavation area for new pipe laying, there is a possibility of ground subsidence. **During operation:** Insufficient measures (burial depth, laying method, road pavement) at the time of pipe laying may lead to progressive ground subsidence due to heavy vehicle traffic on it.
Natural environment	Sanctuary	—	—	**During construction/operation:** No protected areas exist in and around the planned project area for pipe laying.
	Biodiversity	—	—	**During construction:** No rare species of flora or fauna have been identified on/around the construction site for pipe laying, and there is no tree cutting and pruning associated with the construction. **During operation:** No impact on flora and fauna is expected from the water transmission by pipeline.
	Hydrological phenomena	—	—	**During construction/operation:** No activities (large-scale drilling or water pumping from underground) are planned that would significantly lower groundwater levels.
Social environment	Resettlement and site acquisition	—	—	**During construction/operation:** No activities are expected to induce land acquisition and resettlement.
	Livelihoods	—	—	**During construction/operation:** No impact on livelihoods is expected.
	Socially vulnerable people	—	—	**During construction:** It has been confirmed that there are no socially vulnerable people living in or around the construction area. **During operation:** No activities that would have a negative impact on vulnerable groups in society are expected.
	Cultural heritage	—	—	**During construction/operation:** There is no cultural heritage (tangible or intangible), etc., in the area subject to construction and nearby.
	Landscape	—	—	**During construction/operation:** Since this work is underground construction, no landscape impacts are expected.
	Ethnic minorities and indigenous peoples	—	—	**During construction:** It has been confirmed that there are no ethnic minorities or indigenous peoples living in the construction area. **During operation:** No activities that would adversely affect ethnic minorities or indigenous peoples are expected.
	Work environment	✓	✓	**During construction:** In accordance with relevant laws and regulations, it is necessary to ensure that the construction working environment, especially for female workers, is taken into consideration (rest rooms and separate toilets for men and women). **During operation:** The working environment for UMAPS staff must be ensured in accordance with relevant laws and regulations.
	Community health, safety and security	✓	—	**During construction:** Infectious diseases such as Sexually Transmitted Disease (STD) and COVID-19 may spread due to the influx of construction workers. Traffic accidents may increase due to the use of surrounding roads by construction vehicles.

				During operation: No activities that would adversely affect the local community are expected.
Other	Transboundary impacts and climate change	—	—	**During construction:** No climate change impacts are expected, such as large-scale deforestation or increased greenhouse gas (GHG) emissions. **During operation:** No impact activities are expected.

Source: JICA Study Team

10.5.2 Setting of Baseline Survey Items and Methodology

For the impact items narrowed down by scoping above, the items and methodology in the baseline study in the environmental social consideration were set as shown in Table 10.5.4.

Table 10.5.4 Baseline Survey Items and Methodology

Field	Item	Survey Item	Survey Method	Construction Type		
				Water Distribution tank	Pump Facility	Pipe Laying
Pollution control measures	Air quality	• Confirmation of environmental standards, etc. (Honduran environmental standards, WHO standards, etc.: items: SO2, NO2, PM10, PM2.5) • Confirmation of residences, schools, hospitals, etc., in the vicinity of the project site • Impact during construction	• Literature review • Field survey	✓	✓	✓
	Water quality	• Confirmation of emission standards（items; Turbidity, Total Coliforms）	• Review of standards	✓	✓	✓
	Waste	• Confirmation of standards for disposal of construction waste • Amount of surplus soil in construction	• Review of relevant laws and regulations • Amount of surplus soil calculated in site development plans • Review of disposal site for surplus soil and debris, etc.	✓	✓	✓
	Soil pollution	• Confirmation of oil to be used	• Confirmation of oil management methods	✓	✓	✓
	Noise and vibration	• Confirmation of noise and vibration standards	• Review of relevant laws and regulations • Survey of mitigation methods	✓	✓	✓
	Land subsidence	• geological features • Case study of similar projects	• Literature review • Field survey	—	—	✓

Natural environment	Biodiversity	• Confirmation of vegetation and valuable species	• Literature review • Field survey	✓	✓	–
Social environment	Work environment	• Required working environment	• Review of relevant laws and regulations • Case study of similar projects	✓	✓	✓
	Community health, safety and security	• Status of infectious diseases outbreak • Traffic conditions in/around the construction area	• Literature and statistics review • Field survey	✓	✓	✓

Source: JICA Study Team

10.6 Result of Environmental Social Consideration Survey

The results of the environmental and social considerations survey conducted based on scoping are summarized in Table 10.6.1

Table 10.6.1 Survey Results Summary of Environmental Social Consideration

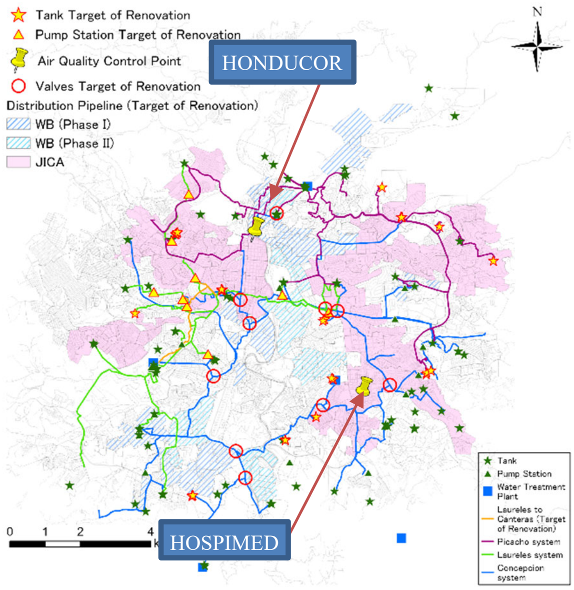
<table>
<tr><th>Field</th><th>Item</th><th>Survey Result Summary</th></tr>
<tr><td rowspan="4">Pollution control measures</td><td>Air quality</td><td>In Honduras, environmental standards for air quality are established in the Regulation for the Control of Emissions from Stationary Sources (2011). The criteria and the items to be observed are shown in Table 10.1.7. There are two observation points in DC (Barrio El Centro: HONDUCOR and Colonia Kennedy: HOSPIMED) and their measurements are shown in Figure 10.1.13.
While the annual mean of PM10 is in line with the national standard, it is above the recommended annual mean AQG level as indicated in the WHO guidelines. The average value of TSP is below the USEAP and the corresponding Honduran standard. Both observation points are located in JICA project area, but far from the construction sites which is in the suburbs with less possibility of air pollution than observation points (see Figure 10.6.1). Therefore the value in air pollution in the construction site could be smaller than those of the observation points.


Figure 10.6.1 Project Area and Air Quality Observation Sites
Source: JICA Study Team</td></tr>
<tr><td>Water quality</td><td>Drinking water quality standards in Honduras are shown in Appendix-10. These water quality standards are to be applied to water that is to be transmitted from the existing water treatment plants to the storage tanks by pumping facilities and then be gravity-distributed through a pipeline going to the water supply area.</td></tr>
<tr><td>Waste</td><td>During construction, it is expected that more than 10,000 tons of surplus soil, logged trees, and scrap (concrete and steel debris, etc.) will be generated. The disposal site is located at Km 6.5 of the road to Olancho in Tusquerique Village of El Guanábano Sector (see "10.1.10 Solid Waste Treatment and Disposal").
At this time, AMDC-GAM, Municipal Waste Management, has an idea to separate and recycle solid waste in the future*, which will need to be addressed when the work is implemented in construction phase. And the asbestos cement AC pipe to be removed from the existing pipeline will be stored in a reserved area at the Laureres water treatment plant site of UMAPS (see photo below).
*: Interviewed at AMDC-GAM on July 12, 2023</td></tr>
<tr><td>Soil pollution</td><td>Countermeasures for soil pollution are confirmed in the similar construction projects as follows. These measures will be implemented in this Project as well.
●Conduct daily inspections of heavy construction equipment and machinery
●Use of absorbent mats, etc.</td></tr>
</table>

	Noise and vibration	The water storage tank and pump facilities are located on the UMAPS site in the suburban areas away from residences, so the impact of noise and vibration from construction on the surrounding area will be very limited. Some of the pipeline installation areas are located in urban areas, which would be affected by noise and vibration from the construction. Since there are no standards for noise levels in Honduras, the noise levels for the construction phase will be based on the acceptable levels for residential areas according to the WHO guidelines shown in Table 10.1.8.
	Land subsidence	No cases of land subsidence due to piping installation performed by UMAPS in the past were confirmed. In addition, when laying new piping due to tunnel excavation, land subsidence will be prevented by protecting the tunnel section with concrete and passing the piping through it. During construction, sensors are planned to be installed so that construction can be stopped immediately if any abnormality is detected.
Natural environment	Biodiversity	(1) Rare species In the literature review and field survey it was confirmed that no rare species in the list of "Species of Special Concern in Honduras" (SERNA) based on the IUCN Red List are present in and around the construction sites. (2) Trees In the field survey the presence of trees on the construction site was confirmed. These are either native trees and/or planted trees. The majority of the trees at the water storage tank facility and pumping facility were installed for protective fence to delineate between the interior and exterior of the UMAPS site. In addition, a permit must be obtained from the AMDC-UGA for tree cutting and trimming in construction (See p.10-26, 10.2.1(2)10) Tree Cutting and/or Trimming Permit for AMDC).
Social environment	Work environment	Although the labor law in Honduras have been enacted, it is considered to be inadequately implemented in the construction sector. In particular, little attention has been paid to female workers at construction sites (See p.11-13). Regarding the working environment and safety measures for site workers, it is necessary to ensure that the labor law is complied with as it is (See p.11-14~15).

Community health, safety and security

(1) Infectious disease

No outbreak of HIV/AIDS or COVID-19 infections have been identified in the construction sector. The incidence of HIV/AIDS in the CD is shown on p. 10-20. On the other hand, as shown in the Figure 10.6.2, the number of COVID-19 cases in the CD has been on an increase since the removal of the mask-use requirement on March 8, 2023. Therefore, caution must be needed to avoid further transmission of COVID-19.

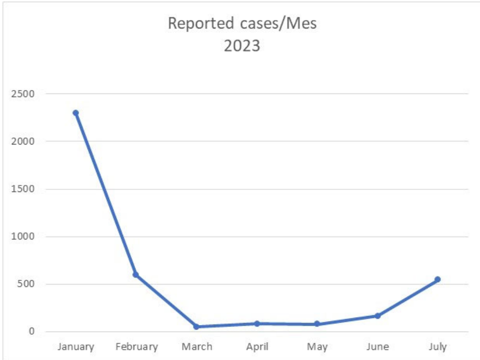


Figure 10.6.2 Number of Cases of COVID-19 by Month in Tegucigalpa (January-July 2023)

Source: Secretary of Health,
https://www.salud.gob.hn/sshome/index.php/covid19#boletin-vigilancia

(2) Traffic conditions

There is almost no traffic on the roads around the construction sites for water storage tanks and pump facilities.

On the other hand, some of the roads for the pipeline installation work are relatively busy (circled area in Figure 10.6.3 below), requiring alternative routes and traffic control during construction. The results of a one-hour traffic volume sample survey conducted from 2:00 p.m. to 3:00 p.m. on weekdays is shown in Table 10.6.2.

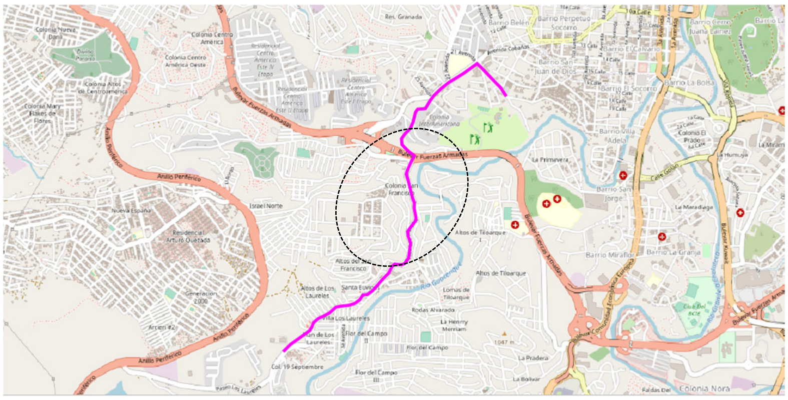


Figure 10.6.3 Transmission Pipeline Installation Work (purple lines in the map)
and Relatively Heavy Traffic Area (encircled in the map)

Source: JICA Study Team

Table 10.6.2 Traffic Volume Sample Survey

Type	Number
Pedestrian	24
Motorbike	122
Sedan	175
Pick-up	112
Bus	48
Commercial truck	32
Large dump truck	2

		Total / 515 Source: Data surveyed JICA Study Team (at 14:00-15:00 on 20th July 2023)

Source：JICA Study Team

10.7 Summary of Impact Assessment

Based on the results of the environmental and social considerations study, the impacts of the project were evaluated as shown in Table 10.7.1.

Table 10.7.1 Summary of Impact Assessment

Field	Item	Impact Assessment during Scoping		Impact Assessment based on the Survey Results		Evaluation
		Before/During Construction	During Operation	Before/During Construction	During Operation	
Pollution control measures	Air quality	✓	―	B-	N/A	**During construction:** The operation of construction machinery/equipment and the demolition of existing tanks and pump facilities are expected to have a temporary negative impact on air quality. **During operation:** Pumping water to the storage tanks by using commercial electric power and water distribution through pipelines do not affect air quality.
	Water quality	✓	―	B-	N/A	**During construction:** Rainfall during removal of existing facilities, leveling work, and excavation of pipeline (the rainy season in Tegucigalpa is from April to November) will lead to discharge of muddy water from the construction site. **During operation:** Water to be delivered from the water storage tank is a treated one at the treatment plant, so there is no possibility of water pollution even if the water is discharged due to overflow, etc.
	Waste	✓	―	A-	N/A	**During construction:** More than 10,000 m^3 of construction waste will be generated, including surplus soil, concrete debris, steel scraps after removal of facilities, and logged trees. General waste and excreta may be generated from the base camp. **During operation:** Pumping water to the storage tanks by using commercial electric power and water distribution through pipelines do not generate any waste.

	Soil pollution	✓	—	B-	N/A	**During construction:** Minor soil pollution is possible due to oil leakage from construction machinery/equipment and transport vehicles. There is potential for soil pollution if waste is left as it is on the site. **During operation:** No waste is generated in the operation of the facility, and the water to be delivered has already been treated at the water treatment plant, so there is no possibility of soil pollution even if the water is discharged from the storage tank due to overflow.
	Noise and vibration	✓	—	B-	D	**During construction:** Noise and vibration are expected to affect residents nearby due to the operation of construction machinery/ equipment during the pipeline installation work near some urban areas. **During operation:** Pumping water to the storage tanks by using commercial electric power and water distribution through pipelines do not generate noise and vibration.
	Land subsidence	✓	✓	A-	A-	**During construction:** Land subsidence may occur if the groundwork is not sufficiently done at the pipe laying points with tunnel excavation work and/or at the new pipe laying points. **During operation:** Insufficient measures (burial depth, laying method, road pavement) at the time of pipe laying may lead to progressive land subsidence due to heavy traffic.
Natural environment	Sanctuary	—	—	N/A	N/A	**During construction/operation:** No impact will occur because there are no protected areas in and around the project area.
	Biodiversity	—	—	N/A	N/A	**During construction:** No rare species of flora and fauna have been identified on the construction site, so no impact will occur. **During operation:** Pumping water to the storage tanks by using commercial electric power and water distribution through pipelines do not cause any impact to the biodiversity.
	Hydrological phenomena	—	—	N/A	N/A	**During construction/operation:** No activities (large-scale drilling or water pumping from underground) that would significantly lower groundwater levels will occur, so no impacts are to be expected.
Social environment	Resettlement and site acquisition	—	—	N/A	N/A	**During construction/operation:** No impact will occur because there are no activities that will induce land acquisition and resettlement.
	Livelihoods	—	—	N/A	N/A	**During construction/operation:** No impact will occur because there are no activities that will adversely affect livelihoods.

	Socially vulnerable people	–	–	N/A	N/A	**During construction:** No impact will occur because there are no socially vulnerable people living in or near the construction area. **During operation:** No impact will occur because there are no activities that would adversely affect socially vulnerable people.
	Cultural heritage	–	–	N/A	N/A	**During construction/operation:** No impact will occur because there is no cultural heritage (tangible or intangible) in or around the construction area.
	Landscape	–	–	N/A	N/A	**During construction/operation:** No landscape impacts will occur because the facility is constructed on the UMAPS sites and pipe laying is also done on the side of the road.
	Ethnic minorities and indigenous peoples	–	–	N/A	N/A	**During construction:** No impact will occur because there are no ethnic minorities or indigenous peoples living in the construction area. **During operation:** Pumping water to the storage tanks by using commercial electric power and water distribution through pipelines do not cause any impact adversely to the ethnic minorities or indigenous peoples.
	Work environment	✓	✓	A-	A-	**During construction:** In accordance with relevant laws and regulations, it is necessary to ensure that the construction working environment, especially for female workers, is taken into consideration (rest rooms and separate toilets for men and women). **During operation:** The working environment for UMAPS staff must be ensured in accordance with relevant laws and regulations.
	Community health, safety and security	✓	–	A-	A+	**During construction:** COVID-19 may spread due to the influx of construction workers. Traffic accidents may increase due to the use of surrounding roads by construction vehicles. **During construction:** Improved water supply services will improve sanitation in the community.
Other	Transboundary impacts and climate change	–	–	N/A	A+	**During construction:** No climate change impacts will occur, such as large-scale deforestation or increased GHG gas emissions. **During operation:** Reduced electricity consumption associated with the operation of new pumps will contribute to climate change mitigation through reduced GHG emissions.

Source：JICA Study team
A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified as the study progresses).
D: No impact is expected.
N/A：Impact assessment is not conducted because the item was categorized as no effect in scoping phase.

10.8 Mitigation Measures and its Cost

Mitigation measures or future actions for all items rated A- and B- in the impact assessment (see Table 10.7.1) are described below as shown in Table 10.8.1.

Table 10.8.1 Mitigation Measures and its Cost

No.	Item	Expected Impact	Mitigation Measures	Implementation Organization	Responsible Organization	Cost
【Before /During Construction】						
1	Air quality	There may be impact on air quality in/around the site due to emissions and dust generated by the operation of construction machinery/equipment and the removal of existing water storage tanks and pumping facilities	• Enclose the area around the construction site with fencing or other means. • Vehicles used to transport construction materials should be securely covered to prevent materials and equipment from being dropped. • The construction site and access road will be watered for dust abatement. • Ensure idling stop and mufflers installed to the construction machinery/equipment and vehicle. • Maintain construction machinery/equipment and vehicle to meet emission standards. • Establishment of a contact point and assignment of a contact person. • Publicize and notify the public in advance of the construction details and timing. • Assignment of traffic control staff. • Speed on construction site is limited to 25 km/hr. • Periodic air quality inspection.	Constructor	UMAPS	Constructor
2	Water quality	Rainfall during removal of existing facilities, leveling work, and excavation of pipeline will lead to discharge of muddy water from the construction site.	• Plan the construction work appropriately to minimize muddy water discharge during the rainy season. • If construction work cannot be avoided during rainy days, the structure should be designed to store water in such a way as to stop the runoff of muddy water. • Steep banks should be stabilized with gabions, etc. • Use embankment, sandbags, etc. when storing large quantities of soil. • Cover with waterproof cloth or tarp. • Lay concrete roads and/or protect temporary access roads with crushed stone and/or gravel.	Constructor	UMAPS	Constructor
3	Wa	More than 10,000 m^3 of construction waste	• Waste is transported and disposed of by constructors after reporting	Constructor	UMAPS	Burden of constructor

		will be generated, including surplus soil, concrete debris, steel scraps after removal of facilities, and logged trees.	to AMDC-GAM on the use of the final disposal site. • During transport, cover the waste to prevent it from falling or spilling. • The constructor will keep records of the disposed waste and UMAPS will supervise it.			
		General waste and excreta may be generated from the base camp.	• Provide toilets separated for men and women on the construction sites. • Install waste bins and separate disposal on the construction sites.			
4	Soil pollution	Minor soil pollution is possible due to oil leakage from construction machinery/equipment and transport vehicles.	• Control and maintain heavy machineries and transport vehicles to prevent oil spillage from them. • Use oil mats. • If soil is contaminated, it is properly removed and disposed of.	Constructor	UMAPS	Burden of constructor
		There is potential for soil pollution if waste is left as it is on the site.	• If the existing pipe material to be replaced is asbestos concrete AC, it is stored on the UMAPS site (vacant lot in the Laureres water treatment plant).	UMAPS		No storage costs will be incurred because AC pipes are stored on the UMAPS site.
5	Noise and vibration	Noise and vibration are expected to affect residents nearby due to the operation of construction machinery/ equipment during the pipeline installation work near some urban areas.	• In principle, construction work at night is prohibited from 7:00PM to 5:00AM, etc. • Equipment used in construction work is fitted with vibration isolators. • Nearby residents will be notified in advance of construction plans, duration, and negative impacts.	Constructor	UMAPS	Constructor
6	Land subsidence	Land subsidence may occur if the groundwork is not sufficiently done at the pipe laying points with tunnel excavation work and/or at the new pipe laying points.	• Careful topographic and geotechnical surveys are conducted prior to tunnel excavation work to determine the presence of obstructions, stratigraphic composition, groundwater, and soil quality. • During the tunnel excavation work, the ground conditions are monitored, and if any abnormality is detected, work is immediately stopped and confirmation work is done. • When laying pipes, backfilling should be done carefully, and after trampling, the road surface should be paved.	Constructor	UMAPS	Constructor

7	Work environment	In accordance with relevant laws and regulations, it is necessary to ensure that the construction working environment, especially for female workers, is taken into consideration (rest rooms and separate toilets for men and women).	• The tender documents shall clearly state in accordance with the labor laws that the tenderer will comply with the labor laws regarding the maintenance of the labor environment at the construction sites. • Develop a safety plan and provide safety training, such as the use of safety equipment and compliance with traffic rules. • Separate men's and women's restrooms and toilets shall be provided at each construction site.	Constructor	UMAPS	Constructor
8	Community health, safety and security	COVID-19 may spread due to the influx of construction workers.	• While masks are not mandatory, they should be worn during travel and breaks, and hand washing is encouraged. • Ensure ventilation in restrooms and toilets.	Constructor	UMAPS	Constructor
		Traffic accidents may increase due to the use of surrounding roads by construction vehicles.	• Hired traffic guards to manage traffic control and transport of construction materials. • After applying to AMDC-GMU, alternative routes will be set to disperse and control traffic.			
【During Operation】						
No.	Item	Expected Impact	Mitigation Measures	Implementation Organization	Responsible Organization	Cost
1	Land subsidence	Insufficient measures (burial depth, laying method, road pavement) at the time of pipe laying may lead to progressive land subsidence due to heavy traffic.	• If land subsidence is confirmed through reports from nearby residents or through confirmation by UMAPS staff during on-site work, backfilling and road surface restoration work will be done after confirming no water leakage or other impacts existing.	Constructor	UMAPS	If any defects are found, the constructor will bear the cost. Otherwise, UMAPS will bear the cost (HNL 3,000/m).
2	Work environment	The working environment for UMAPS staff must be ensured in accordance with relevant laws and regulations.	• Ensure compliance with UMAPS regulations (Internal Labor Regulations and Ethics Regulations). • If any violation is discovered using the complaint post set in UMAPS, etc., necessary action will be taken promptly in accordance with the judgment of the UMAPS Ethics Committee.	UMAPS	UMAPS	UMAPS

Source：JICA Study Team

10.9 Monitoring

10.9.1 Monitoring Plan

In principle, all items for which mitigation measures have been taken will be monitored to verify the impact of the Project and the effectiveness of the mitigation measures for the period of before/during construction and during operation. As shown in Table 10.9.1, the monitoring plan includes 1) the monitoring items, 2) criteria, 3) location, 4) implementation organization which will conduct the monitoring, 5) duration and frequency, and 6) cost.

Table 10.9.1 Monitoring Plan

【Before/During Construction】

No.	Item	Mitigation Measures	Item	Criteria	Location	Implementation Organization	Duration and Frequency	Cost
1-a	Air quality	Enclose the area around the construction site with fencing or other means.	Implemented or not	N/A*	Construction site boundary	Constructor	Once at the beginning of construction	Included in construction cost
1-b		Vehicles used to transport construction materials should be securely covered to prevent materials and equipment from being dropped.			Construction site and around		Every time the vehicle is used	
1-c		The construction site and access road will be watered for dust abatement.					Daily (dry season)	
1-d		Ensure idling stop and mufflers installed to the construction machinery/equipment and vehicle.			Construction Site		Daily	
1-e		Maintain construction machinery/equipment and vehicle to meet emission standards.						
1-f		Establishment of a contact point and assignment of a contact person.						
1-g		Publicize and notify the public in advance of the construction details and timing.			Barrio/colonia in which construction site is located		At the beginning of construction	
1-h		Assignment of traffic control staff.			Construction site and around		Daily	
1-i		Speed on construction site is limited to 25 km/hr.		25 km/hr or less	Construction Site			
1-g		Periodic air quality inspection	Honduras National Standards	SO2, NO2, PM10, PM2.5	Construction site Boundary		Every month	
2-a	Water quality	Plan the construction work appropriately to minimize muddy water discharge during the rainy season.	Implemented or not	N/A*	Construction site		At the beginning of construction	
2-b		If construction work cannot be avoided during rainy days, the structure should be designed to store water in such a way as to stop the runoff of muddy water.					Daily (rainy season)	
2-c		Steep banks should be stabilized with						

		gabions, etc.						
		Use embankment, sandbags, etc., when storing large quantities of soil.						
2-d		Cover with waterproof cloth or tarp.						
2-e		Lay concrete roads and/or protect temporary access roads with crushed stone and gravel.			Construction site and around			
3-a	Waste	Waste is transported and disposed of by constructors after reporting to AMDC-GAM on the use of the final disposal site.			Construction site		Every time when transporting and disposing of waste	
3-b		During transport, cover the waste to prevent it from falling or spilling.			Construction site and around		Every time when transporting waste	
3-c		The constructor will keep records of the disposed waste and UMAPS will supervise it.			Construction site		Every time when transporting and disposing of waste	
3-d		Provide toilets separated for men and women on the construction sites.					at the beginning of construction	
3-e		Install waste bins and separate disposal on the construction sites.					Daily	
4-a	Soil pollution	Control and maintain heavy machineries and transport vehicles to prevent oil spillage from them.						
4-b		Use oil mats.						
4-c		If soil is contaminated, it is properly removed and disposed of.					Every time when contaminated	
4-d		If the existing pipe material to be replaced is asbestos concrete AC, it is stored on the UMAPS site (vacant lot in the Laureres water treatment plant).				UMAPS	Every time when replacing AC pipe	Use of UMAPS property
5-a	Noise and vibration	In principle, construction work at night is prohibited from 7:00 PM to 5:00 AM, etc.				Constructor	Daily	Included in construction cost
5-b		Equipment used in construction work is fitted with vibration isolators.						
5-c		Residents nearby will be notified in advance of construction plans, duration, and negative impacts.					Before construction begins	
6-a	Land subsidence	Careful topographic and geotechnical surveys are conducted prior to tunnel excavation work to determine the presence of obstructions, stratigraphic composition, groundwater, and soil quality.						

6-b		During the tunnel excavation work, the ground conditions are monitored, and if any abnormality is detected, work is immediately stopped and confirmation work is done.					During construction	
6-c		When laying pipes, backfilling should be done carefully, and after trampling, the road surface should be paved.						
7-a	Work environment	The tender documents shall clearly state in accordance with the labor laws that the tenderer will comply with the labor laws regarding the maintenance of the labor environment at the construction sites.				UMAPS	At the time of preparation of tender documents	Included in UMAPS administrative cost
7-b		Develop a safety plan and provide safety training, such as the use of safety equipment and compliance with traffic rules.				Constructor	Before construction begins	Included in construction cost
7-c		Separate men's and women's restrooms and toilets shall be provided at each construction site.						
8-a	Community health, Safety, and security	While masks are not mandatory, they should be worn during travel and breaks, and hand washing is encouraged.					During construction	
8-b		Ensure ventilation in restrooms and toilets.						
8-c		Hired traffic guards to manage traffic control and transport of construction materials.			Construction site and around			
8-d		After applying to AMDC-GMU, alternative routes will be set to disperse and control traffic.						
【During Operation】								
9	Land subsidence	If land subsidence is confirmed through reports from nearby residents or through confirmation by UMAPS staff during on-site work, backfilling and road surface restoration work will be done after confirming no water leakage or other impacts existing.	Implemented or not	N/A*	Construction site	Constructor or UMAPS	After handover	If a defect is found, the constructor will bear the cost. Otherwise, UMAPS will bear the cost (HNL 3,000/m).
10	Work environment	Ensure compliance with UMAPS regulations (Internal Labor Regulations and Ethics Regulations).				UMAPS		Included in construction cost
		If any violation is discovered using the complaint post set in UMAPS, etc., necessary action will be taken promptly in accordance with the judgment of the UMAPS ethics committee.						

Source：JICA Study Team

*: This is also an item to be monitored, and since it is difficult to set clear criteria, we have used this notation like N/A.

10.9.2 Monitoring Form

The following forms will be used for monitoring. The latest results will be documented on the form below and submitted with the quarterly progress reports.

＜Before construction＞

Licensing and consultation

Monitoring Item	Status in the reporting period (for example, in the case of community consultation, existence of consultation records, the number of people participating in the meeting, etc.)
Responding to points raised by authorities when obtaining environmental permits and approvals	
Acquisition of various permits	
Status of public consultation/stakeholder meeting	

Social environment/Work environment

Monitoring Item	Status in the Reporting Period
The tender documents shall clearly state in accordance with the labor laws that the tenderer will comply with the work environment at the construction sites.	

Grievance

Number and Content of Complaints	Corresponding Organization	Status of Response

＜During Construction＞

Licensing and Consultation

Monitoring Item	Status in the Reporting Period (for example, in the case of community consultation, existence of consultation records, the number of people participating in the meeting, etc.)
Responding to points raised by authorities when obtaining environmental permits and approvals	
Acquisition of various permits	
Status of public consultation/stakeholder meeting	

Pollution Control Measures

Monitoring Item		Status in the Reporting Period			
Air quality	Fence around construction site				
	Material and equipment cover for vehicles used to transport construction materials				
	Watering of construction sites and access roads for dust mitigation				
	Idling stop and muffler installation				
	Maintenance of construction machinery/equipment and vehicles that meet emission standards				
	Establishment of a contact point and assignment of a contact person				
	Monitoring item of air quality （micrograms/cubic meter）	Measured Value (Average Value)	Measured Value (Maximum Value)	Honduran Standard	Remarks (measurement location, frequency, method, etc.)
	SO_2			125/24 hrs., 500/10 min.	
	NO_2			40/year, 400/hr.	
	PM_{10}			70/year, 150/24hrs.	
	$PM_{2.5}$			15/year, 65/24hrs.	
Water quality	Adequate construction work plan to minimize muddy water discharge during the rainy season				
	Water storage structures to stop muddy runoff when construction cannot be avoided during wet weather				
	Stabilization of steep banks with gabions, etc.				
	Use of embankments, sandbags, etc., when storing				

	large amounts of soil	
	Protection with waterproof cloth or tarp	
	Laying concrete roads and protecting temporary access roads with crushed stone and/or gravel	
Waste	Report to AMDC-GAM on the use of the final disposal site, and the constructor transports and disposes of the materials	
	Covers to prevent falling or spilling during transport	
	Record keeping and supervision by UMAPS of constructor's waste transport and disposal	
	Installation of simple toilets separated for men's and women's	
	Installation of waste bins and separate disposal	
Soil pollution	Control and maintenance of construction machineries/equipment and transport vehicles to prevent oil spillage from them	
	Use of oil mats	
	Proper removal and disposal of soil in the event of soil contamination	
	Storage of asbestos concrete AC on UMAPS property (at vacant lot in Laureres water treatment plant) after replacement with new pipes	
Noise and vibration	Prohibition of construction work at night in principle (7:00 PM to 5:00 AM, etc.)	
	Installation of vibration isolators on equipment used in construction work	
	Advance notification to nearby residents of construction plans, duration, and negative impacts	
Land subsidence	Careful topographic and geotechnical surveys prior to tunnel excavation to determine the presence of obstructions, stratigraphic composition, groundwater, and soil quality.	
	Monitoring of ground conditions during tunnel excavation, and immediate stop of work to confirm the reason in case of any abnormality detected	
	Careful backfill and road surface pavement after trampling when burying pipes	

Social Environment

Work environment

Monitoring Item	Status in the Reporting Period
Development of safety plan including the use of safety equipment and compliance with traffic rules and implementation of safety training	
Separate men's and women's restrooms and toilets at each construction site	

Community health, safety and security

Monitoring Item	Status in the Reporting Period
Mask wearing during travel and breaks in construction work, and hand washing	
Ventilation of restrooms and toilets	
Hired traffic guards to manage traffic control and transport of construction materials	
Alternative routes to disperse and control traffic	

Grievance

Number and Content of Complaints	Corresponding Organization	Status of Response

＜During operation＞

Pollution control measures

Item	Monitoring Item	Remarks (measurement, location, frequency, method, etc.)
Land subsidence	Backfilling and road surface restoration work after checking the impact on piping such as water leakage when land subsidence is confirmed through reports from nearby residents or through confirmation by UMAPS staff	

Social environment/work environment

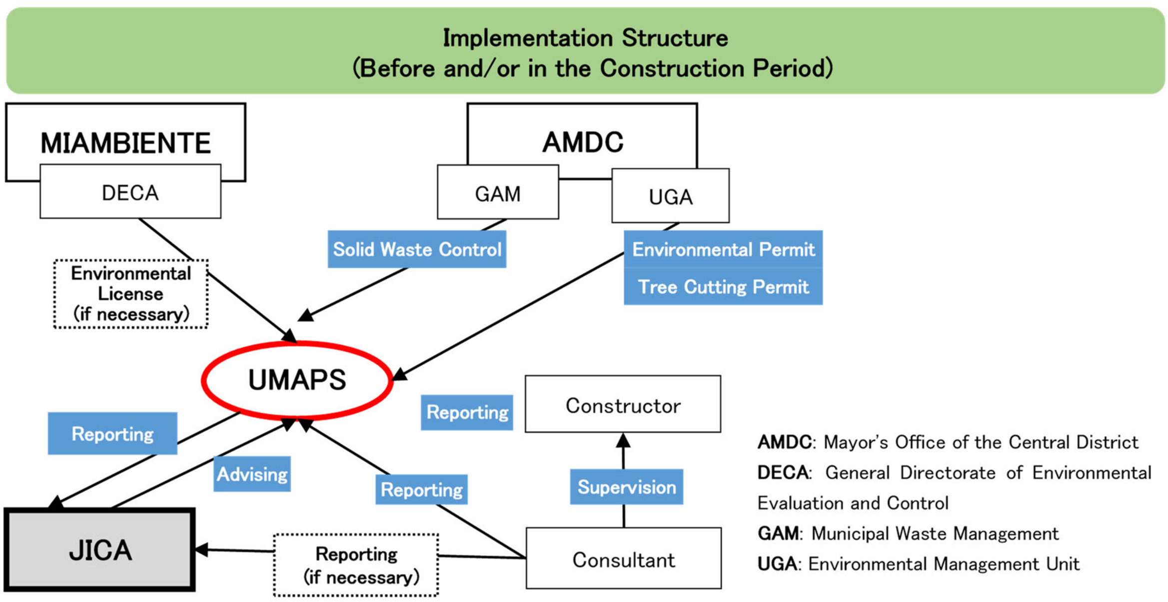
Monitoring Item	Status in the Reporting Period
Compliance with UMAPS regulations (labor regulations and ethics rules). If violations are discovered through the complaint post set in UMAPS, necessary measures will be taken promptly in accordance with the judgment of the internal ethics committee in UMAPS.	

Grievance

Number and Content of Complaints	Corresponding Organization	Status of Response

10.10 Implementation Structure

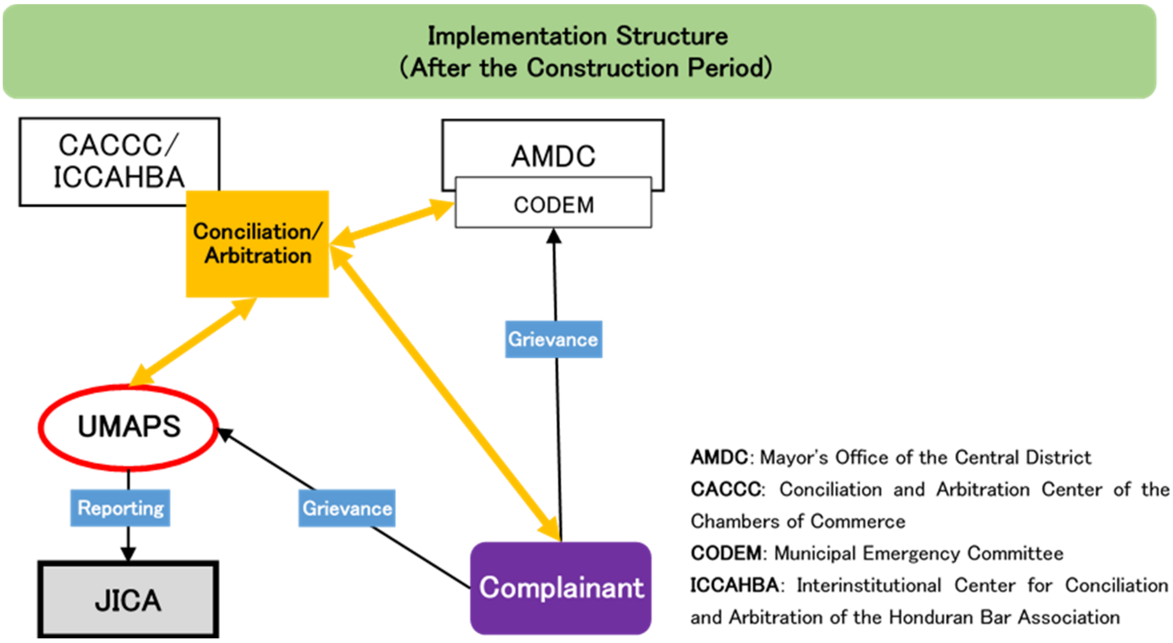
10.10.1 Implementation Structure Before and/or in the Construction Period



Source：JICA Study Team

Figure 10.10.1 Implementation Structure Before and/or in the Construction Period

10.10.2 Implementation Structure after the Construction Period



Source：JICA Study Team

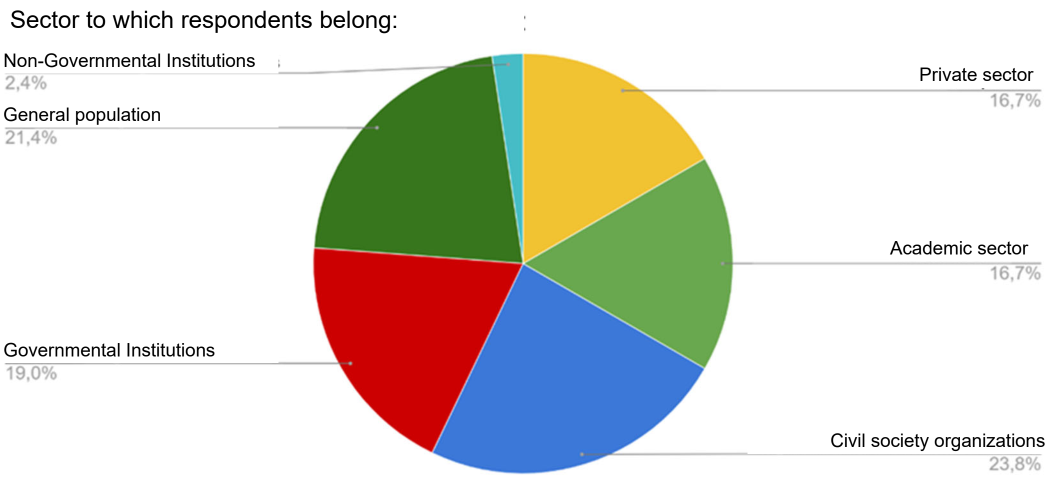
Figure 10.10.2 Implementation Structure after the Construction Period

10.11 Stakeholder Meeting

10.11.1 Identification and analysis of local stakeholders

(1) Identification and analysis of local stakeholders

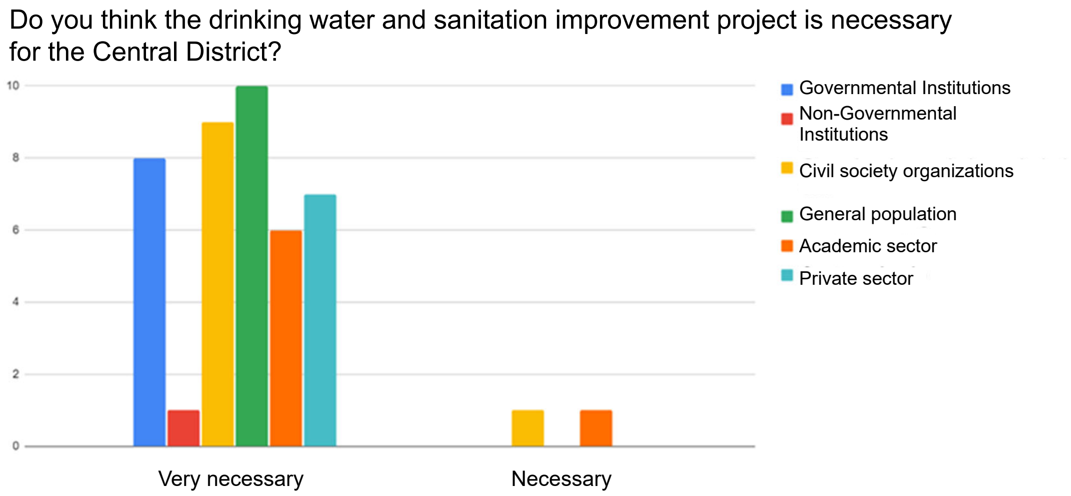
To identify and analyze local stakeholders in this Project, six subsectors (①non-governmental organizations, ②community organizations, ③government agencies, ④private sector, ⑤academic sector, and ⑥civil society organizations) were selected as important groups for the water sector in the Project area, from which a total of 43 sample organizations were selected to complete a web questionnaire survey. The percentages by subsector in the sample are shown in Figure 10.11.1 below.



Source：JICA Study Team

Figure 10.11.1 Sample breakdown of the web questionnaire survey

As a result of the interviews (5-point scale: "very necessary," "necessary," "normal," "not necessary," and "not at all necessary") regarding the need for the Project, positive opinions (41 very necessary, 2 necessary) were confirmed from the entire survey sample for project implementation as shown in the Figure 10.11.2.



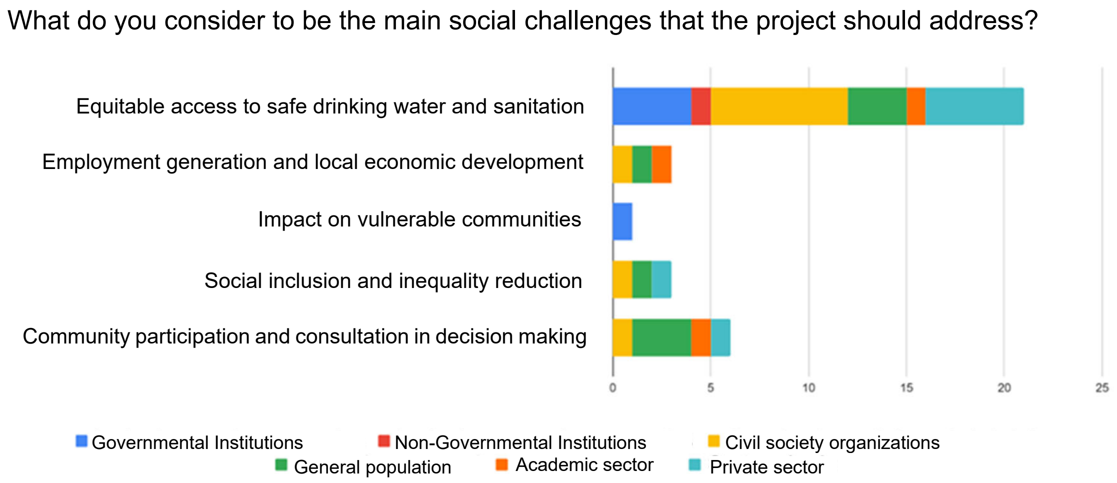
Source：JICA Study Team

Figure 10.11.2 Opinion about the Needs for the Project

(2) Narrowing down local stakeholders

Furthermore, the analysis was conducted to identify individuals or groups of affected stakeholders who, depending on their individual circumstances and social vulnerabilities, may have different concerns or issues regarding the Project's impacts, mitigation measures, and benefits that require separate consultation methods.

As a result of the questionnaire survey, any individuals or groups with significant concerns or challenges to the construction of facilities by the project were not identified. On the other hand, as shown in Figure 10.11.3 below, it was confirmed that the main social issues to be considered in the Project are mainly "equal access to water supply and sanitation" and "community participation and consultation in decision making". Therefore, it was determined that it is very important to explain the project to the residents of the districts where the water distribution reservoirs are located as well as those of the target districts for water supply, who will be the main beneficiaries of the water supply services in future.



Source：JICA Study Team

Figure 10.11.3 Main Social Issues to be considered in the Project

10.11.2 Plan for meaningful consultation methods with local stakeholders

The stakeholder meetings were conducted according to the following plan. The following points (1) through (5) were noted as the important conditions in the planning.

Date: Saturday, August 19, 2023 (1st meeting), Saturday, August 26, 2023 (2nd meeting)

Hours: 1:00-4:00 p.m.

Venue: Meeting room "CODEM 21 Octubre" in AMDC

Participants: AMDC, UMAPS, JICA Study Team (local consultants, local staff), district representatives (1st meeting: 14 de Marzo, Barrio El Rincón, Israel Norte, El Carrito, Brisas de Olancho, Los Alpes de Oriente; 2nd meeting: Loma Linda Norte, Altos de Trapiche, Lomas de Toncontin, Divanna, Lomas de Miraflores, San José de Los Llanos, Morinos)

Table 10.11.1 Stakeholder Meeting Agenda

No.	Agenda	Start time	End time	Person in charge
1	Participant registration	1:00	1:25	JICA Study Team
2	Opening Remarks	1:25	1:35	UMAPS
3	Introduction of Attendees	1:35	1:55	All participants
4	Project Explanation	1:55	2:45	UMAPS
5	Question-and-Answer session	2:45	3:30	All participants
6	Closing & Reception	3:30	4:00	All participants

The venue, CODEM conference room owned by AMDC

The venue can accommodate up to 50 people. Various facilities for meetings are already in place.

Source：JICA Study Team

(1) Sufficient question and answer time for meaningful discussion

AMDC and UMAPS ensured that sufficient time for questions from community representatives during meetings was allowed as an opportunity for local stakeholders to express their opinions on the impacts and mitigation measures of the Project. And the AMDC and UMAPS also considered and respond to such opinions (e.g., providing explanations from AMDC and UMAPS and reflecting such opinions in the Project), thereby conducting meaningful discussions to avoid potential conflicts and complaints.

(2) Two-way discussion with enough information

The meaningful consultation was a two-way process, with direct dialogue between AMDC and UMAPS and community representatives. AMDC and UMAPS made information available to prospective participants well in advance (approximately two weeks) through the UMAPS Social Development Department. The information was presented in a format that can be easily understood by the local community, including explanations in Spanish using simple, concise, and visual technical materials that could be easily understood by the residents.

(3) Adequate facilitation

Consultations with local stakeholders were conducted in a culturally appropriate manner, without manipulation of attitudes, interference, coercion, discrimination, or intimidation, with facilitation assistance by an experienced local consultant with a neutral position and technical briefing assistance by local staff of the JICA Study Team.

(4) Meaningful meeting method

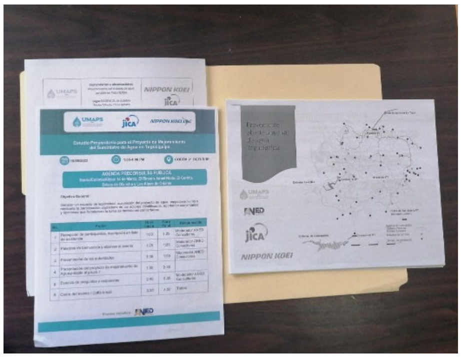
Discussions with local stakeholders were conducted face-to-face at AMDC facilities and were scheduled for Saturday afternoons on weekends to facilitate participation by local representatives. The meeting was divided into two groups to ensure that the number of participants would be sufficient to facilitate a smooth exchange of opinions. Although remote web conferencing and other technologies were considered feasible given the local conditions, the web meeting was not held this time due to the risk of power outages and other local communication problems in internet.

(5) Recording of the meeting results

When consulting with local stakeholders, the results of the consultations were properly recorded by preparing a consultation record format in advance and noting the gender and other attributes of the participants in the meetings.

10.11.3 Information disclosure

For the stakeholder meetings, AMDC and UMAPS prepared presentation materials in Spanish, which were distributed to resident representatives for detailed explanation. The materials were prepared in a clear, concise, and visual manner to facilitate understanding on the part of residents, without relying on difficult technical terms or drawings.



A set of handouts for the meeting

10.11.4 Consultation with Local Stakeholders and Feedback

The breakdown of meeting participants (Table 10.11.2) and the main results of discussions (Table 10.11.3) are as follows. In both meetings, participants expressed favorable and constructive opinions about the Project implementation, and no opposition to the Project implementation was identified.

Table 10.11.2 Breakdown of Stakeholder Meeting Participants

	1st meeting	2nd meeting
Local organization leaders	11 (47.8%)	11 (30.6%)
Community leaders	12 (52.2%)	25 (69.4%)
Male	9 (39.1%)	18 (50.0%)
Female	14 (60.9%)	18 (50.0%)
Total	23 (100%)	36 (100%)

Source：JICA Study Team

Table 10.11.3 Key Comments Received at Local Stakeholder Meetings (excerpts)

1st meeting
• It is a good to hold meetings with the neighborhoods and colonies where construction will take place in order to let them know how the project is progressing, at what stage it is now, and which direction being taken with the authorities in charge is viable. • It is necessary that the communities be supervised due to the illegal connection of water pipes that is occurring. It is extremely necessary. This would avoid later problems with people and the manipulation of the valves as well as the abuse and loss of water.
2nd meeting
• It would be important to be able to hold subsequent meetings with a larger number of people. In this sense, the community leaders are requested to convene more people, since we are a large population in Comayagüela and Tegucigalpa. • It is necessary to continue with the process of sensitizing the population to know and make

known the benefits in the short, medium and long term. Thank you for the excellent presentation and explanation of the Project.
- We extend our congratulations for this good initiative of socialization of such an important project of expansion of the potable water network, but, on the other hand, more attention is needed to complaint about the water pipes in bad condition.
- A concern arises, in what degree of collaboration can you help us with people who do not want to pay for the projects, not even the payment of the water service ?
- More attention is needed to repair broken pipes in each Colonia more promptly when calls and complaints are made.
- It is necessary to carry out operations in each neighborhood to supervise leaks in household tanks.
- When implementing pipe repairs in the streets, please repair the pavement of the public road no to leave the holes uncovered.
- The organization and training of the water board in all the beneficiary communities is necessary.
- It is necessary to establish a 24-hour emergency response mechanism, and to provide effective communication to report leak and/or loss of water supply system.

Source：JICA Study Team

Some of the opinions provided above are not necessarily directly related to the components of this Project, but this is understood to be an indication of the residents' high expectations for the improvement of the water supply services. And there are comments which could be related to components of future technical cooperation (e.g., Reduction of illegal connection to water supply, leakage prevention, improvement of meter reading/collection services), which is considered in the survey conducted in conjunction with this Project and might be referred to in the consideration of JICA's technical cooperation in future.

10.11.5 Receiving and responding to complaints

No complaints were presented by resident representatives at this meeting. On the other hand, as there was a request for continuous publicity of the Project, AMDC and UMAPS have agreed to continue to share information widely in the future. In addition, as a system for receiving and responding to complaints has been established as described in "**10.12 Grievance Mechanisms**" later, AMDC and UMAPS intend to make use of this system as appropriate.

10.11.6 Consideration for Socially Vulnerable People

AMDC and UMAPS actively took into consideration women's groups among local stakeholders, who are considered important users of urban water services but whose opinions are often not adequately reflected in the implementation of public works in the water sector, and ensured their participation in order that their opinions were actively expressed and treated fairly. For this purpose, women's participation has been encouraged from the stage of convening participants to ensure gender balance in the meetings. As a result, the meeting participants consisted of approximately 40% men and 60% women in the first meeting, then 50% men and 50% women in the second meeting.

10.11.7 Significant Changes

If there are significant changes to the Project in the future and additional impacts are anticipated, AMDC and UMAPS intend to provide information to local stakeholders on additional impacts and mitigation measures, and to consult with local stakeholders as necessary, as has been done in above meetings.

10.12 Grievance Mechanisms

10.12.1 Grievance Mechanism in AMDC and UMAPS

Currently, the Municipal Mayor's Office of the Central District has a citizen hotline called “Line 100”, administered by the Municipal Emergency Committee (CODEM). In addition, it has its own protocol for answering calls that establish the procedure for attending to people.

There is a UMAPS claims unit in the Distribution Department that receives calls at 94083544 and 93987054 and also receives drinking water service claims in person. For this purpose, a work order is filled out in accordance with the claims’ attention.

10.12.2 Arbitration System and Its Procedure

(1) Arbitration

Honduras has official arbitration centers for the resolution of extrajudicial conflicts, such as the Conciliation and Arbitration Center of the Chambers of Commerce of Cortés and Tegucigalpa, and the Interinstitutional Center for Conciliation and Arbitration of the Honduran Bar Association. If not provided for in the arbitration agreement, the rules of the arbitral institution shall apply if the arbitration is an institution; otherwise, the rules of the arbitrator shall apply.

(2) Procedure

The parties may freely determine the rules of procedure if they have not been subjected to those of an arbitration institution. If the parties are unable to resolve the dispute between them, the dispute shall be subject to the rules of the arbitral institution conducting the arbitration proceedings in the case of institutional arbitration, or the rules set forth in the Act in the case of ad hoc arbitration.

Pursuant to the foregoing, unless the parties or the arbitrators provide otherwise, the arbitral procedure for ad hoc arbitrations shall be governed by the provisions of Article 52 of the Arbitration Law, a summary of which is as follows:

- Presentation of the claim.
- Answer to the claim and/or counterclaim.
- Presentation of exceptions.
- Conciliation hearing; in case the settlement is reached, the parties may request the Tribunal that the settlement be elevated to the category of a final arbitration award.
- If there is no total agreement on the claims, the proceeding will continue with the initiation of the evidentiary period.
- Once the evidence has been heard, the parties shall submit within three days a written summary of their arguments.
- Once the foregoing has been verified, the arbitrators shall proceed to issue the award.

Disputes arising from contracts entered into by the State of Honduras and entities under public law with nationals or non-indigenous foreigners may be submitted to international arbitration, domestic or foreign.

10.13 Environmental Checklist

The summary of environmental and social consideration surveyed in this preliminary study is shown in Table 10.13.1.

Table 10.13.1 Environmental Checklist

Field	Item	Main Check Point	Yes: Y No: N	Specific Environmental and Social Considerations (reasons for Yes/No, rationale, mitigation measures, etc.)
1 Licensing and consultation	(1) Environmental Assessment and Environmental Permits	(a) Has an environmental impact assessment report (EIA report) or similar been prepared? (b) Are the EIA reports, etc. written in the official or widely used language of the country concerned? (c) Has the EIA report, etc. been approved by the government of Honduras (if not, indicate the expected date of approval in the "Specific Environmental and Social Considerations" column)? (d) Does the approval of the EIA report, etc., come with ancillary conditions? If there are ancillary conditions, are they satisfied? (e) In addition to the above, have environmental permits and licenses been obtained from the local competent authorities, if necessary? (f) Are the items listed in Appendix 2 of the JICA Guidelines covered (the scope and level of detail may be adjusted depending on the potential impact of the project)? (g) Have environmental and social considerations been verified for the entire scope of the subject project, cumulative impacts, derivative and secondary impacts, and indivisible operations?	(a)-N (b)-N (c)-N (d)-N (e)-N (f)-N (g)-Y	(a)to(d) It has been confirmed that an EIA is not required for this project as it will be addressed through an environmental permit application to AMDC-UGA (e) An application for tree cutting and/or trimming will be submitted to AMDC-UGA after implementation of the detailed study for the Project. (f) This project corresponds to Category B in the JICA Guidelines and does not fall under this item. (g) Implemented.
	(2) Explanation and discussion with local residents	(a) Have local stakeholders been properly analyzed and identified? (b) Have the project details and impacts been adequately explained to and understood by local stakeholders through a process that ensures meaningful consultation, including information disclosure? (c) For local stakeholder consultations, have records of consultations been prepared, including the gender and other attributes of the participants? (d) Have comments from residents and others been reflected in the project content, etc.?	(a)-Y (b)-Y (c)-Y (d)-Y	(a)and(b) The stakeholder meeting was held in August 2023 to explain the project and its anticipated impacts. The Project was well understood by the stakeholders without any complaints nor disagree to the Project. (c) Minutes of meetings was prepared with summarizing the agenda, list of participants, remarks, photos, etc. (d) Comments will be reflected in the Project due to the necessity.
	(3) Consideration of alternatives	(a) Is the scope of the multiple alternatives for the Project appropriate? (b) Have feasible alternatives been considered in terms of technical, financial, and environmental and social considerations from the environmental and social items and, if necessary, from the perspective of reducing total GHG emissions? (c) Have comparisons been made with options that do not implement the Project?	(a)-Y (b)-Y (c)-Y	(a)to(c) Several alternatives, including an option not to implement the Project, are being considered from technical, financial, and environmental and social considerations.

2 Pollution control	(1) Air quality	(a)Is there air pollution from chlorine from disinfectant chlorine storage and injection facilities? (b) Does the chlorine in the work environment meet the safety standards, etc. of the Honduras? (c) Do the emitted sulfur oxides (SOx), nitrogen oxides (NOx), soot and dust, and other air pollutants meet the emission standards, etc. of Honduras? (d) Will air pollutants resulting from the project result in areas that do not meet the environmental standards, etc. of Honduras? (e) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N (c)-Y (d)-N (e)-N	(a)and(b) The project does not anticipate the use of chlorine. (c)to(e) Large-scale air pollutant emissions are not anticipated, but measures and monitoring will be implemented at the construction site to ensure that emission standards are met.
	(2) Water quality	(a) Do the SS, BOD, COD, pH, and other items in the wastewater generated as a result of facility operation meet the wastewater standards, etc. of Honduras? (b) Do domestic wastewater and storm water discharges meet the discharge standards, etc. of Honduras? (c) Will the wastewater create areas that do not meet the environmental standards, etc. of Honduras? (d) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-Y (b)-Y (c)-N (d)-Y	(a) Since the construction of the water treatment plant is not included in the Project, no wastewater will result from the operation of the facility. (b)and(c) No domestic wastewater or storm water runoff will be generated by the Project. (d) Mitigation measures are planned for muddy water discharge during construction in rainy season.
	(3) Waste	(a) Are sludge and other wastes generated as a result of facility operation properly treated and disposed of in accordance with the regulations of Honduras? (b) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-Y (b)-Y	(a)and(b) Waste shall be disposed of at the final disposal site designated by AMDC. In addition, mitigation measures will be prepared to prevent falling and spills during transportation to the final disposal site.
	(4) Soil pollution	(a) Has the soil at the site been polluted in the past? (b) Will measures be taken to prevent soil pollution? (c) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-Y (c)-Y	(a) No past contamination was identified in this study. (b)and(c) In addition to taking measures to prevent oil from machinery/equipment, etc., old AC pipes will be properly stored on UMAPS property after pipe replacement.
	(5) Noise and vibration	(a) Do the noise and vibration from pumping facilities, etc. meet the standards, etc. of Honduras? (b) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-Y (b)-Y	(a) The new pumps will be installed in the pump house and operated using commercial electric power, so there will be no external noise and vibration impact. (b) Mitigation measures, such as vibration isolation devices on construction equipment and a ban on nighttime operations during construction, will be implemented.
	(6) Land subsidence	(a) Is there a risk of land subsidence if large amounts of groundwater are pumped? (b) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N	(a) Groundwater pumping will not be done in this Project. (b) Although the potential for negative impacts is very low, measures should be taken to prevent their occurrence through topographical and geotechnical surveys and proper installation during pipe laying.
3 Natural environment	(1) Sanctuary	(a) Is the site located within a protected area as defined by the laws of Honduras, international treaties, etc.? (b) Will the Project affect the protected area? (c) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N (c)-N	(a)to(c)No protected areas exist in and around the planned project area, thus protected areas will not be impacted negatively

	(2) Biodiversity	(a) Does the project site include primary forest, natural tropical forest, or ecologically important habitats (coral reefs, mangrove swamps, tidal flats, etc.)? (b) Does the project site contain habitats of valuable species that require protection under the laws of the country concerned, international treaties, etc.? (c) Does the project involve significant conversion or significant degradation of critical habitats or important forests, and are there concerns about significant impacts on biodiversity? If so, will appropriate measures be taken to address the impacts on biodiversity? (d) Will the project's water withdrawals (surface water and groundwater) affect the environment of rivers and other water bodies (measures to reduce impacts on aquatic organisms, etc., should also be included in the "Specific Environmental and Social Considerations" section)? (e) If there are concerns about other significant impacts on biodiversity, will measures be taken to reduce impacts on biodiversity? (f) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N (c)-N (d)-N (e)-N (f)-N	(a)to(c) Based on the results of the field survey and literature review, there are no impacts or concerns regarding rare species of flora and fauna or their habitat areas as a result of this project. (d) There will be no impact on the aquatic environment because no water will be withdrawn by the Project. (e)and(f) The construction area for this Project is within the UMAPS sites, existing road at the existing pipeline installed and underground in private property, so there is no concern about impacts on biodiversity.
	(3) Hydrological phenomena	(a)Will the Project's water withdrawals (groundwater and surface water) have a negative impact on surface water and groundwater flow? (b)Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N	(a)and(b) No water withdrawals are planned under the project; therefore, impacts are not a concern.

4 Social environment	(1) Resettlement and site acquisition	(a) Will land acquisition with involuntary resettlement occur as a result of project implementation? If so, describe the scale of land acquisition and resettlement. (b)Will efforts be made to minimize the impact of the resettlement? Will there be any other land acquisition or loss of means of livelihood? (c) Will the residents to resettle be provided with appropriate explanations regarding compensation and livelihood restoration measures prior to resettlement? (d) Will a resettlement study be conducted and a resettlement plan be developed that includes compensation at reacquisition price and restoration of livelihoods after resettlement? (e) Will payments of compensation be made prior to relocation? (f) Has a compensation policy been developed in writing? (g) Does the plan give appropriate consideration to socially vulnerable people among the resettled residents, especially women, children, the elderly, the poor, the disabled, refugees and internally displaced persons, and minorities? (h) Will the compensation to be agreed upon be explained to the subject in writing and will agreement be reached on the resettled residents prior to resettlement? (i) Will a system be in place to properly implement the resettlement? Will sufficient implementation capacity and budgetary measures be put in place? (j) Is monitoring of the impact of the resettlement planned? (k) Has a grievance mechanism been established?	(a)-N (b)-N (c)-N (d)-N (e)-N (f)-N (g)-N (h)-N (i)-N (j)-N (k)-N	(a)to(k) The project involves construction work on the UMAPS sites and renewal of existing piping on the side of the road and will not require resettlement of residents or land acquisition for the Project. Although some of the pipe laying work will involve tunnel construction under private property, UMAPS and the owner have agreed that this will be handled with an underground excavation permit by the owner, so there is no need for land acquisition (Agreement in the document is in preparation process as of August 2023).
4 Social environment	(2) Livelihoods	(a) Will the Project have a negative impact on the livelihoods of residents? Will consideration be given to mitigating impacts, if necessary? (b) Will the project's water withdrawals (surface water and groundwater) affect existing water use and waterbody use? (c) Will the project negatively impact ecosystem services (supply and coordination) and affect the health and safety of communities (especially indigenous peoples dependent on said services, etc.)? (d) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N (c)-N (d)-N	(a) The project will not affect the livelihood of the residents negatively. Project implementation is expected to improve water supply services. (b) No water withdrawal will occur as a result of this Project. (c) The project will improve water service and positively impact community health and safety. (d) No negative impacts from construction are anticipated.
	(3) Socially vulnerable	(a) Will appropriate consideration be given to socially vulnerable people such as women, children, the elderly, the poor, the disabled, refugees and internally displaced persons, and minorities? (b) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N	(a)and(b) The construction area and its surroundings are not in close proximity to residential areas, and negative impacts are not a concern.
	(4) Cultural heritage	(a) Is there a risk that the Project may damage archaeological, historical, cultural, or religious heritage or historic sites? Are the measures required by the national law of Honduras taken into account? (b) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N	(a)and(b) No cultural heritage exists in the construction area.

	(5) Landscape	(a) If there are landscapes that require special consideration, will there be a negative impact on them? (b) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N	(a)and(b) The Project consists of construction work on the UMAPS sites, pipe installation on the road and underground, and there are no landscapes that require special consideration.
	(6) Ethnic Minorities and Indigenous Peoples	(a) Has consideration been given to reduce the impact on the culture and lifestyle of ethnic minorities and indigenous peoples of Honduras? (b) Are the land and resource rights of ethnic minorities and indigenous peoples respected? © If required, has an Indigenous Peoples Plan (IPP) been prepared and published? (d) Are efforts made to ensure that ethnic minorities and indigenous peoples are provided with sufficient information and free prior agreement? (e) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N (c)-N (d)-N (e)-N	(a)to(e) The area covered by this Project does not fall within the area inhabited by ethnic minorities and indigenous peoples.
	(7) Work environment	(a) Will the occupational health and safety laws in Honduras that must be observed in the Project be followed? (b) Will hard measures be taken to provide safety considerations for project-related personnel, such as installation of safety equipment and control of hazardous substances related to the prevention of work-related injury or death? (c) Will soft measures be planned and implemented for project-related personnel, such as the development of a health and safety plan and the implementation of safety training (including traffic safety and public health) for workers and others?	(a)-Y (b)-Y (c)-Y	(a) Ensure compliance with Honduran labor laws. (b) Specific safety measures will be taken into consideration by the constructor. Safety measures in accordance with the labor laws will be included in the contract with the constructor. (c) Constructor will comply with safety plans and education, such as safety equipment and traffic rules.
	(8) Community health, safety and security	(a) Are there any negative impacts in terms of hygiene, etc., such as disease outbreaks (including HIV and other infectious diseases) due to the influx of workers, etc. associated with the Project? Are there any mitigation measures in place? (b) Are there any negative impacts on community safety, such as worsening of public security, due to the influx of workers, etc. associated with the Project? Will mitigation measures be provided for the impacts? (c) If security personnel are employed by the Honduran side in the formation and implementation of the project, will appropriate measures be taken to ensure that they do not use their security capabilities except for preventive and self-protection purposes? (d) Will the construction have a negative impact? Will mitigation measures be provided for the impacts?	(a)-N (b)-N (c)-Y (d)-Y	(a) No negative effects are anticipated. As for COVID-19, sanitary measures (masks wearing, ventilation of restrooms and toilets, hands washing, etc.) will be taken at construction sites to prevent infection. (b) Although no deterioration in public safety is anticipated, the constructor will deploy security personnel in and around the construction sites. (c) Appropriate measures are taken to ensure that constructor do not use their security capabilities except for preventative and self-protection purposes, and any complaints or other problems are reported to AMDC and UMAPS. (d) When construction machinery/vehicles are used on the surrounding roads or pipe laying, alternative routes will be set and traffic will be controlled to mitigate the impact on the surrounding area.

5 Other	(1) Monitoring	(a) Will monitoring by the operator be planned and implemented for the above environmental and social items with possible impacts? (b) How are the items, methods, frequency, etc. of such monitoring plans defined? (c) Will a monitoring system (organization, personnel, equipment, budget, etc. and their continuity) be established for the Project? (d) Are the method and frequency of reporting monitoring results, etc. from the responsible organization to the competent authorities specified? (e) Will there be a grievance mechanism in place for environmental and social considerations?	(a)-Y (b)-Y (c)-Y (d)-Y (e)-Y	(a) A monitoring plan will be developed and implemented by UMAPS. (b) The monitoring plan specifies mitigation measures, items, criteria, frequency, etc. (c) The monitoring plan defines the implementation organizations and costs, and an implementation system is also developed. (d) The reporting method and its contents are stipulated in the monitoring plan and the implementation structure chart. (e) In addition to complaint handling at AMDC and UMAPS, grievance mechanisms are in place to utilize third-party institutions.
6 Notes	(1) Other environmental checklist references	(a) If necessary, the applicable check items in the checklist for dams and rivers should also be added and evaluated in this checklist.	(a)-Y	(a) Not applicable to this Project.
	(2) Notes on the use of the Environmental Checklist	(a) If necessary, the impact on transboundary or global environmental issues should also be identified (e.g., transboundary disposal of waste, possible elements related to global warming issues, etc.). (b) For projects that are expected to generate more than a certain amount of GHGs, is the total amount of GHGs emissions estimated before the Project is implemented?	(a)-Y (b)-Y	(a) This Project will contribute to the effective use of water resources by reducing water leakage (climate change adaptation measure) and to the reduction of GHGs emissions by reducing electricity consumption through the replacement of water pumps (climate change mitigation measure). (b) Total GHG emissions are expected to be very much lower than 25,000 tCO_2/year, threshold value in JICA Project.

Source：JICA Study Team

CHAPTER 11 GENDER CONSIDERATION

11.1 Gender Mainstreaming in Honduras

11.1.1 Progress in Domestic Law and Related Policy Development

(1) Gender Considerations from a Labor Protection Perspective

1) Provisions of the "Labor Code"

Gender considerations in the Honduran legal system begin with the clarification of the rights of women workers and their protection by the labor code. The **Labor Code of Honduras (Decree No. 189 of 1959) that is initialed and agreed with national and international labor standards** clearly stipulates the rights and protection of female workers as well as child labor, mainly in Chapter I: Work of Women and Minors, as shown in the Table 11.1.1.

Table 11.1.1 Provisions on the Rights and Protection of Women Workers as Indicated in the Labor Code (excerpts)

Chapter/Article	Contents of Provisions
Title II. Chapter IX:	Employment contracts Prior notice
Art. 124.	Pregnant worker protection
Title III. Chapter I:	Work subject to special regimes Women's and minors' labor
Art. 127.	Special protection
Art. 128.	Prohibition of unhealthy or dangerous work
Art. 130.	Intermediate break
Art. 134.	Prohibition of activities against morals and good customs
Art. 135.	Maternity leave
Art. 136.	Coverage: employer and Social Security Institute of Honduras (IHSS)
Art. 137.	Leave in case of miscarriage or non-viable premature delivery
Art. 138.	Sick leave due to pregnancy or childbirth
Art. 139.	Pre- and post-natal allowance
Art. 140.	Facilities for breastfeeding workers
Art. 141.	Calculation of remuneration
Art. 142.	Infant care and feeding facility
Art. 143.	Counting the number of female workers
Art. 144.	Pregnant worker protection
Art. 145.	Authorization to dismiss pregnant women
Art. 146.	Compensation for not granting rest breaks
Art. 147.	Prohibition for heavy and night work
Art. 148.	Complaint for violation of regulations for the protection of women and minors

Source : Labor Code of Honduras (Decree No. 189 of 1959) of Edition initialed and agreed with national and international labor standards

(2) Gender Mainstreaming in State Institutions and Policies

1) Establishment of the Law of the National Women's Institute (INAM)

The Government of Honduras created **the Law of the National Women's Institute (INAM) by Decree No. 232-98**. The mission is "to achieve equal rights and equal opportunities for women and men in the

Honduran society by promoting women’s economic, civil, political, and cultural rights within a framework of democratic participation, social justice, and solidarity”. The INAM is composed of six departments, including the National Women's Board of Directors, as its organizational structure. And it has functions such as “to formulate, develop, promote, and coordinate the implementation and monitoring of the National Women's Policy and its integration into sustainable development, as well as the action plans that make them operative”.

The policy context for this is the Convention on the Elimination of All Forms of Discrimination Against Women, ratified by Honduras in 1982. Its Article 2 establishes: ‘The States Parties, condemn discrimination against women in all its forms, agree to pursue, by all appropriate means and without delay, a policy of eliminating discrimination against women’. And its Article 3 reads as follows: ‘States Parties shall take in all fields, in particular in the political, social, economic, and cultural fields, all appropriate measures, including legislation, to ensure the full development and advancement of women, for the purpose of guaranteeing them the exercise and enjoyment of human rights and fundamental freedoms on a basis of equality with men’.

Furthermore, at the Continental Summit of Heads of State and Government held in Santiago, Chile, in April 1998, and as in previous summits, the governments of the continent committed themselves to combat all forms of discrimination in the hemisphere, to promote equal rights and opportunities between women and men, with the objective of ensuring a dynamic participation of women in all areas of work of each of their countries.

2) "Equal Opportunity for Women Law"

In 2000, the Government of Honduras issued the **"Equal Opportunity for Women Law" (Decree No. 34-2000)**, which eliminates discrimination against women and clearly established equal opportunity as a right in law. In the area of "Labor and Social Security", which is particularly relevant to this Project, Chapter 4 of the law, “Equal Opportunities in Employment and Social Security”, stipulates prohibition of discrimination on the basis of sex and age (Article 46); equality in selection, employment, placement, promotion, and education and training (Article 48); protection of women during pregnancy and before and after childbirth (Article 51); prohibition of harassment for the purpose of dismissal (Article 60); and promotion of gender balance in the workplace (Article 67) as shown in Table 11.1.2.

Table 11.1.2 Provisions on Labor and Social Security as Presented in the Equal Opportunity for Women Law (Excerpts)

Chapter/Article	Contents of Provision
Chapter IV	Equal Opportunities in Employment and Social Security
Art. 46	The State shall not permit any kind of discrimination based on gender or on the age of a man or woman, with the purpose of nullifying or impairing equality of opportunity or treatment in employment or training.
Art. 48	Employers must provide equal opportunities under similar conditions to women in the aspects of selection, employment, job assignment, and promotion, as well as in training, education and training, and prohibit gender discrimination in staff cuts and dismissals.
Art. 51	The State and social actors shall promote the effective protection of women during pregnancy and the post-natal period, adopting written measures aimed at eliminating discrimination in

	employment and ensuring their job stability and prohibiting the performance of certain types of work that affect their health.
Art. 60	Sexual harassment committed by the employer or owner of the State or of a private company, entitles the worker or public servant, as the case may be, to terminate the employment relationship without notice and without liability on her part, retaining the right to benefits and compensation as in the case of unfair dismissal. When the harassment is carried out by a worker, he/she shall be immediately dismissed without liability for the employer or state institution.
Art. 67	It is the State's responsibility to promote the equal presence of women at all levels of public administration, helping to eliminate discrimination against women in access to and promotion within it.

Source: Equal Opportunity for Women Law (Decree No. 34-2000)

In response to the progress of the above legal developments, medium- and long-term policies such as **the First Equal Opportunity Plan 2002-2007** and **the Second Gender Equality and Equity Plan of Honduras 2010-2022** (II PIEGH) have been formulated at the policy level. The latter is a plan consisting of six policy axes, 43 policy agendas, and 206 strategic objectives, as shown in Table 11.1.3 below. Of particular relevance to this Project is "Axis 5: Promotion, protection, and guarantee of economic rights, labor, employment, and access to, use, and control of resources", which contains 10 policy agendas and 40 strategic objectives related to these agendas[1].

Table 11.1.3 Six Policy Axes in II PIEGH

Axis of II PIEGH	Number of Policy Agenda	Number of Strategic Objective
Axis 1: Promotion, protection, and guarantee of women's social and political participation and the exercise of their citizenship	5	18
Area 2: Promotion, protection, and guarantee of the right of women, girls, and adolescents to peace and a life with violence free	6	52
Area 3: Promotion, protection, and guarantee of women's health throughout the life cycle and sexual and reproductive rights	8	41
Area 4: Promotion, protection, and guarantee of the right to education, cultural, and intercultural rights and the right to information	9	30
Axis 5: Promotion, protection, and guarantee of economic rights, labor, employment, and access to, use, and control of resources	10	40
Axis 6: Gender, access, sustainable use, and control of biodiversity and natural resources	5	25
Total	43	206

Source: Second Gender Equality and Equity Plan of Honduras 2010-2022 - II PIEGH（2010）

(3) Gender Mainstreaming in the Water Sector

1) Gender Consideration in the National Drinking Water and Sanitation Plan

Following the above progress in gender mainstreaming in Honduran legislation and policy, the Government of Honduras is also promoting gender mainstreaming in its water sector policy. **The National Drinking Water and Sanitation Plan: PLANASA 2022-2030** was issued with a focus on risk management and climate resilience, in addition to the fulfillment of human rights with gender equity and inclusion of all people as important planning perspectives in the sector[2].

[1] INAM(2010), National Women's Policy: the second Gender Equality and Equity Plan of Honduras 2010-2022 - II PIEGH (P.129-136)
[2] CONASA (2022), PLANASA 2022-2030, Presentation (P.9) and Introduction (P.13)

In the PLANASA, it is said that the role that women and girls play in the drinking water and sanitation sector should be recognized, and therefore, sustainable and quality access to services represents a great change in their quality of life and wellbeing and that of the rest of their families. Therefore, the strengthening of strategies for effective and sustainable inclusion and gender-responsive participation is a key element regarding the application of the principle of non-discrimination and equality in the management and provision of services[3].

11.1.2 Statistical Status of Gender Mainstreaming

(1) Low Performance in the Global Gender Gap Index

Latin America and the Caribbean has bridged 72.6% of the gender gap in 2022, an increase of almost 0.4 percentage points since 2021. Based on the current pace of progress, the region will close its gender gap in 67 years (GGG Report 2022, World Economic Forum). Six of the 22 indexed countries in the Global Gender Gap Report 2022 improved their gender gap score by at least 1 percentage point. The rank of Honduras is shown in Table 11.1.4 (regional rank: 18th; the global rank of Honduras is 82th, which dropped from 67th).

Table 11.1.4 Global Gender Gap Index 2022 Rankings

Rank	Country	Score (0－1)	Score Change (2021)
82 (Global Rank)	Honduras	0.705	-0.011
18 (Regional Rank)			

Source：World Economic Forum (2022), Global Gender Gap Report 2022, p.10 and p.25

(2) Performance in the Subindex

Looking at the status for each subindex, Educational Attainment ranks highest in the world as shown in Table 11.1.5. While there are some improvements in the other three subindexes, the overall ranking remains stagnant. The ranking in Economic Participation and Opportunity has declined significantly since 2021 (from 52nd in 2021 to 96th in 2022) due to the increase of gender gap in the percentage of legislators, senior officials, and managers (1st: 2021→35th: 2022) and professional and technical workers (1st: 2021→84th: 2022).

Table 11.1.5 Global Gender Gap Subindex: Performance of Honduras

Subindex		Global Rank	Score (0－1)
Economic Participation and Opportunity	2022	96	0.643
	2021	52	0.721
Educational Attainment	2022	1	1.000
	2021	1	1.000
Health and Survival	2022	112	0.964
	2021	122	0.964
Political Empowerment	2022	71	0.213
	2021	85	0.179

Source: World Economic Forum (2022), Global Gender Gap Report, pp.15-16

[3] Ibid. (p.121)

As seen in Table 11.1.6, the UNDP Human Development Report (2022) also points out a very large difference in gender inequality (2021: 107th), especially in labor market participation rates (42.3 for women and 78.9 for men), as shown in Table 11.1.6 below. When the gender difference in the population with second basic education level (35.8 for women and 44.8 for men) is taken into account, it can be inferred that a much larger percentage of women are not employed in spite of having received this level of education.

Table 11.1.6 Gender Inequality Index of Honduras（2021）

Country	**Gender Inequality Index**		**Population with at least Some Secondary Education (% of 25 years old and over)**		**Labor Force Participation Rate (% of 15 years and older)**	
	Score	Rank	Women	Men	Women	Men
Honduras	0.431	107	35.8	44.8	42.3	78.9

Source: UNDP Human Development Report (2022), p.329

11.2 Gender Mainstreaming in UMAPS

11.2.1 Current Status and Challenges of Gender Mainstreaming in UMAPS

(1) Gender Mainstreaming in UMAPS Policies and Activities

Gender mainstreaming is an important national policy approach in Honduras. However, the water and sanitation sector is still a predominantly male sector, which in recent years shows a gradual incorporation of women in different job positions. However, it has not been found that this presence responds to previous planning or is a consequence of the political will expressed by the institution. Therefore, UMAPS has developed the **Gender Equality Policy for UMAPS** and the **Gender Equality Policy Action Plan**[4] **- UMAPS**. With the reorganization from SANNA to UMAPS, new labor regulations such as **Internal Labor Regulations** and **Ethics Regulations** are in process of development, as of August 2023, which also reflect gender mainstreaming.

1) Gender Equality Policy for UMAPS

The Board of Directors of UMAPS approved the **Gender Equality Policy for UMAPS** in Agreement No. 001 of Act 001 in January 2021. This is a policy guideline to promote gender mainstreaming in UMAPS and consists of seven principles and four strategic lines as shown in Table 11.2.1.

Table 11.2.1 Outline of the Gender Equality Policy for UMAPS

General Objectives: Establish a clear vision and assume commitments of strict compliance, which guide the process of gender mainstreaming in the Municipal Unit of Drinking Water and Sanitation - UMAPS - to influence policies, procedures, and institutional practices that accelerate the achievement of gender equality and non-discrimination in the workplace in the Municipality of the Central District.
Strategic Objectives: ➢ To build the organizational culture of UMAPS from a model that contributes to the reduction of gender inequalities in the workplace and to a gender-sensitive environment. ➢ To progressively achieve gender equality and empowerment of women workers in UMAPS, by reducing the gender gap in labor participation.

[4] For the details, please see the Gender Equality Policy Action Plan in Appendix-11

➢ To contribute to the eradication of gender-based violence in the UMAPS workplace.
Principles ➢ Equality ➢ Non-discrimination ➢ Human right to water and sanitation ➢ Transparency and accountability ➢ Importance of male involvement and participation ➢ Knowledge management in gender equality ➢ Sustainability
Strategic Lines ➢ Organizational culture -Development of common values -Balance between work and personal life -Gender equality training process ➢ Human resources management -Recruitment, selection, and hiring processes -Equal pay -Training and professional development processes -Management tools ➢ Safe working space free of discrimination and gender-based violence -Prevention of gender-based violence against women -Prevention and eradication of sexual harassment in the workplace ➢ Resources and responsibilities -Gender Equality Unit -Human Resources Deputy Manager -Budget
Strategic policy communication ➢ Internal communication ➢ External communication
Construction of Strategic Alliances

Source: UMAPS (2021), Gender Equality Policy for UMAPS

2) Gender Equality Policy Action Plan - UMAPS

As stated in Chapter 9 Action Plan of the Gender Equality Policy for UMAPS, it is mandatory to implement an action plan that determines the actions, objectives, goals, follow-up, and monitoring of the execution of this instrument (see Table 11.2.2).

The action plan has its general objective to establish a clear vision and to assume commitments of strict compliance, which guide the process of gender mainstreaming in the UMAPS, and to influence policies, procedures, and institutional practices that accelerate the achievement of gender equality and non-discrimination in the workplace in the Municipality of the Central District in the next ten years.

Therefore, as shown in Table 11.2.2, the action plan has 30 actions with target period, indicator, etc., and these actions are to be implemented mainly by the UMAPS Human Resources Sub-Management and its internal Gender Equality Unit.

On the other hand, because it was planned during the transfer process from SANAA to UMAPS, the target period for implementation is subject to the timeline of the handover process by the senior management of the UMAPS who will determine the actual dates.

Table 11.2.2 Outline of Gender Equality Policy Action Plan - UMAPS

General Objective: To establish a clear vision and assume commitments of strict compliance, which guide the process of gender mainstreaming in the Municipal Unit of Potable Water and Sanitation-UMAPS, to influence policies, procedures, and institutional practices that accelerate the achievement of gender equality and non-discrimination in the workplace in the Municipality of the Central District in the next ten years.	
Strategic Directions/Actions	
1.	Generate a process of appropriation of the Gender Equality Policy among UMAPS personnel (institutionalization).
2.	Creation of the organizational structure of the Gender Equality Unit in the UMAPS Organization's and Function's Regulation (technical team, functions).
3.	Creation and approval of the budget items for the operation of the Gender Equality Unit.
4.	Permanent socialization of the gender equality policy and the application instruments in Human Resources management.
5.	Design, approve, and implement a training plan to implement the gender policy, incorporated into the General Training and Education Plan of the UMAPS Human Resources Sub-management Office.
6.	Elaboration of a training plan based on a diagnosis of knowledge, attitudes, and practices on gender equality policy with the objective of dismantling patriarchal and heteronormative conceptions that sustain gender inequality.
7.	Execution of the training process through face-to-face or virtual workshops on gender equality policy with emphasis on the exercise of power relations that sustain gender inequality.
8.	Create, approve, and implement a career mentoring program for UMAPS women workers (high impact activity).
9.	Development of the investment plan and allocation of resources for the construction of infrastructure and equipment, with the objective of ensuring adequate and convenient facilities within the framework of the implementation of the Gender Equality Policy.
10.	Elaborate a five-year development plan that incorporates the implementation of essential services needed by workers in order to ensure decent working conditions according to the gender criteria (safe and well-lit sanitary facilities, childcare centers, breastfeeding rooms, etc.) in coordination with the UMAPS Health and Safety Regulations.
11.	Optimization of services for women and men and of breastfeeding rooms by taking into account the differentiated needs (sanitary facilities, breastfeeding rooms, and nurseries).
12.	Strategic communication of the Gender Equality Policy internally and externally to UMAPS.
13.	Create, approve, and execute the "Annual Participative Meetings" to discuss the progress, difficulties, and challenges in the implementation of the gender equality policy, as well as to gather suggestions from the voices of the workers.
14.	Building strategic alliances with various sectors of the state and society, such as academia, NGOs, universities, international cooperation, and mainly with the governing entity on gender issues.
Strategic Guideline 1: Progressively achieve gender equality and empowerment of UMAPS' women workers by reducing the gender gap in labor participation.	
1.	The human resources management system incorporates the gender approach to increase the number of women with competencies in decision-making positions and at middle management technical levels, with an annual increase of 5%.
2.	Development or adaptation of instruments that incorporate gender criteria to increase the participation of women with competencies in management and operational positions in the UMAPS. Instruments: Recruitment, selection, hiring, evaluation, recognition, and labor flexibility.
3.	Establish an ad hoc committee for the selection and performance evaluation of personnel with members that have expertise in the management of the gender approach by taking into account the parity criteria.
4.	Design, approve, and execute a women's empowerment plan to strengthen their skills on leadership, negotiation, and management according to identified gaps by taking into account the transformation of asymmetrical power relations between genders.
Strategic Guideline 2: Contribute to the eradication of gender-based violence in the UMAPS workplace.	
1.	Install mechanisms to prevent gender-based violence in UMAPS.
2.	Design and implement a training plan on the prevention of gender-based violence with differentiated groups of men and women in the UMAPS.
3.	Design and implement a sensitization/training plan on new masculinities aimed at UMAPS male workers, according to priorities.
4.	Elaborate route to activate inter-institutional protection mechanisms in cases of risk or situation of gender-based violence (GBV).
5.	Generate institutional regulatory frameworks to prevent and report sexual harassment in the workplace.
6.	Develop and approve a special protocol on prevention and action in cases of sexual harassment in the workplace.
7.	Dissemination and training of UMAPS management and operational personnel on the protocol for sexual harassment

	in the workplace.
8.	Internal communication campaign to prevent sexual harassment in the workplace.
9.	Design, layout, and disseminate communication materials in visible, high-traffic places about the right to live a life free of GBV and to work in a safe space without sexual harassment.
Monitoring and evaluation of the implementation of the Gender Equality Policy	
1.	Every two years, an internal participatory mid-term evaluation is carried out about the implementation of the gender policy.
2.	Conduct a final external evaluation of the implementation of the gender policy every five years.
3.	Elaboration of a control and follow-up plan to verify the progress of compliance with the policy and its action plan (monitoring).

Source: UMAPS

3) Gender Balance in the UMAPS[5]

Looking at the gender balance in UMAPS, both organization-wide and by unit/department, Table 11.2.3 shows that there are 142 female and 767 male employees overall, with the former accounting for 16% and the latter for 84%, making the number of male employees overwhelmingly high. This is not much change from the situation in SANAA before the transition to UMAPS, where the female percentage was 15.2%[6].

On the other hand, looking at the management/sub-management, the percentage of women tends to be high in Human Resource Sub-Management (80%) and General Management (59%), while the percentage of men is high in other sub-managements. These are mainly engineering sub-managements, such as the Drinking Water Sub-Management, as well as Finance Sub-Management, and Service Sub-Management.

[5] Figures as of the end of February 2023 confirmed by the UMAPS Human Resources Sub-Management
[6] WB(2020), Evaluation Document: Project of Strengthening Tegucigalpa's Drinking Water Services (P170469)

Table 11.2.3 Gender Balance of UMAPS

	UNIT/DEPARTMENTS	Female		Male	
1	**GENERAL MANAGEMENT**	**13**	**59%**	**9**	**41%**
	GENERAL MANAGEMENT	7	54%	6	46%
	GENERAL SECRETARY	3	100%	0	0%
	TRANSPARENCY AND ACCESS TO PUBLIC INFORMATION UNIT	1	100%	0	0%
	LEGAL ADVISORY UNIT	2	67%	1	33%
	PUBLIC RELATIONS	0	0%	2	100%
2	**ADMINISTRATIVE FINANCIAL SUB-MANAGEMENT**	**38**	**18%**	**170**	**82%**
	ADMINISTRATIVE FINANCIAL SUB-MANAGEMENT	7	58%	5	42%
	GENERAL SERVICES	12	14%	73	86%
	CONTRACTS AND TENDERS	1	50%	1	50%
	PURCHASING AND SUPPLIES	4	80%	1	20%
	TRANSPORT	1	1%	72	99%
	ACCOUNTING	4	67%	2	33%
	TREASURY	1	50%	1	50%
	WAREHOUSE	3	38%	5	63%
	BUDGET	3	75%	1	25%
	FINANCIAL PROGRAMMING	2	100%	0	0%
	ADMINISTRATION	2	67%	1	33%
	ASSETS	0	0%	7	100%
3	**COMMERCIAL SUB-MANAGEMENT**	**46**	**32%**	**99**	**68%**
	COMMERCIAL SUB-MANAGEMENT	1	50%	1	50%
	CUSTOMER ATTENTION AND SERVICE	21	75%	7	25%
	CUSTOMER REGISTRATION	5	20%	20	80%
	RECOVERY	6	19%	25	81%
	BILLING	8	80%	2	20%
	USER EDUCATION AND QUALITY	2	40%	3	60%
	COLLECTION	9	26%	25	74%
	MEASUREMENT	0	0%	41	100%
4	**DRINKING WATER SUB-MANAGEMENT**	**16**	**4%**	**412**	**96%**
	DRINKING WATER SUB-MANAGEMENT	2	40%	3	60%
	LA CONCEPCION SUBSYSTEM	4	6%	58	94%
	AQUABLOQ	3	33%	6	67%
	BLOCK DISTRIBUTION SUBSYSTEM	2	1%	242	99%
	EL PICACHO SUBSYSTEM	1	3%	37	97%
	LOS LAURELES SUBSYSTEM	1	6%	15	94%
	REPAIR AND MAINTENANCE	3	6%	51	94%
5	**SANITARY SEWERAGE AND STORM DRAINAGE SUB-MANAGEMENT**	**9**	**12%**	**67**	**88%**
	SANITARY SEWERAGE AND STORM DRAINAGE SUB-MANAGEMENT	0	0%	1	100%
	ALCANTARILLADO SANITARIO	5	8%	60	92%
	TRATAMIENTO DE AGUAS RESIDUALES	4	36%	7	64%
6	**SUBGERENCIA DE INGENIERIA Y DESARROLLO**	**4**	**40%**	**6**	**60%**
	ENGINEERING AND DEVELOPMENT SUB-MANAGEMENT	3	60%	2	40%
	HYDROLOGY AND GEO-HYDROLOGY	0	0%	1	100%
	ELECTROMECHANICS	0	0%	2	100%
	DESIGN, STANDARDS AND SUPERVISION	1	50%	1	50%
7	**HUMAN RESOURCE SUB-MANAGEMENT**	**16**	**80%**	**4**	**20%**
	HUMAN RESOURCE SUB-MANAGEMENT	7	70%	3	30%
	LABOR RELATIONS	2	100%	0	0%
	PAYROLLS	5	83%	1	17%
	OCCUPATIONAL HEALTH	2	100%	0	0%
	Total	**142**	**16%**	**767**	**84%**

Source: UMAPS Human Resource Department (End of Feb. 2023)
Note: There are cases where a person belongs to more than one department.

On the other hand, the gender balance in senior and middle management positions is 16 women (34%) and 31 men (66%), as shown in Table 11.2.4, which is an improvement of the ratio for UMAPS as a whole. In this respect, UMAPS has achieved the numerical target set forth in the action plan (by the end of 2025, at least 25% of managerial and middle management positions are occupied by women in UMAPS).

Table 11.2.4 Gender Balance in Senior and Middle Management Positions

UNIT/DEPARTMENTS	Sex	%
BOARD OF DIRECTORS		
Municipal Mayor or his/her representative	M	
Three Councilors of the Municipal Corporation	-	
Representative of the Water Administration Boards of Urban Area 1	F	
Representative of the Water Administration Boards of Urban Area 2	F	
Representative of the Chamber of Commerce and Industry of Tegucigalpa CCIT	M	
Representative of the Association of Municipalities of Honduras AMHON	M	
Representative of the Honduran Chamber of the Construction Industry CHICO	M	
Secretary of the UMAPS Board of Directors	M	
INTERNAL AUDIT	F	
GENERAL MANAGER	M	
General Secretary	F	
Public Relations Manager	M	
Legal Advisory Unit	M	
Transparency and Access to Public Information Unit	F	
Management Planning and Evaluation Unit	F	
Administrative and Financial Sub-Management	M	
Commercial Sub-Management	F	
Sanitary Sewage and Storm Drainage Sub-Management	M	
Engineering and Development Sub-Management	M	
Human Resources Sub-Management	F	
Administration	M	
Information Technology and Systems	M	
Contracts and Tenders	F	
Purchasing and Supplies	M	
Transport	M	
Warehouse	M	
Assets	M	
General Services	M	
Finance	M	
Accounting and Budget	F	
Financial Programming	F	
Treasury	M	
Customer Service and Attention	F	
Measurement	M	
Billing	M	
Recovery and Collections	F	
Customer Registration	M	
User Education	F	
Block Distribution Subsystem	M	
Drinking Water Treatment Plant Manager	M	
Concepción Subsystem	M	
Los Laureles Subsystem	M	
El Picacho Subsystem	M	
Wastewater Treatment	M	
Design, Standards and Supervision	F	
Hydrology and Geo-hydrology	M	
Hydrographic Basins	M	
Payroll Manager	F	
Male	**31**	**66%**
Female	**16**	**34%**

Source: UMAPS Human Resource Sub-Management (End of Feb. 2023)

(2) Challenges Faced by UMAPS

Although UMAPS has been working incrementally to develop the Gender Equality Policy and the action plan and to improve the gender balance within the organization as described above, progress in organizational reforms reflecting gender mainstreaming has not been sufficient, and several challenges can be observed.

The first is that the Gender Unit under the Human Resources Sub-Management has been vacant for an extended period of time (as of the end of August 2023) due to delays in the transition process from SANAA to UMAPS and its impact on personnel transfers. This is directly related to the delay in the implementation of the action plan, which requires immediate action. The construction of nursing rooms, women's restrooms, and other facilities specified in the action plan are also pending, which is a negative factor for the improvement of the working environment in order to systematically increase the number of female workers in the future.

Second, some units/departments have a very low ratio of women. It is pointed out that in some fields, such as the engineering departments, there are few female personnel in the labor market. While in some departments, such as the service department, female staff do not want to work due to inadequate safety measures and working environment. For example, security measures are inadequate when collecting fees at communities. Although they work in groups of men and women, they are not provided with adequate security measures. Unnecessary friction with local residents tends to happen because staff of UMAPS are not wearing uniforms when visiting communities and are not recognized as part of UMAPS operations.

Third, it is pointed out that **UMAPS Internal Labor Regulations** and **Ethics Regulations** are currently in the process of approval[7] and expected to be fully recognized among all of the UMAPS workers. The UMAPS Internal Labor Regulations is in compliance with the Labor Code and includes the rights and protection of women workers appropriately[8]. And based on the UMAPS Ethics Regulations, as part of the anti-harassment measures, an ethics committee will be established and a suggestion box (complaint post) will be also created to identify and promptly resolve grievances, dissatisfaction, and complaints within the organization.

11.2.2 Donors' Support for Gender Mainstreaming in UMAPS

(1) Current Status of Donors' Support

The main support donors are WB and IDB. The gender mainstreaming has been positioned as an essential requirement in recent years in support of UMAPS.

1) WB

The WB implemented the Project of Strengthening Tegucigalpa's Drinking Water Services (P170469) where Component 1: Operationalization of the New Service Provider in Tegucigalpa was carried out

[7] Interview with UMAPS Human Resources Sub-management (July 28, 2023)
[8] Ditto.

with gender mainstreaming activity such as development and implementation of a gender policy to encourage a gender-sensitive work environment, including the improvement of gender equality. In Component 3: Project Management and Technical Assistance, gender gap analysis was conducted to explore disparities related to water supply services in specific areas.

The Project design reflects a strong gender focus. On the one hand, it contributes to reducing water-related gender gaps by supporting the development and implementation of a gender policy that increases the employment of women in high-level decision making as well as in technical positions in UMAPS. The Project also supports a gender gap analysis on the impacts of intermittent services on male and female household members in the target areas. UMAPS could use well-sampled data, primarily derived from the focus group and household surveys, to inform a future strategy that prioritizes service improvement intervention in areas where women benefit the most[9].

2) IDB

In the Water and Sanitation Reform Program in the Central District (HO-L1207), the IDB has been strengthening UMAPS' capacity through the implementation of its five components. Among them, Component 2: Operational and Management Development aims to contribute to the organizational development of the UMAPS and the development of sectoral and management information systems to obtain timely and reliable information. This is achieved through the implementation of a corporate governance action plan, an improvement plan including the peri-urban area, guidelines for the formulation of the human resources plan and strengthening of the UMAPS in gender equity, a business plan that includes investment needs for the next five years, monitoring and control scheme, and guidelines for the preparation of the gender action plan[10].

11.3 Gender Mainstreaming in the Construction Industry

11.3.1 Gender Mainstreaming in the Construction Industry: Current Status and Challenges

(1) Current Status of the Construction Industry

Statistics in Honduras show that women in the construction sector are relatively earning higher and are better educated than men, but they are a very small minority in the construction sector as a whole.

As for the labor market, with the data provided by INE (LXXIV Permanent Multi-purpose Household Survey, 2022), at the national level, a clear gender gap can be observed in the labor sector. **In the construction, a great disparity is observed in the number of men and women employed, with men having much more representatives than women. In this case, men outnumbered women by more than 150 times.**

Income level at the national level shows **the average income of men in construction is at Lps 6,740 per month, while that of women is Lps 7,241.**

[9] WB(2020), Evaluation Document: Project of Strengthening Tegucigalpa's Drinking Water Services (P170469)

[10] IDB(2019), Water and Sanitation Reform Program in the Central District (HO-L1207), Project Profile

As to education level by occupational category, it is observed that **women working in construction have an average of 11.9 years of study, while men in the same category have an average of 7 years.**

Although not confirmed by statistics, the impression that administrative staff and consultants have of the construction industry is that **while there are female employees engaged in office work such as design, procurement, and administrative work, there are still only a few in the construction workforce.** In general, construction workplaces are not popular among female workers due to the strong impression of heavy work[11].

(2) Challenges in the Construction Industry

In addition, compliance with the Labor Code and improvement of the rights and working environment for female employees tend not to be well observed in the construction industry. Infrastructure to ensure the working environment for female workers, such as separate restrooms for men and women, nursing rooms, and restrooms for women, is virtually nonexistent[12].

11.4 Promoting Gender Mainstreaming in the Project

11.4.1 Design, Specifications, and Initiatives to Resolve Gender Issues within the Framework of the Project

(1) Promotion of Gender Mainstreaming in UMAPS (It is to be implemented in the annual UMAPS budget)

It is important to move from the stage of formulation and development of gender-related policies, plans, and regulations in UMAPS to the stage of concrete implementation of them in practice. Basically, activities for gender mainstreaming should focus on the promotion of the UMAPS Gender Action Plan, but with particular emphasis on the following points.

Promote organizational and institutional reform of UMAPS: 1) Promote the gender action plan by assigning personnel to the gender unit, 2) Continue efforts to increase the number of female employees, and 3) Ensure that new rules, including Internal Labor Regulations and the Ethics Regulations, are well known, and complied with throughout the organization.

Improvement of working environment for female employees: Infrastructure improvement, particularly the provision of separate men's and women's rooms for break and health and nursing room in UMAPS headquarter, is urgently needed. By ensuring a safe working environment, it is aimed to improve operational performance through the retention and continued employment of female employees.

Improvement of working environment for employees outside the office: In particular, it is necessary to change unpopular workplaces for female employees into more attractive ones through improving the working environment for employees working onsite in residential areas like colonias/barrios. There is an urgent need to improve the working environment and dissatisfaction among female field workers

[11] Interviews with UMAPS and construction consultants (February 2023)
[12] Ditto.

(meter reading, billing, water tariff collection, O&M etc.). Measures to address public safety should be taken by 1) providing uniforms with UMAPS' name and logos for both men and women to evade unnecessary friction with local people, 2) giving them cell phones procured by UMAPS instead of using their own cell phones, and 3) strengthening cooperation with AMDC and the police for security control in the field work.

(2) Improvement of working environment for construction workers (to be included in the bidding documents of the Project)

Improvement of the working environment through compliance with Labor Laws is essential. UMAPS will take the lead in taking an approach that considers the working conditions of women, especially at construction sites, in construction projects that it supervises, in order to serve as a model case for the gender mainstreaming of the construction sector in the future.

Improvement of working environment at the construction site: separate men's and women's restrooms and toilets in each construction site (It is included in the project budget as miscellaneous item in the cost estimate)

Safety management at construction site: 1) strengthen safety measures around socially unsafe construction sites in cooperation and coordination with AMDC's Urban Mobility Management Office and the police and 2) take into consideration carefully demarcation of work for women at the construction sites, and mandate the establishment of an organizational harassment hotline in the construction management.

11.4.2 Examination of the Need to Set Outputs (Operations and Effects) from a Gender Perspective

UMAPS has set outputs when formulating its gender action plan. By following this plan, UMAPS's organizational activities should be operated with clear output settings. The same institutional design also should be followed in the implementation of construction projects such as this Project.

11.4.3 Establish Operational and Effectiveness Indicators to Ensure and Measure the Design, Specifications, and Initiatives from a Gender Perspective

Necessary indicators will be set with activity, implementer, output, and financial source as shown in the following Table 11.4.1.

Table 11.4.1 Table of Activities for Gender Mainstreaming in the Project

Activity	Implementer	Output	Indicator	Financial Source
Promote Organizational and Institutional Reform of UMAPS				
Promote the gender action plan by assigning personnel to the gender unit	UMAPS Human Resources Sub-management	Outputs in gender action plan achieved	Assignment of staff to the gender units. Number of outputs achieved in the gender action plan.	UMAPS annual budget

Continue efforts to increase the number of female employees	UMAPS Human Resources Sub-management	Number of female workers increased	Percentage of female worker in UMAPS	UMAPS annual budget
Ensure that new rules, including Internal Labor Regulations and the Ethics Regulations, are well known, and complied with throughout the organization	UMAPS Human Resources Sub-management	Regulations are well understood by staffs.	Percentage of staffs who know the regulations. Number of harassment cases recognized in UMAPS	UMAPS annual budget
Improvement of Working Environment for Female Employees				
Men's and women's rooms for break and health in UMAPS headquarter is constructed.	UMAPS Financial Administrative Sub-management	Female workers own restrooms.	Number of restrooms. Number of restroom users.	UMAPS annual budget
Nursing room in UMAPS headquarter is constructed.	UMAPS Financial Administrative Sub-management	Working mothers in UMAPS own nursing room.	Number of nursing room Number of nursing room user	UMAPS annual budget
Improvement of Working Environment for Employees Outside the Office				
Providing uniforms with UMAPS' name and logos for both men and women to evade unnecessary friction with local people in the field work	UMAPS Commercial Sub-management	Uniform provided	Number of field worker with uniform	UMAPS annual budget
Giving them cell phones procured by UMAPS instead of using their own cellphones	UMAPS Commercial Sub-management	Cell phone provided	Number of field worker with cell phone given	UMAPS annual budget
Strengthening cooperation with AMDC and the police for security control in the field work	UMAPS Commercial Sub-management	Conflict and/or accident in the field work reduced	Number of conflict and/or accident in the field work	UMAPS annual budget
Improvement of Working Environment at Construction Site				
Separate men's and women's restrooms in each construction site	Constructor	Restroom constructed in the project site	Percentage of construction site with separate restroom	Project budget for construction
Separate men's and women's toilets in each construction site	Constructor	Separate toilets constructed in the project site	Percentage of construction site with separate toilets	Project budget for construction
Safety Management at Construction Site				
Strengthen safety measures around socially unsafe construction sites in cooperation and coordination with AMDC's Urban Mobility Management Office and the police	Constructor	Conflict and/or accident do not happen at construction site	Number of conflict and/or accident at construction sites.	Project budget for construction
Mandate the establishment of an organizational harassment hotline in the construction management	Constructor	Harassment hotline established	Number of harassment cases recorded in hotline	Project budget for construction

Source: JICA Study Team

CHAPTER 12 STUDY ON CLIMATE CHANGE ASPECTS

12.1 Climate Change Adaptation

12.1.1 Exposures in this Project

Exposure is defined as "the presence of people, livelihoods, species or ecosystems, environmental functions and services and resources, infrastructure or economic, social or cultural assets in locations and environments that may be adversely affected"[1]. Therefore, taking into account the proposed Project plan, the relevant infrastructure (especially water source facilities, etc.) necessary for the Project and information on ancillary facilities, and the socio-economic conditions (especially water supply conditions) in the Project area, the exposure for the Project is identified as shown in Table 12.1.1.

Table 12.1.1 Exposures in this Project

Exposures	Area under Consideration	Reasons for Selection
1. Water main	Draft Project plan (Project request form)	Central District is a city formed in a basin surrounded by mountains with a specific elevation of about 500 m. The surrounding slopes are well developed with landslide topography[2].
2. Reservoir	Same as above	
3. Pipe network	Same as above	
4. Water pumping station	Same as above	
5. Water meter	Same as above	
6. Water source facilities (dams)	Relevant infrastructure necessary for this Project	Chronic shortage of water supply in the Central District.
7. Water supply service for residents in the Central District	Socio-economic conditions	

Source: JICA Study Team

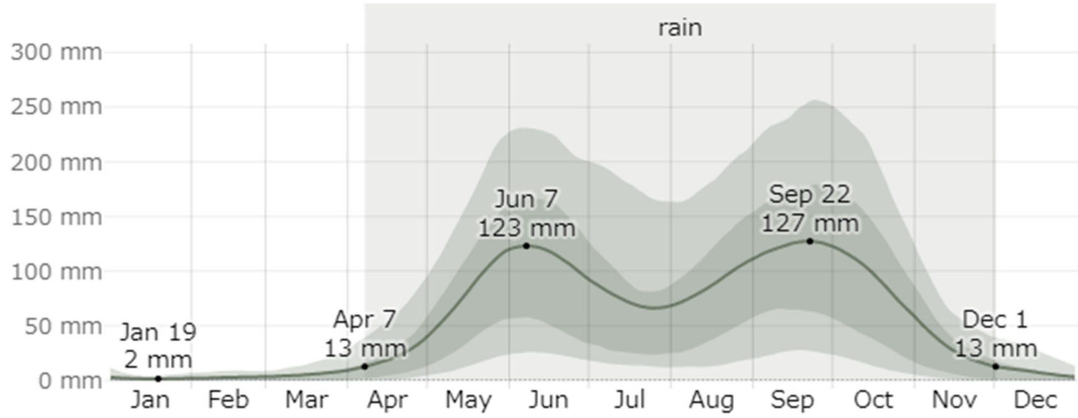
12.1.2 Hazards Associated with this Project

A hazard is defined as a climate-related physical event, trend, or their physical effects. As a result of the survey, three climate-related hazards that may be relevant to this Project were identified such as drought due to decreased annual precipitation, flooding due to heavy rainfall/storms, and landslides due to heavy rainfall/storms.

(1) Drought Due to Decreased Annual Precipitation

The Central District of the Project area belongs to the Savannah climate (Aw) in the Köppen Climate Classification. As shown in Figure 12.1.1, the rainy period of the year lasts for eight months, from April to December. The month with the most rain in Tegucigalpa is September, with an average rainfall of 125 millimeters. The rainless period of the year lasts for four months, from December to April. The month with the least rain in Tegucigalpa is January, with an average rainfall of 2 millimeters. Availability of water resource is limited by this climate pattern and is always critical in the Central District, which is under the pressure of water demand due to increasing population and economic activities.

[1] JICA (2019), JICA Climate-FIT (Adaptation): Climate Change Support Tools/Adaptation Measures - Guidance for Climate Risk Assessment and Adaptation Study, Table 2 (p. 9).
[2] Sato/Kamiya/Hirota (2015), Technical Report: Investigation and Mitigation of Landslides in Republic of Honduras as Japan's International Cooperation Program, Journal of the Japan Landslide Society, Vol.52, No.4, 165(2015)



Source: https://weatherspark.com/y/13697/Average-Weather-in-Tegucigalpa-Honduras-Year-Round

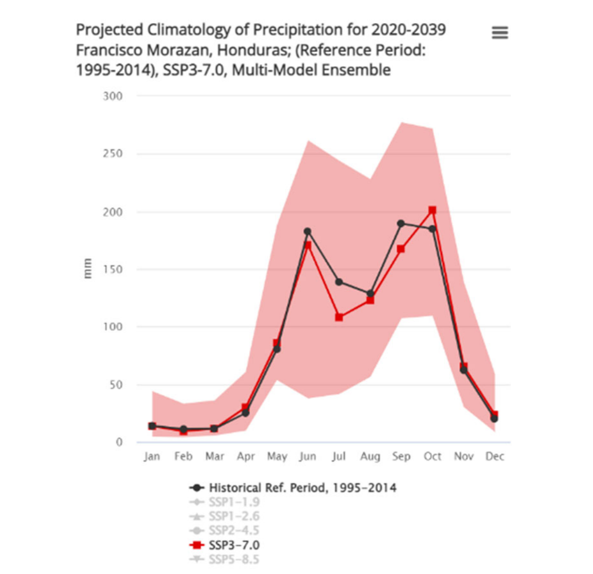
Figure 12.1.1 Monthly Precipitation in Tegucigalpa

According to the World Bank's future projections, based on the Shared Socioeconomic Pathways (SSP) scenarios (See Table 12.1.2) in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, SSP3-7.0, and SSP5-8.5, there will be a significant decrease in monthly precipitation during the peak rainy season and annual precipitation in Francisco Morazán Department, where the Central District is located (See Figure 12.1.2). According to these scenarios, the risk of drought in the Central District would be higher if climate policies were not adopted.

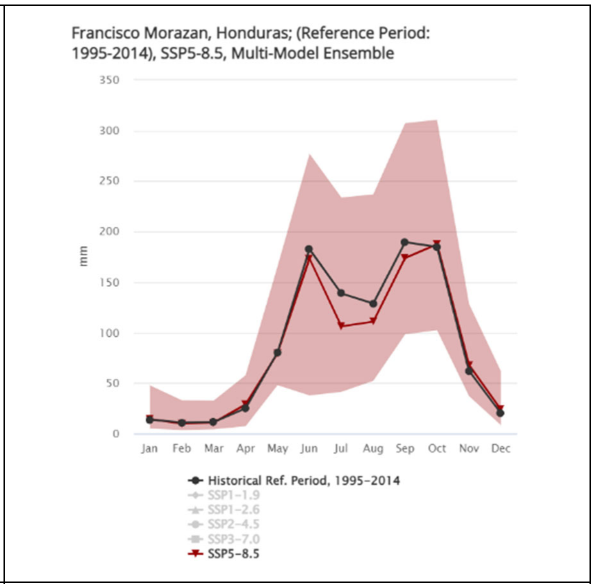
Table 12.1.2 Summary of SSP Scenarios

Scenario	Summary of SSP
SSP1-1.9	Scenario for keeping temperature rise below 1.5 °C under sustainable development: Policies to keep temperature rise (pre-industrial base) below 1.5 °C by the end of the 21st century - Net zero CO_2 emissions expected in the mid-21st century
SSP1-2.6	Scenario for keeping temperature rise to less than 2 °C under sustainable development: Policies to keep temperature rise (pre-industrial base) to less than 2 °C by the end of the 21st century - Net zero CO_2 emissions expected in the second half of the 21st century
SSP2-4.5	Scenario with climate policy under middle way development: roughly at the upper limit of emissions with aggregate national reduction targets (Nationally Determined Contribution: NDCs) for each country by 2030
SSP3-7.0	Scenario without climate policy under regionally confrontational development
SSP5-8.5	Maximum emissions scenario without climate policy under fossil fuel dependent development

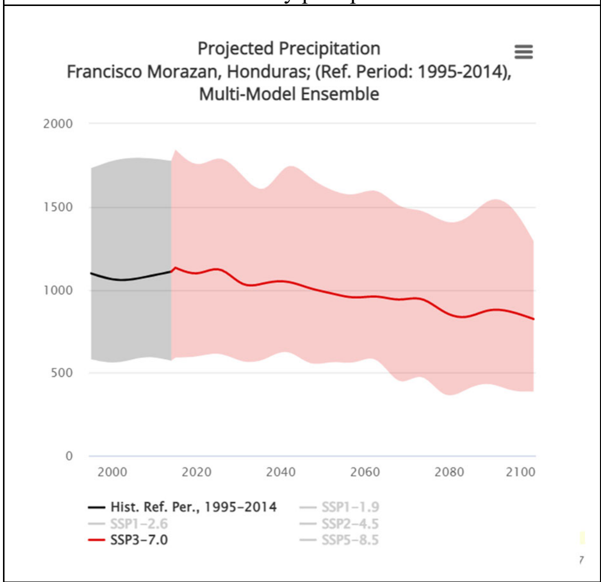
Source: Compiled by Japan Center for Climate Change Actions (JCCCA) based on the IPCC Sixth Assessment Report and materials from the Ministry of the Environment of Japan.



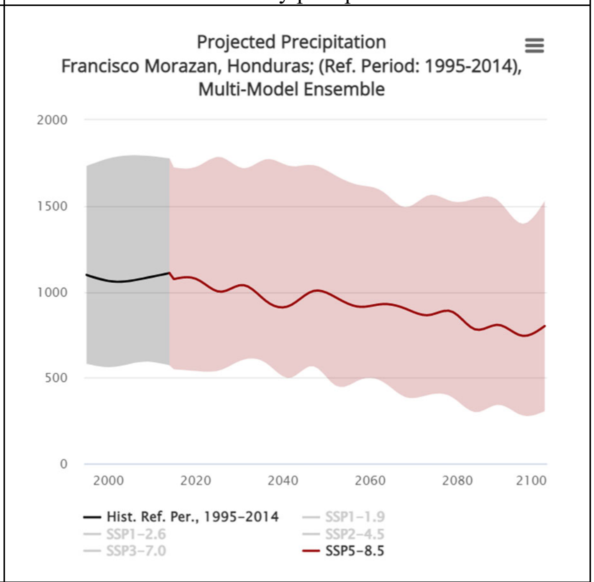
SSP3-7.0：Monthly precipitation forecast



SSP5-8.5：Monthly precipitation forecast



SSP3-7.0：Annual precipitation forecast



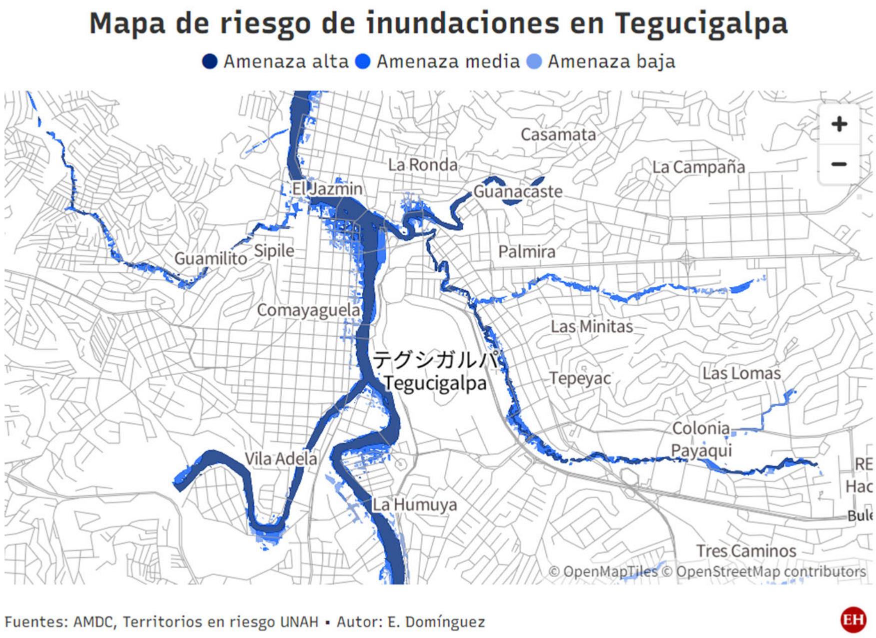
SSP5-8.5：Annual precipitation forecast

Source: WB Climate Change Knowledge Portal, https://climateknowledgeportal.worldbank.org/country/honduras/climate-data-projections

Figure 12.1.2 Precipitation Forecast Based on the SSP Scenario: Francisco Morazán Department

(2) Flooding Due to Heavy Rainfall/Storms

Although no statistical records of flooding in the Central District have been identified in this study, the risk of flooding has been noted in the past, as exemplified by the heavy rainfall disaster caused by Hurricane Mitch in 1998, which resulted in large-scale flooding damage. The mayor's office of the Central District (*Alcaldía Municipal del Distrito Central*: AMDC) has developed a flood risk map for the Central District (see Figure 12.1.3), which visualizes the risk of flooding around the Choluteca River and its tributaries that flow through the center of the city.

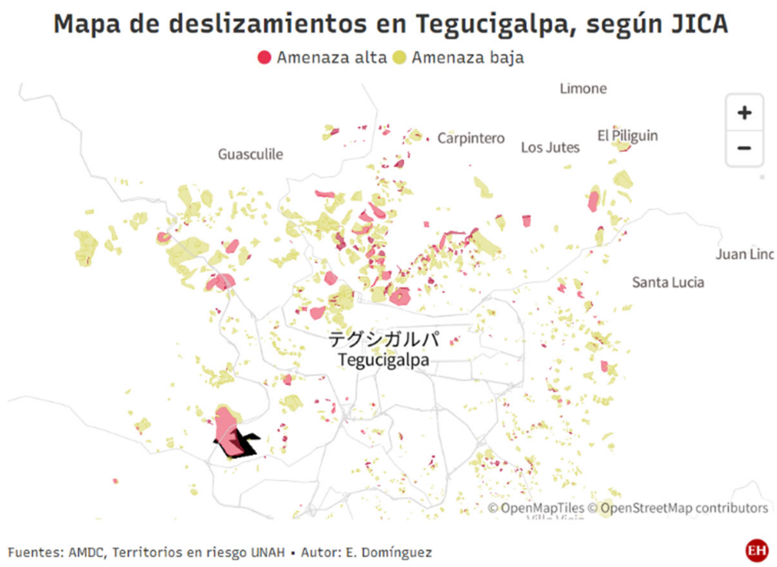


Source: https://flo.uri.sh/visualisation/3802948/embed

Figure 12.1.3 Central District Flood Risk Map

(3) Landslides Due to Heavy Rainfall/Storms

Landslides are also a high risk due to the surrounding topography in which the Central District is located. A landslide risk map (see Figure 12.1.4) prepared by AMDC with JICA support shows the risk of landslides in many areas of the Central District.



Source: https://www.elheraldo.hn/elheraldoplus/interactivos/los-mapas-del-riesgo-en-tegucigalpa-si-vives-en-estas-zonas-mantente-alerta-OYEH1410385

Figure 12.1.4 Central District Landslide Risk Map

In relation to the above flood and landslide risks, Table 12.1.3 below shows a total of 26 heavy rainfall/storms[3] that have affected the land of Honduras since 2000. Although not all of these have affected the Central District, these are recognized as one of the major causes of natural disasters in Honduras.

Table 12.1.3 Heavy Rainfall/Storms Affecting the Land of Honduras (since 2000)

	Date	Name	Category
1	**2020, 16 November**	**Iota**	**Tropical Storm**
2	**2020, 4 November**	**Eta**	**Tropical Storm**
3	2012, 01-10 August	Huracán Ernesto	Hurricane Category 1
4	2011, 23-28 October	Huracán Rina	Hurricane Category 2
5	2011, 19-22 August	Harvey	Tropical Storm
6	2010, 21-26 October	Richard	Tropical Storm
7	2010, 11-15 October	Huracán Paula	Hurricane Category 2
8	2010, 23-26 September	Matthew	Tropical Storm
9	2010, 25 June-02 July	Huracán Alex	Hurricane Category 2
10	2009, 04-10 November	Huracán Ida	Hurricane Category 2
11	2008, 14-16 October	Sixtee	Tropical Depression
12	2008, 05-10 November	Huracán Paloma	Hurricane Category 4
13	2007, 31 August-5 September	Huracán Felix	Hurricane Category 5
14	2007, 13-23 August	Huracán Dean	Hurricane Category 5
15	2005, 15-25 October	Huracán Wilma	Hurricane Category 5
16	**2005, 27-31 October**	**Huracán Beta**	**Hurricane Category 3**
17	2005, 11-21 July	Huracán Emily	Hurricane Category 4
18	**2005, 18-21 November**	**Gamma**	**Tropical Storm**
19	2005, 08-31 June	Arlene	Tropical Storm
20	2003, 08-16 July	Huracán Claudette	Hurricane Category 1
21	2002, 14-16 October	Fourteen	Tropical Depression
22	2001, 28 October-6 November	Huracán Michelle	Hurricane Category 4
23	2001, 04-09 October	Huracán Iris	Hurricane Category 4
24	**2001, -**	**Michelle**	**-**
25	2001, 15-22 August	Chantal	Tropical Storm
26	2000, 28 September-6 October	Huracán Keith	Hurricane Category 4

Note: Bolded designations are those said to have caused more extensive damage.
Source：https://www.laprensa.hn/honduras/catastrofes-naturales-honduras-ruta-tormentas-huracanes-FWLP1441602

For reference, Table 12.1.4 below shows their classification based on wind speed (one-minute average maximum wind speed). As shown in Table 12.1.3, three cases of Hurricane Category 5 (70 m/s or more) and five cases of Hurricane Category 4 (59 or more ~ less than 70 m/s) have been recorded in Honduras in the past.

Table 12.1.4 Classification of Hurricane

One-minute Average Maximum Wind Speed	Classification
Less than 17 m/s	Tropical Depression
17 or more~ less than 33 m/s	Tropical Storm
33 or more~ less than 43 m/s	Hurricane Category 1
43 or more~ less than 50 m/s	Hurricane Category 2
50 or more~ less than 59 m/s	Hurricane Category 3
59 or more~ less than 70 m/s	Hurricane Category 4

[3] A hurricane is a tropical depression in the North Atlantic, Caribbean Sea, Gulf of Mexico, and Northeast Pacific Ocean east of 180° W with maximum wind speeds of about 33 m/s or higher.

70 m/s or more	Hurricane Category 5

Source: Japan Meteorological Agency

(4) Rating Scale for Frequency of Occurrence

The frequency of occurrence of the three aforementioned hazards (drought due to decreased annual precipitation, flooding due to heavy rainfall/storms, and landslides due to heavy rainfall/storms) was set as shown in Table 12.1.5 below, after determining the specific definitions for the rating scales.

Table 12.1.5 Rating Scale for Frequency of Occurrence

Frequency of Occurrence	Description/Definition	Specific Criteria Set for this Project
＋＋	It has occurred frequently in the past and now.	It has occurred more than 10 times in the past 20 years.
＋	It has occurred in the past and now from time to time.	It has occurred more than 5 times in the past 20 years.
－	It has rarely occurred in the past or at present.	Less than one occurrence in the past 20 years.

Source: JICA Study Team

12.1.3 "Climate Risk Assessment" Using the Climate Risk Assessment Matrix

(1) Impacts that have Occurred/Are Likely to Occur to the Project Under the Current Climate

The exposures and hazards examined above were organized and analyzed for impacts that have occurred or are likely to occur under the current climate. The severity of the impact is described by a 4-point rating from "0" to "3" as shown in Table 12.1.6, and summarized as analysis of "Impact (Risk)" in Table 12.1.7.

Table 12.1.6 Definition of Criteria in the Project for Rating Scale of Impacts Already Occurring at Present

Scale of Impact Levels	Description/Definition	Specific Criteria Set for this Project
3	The events and impacts that have occurred to date so far have been so difficult that they cannot be addressed or handled (Difficult).	The entire water supply system was shut down, and the water supply was not available for more than several months before it was restored.
2	Events and impacts that have occurred to date have been moderately difficult to manage and address (Moderately Difficult).	Although some of the water supply facilities became inoperable, they were restored within a few weeks and water supply was able to resume.
1	The events and impacts that have occurred to date have not been very difficult to address or handle. The events and impacts that have occurred and are occurring have been minor. It has been handled to some extent (Minor/able to be handled).	Although a portion of the water supply facilities were temporarily shut down, they were quickly restored and water supply was able to resume.
0	There was little impact from the events that have occurred to date (Almost none).	Facility operations were essentially unaffected and water supply was able to continue.

Source: JICA Study Team.

Table 12.1.7 Analysis of "Impact (Risk)"

		Climate Hazard			Count
		H1 drought due to decreased annual precipitation	H2 flooding due to heavy rainfall/storms	H3 landslides due to heavy rainfall/storms	
	Frecuency	−	+	++	
	Future tendency	↗	→	→	
Exposure	E1 water main	0	1	1	0
	E2 reservoir	0	0	0	0
	E3 pipe network	0	1	1	0
	E4 water pumping station	0	0	0	0
	E5 water meter	0	0	0	0
	E6 Water source facilities (dams)	2	0	0	0
	E7 Water supply service for residents in Central District	2	0	0	0

Note: "Count" means the number of Climate Hazard with an "Impact Level 3", and since there is no equivalent of 3 in the table, all "Count" are indicated with 0.

Source: JICA Study Team

1) "E6 water source facilities (dams)" or "E7 water supply service for residents in the Central District" + "H1 drought due to decreased annual precipitation" :

Based on the drought problems experienced in the Central District in the past due to reduced water storage in the dam and how they were handled, it is judged to be moderately difficult with a rating of "2" in Table 7 above.

Historically, water supply in the Central District has not been provided everyday due to the limited amount of water resources available for drinking water, and water supply has been restricted to a fixed time every few days. But in 2018, the Central District experienced further water supply restrictions due to lower dam storage. In this case, the interval between water supply days was further expanded. However, the development of alternative water sources in the short term was not easy and it took time for the water sources to recover, which resulted in this emergency response having to be prolonged.

2) "E1 water main" or "E3 pipe network" + "H2 flooding due to heavy rainfall/storms" or "H3 landslides due to heavy rainfall/storms" :

The UMAPS' Repairs and Maintenance Unit was referred to for the past repair responses and it is judged to be minor/addressable with a rating of "1" in Table 7 above.

During floods and landslides, leaks often occur due to breaks in water mains and pipe networks. For UMAPS, however, repair itself is a matter of time and money, and not a technical problem. On the other hand, due to the lack of sufficient budget for investment and adequate knowledge of disaster prevention works, UMAPS is mainly engaged in emergency measures (provisional repairs) and cannot take measures to minimize damage in the event of a disaster, such as laying pipes at a point where landslides are less likely to occur. Therefore, the same areas may be damaged repeatedly during the next disaster. During repairs, UMAPS-owned water tanks provide drinking water to prevent interruption of water supply services. Small-scale repairs can be completed in one day, but large-diameter pipes may take several days.

(2) Potential Impacts (Risks) to the Project Under Future Climate

In light of the above evaluation results, the direction of change in the ratings is considered by taking into account future occurrences (frequency and extent) (see (A) and (C) in Table 12.1.8 below).

1) "H1 drought due to decreased annual precipitation" :

Based on the SSP scenarios (SSP3-7.0 and SSP5-8.5), a decrease in rainfall in the Francisco Morazán Department is projected in the long term, and the population growth and industrial activities in the Central District are increasing the water demand. Therefore, the speed with which water supply services are degraded and their effects manifested when annual rainfall decreases is likely to increase in the future.

UMAPS is in the process of developing two new dams (San José and Jiniguale). While it is assumed that the impact of reduced annual rainfall will be mitigated after their completion, the long-term impact of the reduction in the volume of water resources themselves will still remain. Therefore, it is judged that the gap between supply and demand of water supply may not be reduced (or even widened) due to the decrease in annual rainfall.

2) "H2 flooding due to heavy rainfall/storms" and "H3 landslides due to heavy rainfall/storms" :

Although no future projections for the occurrence of heavy rain/storm events were identified in this study, no data were identified that indicated future changes in the risk of flooding or landslides in the Central District, and therefore, it is assumed that the potential impacts (risks) to the Project will remain the same as the current level. Therefore, the cost of repeating repairs in the event of pipe network damage is judged to become a financial burden of the UMAPS management in the long term.

(3) "Vulnerability" for this Project

The responses (activities, some measures, organizational structure, technical level, etc.) being taken (see (B) in Table 8 below) were analyzed about the impacts (corresponding to the impacts (risks) selected in (2) above) occurring under the current climate at the existing UMAPS facilities and related infrastructure facilities targeted by the Project (see (B) in Table 8 below).

The UMAPS is developing new water sources (San José and Jiniguale) to secure raw water for water supply in the Central District, but has not been able to fully meet the increasing water demand. In addition, despite this high water demand, the percentage of unaccounted for water, such as leakage from pipelines, is extremely high, and precious water resources are not being used effectively. In addition, it is not easy to identify the location of leaks, and it is difficult to significantly reduce the percentage of unaccounted for water in the short term. In addition, the UMAPS' budget shortfalls have prevented the expansion of piped water supply services, and UMAPS' and private water trucks are currently providing water supply services outside the piped water supply area.

The UMAPS has a Repair and Maintenance Unit within the organization that has responded promptly to every pipe damage in the Central District in the past, and has the necessary repair techniques and measures (for example, UMAPS' water trucks continue to provide water service while pipes are being repaired). On the other hand, it is also true that each time floods and landslides occur, the need for repairs arises again. This is due to the fact that when pipelines are repaired, it is not always possible to lay pipes in locations with low disaster risk or to lay pipes with reinforcement work to increase disaster resistance. Due to budget shortfalls, simple repairs are generally made at existing locations.

Table 12.1.8 Narrowing Down of the Potentially Significant Future Impacts (Risks) of the Project

	(A)	(B)	(C)
	Potentially significant <u>future</u> impacts (climate risk) (hazard + exposure)	**Vulnerabilities that contribute to the occurrence of impacts** (susceptibility to influence, ability to cope with influence)	**Impact (climate risk) considered likely to be significant in <u>the future</u> for the Project (risk to be selected finally)**
Climate Risk 1	<u>H1（drought due to decreased annual precipitation）+E6（Water source facilities） / E7（Water supply service for residents in Central District）</u> Water supply services are expected to be limited due to a decrease in the storage of water sources and the inability to secure sufficient amounts of raw water for drinking water supply.	UMAPS is developing new water sources to secure raw water, but has not been able to fully meet the increasing demand.	By decrease in annual precipitation, the gap between supply and demand of water may not be reduced (but may be increased) .
Climate Risk 2	<u>H2（flooding due to heavy rainfall/storms） / H3（landslides due to heavy rainfall/storms） + E1（water main） / E3（pipe network）</u> Pipes are expected to be damaged due to landslides caused by floods and storms.	The pipes have been repaired each time they have been damaged, but each time a flood or landslide occurs, they need to be repaired again.	Repeated pipe repair costs could become financial burden on UMAPS management.

Source: JICA Study Team

12.1.4 Possible "Adaptation Options" Considered Based on Climate Risk Assessment Results

Table 12.1.9 below shows the results of the analysis of possible adaptation options for the aforementioned "potentially significant future impacts (risks)" to be considered.

Table 12.1.9 Analysis of Adaptation Option

Risk	**Impact (climate risk) considered likely to be significant in the future for the Project (risk to be selected finally)**	**Adaptation options for climate risks**	**Corresponding SDGs**
Climate Risk 1	By decrease in annual precipitation, the gap between supply and demand of water may not be reduced (but may be increased) .	1.Reduce leakage and improve water supply service by upgrading water transmission and distribution facilities（High-priority） 2.Development of new water sources（Low-priority）	6 CLEAN WATER AND SANITATION
Climate Risk 2	Repeated pipe repair costs could become financial burden on UMAPS management.	1.Reducing the negative impact of landslides by renewing aging pipe networks（High-priority） 2. Speed-up of pipe damage detection and repair by improvement of management system (introduction of SCADA)（High-priority） 3.Procurement of new repair materials and equipment to speed up and improve the quality of repairs（Low-priority）	6 CLEAN WATER AND SANITATION

Source: JICA Study Team

The adaptation options considered were also subjected to a simplified evaluation in terms of economic efficiency, effectiveness, and feasibility, and candidate adaptation options were tentatively prioritized (see Table 12.1.10).

Table 12.1.10 Simplified Evaluation and Prioritization of Adaptation Options

Adaptation Options	Economic Efficiency	Effectiveness	Feasibility	Priority
1-1. Reduce leakage and improve water supply service by upgrading water transmission and distribution facilities (High priority)	**High**：This is a budget size that can be accommodated by this Project. The economic efficiency is high because leakage reduction is directly related to increase of revenue for UMAPS.	**High**：Leakage reduction is effective in terms of effective use of limited water resources in response to the forecasted decrease in precipitation.	**High**: It is also compatible with existing UMAPS policies and technology levels and is highly feasible.	1
1-2. Implementation of new water source development (Low priority)	**Low**：It is not economically efficient because it would require a long study period and a large investment that is beyond the scale of what can be handled by this Project.	**High**：It is effective in predicting precipitation decreases because it is expected to significantly increase the amount of water that can be supplied.	**Low**：It is difficult to implement. This is an option that cannot be technically addressed and is out of the scope of this preparatory survey,	excluded
2-1. Reducing the risk of landslides by renewing aging pipe networks (High priority)	**High**: This is the budget size that can be accommodated by this project when implemented after establishing priority areas for implementation. The project will reduce the economic burden on UMAPS by reducing the amount of rehabilitation work that is repeated each time a landslide occurs.	**High**：By selecting areas with low risk of landslides during renewal work and replacing old pipes with new pipe materials, the tolerance of landslide risk will be increased.	**High**：Design of appropriate pipe laying locations by the Project and current UMAPS capabilities of construction supervision are sufficient to achieve this works.	1
2-2. Speed up of pipe damage detection and repair by improvement of management system (introduction of SCADA) (High priority)	**High**: This is the budget size that can be addressed by this project. Reduction of UMAPS' economic losses by reducing water resource losses and rapid assessment in the event of problem through optimization of water supply system operations.	**Middle**：In addition to the conventional method of identifying leakage points based on information from residents, this method reinforces identification of the problems, thus mitigating the loss of water resources even in the face of predicted decreases in rainfall.	**High**：UMAPS already has experience in SCADA operation and can implement it in this project.	1
2-3. Procurement of new repair materials and equipment to speed up and improve the quality of repairs (Low priority)	**Low**：Repairs can be made with existing repair equipment and materials, and it is not economically efficient to invest in new procurement.	**Low**：When leakages are discovered, UMAPS has traditionally responded quickly to repair them, and the implementation of equipment procurement does not have much impact on the quality or speed of leakage repair, and it is not very effective in terms of water resource loss mitigation.	**Low**：Since it can be handled with existing technology and equipment, it is a low priority for UMAPS.	excluded

Source: JICA Study Team

Based on the results of the above study, a second field survey will be conducted to specifically consider the incorporation of the tentatively prioritized candidate adaptation options into the Project plan.

12.1.5 Final Consideration Results in Project Planning for Adaptation Options

Ultimately, all three proposed adaptation options, which are the first priority options shown in Table 12.1.10, were adopted in the project plan (See Table 12.1.11). The Project is judged to be appropriate as an adaptation measure to climate change because 1) Adaptation Options 1 and 3 will contribute to the maintenance of a stable water supply service through further effective use of water resources, which are expected to decrease in precipitation in the future, while 2) Adaptation Option 2 will also contribute by improving the resilience to natural disasters such as landslides caused by torrential rains.

Table 12.1.11 Adaptation Options Adopted in this Project

	Adaptation Option
Adaptation Option 1:	Reduce leakage and improve water supply service by upgrading water transmission and distribution facilities
Adaptation Option 2:	Reducing the risk of landslides by renewing aging pipe networks
Adaptation Option 3:	Speed up of pipe damage detection and repair by improvement of management system (introduction of SCADA)

Source: JICA Study Team

In addition, UMAPS is currently planning to further increase its water supply capacity by developing new water sources to meet the expected future increase in water demand, and the adoption of Adaptation Options 1 and 3 in this Project will continue to contribute to reducing water losses that could be lost before these additional water supplies reach the water users. Adaptation Option 2 does not completely eliminate the possibility of impact by landslides, but disaster resilience can be enhanced by using appropriate laying techniques when upgrading old pipes.

12.2 Climate Change Mitigation

Considering the characteristics of energy use in the Project, it is expected to reduce energy consumption and greenhouse gas (GHG) emissions by promoting the installation of energy-saving equipment such as water pumps and reducing the non-revenue water. The Project may also contribute to climate change countermeasures as a mitigation measure. Therefore, the estimation of mitigation effects (GHG emission reductions) was studied with reference to the "JICA Climate FIT (Mitigation Measures)" and other tools.

While the Project is expected to contribute to GHG reduction, the direct GHG emissions from the Project during the operation phase are expected to be less than 25,000 tCO_2/year[4]. For example, the main factors to impact GHG emissions in the Project are: 1) improvement of pump efficiency (45% before the Project to 85% after the Project) by replacing water pumps (in total, 16 pumps at 9 pump stations), 2) increase of water supply (from 73,288,300 m^3 before the Project to 79,227,433 m^3 after the Project) through renovation of tanks (at 14 distribution facilities) and water pipelines.

[4] This is the threshold value for greenhouse gas emission conversions in the environmental and social consideration survey of the JICA Project.

Since this is expected to reduce electricity consumption per unit of water supply, this Project is determined to be a climate change mitigation measure by reducing GHG emissions. As shown in Table 12.2.1, the direct GHG emissions after the Project will be 3,152 tCO_2/year, a reduction of 1,242 tCO2/year from the same emissions of 4,394 tCO_2/year before the project implementation.

Table 12.2.1 Emission Reduction

		Value	Unit
ER_y	Emission reduction	1,242	tCO_2/year
BE_y	Baseline emission	4,394	tCO_2/year
PE_y	Project emission	3,152	tCO_2/year

Source: JICA Study Team, based on the JICA Climate FIT (Mitigation) Guideline (2019)

The values used to estimate the emission reduction are summarized in Table 12.2.2.

Table 12.2.2 Values Used for Estimation of Emission Reduction

Parameter	Description	Value	Unit
P_{BL}	Production capacity (or other appropriate factors) in the baseline	73,288,300	-
P_{PJ}	Production capacity (or other appropriate factors) in the project	79,227,433	-
ηBL	Energy efficiency before the project is implemented	45.00	%
ηBL, country	Energy efficiency of the most comon industrial facility in the country where the project is implemented	85.00	%
EC_{BL}	Electricity consumption in the baseline in year y	6,552.2	MWh/year
$FC_{BL,i}$	Consumption of the fuel i in the baseline in year y	0	t/year
$EC_{PJ,y}$	Electricity consumption in the project in year y	4,902.7	MWh/year
$FC_{PJ,i,y}$	Consumption of the fuel i in the project in year y	0	t/year
EF_{elec}	CO_2 emission factor of the grid electricity	0.643	t-CO_2/MWh
NCV_i	Net calorific value of fuel i	0	TJ/t
$EF_{fuel,i}$	CO_2 emission factor of fuel i	0	t-CO_2/TJ

Note: Basis of electricity consumption is presented in Appendix-12.
Source: JICA Study Team, based on the JICA Climate FIT (Mitigation) Guideline (2019)

CHAPTER 13 FINANCIAL AND ECONOMIC ANALYSIS

This chapter presents the financial and economic analysis of JICA portion.

13.1 Financial Analysis

13.1.1 Methodology and Assumptions

Conventionally, the financial internal rates of return (FIRR) and the financial net present value (FNPV) are calculated for financial evaluation of a project from the perspective of the operating entity, rather than the economy as a whole. The FIRR is the discount rate that equalizes the present values of costs and revenues over the project life. The FIRR, calculated on the net cash flows, shows the project's profitability. The financial viability of a project can be evaluated by comparing its FIRR with the financial opportunity cost of capital (FOCC). If the FIRR exceeds the FOCC, the project is regarded financially viable. This also means that the FNPV computed by using a discount rate equal to the FOCC will be positive when the project is financially viable. The FNPV is also useful to evaluate the financial viability of projects whose FIRR is not computable.

In the context of a strictly new facility development project, both costs and benefits are non-existent before the project is implemented (Ex-ante). Costs are incurred, and benefits are generated only after the project is put into action (Ex-post). However, this project's primary objective is to restore water distribution capability and increase revenue water by replacing existing facilities. It is worth noting that the Municipal Drinking Water and Sanitation Unit: *Unidad Municipal de Agua Potable y Saneamiento* (UMAPS) already operates the existing facilities and receives water revenues even before the project is implemented.

Consequently, the operating costs and water revenues will undergo changes once the project is implemented in the "with project" situation. A crucial assumption to consider is that if the project is not executed in the "without project" situation, the current cost and revenue structure will alter. Specifically, without the project, the water revenue is expected to decline in the future due to increased water loss resulting from the deterioration of the existing facilities. The operation and maintenance cost will also be subject to change, depending on the behavior of each cost component. The project's financial analysis is conducted using constant monetary values in the 2023 prices.

The projected financial cash flows for the project are determined using specified parameters and assumptions. This involves differentiating between the "without project" and "with project" situations, with key distinctions presented in Table 13.1.1 and summarized in Table 13.1.2.

Table 13.1.1 Comparison Between "Without Project" and "With Project" Scenarios

Component	Current Situation	"Without Project" Scenario	"With Project" Scenario
Component 1 1a. Laureles transmission pipeline	One pipeline accident occurs annually at the Laureles transmission, leading to a five-day halt in the water supply through the transmission pipeline. This results in a daily loss of 45,000 m^3 of water.	The current situation persists until 2026, worsening between 2027 and 2030, with accidents occurring twice yearly and water supply halts lasting ten days. From 2031, the situation will deteriorate even more, with three yearly accidents and a 15-day water supply halt.	The current situation persists until 2026, worsening between 2027 and 2030, with accidents occurring twice yearly and water supply halts lasting ten days. Starting in 2031, the yearly occurrence of accidents will be eliminated as a result of project implementation.
Component 1 1b. Concepcion transmission pipeline	Basically no accident in a year at the Concepcion transmission pipeline.	The current condition can remain stable until 2030. However, from 2031 onwards, it will deteriorate, resulting in a yearly five-day interruption due to accidents. This will lead to a daily water loss of 113,000 m^3 through the Concepcion transmission.	The current condition will remain stable until 2030. However, from 2031 onwards, it will deteriorate, with a yearly occurrence of a five-day disruption. Yet, the project execution will limit the harm to the affected region to 30 percent.
Component 2 Transmission pump station	The project's targeted nine pump stations have one accident a year.	The current state is unchanged until the end of 2026. However, from 2027, it will deteriorate with two annual accidents. Each incident will halt water supply for 30 days through the pump stations, causing a daily water loss of 23,000 m^3. The yearly accident frequency will begin as three in 2031 and that state will be somehow maintained throughout the project period.	The annual accident frequency will become zero from 2031.
	The pump stations included in this component have an annual power consumption of 6,552 MWh in total, with an average pump efficiency of 45%.	The current pump efficiency is maintainable until 2030, but starting from 2031, it will decline biennially by 1%.	The new pumps' efficiency will reach 85% and remain operational throughout the projected operation period.
Component 3 Instrumentation	There is no instrumentation system that can efficiently manage the water supply. The current water transmission and distribution system collectively consume 10,555 MWh electricity per year.	There will be no saving in electricity consumption of the water supply system.	The instrumentation system can lower the electricity usage of the water supply system by 20%.
Component 4 Distribution tank	The target distribution tanks experience a combined daily	The existing state will not change until the end of the	No water leakage will occur at these distribution tanks.

Component	Current Situation	"Without Project" Scenario	"With Project" Scenario
	water leakage of 100 m^3.	project's forecasted duration.	
Component 5 Distribution network	The water leakage rate in the target area is 15%.	The existing state will not change until the end of the project's forecasted duration.	The water leakage rate will decrease to 9%. Note: The leakage will reduce to 5% by the Project. However, considering the rebound of the water leakage, 9% was taken for the evaluation.
Component 6 Customer meter	Meter readings when meters are installed, or estimated usage without meters, are thought to be about a half of the real usage. UMAPS does not bill discrepancies between actual usage and meter readings/estimates. A customer's typical monthly billing volume is 36 m^3. UMAPS demonstrates a collection efficiency of 90%.	The existing state will not change until the end of the project's forecasted duration.	Newly metered customers will be billed 30% more than they were previously billed. The collection efficiency remains unchanged.

Source: JICA Study Team

Table 13.1.2 Summary of With/Without Project Scenario

Item		Current Situation 2023	Project Implementation Period 2025 - 2030	After Completion of the Project 2031 -
Component 1 1a. Laureles transmission pipeline	Without Project	· One accident in a year · Five-day halt throughout the Laureles system · Daily water loss of 45,000m^3 of water	· The situation gets worse. · The loss is doubled.	· The situation gets worse. · The loss is tripled.
	With Project		· The situation gets worse. · The loss is doubled.	· The situation is improved. · The loss is eliminated.
Component 1 1b. Concepcion transmission pipeline	Without Project	· Basically, no accident in the transmission pipeline	· The current situation remains	· Yearly five-day interruptions · Daily loss of 113,000m^3
	With Project		· The current situation remains	· Yearly five-day interruptions · Daily loss is limited to 30%
Component 2 Transmission pump station	Without Project	· Targeted nine pump stations have one accident a year causing daily water loss of 23,000m^3	· The situation gets worse to double	· The situation gets worse to triple
	With Project		· The situation gets worse to double	· The situation is improved. · The loss is eliminated.
	Without Project	· Average pump efficiency of targeted nine pump stations: 45%. · Annual power consumption: 6,552 MWh	· Current pump efficiency is maintained	· Pump efficiency decline biennially by 1%.
	With Project		· Current pump efficiency is maintained	· The new pump's efficiency is improved to 85 %.
Component 3 Instrumentation	Without Project	· No instrumentation system that can efficiently manage the water supply. · The current water transmission and distribution system collectively consume 10,555 MWh electricity per year.	· No saving in electricity consumption	· No saving in electricity consumption
	With Project		· No saving in electricity consumption	· Saving electricity by 20%
Component 4 Distribution tank	Without Project	· Daily water leakage of target distribution tanks: 100 m3.	· No change of the situation	· No change of the situation
	With Project		· No change of the situation	· Water leakage is eliminated
Component 5 Distribution network	Without Project	· Water leakage rate: 15%.	· No change of the situation	· No change of the situation
	With Project		· No change of the situation	· Water leakage rate: 9% (Note)
Component 6 Customer meter	Without Project	· Estimated water usage without meter are thought to be about half of the real usage.	· No change of the situation	· No change of the situation
	With Project		· No change of the situation	· Newly metered customers will be billed 30% more than they were previously billed.

Note: As a short term project effect, the water leakage will reduce to 5%. However, 9% was taken conservatively for the financial and economic evaluation, considering the rebound of the water leakage. Source: JICA Study Team

(1) Project Analysis Timeframe

The construction of project facilities will occur from 2027 to 2030, while expenses will be incurred between 2025 and 2031. The facility resulting from the project begins operating in 2031, and the project's lifespan extends to 2060, spanning a 30-year period. The financial analysis covers the project's timeline, from the initial disbursement in 2025 (year 1) through 2060 (year 36).

(2) Capital Cost

Financial analysis is conducted using consistent monetary values unaffected by inflation. This eliminates the price contingency portion from the capital costs. Additionally, the interest during construction is disregarded in the financial cash flow, allowing a direct comparison between the project's yield and financing costs.

(3) Usable Life and Salvage Value

In financial analysis, positive cash flow includes salvage values of facilities at the project's end. Facilities like pipes and tanks remain functional for 50 years, valves for 45, instrumentation and pumps for 15, and customer meters for 8. Asset replacement aligns with the completion of their useful life. Salvage values hinge on attrition rates linked to lifespan and replacement.

(4) Electricity Cost

As shown in Table 9.1.6, O&M costs for UMAPS water supply comprise personnel expenses (36%), electricity (38%), chemicals (13%), and repairs and maintenance (12%), excluding administrative expenses that encompass water and sewerage. As described in Table 13.1.1, the implementation of this project is anticipated to lower electricity expenses. UMAPS is categorized as a low-voltage non-residential electricity consumer, expected to maintain payment of the existing HNL 5.83 per kWh tariff for electricity usage. The expenses associated with personnel, chemicals, and repairs and maintenance possess characteristics of fixed cost or irrelevant expenses in relation to this project's execution. Consequently, only changes in electricity expense are factored into the project's financial cash flow, unlike other expenses.

(5) Avoidable Water Loss

It is expected that the implementation of this project will prevent or reduce facility breakdowns. As a result, this project will deliver a certain amount of water that would not have been delivered to the final user if the project had not been implemented. The current situation and future assumptions regarding water loss at different stages of the water transmission system, including pipelines, valves, pumping stations, tanks, and distribution network, are presented in Table 13.1.1. The financial price of water is estimated at HNL 8.91 per cubic meter based on the total water billed to customers of UMAPS from May to December 2022 of HNL 318,441,588 and total billed water volume of 35,744,751 cubic meters.

(6) Incremental Billing

Meter readings taken during installations, or approximations made in the absence of meters, are believed to represent only about half of the true consumption. UMAPS cannot charge for disparities between real consumption and recorded/estimated readings. The mean billed quantity per customer is calculated as 36 cubic meters monthly, derived from the average monthly billed water volume of 4,468,904 cubic meters from May to December 2022, divided by the average customer count of 124,442 during the same span. It is reasonable to hypothesize that installing new customer meters could elevate the average billing volume by 30%.

(7) Collection Efficiency

The user charge collection efficiency data from May to December 2022 exhibit significant volatility, displaying notable fluctuations from month to month. The recorded values range from a minimum of 65% to a maximum of 121%, with an average of 83%. Given the substantial ongoing efforts by UMAPS in arrears collection, it is justifiable to anticipate that the collection efficiency to stabilize around 90%.

13.1.2 Analysis of Financial Viability

The financial opportunity cost of capital (FOCC) can be calculated based on market interest rates and inflation rates. In March 2023, Honduras experienced an inflation rate of 9.05%. Correspondingly, during the same period, the weighted average loan interest rate for new economic activities denominated in the Honduran currency stood at 11.49%. The FOCC is determined to be 2.24%, derived from the formula [(1+0.1149) / (1+0.0905)-1].

The project's financial cash flows are summarized in Table 13.1.3. Notably, the real FIRR resulted in a low value of 0.51%, which is lower than the FOCC of 2.24%. The FNPV shows a negative figure of minus HNL million. These outcomes indicate that the project lacks financial viability. The apparent cause of this financial unsustainability seems to be linked to elevated capital costs and potentially low water tariffs. Unless the capital costs decrease or water tariffs increase, the FIRR will remain below the FOCC.

Table 13.1.3 Financial Cash Flow of Project

13.1.3 Sensitivity Analysis of Financial Viability

In the base case scenario, both the FIRR and FNPV already exhibited negative values. To explore potential improvements, a sensitivity analysis was conducted involving adjustments to capital costs and water prices. The alterations considered were: (i) a 30% reduction in capital costs, (ii) a 30% increase in water prices or the average water tariff, and (iii) a simultaneous implementation of both a 30% reduction in capital costs and a 30% increase in water prices. The results are summarized in Table 13.1. 4.

Table 13.1.4 Summary of Financial Sensitivity Analysis

	FIRR (Real terms)	FNPV (HNL in Million)
Base case	0.51%	
Capital cost lowered by 30%		
Water tariff elevated by 30%	1.43%	
Implementation of the above two incidents		

Source: JICA Study Team

If the capital cost is lowered by 30%, the FNPV narrowly exceeds the hurdle rate. In terms of improving benefit scale, reducing capital costs proves more impactful than water tariff increase.

If the project aims to surpass the hurdle rate of 2.24% only by raising the water tariff, UMAPS would need to increase the average water tariff by at least 58%. This can be the simplest tariff proposal among numerous possibilities, in terms of timing, pricing, and targeted customer segment. To meet the hurdle rate, a 58% net increase in the average tariff is required in 2031, coinciding with the project's operational commencement. This increase does not account for inflationary effects, necessitating separate tariff adjustments to align with inflation.

13.2 Economic Analysis

13.2.1 Methodology and Assumptions

Whereas financial analysis estimates the financial impact of a project UMAPS, economic analysis estimates the economic impact on the Honduran economy. On the other hand, similar to the financial analysis, the economic analysis compares the "with project" and "without project" scenarios. This involves computing the economic internal rate of return (EIRR) and economic net present value (ENPV) of the project. The EIRR is compared against the economic opportunity cost of capital (EOCC), which is set at 10%. The economic cash flow is discounted using the same rate to calculate the project's ENPV. The economic analysis timeframe coincides with the financial analysis, spanning from 2023 to 2060.

Financial costs of the project are converted to economic costs in 2023 constant prices denominated in Honduran Lempira. Such economic valuation is done at the domestic price level numeraire as economic benefits of the project are mostly non-tradable and thus represented at the domestic prices. Transfer payments within Honduras such as tax, duties, and subsidies are excluded from the economic valuation.

The capital costs should be split into tradable and non-tradable components. For this purpose, foreign cost portions of the project are considered to be tradable. Local cost portions are assumed to be non-tradable. Financial prices of tradable components as reduced by duties and taxes are converted to economic prices by a standard conversion factor (SCF). The SCF is used to remove the trade distortion effect. The SCF is defined as follows:

$$\text{SCF} = \frac{M + X}{(M + t_m - s_m) + (X - t_x + s_x)}$$

Where:

M and X are total imports and exports, respectively, in a particular year at world prices

t_m and t_x are the tax collected to M and X, respectively.

s_m and t_x are the subsidy paid to M and X, respectively.

The computed SCF for the economic analysis of this project is 0.93, as presented in Table 13.2.1.

Table 13.2.1 Computation of Standard Conversion Factor

	Y 2019	Y 2020	Y 2021	Y 2022	Average
Merchandise imports, c.i.f. (Million US$)	10,354	8,969	13,261	15,238	11,955
Commercial services imports (Million US$)	2,406	1,807	2,582	3,216	2,503
Merchandise exports, f.o.b. (Million US$)	8,788	7,684	10,216	12,169	9,714
Commercial services exports (Million US$)	1,193	706	853	1,094	961
Customs and import duties (Million HNL)	40,969	33,307	48,480	50,522	43,319
Exchange rate (HNL / US$1)	24.72	24.20	24.43	24.66	24.50
Standard conversion factor	0.93	0.93	0.93	0.94	0.93

Source: Compiled by JICA Study Team based on data of Honduras Central Bank and Customes Administration of Honduras

(1) Avoidable Water Loss

The Project's objective is to enhance the water distribution and service system in Tegucigalpa. Without its implementation, the deteriorating water system would lead to unused distributed water. Through the Project, the water that would have otherwise remained undelivered will be utilized as additional incremental water by users.

When the outputs of a Project are incremental, the consumer's willingness to pay (WTP) becomes the basis for the valuation of the benefit. The WTP of water consumers can be usually measured through a social survey, which has not yet been conducted in Tegucigalpa. In the absence of a social survey, the affordability to pay (ATP) can serve as a proxy for WTP. Typically, the ATP for water services is around 4% of the household's disposable income.

In 2021, the National Institute of Statistics conducted a national household survey which showed that the average monthly household income in Central District (Tegucigalpa) was HNL 18,675. Based on this figure, the monthly household ATP for water is estimated to be HNL 747 (i.e., 4% of HNL 18,675).

The affordability to pay for water can also be evaluated by comparing it with other utility fees. Table 13.2.2 summarizes the domestic tariffs and monthly bills for water, sewerage, electricity, gas, and telephone in Honduras. The ATP for water, HNL 747, appears to be reasonable since it is lower than the monthly bills for electricity, which is HNL 1,229, and telephone, which is HNL 1,000.

The economic price of water can be determined using the ATP and UMAPS billing data. The average monthly billed water volume from May to December 2022, totaling 4,468,904 cubic meters, is divided by the average customer count of 124,442 within the same period to calculate a mean billed quantity of 36 cubic meters per customer each month. A UMAPS domestic customer is typically considered a six-person family. Comparatively, the monthly ATP for water is HNL 747 per household, as established through a household survey, where a household is usually comprised of four persons. Consequently, the computation of the WTP for water results in HNL 31.20 per cubic meter [747 ÷ (36 ÷ 6 x 4)].

Table 13.2.2 Comparison of Utility Charges

Service Type	Rate	Monthly Household Bill Estimates*
Water (UMAPS, small user in poverty area)	• HNL 31.80/connection for up to 20 m^3 usage • HNL 3.17/m^3 for 21 to 30 m^3 • HNL 5.23/m^3 for 31 to 40 m^3 • HNL 1.50/connection as meter control	HNL 33.30 (assuming monthly usage of 20 m^3)
Water (UMAPS, large user in affluent area)	• HNL 141.60/connection for up to 20 m^3 usage • HNL 8.90/m^3 for 21 to 30 m^3 • HNL 10.93/m^3 for 31 to 40 m^3 • HNL 13.58/m^3 for 41 to 50 m^3 • HNL 1.50/connection as meter control • HNL 150/connection as fixed connection fee	HNL 830.50 (assuming monthly usage of 50 m^3)
Water (San Pedro Sula, metered user)	• HNL 9.363/m^3 for up to 20 m^3 usage • HNL 19.212/m^3 for 21 to 50 m^3 • HNL 29.072/meter rent • HNL 29.072/administrative cost	HNL 245.404 (assuming monthly usage of 20 m^3) HNL 1,018.744 (assuming monthly usage of 50 m^3)
Water (San Pedro Sula, unmetered, small user)	• HNL 276.774/connection • HNL 29.072/administrative cost	HNL 305.846
Sewerage (UMAPS)	25% of water usage fee	HNL 4.95 (small user, assuming 20m^3 water use)
Sewerage (San Pedro Sula)	40% of water usage fee	HNL 74.904 (small user, assuming 20m^3 water use)
Electricity	• HNL 56.92 as fixed charge • HNL 4.7815/kWh up to 50 kWh/month • HNL 6.2219/kWh over 50 kWh/month	HNL 1,229 (assuming 200 kWh consumption)
LP gas	• HNL 217/25 lbs canister	HNL 217 (assuming one canister consumption)
Mobile phone	• Various service plans exist which include telephone and/or data services, ranging approx. HNL 300 to 1,000 monthly	HNL 1,000 (assuming two phones a family at moderate usage)

* Based on likely consumption by an average four-membered family
Source: Compiled by the JICA Study Team based on internet and market research

(2) Medical Cost Saving

The domains of water, sanitation, and hygiene (WASH) are tightly interrelated. Poor hygiene, inadequate quantities and quality of drinking water, and lack of sanitation facilities cause many of the world's poorest people to die from preventable diseases. Inadequate provision of water, sanitation, and hygiene services are major drivers of the disease burden associated with WASH-related illnesses, with these factors contributing significantly to morbidity and mortality rates in impoverished areas.

A variety of diseases are considered to be WASH-attributable, including viral hepatitis, typhoid, cholera, and dysentery, all of which can cause diarrhea in the absence of adequate water for personal hygiene. Other water-based diseases such as trachoma can lead to skin and eye infections and spread easily through contaminated water. Additionally, water-related vector-borne diseases may arise when water supply projects inadvertently create habitats for mosquitoes and snails that act as intermediate hosts for parasites responsible for diseases like malaria, schistosomiasis, lymphatic filariasis, onchocerciasis, and Japanese encephalitis.

The World Health Organization (WHO) maintains a database of global morbidity data, which includes information on WASH-related diseases that occurred in Honduras such as diarrhea, hepatitis A, malaria, chagas disease, leishmaniasis, cysticercosis, echinococcosis, and dengue. Department-wise morbidity data for WASH-related diseases in Honduras are available in the health statistics prepared by the Ministry of Health. The morbidity of WASH-related diseases is summarized in Table 13.2.3.

Table 13.2.3 Morbidity of WASH-attributable Diseases

(Number of cases in 2021)

	Central District (Tegucigalpa)	Honduras Total	Tegucigalpa / Honduras
Diarrhea	27,439	118,148	23%
of which, infants under 5 years old	8,858	80,552	11%
Dysentery	356	3,571	10%
Cholera	0	0	n/a
Typhoid and para typhoid fever	8	22	36%
Hepatitis A (Infectious Hepatitis)	380	843	45%
Malaria (suspected cases)	91	12,849	1%
Malaria (confirmed cases)	1	577	0%
Dengue (suspected cases)	7,665	14,808	52%
Demorrhagic dengue	141	627	22%
Leishmaniasis monocutaneous	41	777	5%
Leishmaniasis Cutaneous	0	0	n/a
Viceral Leishmaniasis	1	2	50%
Acute Chagas	13	111	12%
Chronic Chagas	3	179	2%
Congenital Chagas	0	0	n/a
Total cases	36,139	152,514	24%
Total population	1,293,611	9,450,714	14%
Morbidity (per 100,000)	2,794	1,614	n/a

Source: Compiled by JICA Survey Team based on data of Ministry of Health

With 36,139 cases reported, the morbidity rate of WASH-related diseases in the Central District stands at 2,794 per 100,000, significantly higher than the nationwide rate of 1,614 per 100,000. The elevated morbidity rate in metropolitan areas may be attributed to the ease of access to medical facilities, compared to rural areas, where patients face greater challenges in reaching healthcare institutions. This disparity in access could result in a higher number of reported cases in the metropolitan area.

Among the WASH-related diseases, diarrhea has the most apparent and common symptoms. The healthcare system in Honduras does not completely cover the cost of treating diarrhea, leading patients to bear a significant portion of the expenses associated with the illness. The lack of adequate medical resources further exacerbates the problem. The Project will reduce the number of individuals suffering from diarrhea, which, in turn, will decrease the overall cost of treatment as a society. To determine the expected medical cost savings associated with the project, data was collected from the UMAPS in-house clinic. Results are summarized in Table 13.2.4.

Table 13.2.4 Average Costs for Diarrhea Treatment in Tegucigalpa

Ratio of inpatients (severe diarrhea), outpatients (mild diarrhea), and home patients (mild diarrhea)	In 40%	Out 25%	Home 35%
Drug cost for treatment of a severe diarrhea inpatient		HNL 1500	
Drug cost for treatment of a mild diarrhea outpatient		HNL 1000	
Drug cost for treatment of a mild diarrhea home patient		HNL 500	
Laboratory cost for testing a severe diarrhea inpatient		HNL 1000	
Laboratory cost for testing a mild diarrhea outpatient		HNL 350	
Length of hospital stay of a severe diarrhea inpatient		2 days	
Hospital cost for an inpatient per day		HNL 1500	
Number of hospital visits of a mild diarrhea outpatient		2 times	
Hospital cost for an outpatient per visit		HNL 1000	

Source: UMAPS Clinic

Diarrhea patients were categorized into three groups: inpatients, outpatients, and home patients. The number of patients treated for diarrhea at Tegucigalpa hospitals in 2021 was 27,439. By dividing this figure by the sum of the hospitalization rates for inpatients and outpatients, it was assumed that there were 16,886 inpatients who had severe symptoms. Using the same method, there were supposedly 10,553 outpatients and 14,775 home patients.

The treatment cost for an inpatient is calculated as HNL 5,500 (= 1,500 + 1,000 + 2 x 1,500). For an outpatient, it costs HNL 3,350 (= 1,000 + 350 + 2 x 1,000). A home patient spends HNL 500 on drug costs. To determine the total cost of treating diarrhea in 2021, the number of patients in each category was multiplied by the associated treatment costs, resulting in a total cost of HNL 136 million. The calculation is done as (5,500 x 16,886) + (3,350 x 10,553) + (500 x 14,775).

Anticipated medical cost savings can be approximated using past interventions as a reference. A WHO study[1] found that providing better quality piped water to households reduced diarrheal risk by up to 75%, compared to unsatisfactory drinking water. Likewise, the study noted that continuous access to piped water could potentially decrease diarrheal morbidity risks by up to 36%. It is reasonable to expect that by enhancing both water supply stability and water quality, the project could decrease diarrheal morbidity in Tegucigalpa by 20%.

(3) DALY averted

Disability-adjusted life year (DALY) measures the overall burden of disease in terms of the number of years lost due to ill health, disability, or early death. The use of DALY in assessing development projects is suggested by international authorities, and WHO periodically calculates the annual DALYs of each country.

DALY comprises two components: Years of Life Lost (YLL), which refers to the potential years of life lost due to premature death, and Years Lived with Disability (YLD), which represents the equivalent years of healthy life lost due to poor health or disability. To calculate YLL, the number of deaths at each age is multiplied by a global standard life expectancy for that age. YLD for a particular cause in a specific time period is estimated as the number of incident cases in that period multiplied by the average duration of the disease and a weight factor. The sum of YLL and YLD constitutes the DALY, which is represented by the formula (DALY = YLL + YLD).

Table 13.2.5 presents a comprehensive view of the annual DALYs caused by WASH-related illnesses in Honduras, El Salvador, Nicaragua, Guatemala, and worldwide.

Table 13.2.5 Annual DALYs by WASH-related Diseases

Disesase name	Honduras	El Salvador	Nicaragua	Guatemala	World
Diarrhea	48,084	19,774	15,818	147,229	78,744,265
Acute hepatitis A	743	1,798	844	1,191	2,051,116
Malaria	109	7	135	258	33,381,365
Chagas disease	1,027	808	473	1,256	217,113
Leishmaniasis	290	8	258	462	540,536
Cysticercosis	1,181	623	580	11,945	987,791
Echinococcosis	12	44	9	157	429,765
Dengue	8,358	1,351	1,424	3,210	1,951,611
Total DALYs by WASH-related diseases	59,803	24,415	19,540	165,709	118,303,562
Per-person DALY by WASH-related diseases	0.006	0.004	0.003	0.009	0.015
DALYs by all causes	2,575,644	1,852,475	1,536,022	5,166,110	2,531,710,366
Per-person DALY by all causes	0.264	0.287	0.235	0.294	0.330
Population ('000)	9,746	6,454	6,546	17,581	7,676,574

Source: Compiled by JICA Survey Team based on Global Health Estimates 2019, WHO

Honduras incurs annually an estimated 2,575,644 DALYs, which translates to 0.264 DALYs per person, lower than the global average of 0.330, and similar to neighbouring countries. Additionally, the

[1] WHO. 2018. *Impact of drinking water, sanitation and handwashing with soap on childhood diarrheal disease: updated meta-analysis and meta-regression*

country's WASH-related DALYs, estimated at 59,803, are also lower than the global average of 0.015, with a rate of 0.006 DALYs per person, positioning it within the mid-range among neighbouring countries.

Referring to the WHO report[2], a value of one time of the per capita income to each DALY was assigned for the economic analysis. In the "with project" scenario, a significant reduction in WASH-related DALYs is anticipated within the project area due to improved water supply conditions. The formula below can be used to assess the annual value of these prevented WASH-related DALYs. It is assumed that the reduction trend of these DALYs aligns with that of diarrheal morbidity. Per capita GDP can serve as a proxy for per capita income.

$$D_k = D_i \times R \times S \times (I \times 1)$$

Where:

D_k :WASH-related DALYs to be averted in the project area.

Di :Total WASH-related DALYs in Honduras.

R :Reduction rate of WASH-related DALYs due to the project implementation.

S :Share of the project area's WASH-related morbidities against the total of Honduras.

I :Per capita annual income.

1 :Multiple of earnings to DALY.

(4) Electricity Cost Saving

The assessed electricity cost saving from the financial analysis is converted into an economic value. Both the economic and financial electricity prices are considered identical, at HNL 5.83 per kWh for a low-voltage non-residential consumer.

(5) Residual Value of the System

The economic values of project component's financial residual values at project's end are determined, using the SCF.

13.2.2 Analysis of Economic Viability

The economic cash flows for the project can be found in Table 13.2.6. The real-term EIRR stands at 13.06 %, surpassing the economic hurdle rate of 10%. Furthermore, the ENPV is calculated to be HNL million. These figures collectively indicate the economic viability of the project.

[2] WHO. 2001. *Macroeconomics and health: investing in health for economic development*

Table 13.2.6 Economic Cash Flow of Project

13.2.3 Sensitivity Analysis of Economic Viability

In the base case scenario, both EIRR and ENPV exceeded hurdle values, affirming project's economic viability. To assess its resilience during unfavorable conditions, a sensitivity analysis was performed, involving: (i) a 30% rise in capital costs, (ii) a 30% decrease in the impact of diarrhea reduction, (iii) a combined 30% increase in capital costs and 30% decrease in diarrhea reduction rate, and (iv) exclusion of averted DALYs from economic benefits. These outcomes are outlined in Table 13.2.7.

Table 13.2.7 Summary of Economic Sensitivity Analysis

	EIRR (Real Terms)	ENPV (HNL in Million)
Base case	13.06%	
Capital cost increased by 30%		
Diarrhea morbidity reduction rate deteriorated by 30%	11.26%	
Occurrence of the above two incidents		
Exclusion of averted DALYs from benefits	7.70%	

Source: JICA Study Team

A 30% rise in capital costs or a 30% drop in diarrhea reduction both result in a positive ENPV and exceed the 10% EIRR hurdle rate, ensuring the project's economic viability. Elevated capital costs have a greater negative effect on benefits. When the DALYs averted are excluded from economic benefits, EIRR is heavily impacted, resulting in 7.70% with a negative value of ENPV.

13.3 Conclusion of Financial and Economic Analyses

The financial analysis outcomes indicate that the project falls short of achieving the required FIRR for financial viability, and its execution may not guarantee financial sustainability. Nonetheless, there is potential for enhancing profit margins by raising the currently low water rates. On the other hand, the economic analysis findings demonstrate that executing this project will positively impact the stable water supply to residents and improve water quality. These improvements would substantially decrease the occurrence of diarrhea and promote a healthier sanitary environment for residents. When these advantages are quantified, the EIRR surpasses the standard requisite for project implementation. This provides a rationale for moving forward with the project.

CHAPTER 14 PROJECT EVALUATION AND EVALUATION INDICATORS

This chapter presents the project evaluation and evaluation indicators of JICA portion.

14.1 Project Evaluation

14.1.1 Technical Evaluation

The project component consists of six components: Component 1: Renovation of water transmission pipeline, Component 2: Renovation of water transmission pump station, Component 3: Renovation of instrumentation and SCADA, Component 4: Renovation of water distribution tank, Component 5: Improvement of water distribution network, and Component 6: Procurement of customer meter. The following are the points to be considered for each component.

Component 1:

Pipe jacking method is to be applied. It is necessary to mobilize the foreign companies which can apply this new technology.

Component 2:

During the construction of the pump station of Laureles system, it is necessary to consider sending water to the affected distribution tanks from the Concepcion system and Picacho system

Component 3:

It is necessary to confirm the inventory of the existing water transmission and distribution pipeline, before the detailed design work. The communication method (cellular phone network or UHF frequency band radio) between each tank and the monitoring center needs to be determined at the time of the detailed design.

Component 4:

Glass fused steel tank will be applied for the tank at Hato II, considering the available land.

Component 5:

It is necessary to confirm the inventory of the existing water distribution pipeline, before the detailed design work.

Component 6:

It is necessary to determine the detailed specification of the customer meter as well as the air valve and UFR.

14.1.2 Economic and Financial Evaluation

The financial analysis outcomes indicate that the project falls short of achieving the required FIRR for financial viability. Nonetheless, there is potential for enhancing profit margins by raising the currently low water rates.

On the other hand, the economic analysis findings demonstrate that executing this project will positively impact the stable water supply to residents and improve water quality. This provides a rationale for moving forward with the project.

14.1.3 Environmental Evaluation

No serious environmental impacts have been found. As for the social aspect, the transmission pipeline will pass under private land. However, the permission of the landowner has been obtained, and thus, no land acquisition is required.

14.2 Operational and Effect Indicators

Proposed operational and effect indicators with the target year of 2033, which is about two years after the project completion, are shown in Table 14.2.1.

Table 14.2.1 Operational and Effect Indicators of the Project

Indicators	Baseline (2022)	Target (2033) [Two years after project completion]	Data Sources and Calculation Method of Indicator Values	Remarks
Operational Indicators				
(1) Ratio of number of functional customer meter to the number of connections in the target distribution block	7.6 %	50 %	Calculate by: - Number of connections in the customer register section of Commercial sub-management - Number of measuring by customer meter in the measurement section of Commercial sub-management	2,900 customer meters will be installed by Component 5. In addition, 10,000 customer meter will be procured by Component 6.
(2) Ratio of metered water amount to the amount of total billed water	22 %	50 %	Calculate by: - Billing water amount of the billing section of Commercial sub-management - Metered water amount of the measurement section of Commercial sub-management	By increasing the number of functional customer meters, the ratio is expected to increase.
(3) Population who cannot receive the water supply at least once every three days	Approximately 90,000	Zero	Refer to the water distribution schedule which is prepared every month by the block distribution subsystem of Potable water sub-management.	By renovation/improvement of distribution tank and pipeline, the water leakage is expected to decrease, and available water is expected to increase.
Effect Indicators				
(1) Number of break incidents of transmission pipeline of Laureles System	More than twice per year	Zero	Refer to the operation record and the repair record of Laureles subsystem and repair and maintenance section of Potable water sub-management.	By renovation of the water transmission pipeline, the break incidents will not occur.
(2) Ratio of water transmission amount during the break incidents of transmission pipeline of Concepcion System to that in the normal condition.	N/A	More than 70 %	Refer to the operation record in the normal condition and during the break incidents, in Concepcion subsystem of Potable water sub-management.	By renovation of the valves, the affected area of the pipe break incidents will be reduced.
(3) Ratio of annual unfunctional days of pumps of the pump stations of Laureles system	More than 25%	Zero	Refer to the operation record and repair record of Laureles subsystem and repair and maintenance section of Potable water sub-management.	The pumps of Juan A Lainez PS and Loma Linda PS, which are currently unfunctional, will be functional.
(4) Ratio of NRW	26 % (2022)	11%	Refer to the monthly outflow volume from the distribution tank recorded by Potable water sub-management and the metering data of commercial sub-management	By renovation/improvement of distribution network and increasing the number of functional customer meter, both water leakage and commercial loss is expected to decrease.
(5) Ratio of customer of whose water pressure at the customer connection is adequate	N/A	More than 90%	Refer to the updated pipeline inventory and check the hydrostatic pressure. Check the water pressure at the critical service connection.	Hydrostatic pressure: less than 60m Hydrodynamic pressure: more than 10m

Source: JICA Study Team

14.3 Risk Management Framework

Risk management framework of the Project is shown in Table 14.3.1.

Table 14.3.1 Risk Management Framework of the Project

Potential Project Risks	Assessment	Probability	Impact	Mitigation Measures
1. Stakeholder Risk				
Delay in the project implementation due to delay of work permission for construction work under the existing road	- The D1000 transmission main pipeline is to be constructed under the existing road. It is necessary to obtain work permission of road authority and traffic police.	Middle (High)	High	PIU shall request the Contractor to prepare the detailed construction plan and submit it to AMDC in a timely manner
2. Executing Agency Risk				
2.1 Capacity Risk Delay of mobilization due to insufficient coordination with customs office	- UMAPS needs to take necessary procedure for obtaining timely custom clearance	Middle (High)	High	- PIU, with the help of the consultant, shall have close communication with the contractor and relevant authorities
2.2 Governance Risk Delay in the project due to the delay of approval/ sanction process in AMDC/central government	- Personnel changes in critical positions may affect the approval/ sanction process	Low (Middle)	High	- PIU/UMAPS should have certain authority of approval/sanction
3. Project Risk				
3.1 Design Risk Inadequate design due to insufficient information of the existing facilities	- Adequate design cannot be prepared without sufficient information of the existing facility	Middle (High)	High	- PIU should prepare sufficient and correct information of the existing facilities
3.2 Delivery Quality Risk Delay in project implementation due to the technical incapability of the Contractor	- Package 1-1 (ICB) requires the special technologies: pipe-jacking method. An experienced contractor needs to be appointed.	Middle (High)	High	- Appropriate technical evaluation should be conducted for the selection of the ICB contractor. The experience of the contractor should be checked.

Probability indicated in ( ) is that when the proposed mitigation measure is not taken or successful.

Source: JICA Study Team