long term technical assistance

EU-AFD TECHNICAL ASSISTANCE PROGRAMME TO SUPPORT REFORMS IN THE WATER AND WASTEWATER SECTORS IN LEBANON

Funded by the European Union

Implemented by AFD

A9 : INITIAL DIAGNOSIS OF THE WATER ESTABLISHMENTS

DATA COLLECTION AND DIAGNOSIS REPORT

South Lebanon Water Establishment

REVISED EDITION

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GENERAL CONTENTS

ACRONYMS

AFD	Agence Française de Développement
ALI	Apparent Loss Index
AWWA	American Water Works Association
BMLWE	Beirut and Mount Lebanon Water Establishment
BWE	Beqaa Water Establishment
Capex	Capital Expenditures
CEO	Chief Executive Officer
CMS	Client Management System
DG	Director General
DMA	District metering area
DMAs	District metering areas
EDL	Electricité Du Liban
EDZ	Electricité De Zahleh
ERP	Enterprise Resource Planning
EU	European Union
GAAP	Generally Accepted Accounting Principles
GIS	Geographic Information System
HR	Human Resources
ILI	Infrastructure Leakage Index
IT	Information Technology
IWA	International Water Association
KPI	Key performance Indicator
KPIs	Key performance Indicators
KVA	Kilo Volt Ampere
LBP	Lebanese Pound
LWP	Lebanese Water Project
M LBP	Million Lebanese Pound
MCM	Million Cubic Meters
MoEW	Ministry of Energy and Water
NGOs	Non Governmental Organisations
NLWE	North Lebanon Water Establishment
NRW	Non Revenue Water
NWSS	National Water Sector Strategy 2020
O&M	Operation and Maintenance
Opex	Operation Expenditures
P&L	Profit and Loss
PI	Performance Indicator

PIs	Performance Indicators
PS	Pumping Station
RWE	Regional Water Establishment
SCADA	Supervisory Control And Data Acquisition
SLWE	South Lebanon Water Establishment
TA	Technical Assistance
UARL	Unavoidable Annual Real Loss
UNICEF	United Nations International Children Emergency Fund
USAID	United States Agency for International Development
VAT	value Added Tax
WE	Water Establishment
WEs	Water Establishments
WTP	Water Treatment Plant
WW	Waste Water
WWTP	Waste Water Treatment Plant
WWTPs	Waste Water Treatment Plants

1 INTRODUCTION

Within the framework of the project "*Technical Assistance Programme to support Reforms in the Water and Wastewater sector*", funded by the European Union and implemented by AFD, Activity A9 stipulates to "*Carry out an initial diagnosis at the WEs*".

The purpose is to carry out a diagnosis performance study for the four WEs, aiming to assess their actual situation through the identification of strengths and weaknesses and critical issues along with possible actions/takeaways for the water establishment to implement service management to international standards, in line with the requirements of the NWSS.

The end goal is to eventually define strategic well-tailored orientations for each WEs, and to identify and implement pertinent KPIs for performance monitoring.

The activity was carried out in two-steps: Data collection, then preliminary diagnosis, covering:

- Technical matters:

  The assessment of the actual situation of human resources (quantitatively and qualitatively, job description, adequacy of the positions with the current profiles, description of the reference frame of the professions and in particular of the new professions that the RWE will need in the coming years, organization structure, etc.).

  The NRW: analysis of the major ratios of production, loss and sales actually collected and cleansed

  Energy related issues: Analysis of energy consumption, source of power, power optimisation and else.

  O&M issues : O&M procedures, O&M system components, existing water systems and planned new infrastructures, Information system, Quality of service in terms of complaints system and service coverage.

  And in general all administrative and technical aspects of the WEs activity.

- Financial matters:

  Revenues analysis covering tariffs, budgets, cash flows, profit and loss, billing system and collection rates, accounting system, water sales, subscription rates.

  Expenditures analysis covering Opex analysis and cost recovery.

  Expenditures related to Capex are not addressed in these preliminary diagnosis reports, due to the lack of relevant data in all four WEs. This will be tackled later on in the final diagnosis reports to be prepared subsequently to this report.

Four separate *Preliminary Diagnosis* reports are produced, one for each WE, structured as follows :

1. Introduction – Legal framework
2. Section A: Executive summary - Findings and recommendations
3. Section B: Technical Performance Diagnosis
4. Section C: Financial Performance Diagnosis
5. Section D: Collected Data

In addition, a brief historical background and legal framework of the four WEs is given herein under. More details and key figures and services provided by each WE are given at the beginning the relevant Executive Summary, in order to provide the reader with a full but concise picture on the WE before focusing on diagnosis's results and recommendations.

The present report covers the preliminary diagnosis of NLWE.

2 HISTORICAL BACKGROUND – LEGAL FRAMEWORK

Until 2000, 21 water authorities were in charge of the supply of potable water throughout the Lebanese territory: eight in the North, six in Beirut and Mount Lebanon, four in the South, and 3 in the Beqaa. Of these, only the Beirut Water Authority (today BMLWE) was an independent authority with its own budget and board, under the tutelage of the Ministry of Electric and Hydraulic Resources (today Ministry of Energy and Water - MoEW). The others were under the direct authority of the ministry.

The result of this fragmentation in service provision was a lack of strategic planning and implementation across the regional service areas, which needed to be managed in a more effective, reliable and sustainable manner

Law № 221/2000 of May 29, 2000, rectified by law № 241/2000 of 7 August 2000 and amended by law № 377 of 14 Dec 2001, re-organizes the water sector in Lebanon, introduces the principles of Integrated Water Resources Management (IWRM), and improves efficiency in service provision.

Under this new regulation, the former 21 water authorities were consolidated into four Water Establishments as follows :

- NLWE, based in Tripoli, merges the former water authorities of Batroun, Bcharreh, Minieh-Dannieh, Halba, Koura, Qbaiyyat, Tripoli and Zgharta.
- BMLWE, based in Beirut, merges the former water authorities of Beirut, Metn, kesrouane, Jbeil, Chouf, and Ain el Delbeh.
- SLWE, based in Saida, merges the former water authorities of Saida, Nabeh el Taseh, Sour and Jabal Amel.
- BWE, based in Zahleh, merges the former water authorities of Baalbeck-Hermel, Zahleh, and Chamsine.

On July 3, 2002, Bylaw 8122 set out the merger of all the former water authorities (as well as all communities, local committees and else, operating and managing drinking water, sanitation, and/or irrigation facilities) under the jurisdiction of the above four WEs.

On the administrative level, Article 5 of Law 221/2000 and its amendments states that the four WEs are independent public bodies, governed by a Board of Directors of six members and a CEO, all appointed by decree. The Board is entrusted with establishing all the internal regulations of the WE. The WEs works under special regulations, under the tutelage of the Oversight Department of MoEW.

The adoption of the Law 221 in 2000 led to the promulgation of a number of by-laws in 2005 as follows:

- Decree 14598 of 14/6/2005 – Rules of procedure
- Decree 14599 of 14/6/2005 – Operating rules amended by Decree 1756 of 16/4/2009
- Decree 14636 of 16/6/2005 – Financial regulations
- Decree 14875 of 1/7/2005 – Staff rules and regulations
- Decree 14916 of 5/7/2005 – Administrative organization

The operating rules are the same for all four WEs, except for SLWE where Articles 56 through 86, which govern matters related to irrigation, are not relevant as irrigation in South Lebanon falls under the Litani River Authority (LRA) and not SLWE as is the case for the three others.

The tasks of the WEs can be summarized as follows:

- Study, implement, invest, maintain and renovate water projects to distribute drinking water.
- Collect, and treat wastewater and dispose of effluents and sludge
- Propose tariffs for drinking water and wastewater disposal services.
- Monitor the quality of distributed drinking water and treated effluents.

In 2005, a number of related by-laws were promulgated:

- Decree 14602 of 14/6/2005 – Rules of procedure
- Decree 14603 of 14/6/2005 – Operating rules amended by Decree 1757 of 16/4/2009
- Decree 14639 of 16/6/2005 – Financial regulations
- Decree 14874 of 1/7/2005 – Staff rules and regulations
- Decree 14913 of 5/7/2005 – Administrative organization

3 DATA COLLECTED

The range period of the data collected was mainly the past five years from 2017-2020. However, when available, data ranges from 2015 were provided by the WE. NLWE provided good insights over data management issues.

The data collected covers all what is available to date on:

- Human resources and organization structure
- Technical data in relation with system information (GIS, ERP, etc.), water systems and infrastructures, Water resources and production, Energy use and consumption, O&M approach and system (SCADA system), Water quality.
- Customer service (Subscribers, quality of service, service coverage, etc.).
- Economic and financial data covers the revenues, expenses, tariff and subscriptions, collection, billing, budgets, trial Balance, Administrative and Commercial accounts, cash flow, ERP system, etc.
- Audit and monitoring system.

SECTION A
EXECUTIVE SUMMARY - RECOMMENDATIONS

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A.1 INTRODUCTION

The structural degradation of the past two decades has transformed the WEs into poorly efficient utility vehicles on different functional levels. In addition, the present environment prevailing since 2017 has added to the complexity of the development process. This present crisis, specially the resulting high increase in transportation cost, has crippled all activities that demand human intervention, human presence, or human governance. It has also exposed the fragility of power supply to the production facilities. The non-efficient production and distribution means, poor governance tools, and data scarcity have also reflected heavily on the situation.

It became now integral to adopt new perspectives to overcome the aftermath of the economic and financial meltdown in the country.

Any remedial and development endeavour surely requires, as a prerequisite, the fortification of the Establishment in the following – but not only – fields:

- <u>Strategic vision</u>

  The WE should define and implement a clear development strategy setting out the objectives to be achieved and the way to achieve them within a scheduled time frame.

  The utility provider has to be able to sustain water supply; and at the same time, it has to undergo a rigorous development program that abides to this strategy.

  SLWE has developed its own strategy for 2020-2025, based on the following pillars:

  - Securing consistent water supply:
    By shifting from ground to surface water (springs), increase storage capacity, development and rehabilitation of water networks, use of automation in operations and sustainable energy sources

  - Drinking water quality:
    By upgrading the labs and quality management program, and enforcement of law to control pollution

  - Cost optimization:
    By decreasing production cost (energy reduction by reliance on solar and surface water), increasing the use of technology and automation, decreasing NRW, increasing in-house maintenance capabilities and management system

  - Customer satisfaction:
    By improving customer service, call centre, customer interface (interactive platforms and social media), mobile application and the like

  This Strategy is gradually and slowly being implemented, depending on the means available

- Establishment's structure

  The first step is to revise the structure of the WE and set up a new organizational structure in order that it supports both functional and development processes.

- Human resources

  Due to the current crisis and the dramatic fall in wages, the employees of the establishments (essentially the most qualified and most experienced) are leaving. Additionally, WEs are not allowed to employ; and if so, the official wage scale has become too low to attract applicants. Therefore, the human resources of WEs are slowly depleting.

  The WEs must be able to renew and/or retain their human resources by being authorized to employ and raise salaries to an attractive level. However, the employment ban is a general policy of the Lebanese government which applies to all public institutions, and therefore derogating from it only the WEs is a real political issue.

- Data acquisition and management

  Considering the present great difficulties to retain the human resources, the experience and the knowledge base of the establishment have to be preserved at least. The system has to overcome the challenges of the high turnover rate especially the time required by newcomers to merge into the workplace. The turbulent environment the establishment has been passing through requires rigorous and continuous change management activities that consumes lots of time and energy of the management team.

  Therefore, data has to be properly collected and preserved. No development program can work effectively if it is not based on real and accurate data. This includes credible data collection means, archiving, and processing. The digital transformation of the WE is an essential and necessary milestone in the route towards sustainability.

- Governance

  Another challenge to be realized is the proper governance of the all functional, commercial, and quality processes. The establishment is sustainable if it is commercially viable. Commercial viability implies a turnover with a positive profit to loss ratio and positive cash flow. Added to this, a growing establishment implies an increasing annual asset valuation. Quality governance is an integral part of the establishment’s ethical and professional mission. Functional governance is a necessity for an adequately performing establishment. Another reason for a necessary digital transformation.

- IT and Communication infrastructure

  Proper and credible data collection activities, in addition to the digital transformation, require a concrete and reliable IT and Communication infrastructure. This includes integrated software that can work together and with the central ERP software. The communication means have to be reliable and commercially feasible.

- Billing and collection

  At the bottom of commercial viability and turnover growth are billing and collection. Customer segmentation, tariffs, payment portals, among others, can be included in a comprehensive billing solution. The collection process reflects the performance of a number of processes within the establishment. Collection can always be increased by keeping a comprehensive and up-to-date customer database.

- Production cost

  For a utility provider that depends solely on its collection, a positive cash flow can only be guaranteed by a profitable enterprise. Increasing profit can be realized by decreasing production cost, which mainly consists of energy cost.

  Energy cost can be optimized by choosing adequate energy source and by decreasing the energy demand of production facilities. Production facilities require less energy if they produce less water as well. Automation is a necessary requirement for a well-governed process.

- Automation

  Less water production implies optimized distribution. This means that supply adequately meets demand. The quantity of water produced has to be as close as possible to the quantity in demand. Non-revenue water (NRW) has to be kept minimal, whether technical or due to free riders. Pressure in the network has to be compatible with the customer demand curve to control the technical losses.

  Human interference to control distribution valves proved detrimental and incompatible with this endeavour and has to be eliminated.

  Therefore, Automation is a necessary requirement for optimized distribution.

- Water quality

  Distributed water quality is an essential parameter that has to be compatible to national water standards. The community's ability to purchase drinkable water or to access health facilities in case of illness has been greatly compromised. Enhancing and guarantying water quality can also increase the subscribers' base and their willingness to pay a higher tariff.

- Wastewater

  Sewage is a pollution hazard that poses great risk on water quality at its source.

  Management of the sewage sector is by law the duty of the WEs. Ideally, it should be designed, implemented, and operated to complement water systems in the supply of water for irrigation and possibly industry. This is not the case presently

The legal and structural framework allows the intervention of other stakeholders (such as the Ministry of environment (MoE), the MoEW, the CDR, and the municipalities) in the sector. This, of course, hinders the direct operation of the sector by the WEs.

The sewage sector ought to be monitored and managed by the WEs, while operation could be done by others (i.e. municipalities and/or private sector). The other stakeholders should all participate, within their duties, to make the management of the sector possible. For example, the quality of the sewerage, the standards of the effluent, rainwater, among others should be attended to by the concerned stakeholders as they fall beyond the mandate of the establishments.

- Water Establishments sustainability

Water establishments in Lebanon are already non-sustainable in 2019, before the crisis; so all the more today!

All efforts should be invested to transform the establishments into sustainable enterprise within a midrange period. From what has been studied until to date, SLWE can surely be transformed into a sustainable enterprises if the right decisions are made.

One way would be to realize the core activities of the establishments as to outsource some or all of the non-core activities to private or other public entities that may be able to guarantee operating these non-core activities.

However, for the water utility providers to achieve their sustainable full capacity interference is required on the functional, structural, and legal levels in order to develop production, distribution, and quality activities in a governed manner.

A.2 SLWE GENERAL OVERVIEW

SLWE serves a geographic area of approximately 2,200 Km² divided, for service and management purposes, into 7 potable water distribution sections as shown in Figure A 2-1 below. SLWE is exempted from the irrigation services for the national interest of the Litani River.

The supplied population is around 1,200,000 (2020) with approximately 300,000 housing units, out of which approximately 60% are subscribed to the water supply service.

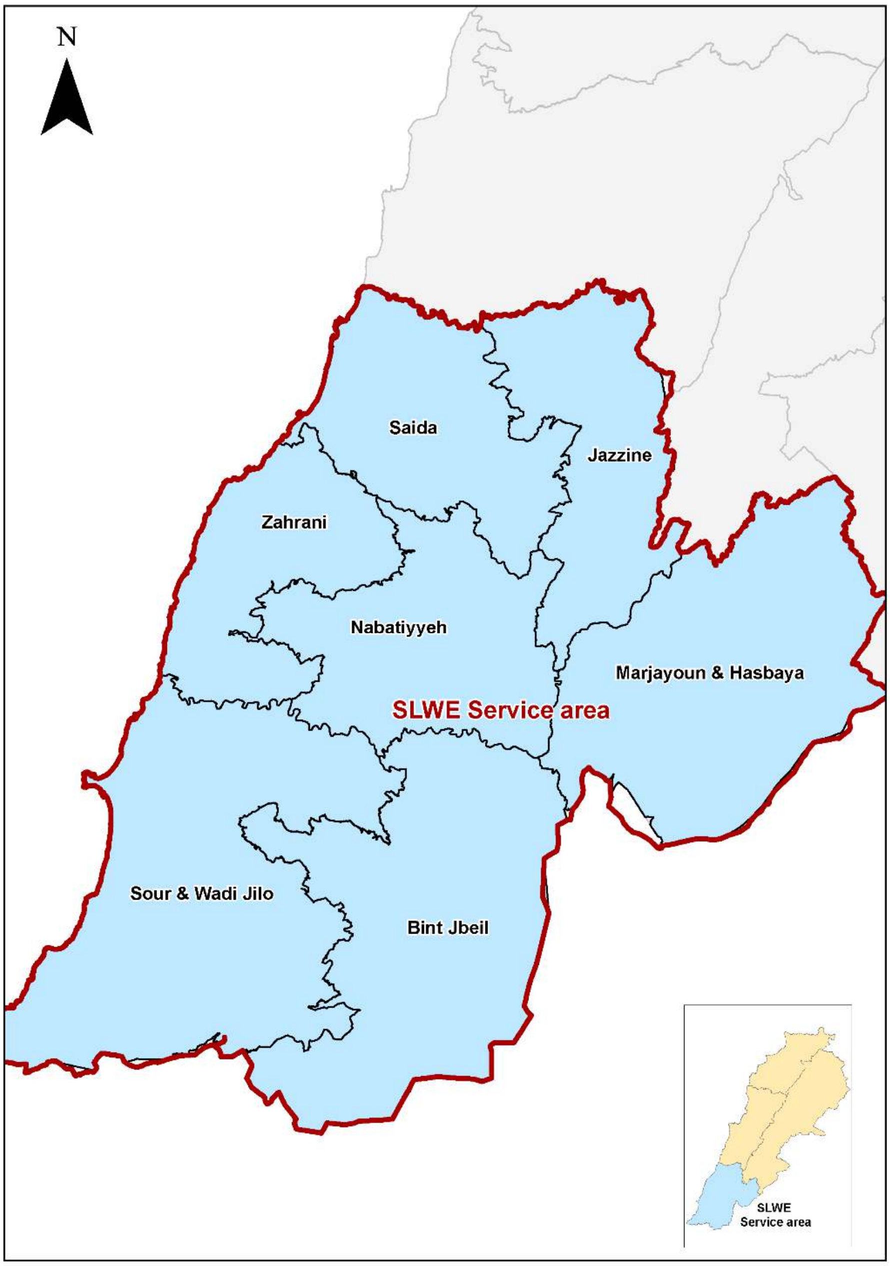


Figure A 2-1 SLWE service area

SLWE has the authority and responsibility to provide sewage collection and treatment services. This has traditionally been a service provided by CDR, at the starting period of the operation, and to date, SLWE is operating 4 treatment plants and is reluctant to take over and operate any new wastewater facility.

The water supply sources of SLWE consist of a combination of 363 wells, 3 treatment plants, 13 pumping stations,8 springs and 0 dams. The length of the network pipelines in SLWE is 8,000 km and the service connections is 75,000 connections. Water treatment to drinking water standards consists largely of chlorine disinfection, conferential treatment and advanced treatment to protect from any possible sources of pollution. A key figure is the losses which is about 5% as technical losses.

Table A 2-1 below shows a general overview of SLWE's key figures.

Table A 2-1 SLWE overview (2020)

Population	
Estimated population served	1 200 000
Nbr of municipalities	385
Nbr of Housing Units	300 000
Nbr of connections	75 000
Housing units per connection	4
Subscribers	
Metered subscriber	34 461
Gauged subscribers	146 957
Total subscribers	**181 418**
Rate of metered subscribers (%)	19%
However meters are not read and billed as gauges	
Water production	
Volume produced (Million m^3/Y)	136
Collection rate (%)	49
Est. NRW rate (%)	47%
Water Resources & Infrastructures	
Nbr of Water TP	3
Nbr of Pumping Stations	13
Nbr of Wells	363
Nbr of Springs	8
Nbr of Dams	- -
Est. length of the water networks (km)	8 000
Wastewater	
Nbr of WWTP under SLWE jurisdiction	
Operated by SLWE	4
Operated by CDR	3
Under Construction	2
	9
Length of existing sewer	Not Known
Staffing	
Nbr of actual employees (Permanent + On demand)	1072

A.3 PERFORMANCE DIAGNOSIS SUMMARY

A.3.1 HUMAN RESOURCES

Figure A 3-1 below shows SLWE's organization chart as specified by Bylaw 14914/5 of July 2005 (*The Organisation of South Lebanon Water Establishment and the Specification of its employees, grades, salary scale, and hiring conditions*)

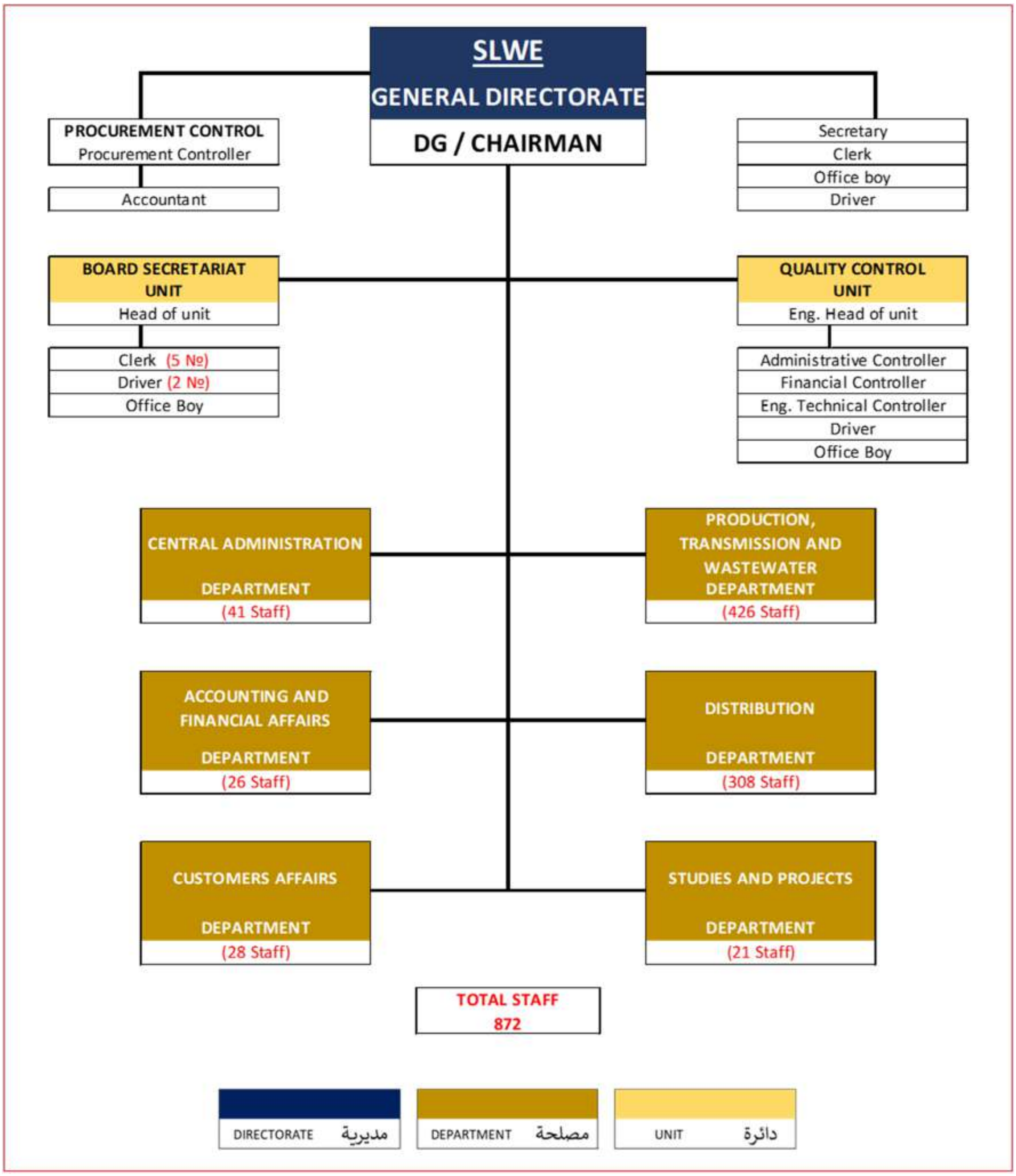


Figure A 3-1 SLWE General Organigram as per By-Law № 14914/5 of July 2005

Detailed Organisation charts by department are provided under *Section D*

Total employees number should be 872, of which only 206 positions are presently (2020) filled, which amounts to 76% vacancy.

Article 21 of law 46/2017 provides for a ban of employment in all public institutions and establishments. To circumvent this ban, SLWE (like all other WEs) hires on-demand staff to fill not only operational but also business development positions, in order to implement its 2020 – 2025 Strategy and ended up with 866 (2020) on-demand personnel representing 81% of the total 1072 (206 + 866) present staff.

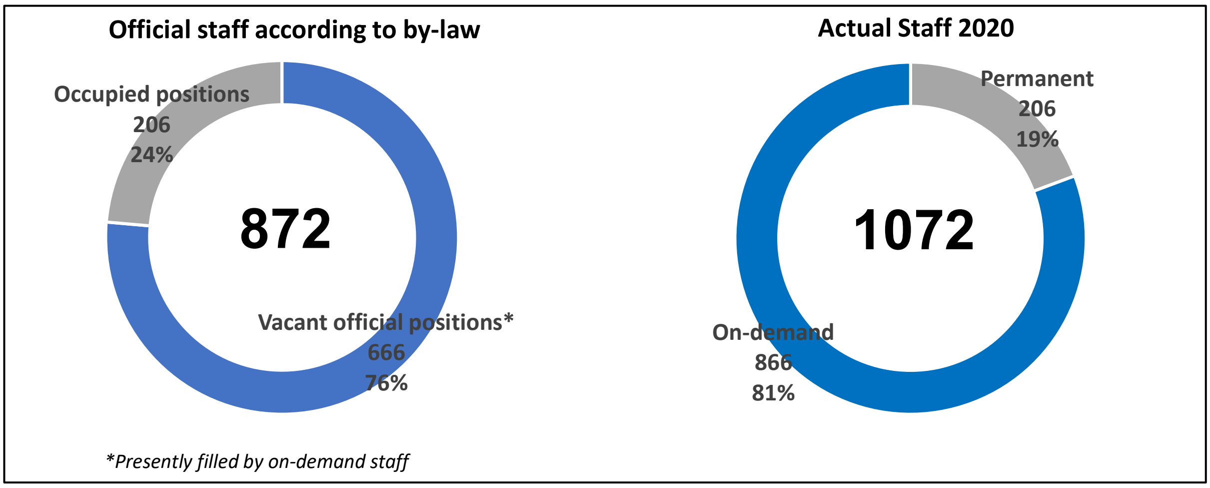


Figure A 3-2 Staff allocation (2020)

The assessment of staff productivity as measured by the number of staff members per 1000 connections was not possible due to the large uncertainty of the number of connections; therefore, the number of subscribers and the number of potential customers were used as alternative methods. The analysis shows that SLWE is not understaffed, thanks to temporary on-demand staffing. However, there is a sharp lack of qualified personnel, which is the key factor behind the WE lack of operational capacity and the low levels of service. The gap between the number of staff specified in the WEs' organizational decrees and the number of positions occupied is a key indicator.

Due to the deteriorating economic situation and the devaluation of the national currency, SLWE is facing high turnover rate of experienced employees and is risking the loss of their knowledgebase. In 2021, SLWE revisited its five-year strategy to alter the means of the implementation of its objectives and consequently the WE called for the digitalization of its workflows and processes in order to overcome the rising impediments, to limit the effect of the human intervention, to retain the knowledgebase and to reinforce the operational optimization in water production and distribution.

A.3.2 WATER PRODUCTION

Presently, the water production is not adequately monitored due to the lack of flow measurement equipment in some of the water sources and the absence of telemetry solution for a simple monitoring system or SCADA system for a fully automated monitoring water management system at the wells, springs and pumping stations. Production figures given by SLWE are known by region from 2017 to 2020 yet, it is based on operators' best estimate.

In 2021, the electricity outage and the rise in fuel prices triggered by exchange rate fluctuations would adversely impact the water volumes pumped; a decrease in water production and a decline in the number of hours of supply are to be expected.

A.3.3 WATER DISTRIBUTION - NRW

In order to examine the nonrevenue water at SLWE, the analysis adopted a well-known procedure of top-down assessment and bottom-up assessment. However, the accuracy of production quantities, actual water consumption and the absence of DMAs are recognized as the main areas of concern.

Almost all production quantities are based on estimates of production and approximate working hours, while the actual water consumed by the customers cannot be known due to the absence of metering practices. On the flip side, the bottom-up estimate of real losses is ideally conducted on the level of a district-metered area, but the distribution networks are not organized into DMAs and there is no flow measurement at the level of the local reservoirs except for some very limited distribution zones.

The lack of data coupled with absence of DMAs compromised the accuracy of the results. The nonrevenue water has shown little progress between 2019 and 2020 and it is estimated by 47%. The vicious circle of NRW is one of the key reasons for poor utility performance and results in both physical and commercial losses. The analysis of the available data shows that the high NRW levels are mainly caused by commercial losses resulting from inefficiencies in billing, illegal connections and theft. The real (physical) losses are estimated to be 5%. While it is hard to draw any stroke conclusions from the current data, it is worth noting as an area for further research.

A.3.4 WATER QUALITY

As for the quality of water, the data show that SLWE developed its own water quality management program “عين” in 2019 to consolidate the water quality results in an accurate, reliable and comparable database, to reduce human error and to ensure the compliance with the national standards and international goals of water safety. The system enables the laboratories and departments to improve their processes and services by accessing and analyzing water quality information and make data-driven decisions. The system is coupled with GIS-based dashboard to visualize the data in a timely manner and to monitor the water supply chain by locating pollution incidents without carrying intensive sanitary surveys.

A.3.5 WASTEWATER

Despite the construction of multiple WWTPs in South Lebanon by the CDR, the water quality is facing hardship as a result of the sanitation sector; the wastewater and hazardous contaminants from cities, villages and industries are often pumped into rivers or seas without appropriate treatment, leading to water pollution and posing a threat to the health of ecosystems and people.

Legally, the wastewater sector in full (collection networks and treatment facilities) is under the responsibility of the WEs. However, SLWE is reluctant to take over this sector, mainly for (i) the lack of funds to operate it and (ii) the lack of adequate expertise among the present WE's staff. Before providing necessary financial and human resources, SLWE cannot take over and operate any wastewater facility. This would be achieved when (i) a new organization chart is implemented and authorization to hire is given to the WEs and (ii) when a new tariff allowing the WE to cover the Opex is enforced.

Table A 3-1 Number of water production and wastewater facilities in 2020.

	Bint Jbeil	**Jezzine**	**Marjaayoun Hasbaya**	**Nabatiyeh**	**Saida**	**Sour**	**Zahrani**	**Total**
Pumping stations	5	2				6		**13**
Springs		5		1	2			**8**
Wells	29	18	25	70	86	93	42	**363**
WTPs	1					2		**3**
WWTPs	1			4	1	1		**7**

A.4 FINANCIAL DIAGNOSIS SUMMARY

A.4.1 KEY FIGURES

Table A 4-1 below summarises the financial key figures of SLWE. Financial data for 2020 was not available.

Table A 4-1 SLWE Financial Key figures

		2017	2018	2019	2020
		(year ends December 31)			
Subscribers, production, NRW					
Total number of customers		155 888	168 097	177 653	181 418
of whom water meters (but not read)		20 751	21 177	30 709	34 461
Volume produced entering into the system	m³/year	108 995 570	113 016 410	142 614 041	135 440 327
Volume billed/subscribed	m³ /year	61 374 385	66 233 995	69 971 595	71 476 855
Estimated NRW rate		43.7%	41.4%	50.9%	47.2%
Revenues; Collection rate; Operating cost					
Accrued revenues	LBP	45 135 018 325	52 182 958 125	52 034 994 644	
Actual revenues	LBP	21 213 458 613	31 831 604 456	25 497 147 376	
Annual collection rate		47%	61%	49%	
Operating cost	LBP	51 924 743 836	55 292 132 461	59 667 256 380	
Operating result, EBITDA					
EBITDA in case 100% collection rate	LBP	-6 789 725 511 (-15%)	-3 109 174 336 (-6%)	-7 632 261 736 (-15%)	
Actual EBITDA considering actual collection rate	LBP	-30 711 285 223 (-145%)	-23 460 528 005 (-74%)	-34 170 109 004 (-134%)	
Cash situation					
Cash situation	LBP	4 938 000 000	13 829 000 000	9 107 000 000	
Account Receivables	LBP	185 356 000 000	192 509 000 000	211 088 000 000	
Estimated Amortization			12 374 159 148	8 014 609 350	
Rates for 1 m³					
Nominal selling price (based on accrued revenues)	LBP/m³	735	788	744	
Actual selling price (based on actual collection)	LBP/m³	346	481	364	
Nominal operating cost (based on volume produced)	LBP/m³	476	835	853	
Actual operating cost (based on volume billed)	LBP/m³	846	835	853	

A.4.2 PROFITABILITY, SUSTAINABILITY

On the financial side, the analysis concentrated on profitability, liquidity and solvency of the WE. A particular attention is paid to the EBITDA, which reflects the profitability of the business together with the capacity to produce sufficient cash-flow.

Generally speaking, SLWE is not in a good financial situation as revenues do not meet O&M costs, leaving the WE without the capacity to replace worn-out assets and the situation has deteriorated after 2019 due to the financial crisis.

Operating result in 2019 is a loss amounting 16% of the accrued revenues with a negative EBITDA. In other words, even with a 100% collection rate, the gross margin is negative. As a consequence, the WE is suffering of treasury problems and due to a low collection rate (50% In average), the accounts receivables are accumulating. In 2019, Accounts receivables by the end of the year are 4 times the annual turnover and the trend is not favourable. On the long run, such accumulation of bad debts will require a provision for unpaid bill.

Major cause for such bad situation is the low level of the tariff with an unchanged tariff while O&M costs are increasing. SLWE is in a situation where O&M cost is higher than the official tariff level and the situation is worst while considering the 50% collection rate. In other words, even with a 100% collection rate, the WE is experiencing losses.

A.4.3 OPEX COST RECOVERY

The analysis reveals the impact of the cost of energy on operational expenditures.

In 2019, energy costs was 48% of the total Opex, against 40% for labour, and 8% for maintenance cost. With a total of 88%, energy and staff costs have the greatest impact on Opex (confirming the *pareto Principle* 80/20!). However, in 2022, the cost of energy became preponderant with nearly 90% of the Opex (Figure A 4-1 below).

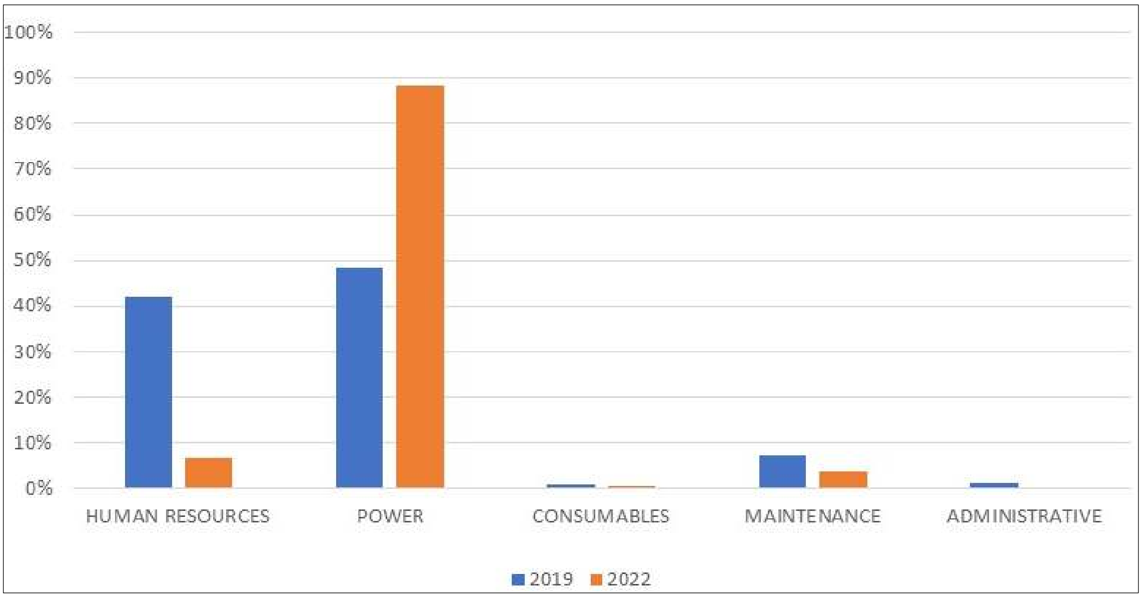
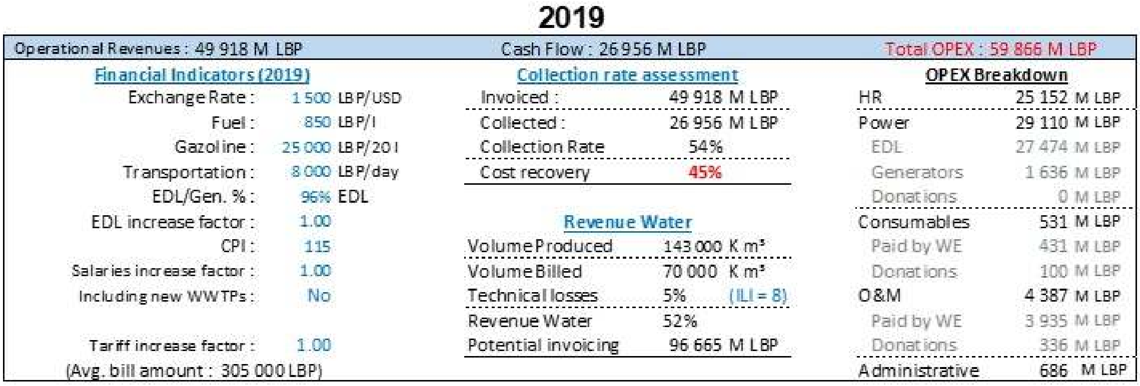


Figure A 4-1 Opex distribution : 2019 v/s 2022

Presently, the situation has worsen with the rising inflationary pressures, the devaluation of the Lebanese Pound and the rise in energy prices. SLWE now barely covers 5% of the operational costs compared to 45% prior to economic meltdown (with the tariff in force in 2021).

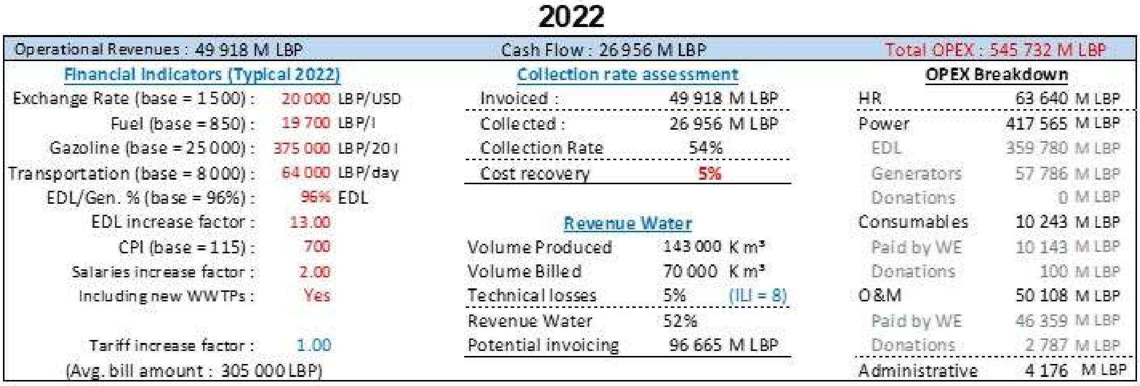
The required tariff to balance the estimated 2022 Opex is around 6 Million LBP, which is simply not applicable from the socio-economic point of view.

Table A 4-2 Compared Opex Cost Recovery 2019 - 2022



2019

Operational Revenues : 49 918 M LBP		Cash Flow : 26 956 M LBP		Total OPEX : 59 866 M LBP	
Financial Indicators (2019)		Collection rate assessment		OPEX Breakdown	
Exchange Rate :	1 500 LBP/USD	Invoiced :	49 918 M LBP	HR	25 152 M LBP
Fuel :	850 LBP/l	Collected :	26 956 M LBP	Power	29 110 M LBP
Gazoline :	25 000 LBP/20 l	Collection Rate	54%	EDL	27 474 M LBP
Transportation :	8 000 LBP/day	Cost recovery	45%	Generators	1 636 M LBP
EDL/Gen. % :	96% EDL			Donations	0 M LBP
EDL increase factor :	1.00	Revenue Water		Consumables	531 M LBP
CPI :	115	Volume Produced	143 000 K m^3	Paid by WE	431 M LBP
Salaries increase factor :	1.00	Volume Billed	70 000 K m^3	Donations	100 M LBP
Including new WWTPs :	No	Technical losses	5% (ILI = 8)	O&M	4 387 M LBP
		Revenue Water	52%	Paid by WE	3 935 M LBP
Tariff increase factor :	1.00	Potential invoicing	96 665 M LBP	Donations	336 M LBP
(Avg. bill amount : 305 000 LBP)				Administrative	686 M LBP



2022

Operational Revenues : 49 918 M LBP		Cash Flow : 26 956 M LBP		Total OPEX : 545 732 M LBP	
Financial Indicators (Typical 2022)		Collection rate assessment		OPEX Breakdown	
Exchange Rate (base = 1 500) :	20 000 LBP/USD	Invoiced :	49 918 M LBP	HR	63 640 M LBP
Fuel (base = 850) :	19 700 LBP/l	Collected :	26 956 M LBP	Power	417 565 M LBP
Gazoline (base = 25 000) :	375 000 LBP/20 l	Collection Rate	54%	EDL	359 780 M LBP
Transportation (base = 8 000) :	64 000 LBP/day	Cost recovery	5%	Generators	57 786 M LBP
EDL/Gen. % (base = 96%) :	96% EDL			Donations	0 M LBP
EDL increase factor :	13.00	Revenue Water		Consumables	10 243 M LBP
CPI (base = 115) :	700	Volume Produced	143 000 K m^3	Paid by WE	10 143 M LBP
Salaries increase factor :	2.00	Volume Billed	70 000 K m^3	Donations	100 M LBP
Including new WWTPs :	Yes	Technical losses	5% (ILI = 8)	O&M	50 108 M LBP
		Revenue Water	52%	Paid by WE	46 359 M LBP
Tariff increase factor :	1.00	Potential invoicing	96 665 M LBP	Donations	2 787 M LBP
(Avg. bill amount : 305 000 LBP)				Administrative	4 176 M LBP

A.4.4 BILLING, COLLECTION, SUBSCRIBERS

Such situation is not sustainable and must be addressed urgently. Increasing billing and collection rates is one of the key tools for enhancing the revenue base of the WE to achieve financial viability, and sustainability; in fact, the benefits of efficient billing and collection practices are almost instant and can improve the revenue accounts almost immediately.

The data show an increase in the overall water subscriptions with time but at a faster pace between 2018 and 2019 before slowing down in 2020 due to the economic downturn. The number of subscribers increased at a 5.2% compound annual rate during 3 years, from 155,888 in 2017 to 181,418 at the end of 2020. This progress reflects the success of SLWE's strategy in rapidly expanding its customer base after 2018.

The annual collection efficiency improved to 61% in 2018 driven by a new momentum created by the management change before getting hit and slowed by the turbulence and the deteriorating economic conditions that started in 2019. The analysis shows that different regions have different trends and wide variance in the collection rate: In Jezzine, the collection rate for 2019 was 89% compared to 39% in Nabatieh raising questions about willingness of customers to pay and/or the inadequate customer records. In fact, the lack of official collectors and incentives and the reliance on contractual collectors are critical issues that prevent SLWE from recovering sufficient costs to properly operate and maintain the facilities.

A.5 KEY RECOMMENDATIONS

The outcome of the Performance Diagnosis is the basis for identifying required action to gradually improve the WE's performance in order to bring the services provided and the financial sustainability up to acceptable standards.

Strategic goals to be achieved are :

- Improve the organization structure and staffing of the water establishment.
- Reduce the non-revenue water and water losses
- Promote the efficient use of energy to reduce the consumption and improve cost recovery
- Establish a comprehensive O&M system to maintain the existing water infrastructures and their associated equipment's and construct new water systems, where needed, to improve the quality of service, reduce the O&M cost and increase the service coverage
- Set up a monitoring and audit system to improve the quality of service.

Under Section A.5, *Main findings and recommendations*, key recommendations are given for each topic separately.

In this Section A.5, key recommendations are grouped and sorted by priority.

A.5.1 MASTER PLAN / STRATEGY

SLWE appointed three consultants to review and update the master plan in line with its 5-year strategy.

Therefore, it is necessary to assess the relevance of existing Master Plans as follows:

- Conduct a cost benefit analysis for the capital investment projects needed in the near term for improved decision making
- Prioritize infrastructure projects based on a standard analysis grid

In addition, the 2020-2025 Strategy developed by SLWE has to be assessed and updated in line with the prevailing economic crisis, in particular in view of the impact of the new situation on the status of the WE's human resources and the ability to implement the set targets.

Estimated duration: 8 Months

A.5.2 ORGANIZATION STRUCTURE AND STAFFING

To improve the organization structure and staff's performance, it is recommended to:

- Assess the pertinence of the present Organisation Chart in light of today's challenges the WE is facing, mainly but not only in the fields of wastewater, data acquisition and

processing, water quality, and else; in addition to the fields of management and development
Propose a new Organization Chart in line with the above, including job description and qualification requirements for each staff member down to the level of first line supervisors

- Set up a staff's performance monitoring body/system based on specific targets to achieve and performance indicators.
- Initiate necessary legal steps in order to implement this new organisation chart, and to allow the WE to fill in the vacant positions.
- Identify staff capacity building needs and set up an adequate training program to bring staff's performance to a satisfactory level in terms of the services to provide.

A.5.3 DIGITALISATION

The various data whether financial or technical should be centralized in one data centre or digital platform, therefore it is necessary to:

- Carry out an assessment of all data acquisition/processing systems in use at the WE and design a new data centre, to be implemented by steps, in the view of a central digitalization system for the whole WE. Based on the outcome of this assessment, the below steps would be carried out, in all or partially.
- Carry out studies for the improvement/replacement - if deemed necessary - of the existing ERP system, with the view of future integration within a central digitalization system; and prepare Tender Documents for the implementation of such a system, including WE's staff training and capacity building.
- Carry out studies for the improvement and extension - if deemed necessary - of the existing GIS system to cover the acquisition of all technical data, with the view of future integration within a central digitalization system; and prepare Tender Documents for the implementation of such a system, including WE's staff training and capacity building.
- Carry out studies for the design of a data acquisition and processing system to cover the monitoring and management of the production and distribution flows; with the view of future integration within a central digitalization system; and prepare Tender Documents for the implementation of such a system, including WE's staff training and capacity building. Supply and installation of the required remote sensors for the operation of the systems shall not be part of these Tender Documents.
- Implementation of the digitalization system.

A.5.4 WATER PRODUCTION – AVAILABLE WATER RESOURCES

Presently, the water production is not adequately monitored; the production figures provided by SLWE are based on operators' *best estimate*.

Therefore, it is necessary to:

- Carry out a general survey of all water sources presently in service; assess the status of the existing flow measurement equipment if any;
- Prepare Tender Documents for the implementation of flow/yield measurement equipment on all water sources, linked to the central production data center.
  Because the cost for installing measurement equipment on all the water sources presently in service is expected to be high, these Tender Documents shall be divided into separate Lots, as may be required.

A.5.5 WATER DISTRIBUTION

Here again, the distributed flow provided by the WE is an operator's *best estimate*, due to the lack flow measurement at the level of the distribution centres or reservoirs.

Therefore, it is necessary to:

- Carry out a general survey of all distribution zones and identify the feeding point(s) of each, and assess the status of the existing flow measurement equipment at each feeding point, if any
- Prepare Tender Documents for the implementation of flow/consumption measurement equipment on each feeding point of each distribution zone, linked to the central production data center.
  Because the cost for installing measurement equipment on all the distribution zones is expected to be high, these Tender Documents shall be divided into separate Lots, as may be required.
- Identify existing DMAs and/or areas that could possibly be turned into DMAs, and identify possible locations for the installation of bulk flow/consumption meters on the distribution network, linked to the central production data center; and prepare Tender Documents for the supply and installation of such equipment.
  Because the cost for installing measurement equipment on all the distribution zones is expected to be high, these Tender Documents shall be divided into separate Lots, as may be required.

A.5.6 PILOT DMA

Identify, in close coordination with the WE, one pilot area to convert into DMA and carry out within this area detailed studies for:

- Detailed customers census in order to assess the consumption needs and its geographic repartition.
- Detailed distribution network survey followed by a hydraulic modelling.
- Installation of bulk flow meters on strategic locations, and water meters on a number of house connections (if not all).

- Assessing the water losses.

A.5.7 NON REVENUE WATER

The lack of data coupled with absence of DMAs impacted the accuracy and quality of the NRW results. Given this finding, the following actions are recommended:

- Implement low cost high impact intervention, the so-called “quick wins” typically the commercial/apparent loss reduction measures instead of the more capital-intensive reduction measures targeting the physical/real loss. The activities consist of customer database update through door-to-door surveys to identify illegal practices, leaks on the service connections, and improved meter management, …
- Implement DMAs for demonstration and trial purposes. The DMAs are used as a diagnostic tool in quantifying physical losses (through bottom-up assessment), and to validate the results of the NRW assessment (top-down assessment).
- Prepare a NRW Reduction Strategy/Plan based on pilot projects outcome and set the NRW targets with the required budget.
- Promote the NRW problem ownership and introduce organizational measures such as working groups, NRW units to boost the implementation capacity.

A.5.8 BILLING AND COLLECTION

The benefits of efficient billing and collection practices are instant and can improve the revenue accounts almost immediately.

Based on the outcome of the present assessment, the below actions are recommended:

- Conduct a study to assess the weak collection efficiency and the inadequate customer records with focus on the reliance on contractual collectors (contract terms, remuneration, number of collectors and performance targets)
- Carry out studies for the assessment of the existing billing and payment processing system and the possibility of the introduction of improved billing technologies, with the view of future integration within a central digitalization system.
- Strengthen the geographic information system mapping to cover the subscribers’ data and the records of properties showing all potential water customers.

A.5.9 TARIFF STUDIES

Tariffs in force are deemed to cover WE's costs including Opex, Capex, and asset depreciation. With the present tariff in force, this is far out of reach.

Therefore, it is recommended to:

- Undertake an economic analysis of production and cost taking into consideration the short-run and long-run to allow for a comprehensive pricing strategy that would allow to gradually recover the operational costs and eventually any future capacity expansion.

- Establish a tariff setting scheme and tariff reforms with mechanisms for obtaining the information on present and future costs of operation and mechanisms of indexation to adjust tariffs by inflation, energy prices and other items that are part of the cost schedule of SLWE.

A.5.10 O&M MANAGEMENT SYSTEM

In order to enhance efficiency and reduce the cost of O&M, it is necessary to design a modern preventive/corrective maintenance system, and implement it in the view of central digitalization system for the whole WE.

A.5.11 PRODUCTION COST OPTIMISATION.

With the present financial situation, energy has become the major component of production cost, nearing 90 % (Figure A 4-1 above).

SLWE's strategy is to implement renewable energy sources such as hydroelectric or solar, in addition to shifting from underground to surface water sources, where possible. However, there is no comprehensive view on the subject: How efficient would this strategy be? How far could one go in power saving? What are the required investments and would it be cost effective? What is the realistic timeframe for implementation?

Therefore, it is necessary to carry out a general *Cost Optimisation Master Plan* covering in details all the available options over the WE's jurisdiction, and setting up the upper threshold of what could be possibly achieved regarding cost optimisation.

A.5.12 TAKING OVER THE WASTEWATER SECTOR

SLWE is reluctant to take over the wastewater sector for reasons detailed under Sub-section A.3.5 above.

In the meantime, financing must be provided from sources other than SLWE own funds (GoL or donors) to:

- Outsource the operation and maintenance of each treatment plant and related network to private operators via performance-based contracts.
- Hire a sewage treatment expert seconded to the WE in order to oversee the execution of these contracts

A.5.13 SHIFTING TO METERED CONSUMPTION POLICY

Metered consumption is the end key for reducing NRW, Opex, and overall water consumption. In fact, the residential meters installed in Jezzine and Bint Jbeil are not officially used for billing as in other WEs.

However, based on lessons learned from past experiences in other WEs, it appears that this is not a top priority and a number of prerequisites are to be implemented before systematically installing water meters, out of which :

- Setting up a team to operate and manage meters maintenance and reading.
- Selecting the most adequate meter type based on the adopted reading policy.
- Securing continuous supply in the areas where the meters shall be installed, in order to encourage the consumers to subscribe and accept the idea of water metering.

Water metering projects may be systematically implemented over the whole jurisdiction once the above is implemented and running smooth.

SECTION B
TECHNICAL PERFORMANCE DIAGNOSIS

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B.1. HUMAN RESOURCES

The assessment of personnel investigates the quantitative sufficiency of different qualities of education and specialisations within the establishment. This assessment considers the current case of Lebanon where hiring and firing have been severely restricted and external contracts have been made to cover not only daily labour but vital positions.

Moreover, it is important to assess the validity of the imposed organisational regulations that specify the number and type of employee for each region and area of business and show irregularities in that design that currently limits the WEs even if hiring was within their ability.

B.1.1 Total personnel

The main reference for the preferred number of staff comes from Tynan and Kingdom where the best performing quartile of water utilities measured 5 employees per 1000 service connection or fewer. The figure cannot be generalised easily given issues such as:

1. The number of connections is not an applicable basis for assessing performance since some activities such as water distribution may be related to the number of connections, but others such has customer service, meter reading, and door-step collection may not. That and with the case of Lebanon a connection often serves an apartment of office building with multiple units.
2. The figure does not consider the method of billing and collection where in some countries the process is done over the mail or using the internet why in others, such as the case of Lebanon and much of the region, billing and collection is primarily done in the field with company staff personally interacting with most customers.
3. Moreover, the number needed to operate and manage the processes related to customer billing and metering would be different depending on the length of a billing cycle, where a monthly cycle would require more than an annual cycle.
4. Also of great relevance is the relative number and distribution of resources, where in some utilities production and transmission facilities are few and centralised, while in others, such as in Lebanese WEs, the resources are many and often localised.

Those and more objections can be drawn, and therefore it was our attempt to focus on the sufficiency of staff for each business area and job type instead, as will be shown next. To assess the total number of staff we took the following:

1. The total number as per the WE organisation by-laws.
2. The number of employees.
3. The number of contracted staff.
4. The total number of staff whether contracted or employed.

First, we look at a faithful demonstration based on an estimate of the number of connections done for the WE. The exact or even approximate number of connections is not known. The number of connections here refer to the total number of supposed tapping points on the network, or approximately the total number of buildings connected to the network. That number does not correspond to either legal tapping points or the number of official subscribers that is estimated for the WE.

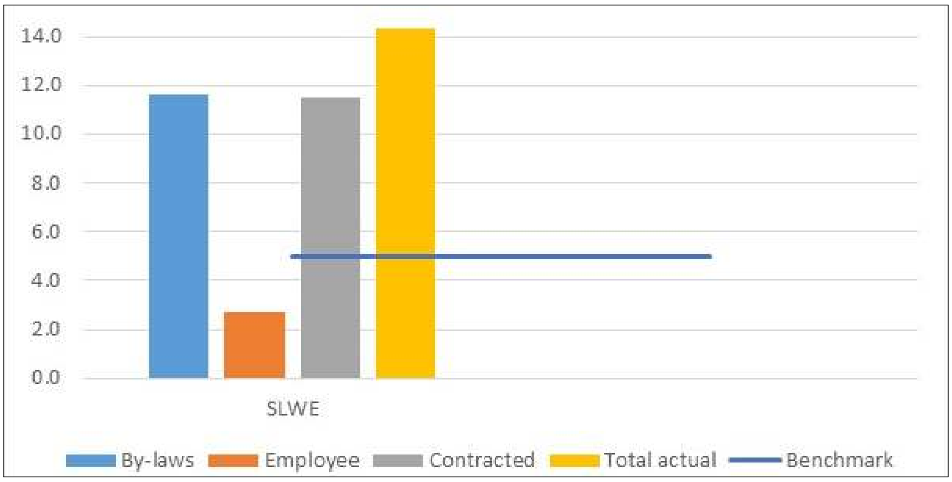

Figure B 1-1 Personnel per 1000 connections.

Acknowledging that the estimated number of connections is prone to a large uncertainty, it can clearly be seen that using the number of connections as a base indicator may not be the best in the cases of Lebanon and using the number of subscribers therefore would be more representative of the idea behind such indicator. Using the number of subscribed customers instead, we can find that for the case of SLWE the results are close to the benchmark.

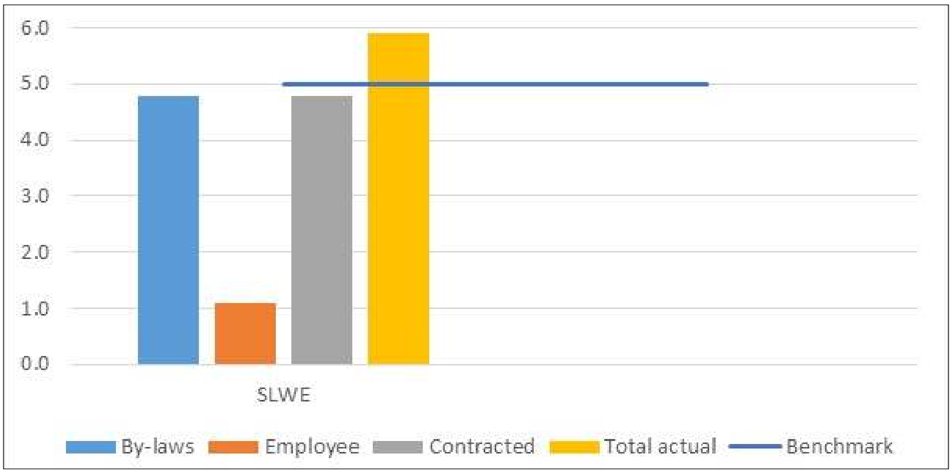

Figure B 1-2 Personnel per 1000 subscribers.

Acknowledging that the number of subscribers does not size the service area, and that the number of illegal in the WE, the previous conclusion could therefore be misleading. Assessing the total number of potential subscribers, we use the number of units as demonstrated below. Having better estimations is priority for many areas of analysis and planning.

Table B 1-1 Approximate system size assumptions used.

Variable	Unit	SLWE
Connections	1000 No.	75
Subscribers	1000 No.	181
Units	1000 No.	300
% Subscribed	%	60%
Implied population	M No.	1.5

Using the number of units instead of the number of current customers a clear picture is formed; the decreed number of staff for SLWE fall well within the benchmark.

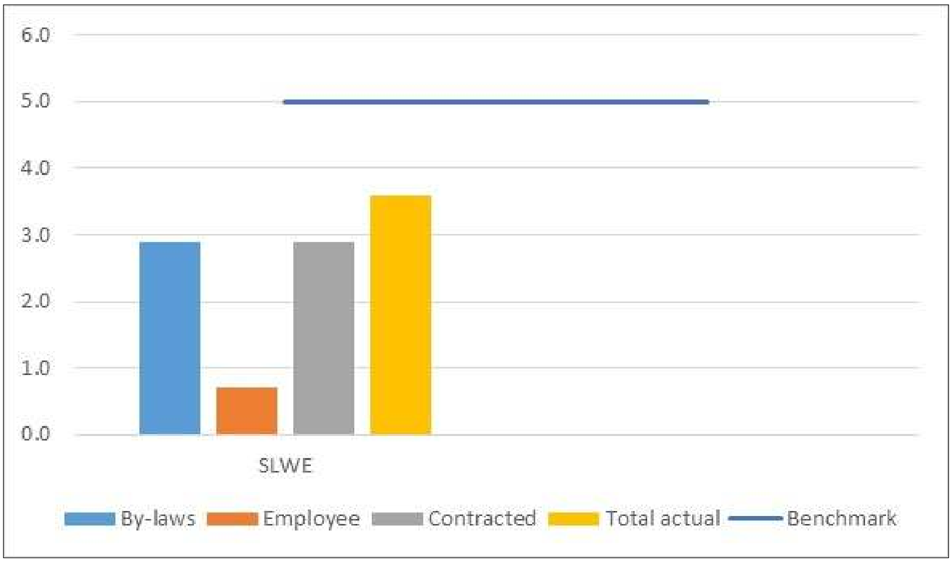

Figure B 1-3 Personnel per 1000 units or potential subscriber.

Another used indicator for sizing the total utility staff is by the quantity produced.

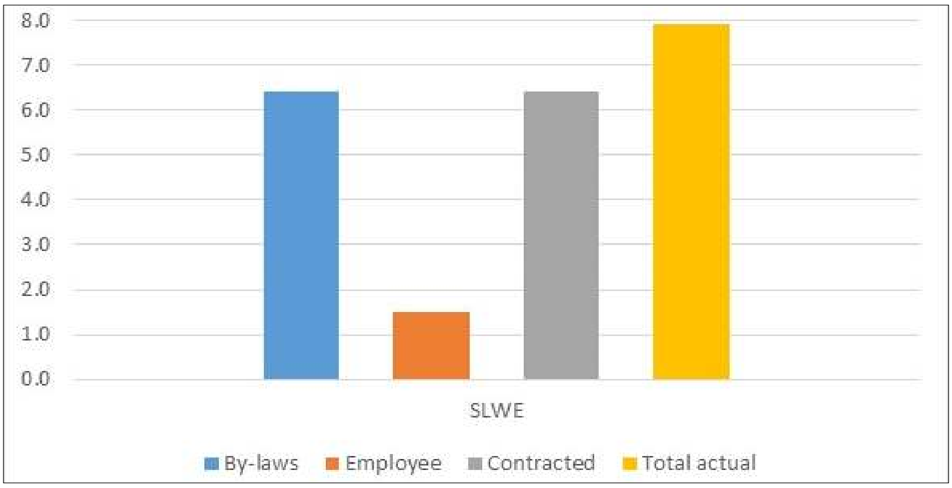

Figure B 1-4 SLWE - Personnel per 1,000,000 m³ produced.

The comparison with other WEs shows a similar trend where the decreed staff of BWE and NLWE according to the by-laws relatively exceed those of BMLWE and SLWE. However, and according to this indicator, the actual total number of staff is similar in all WEs.

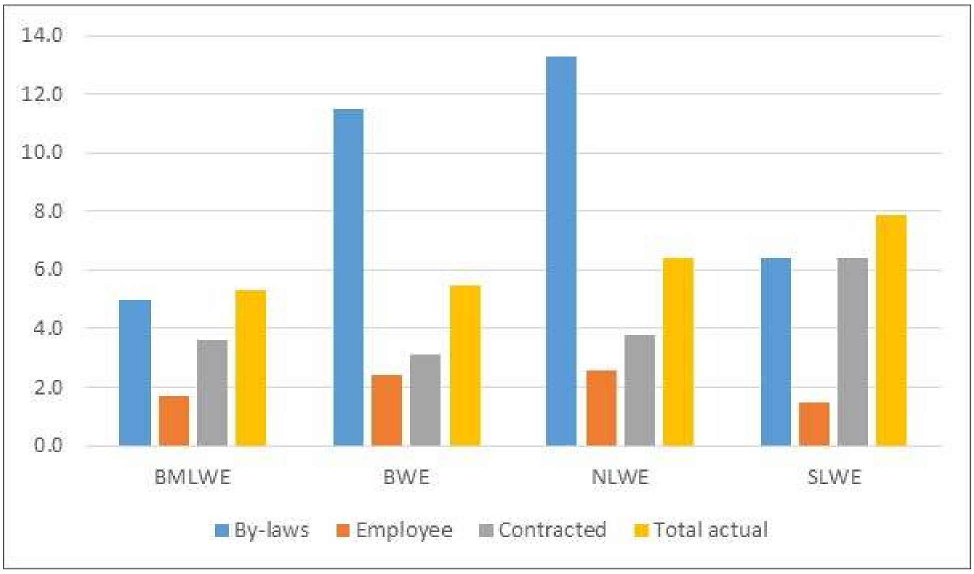

Figure B 1-5 Compared Personnel per 1,000,000 cubic meters produced.

Table B 1-2 Total personnel performance indicators.

Performance indicator	Unit	SLWE		Benchmark
Employees per connection	No./1000 Connections	By Law	11.6	5 (Tynan and kingdom 2002)
		Employees	2.7	
		Contacted	11.5	
		Total actual	14.2	
Employees per customer	No./1000 Customer	By Law	4.8	5 drawing from Y&K 2002
		Employees	1.1	
		Contacted	4.8	
		Total actual	5.9	
Employees per customer	No./1000 Units	By Law	2.9	5 drawing from Y&K 2002
		Employees	0.7	
		Contacted	2.9	
		Total actual	3.6	
Employees per water produced	No./(10^6 m^3)	By Law	6.4	Comparative
		Employees	1.5	
		Contacted	6.4	
		Total actual	7.9	

B.1.2 Personnel business area

Looking at the distribution of personnel by department, and using the concept of business areas, we find that the organisation by-laws has the following features:

- Customer services is a central unit.
- Wastewater management units.
- Structure.
- Stores units have a financial counterpart.

And so on. Also looking at the number of staff under units of each business area we can see the large discrepancy.

Table B 1-3 Personnel according to the by-laws under units of different business areas.

Variable	Unit	SLWE
Customer service units	No.	28
Distribution units	No.	308
Engineering units	No.	21
Facility units	No.	418
Finance units	No.	31
General units	No.	50
HR units	No.	8
Water quality units	No.	8

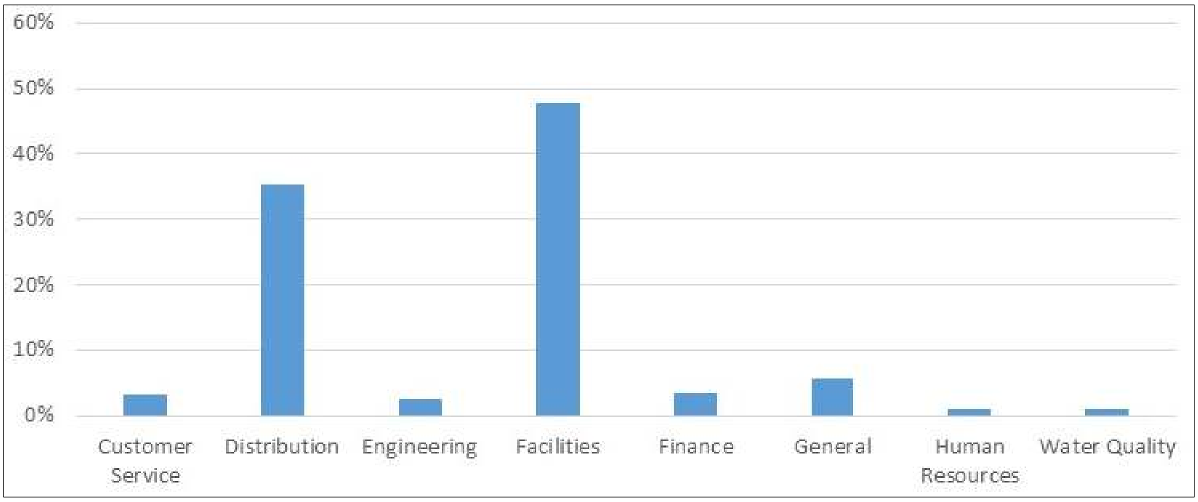

Figure B 1-6 Personnel according to the by-laws under units of different business areas.

To better be able to judge the efficacy of the distribution, we look at the distribution business which usually includes most of the following:

- Operation of water distribution.
- Maintenance of distribution networks and service connections.

- Implementation or overseeing new connections.
- Water loss management.
- Local customer services, metering, and collection.
- Local store management.

And the facilities business, usually includes production, treatment, and transmission operation and maintenance. In most cases also includes water quality labs.

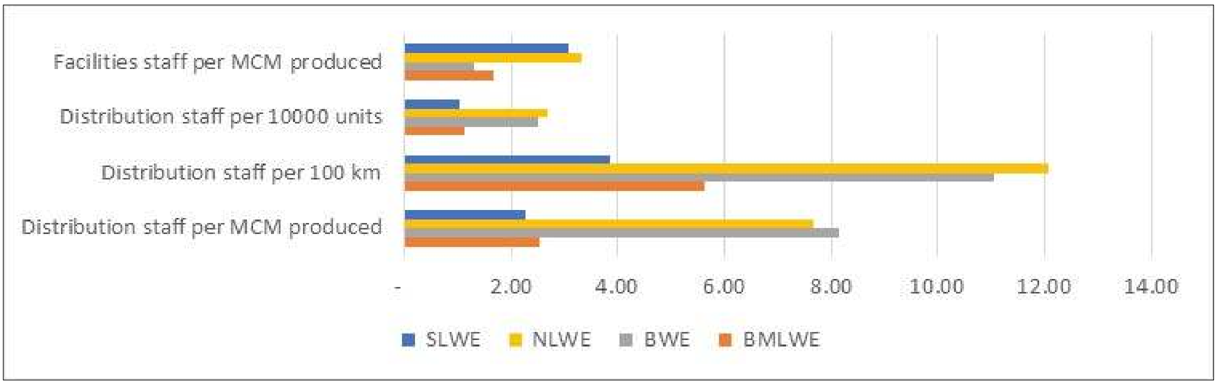

Figure B 1-7 Facilities and distribution personnel performance according to the by-laws under units of different business areas.

The comparison of the four WEs according to facilities and distribution personnel performance marked discrepancy between the number of staff between the four WEs, which promotes the need to revise the organisation structure by specialists.

B.1.3 Personnel job type

We attempted to look at the distribution of current employees and contracted staff by job type, especially since it shows where the WE is being challenged the most and which positions are the most critical. This is limited by the freedom of the WE to choose ideally and therefore should only be seen in terms of general patterns. The analysis is still more limited by the availability of information, for while the detailed information of staff and their current jobs was not completely available for the WE, and similarly for the contracted staff where the needed information was generally sparse. Therefore, we shall concentrate the effort on the available information found in the by-laws as follows:

Table B 1-4 Personnel by job type according to the by-laws.

Variable	Unit	SLWE
Auxiliary - Clerical	No.	63
Auxiliary - Driver	No.	50
Auxiliary - Guard	No.	44
Auxiliary - Office boy	No.	24
Collector/Reader	No.	56
Customer service	No.	21
Financial/Administrative	No.	38
Management	No.	16
Management (Eng.)	No.	19
Technical - Driver	No.	17
Technical - Engineer	No.	22
Technical - Laborer	No.	87
Technical - Other	No.	395
Technical - Water quality	No.	20

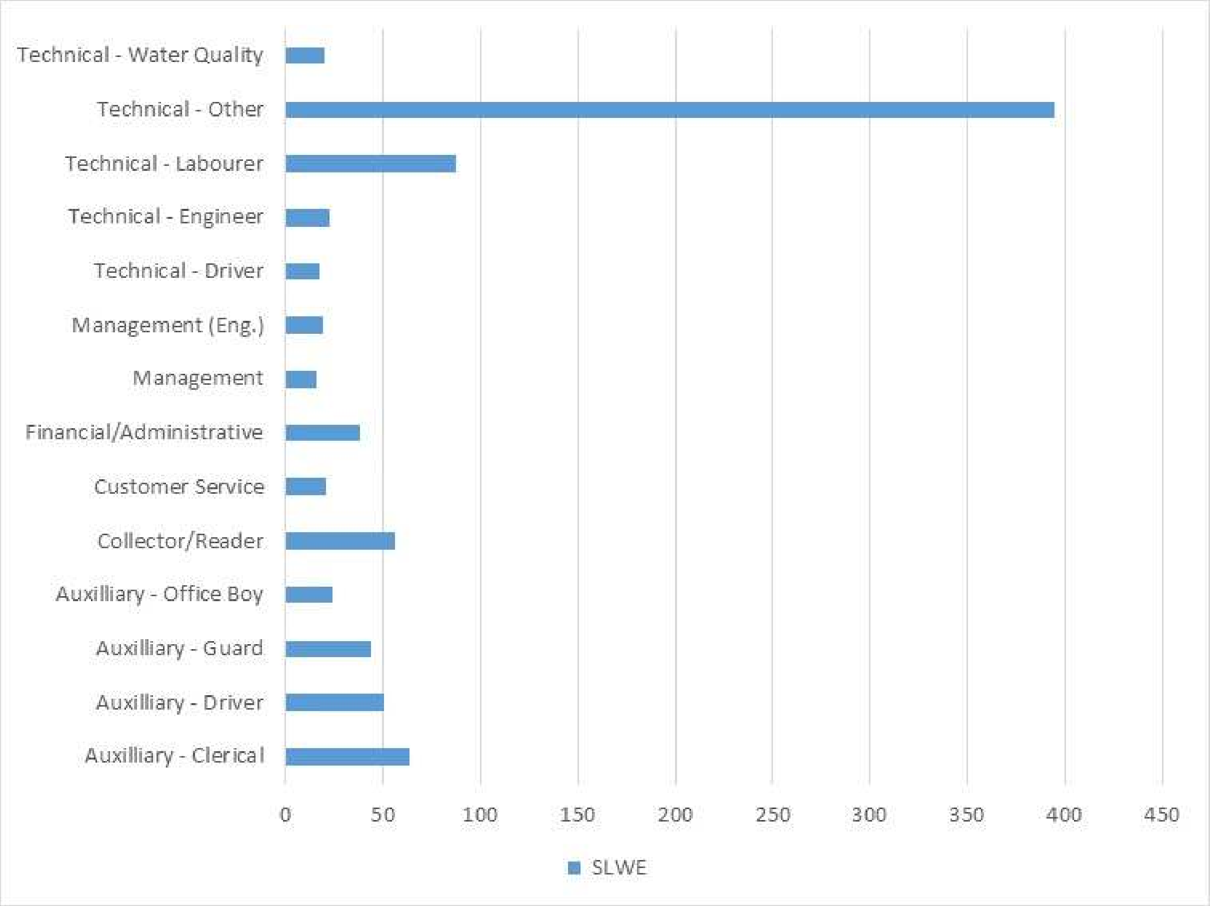

Figure B 1-8 Personnel by job type according to the by-laws.

To calculate the percentage of each job type.

Table B 1-5 Relative number of each job type according to the by-laws.

Relative size	Unit	SLWE
Auxiliary - Clerical	%	7%
Auxiliary - Driver	%	6%
Auxiliary - Guard	%	5%
Auxiliary - Office boy	%	3%
Collector/Reader	%	6%
Customer service	%	2%
Financial/Administrative	%	4%
Management	%	2%
Management (Eng.)	%	2%
Technical - Driver	%	2%
Technical - Engineer	%	3%
Technical - Laborer	%	10%
Technical - Other	%	45%
Technical - Water quality	%	2%

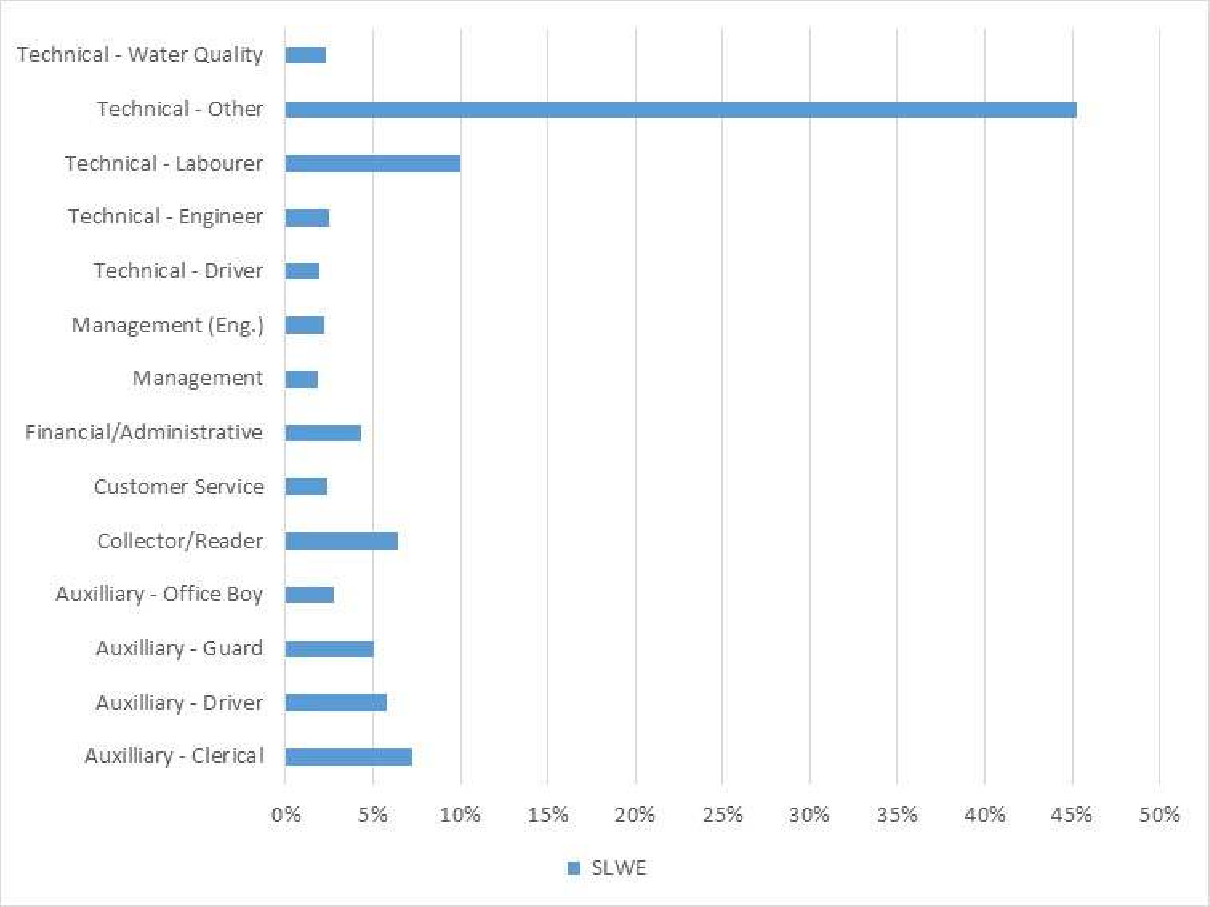

Figure B 1-9 Relative number of each job type according to the by-laws.

It can be clearly seen in the case of SLWE that the technical needs of the establishment in terms of technicians and labourers have outweighed those of hiring clerks and drivers. The apparent discrepancy in the number of management personnel is due to engineering management roles being assigned to non-engineers.

Looking back at the by-laws, we can look at specific areas of interest for improved water supply service performance for the four WEs. Looking at the customer service staff of each WE, here including clerical staff or otherwise involved in customer service office work, as well as the number of collectors and meter readers, we can see the discrepancy between the number of staff expected to perform these duties and the number of customers.

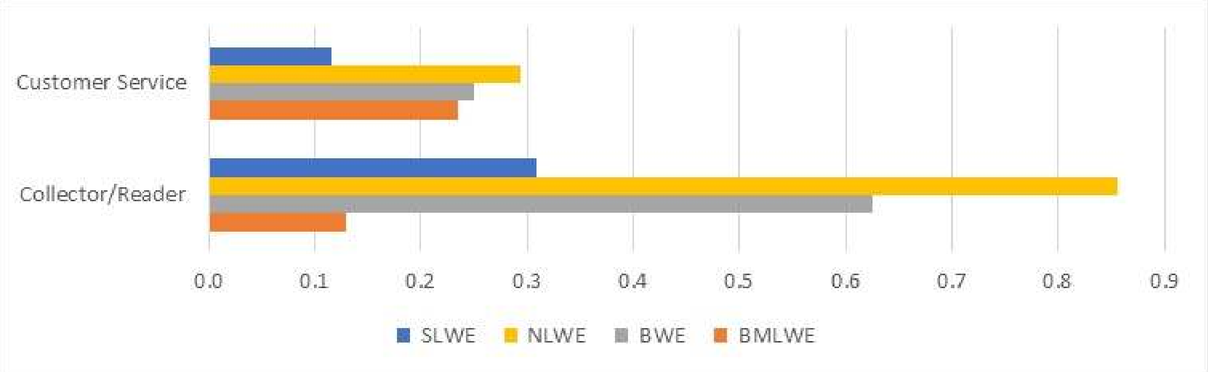

Figure B 1-10 Number of customer service and collection/meter reading staff according to the by-laws per 1000 current subscribers.

The same issue can be seen when using the number of units, or the potential number of customers, and to a larger extent.

Figure B 1-11 The number of customer service and collection/meter reading staff according to the by-laws per 1000 units or potential customer.

Similarly, for technical job types including engineering management, dividing the number of staff according to the by-laws by the number of units or the water produced leads to different results for each WE.

Figure B 1-12 The number of technical staff according to the by-laws per 1000 units and million cubic meter produce.

B.1.4 Personnel education level

Except for few cases where the title includes the terms “engineer” or “graduate”, the organisational diagram does not specify the education level of employees. The education levels for employees and contracted staff were gathered, interpreted, or estimated based on the available data.

Table B 1-6 Number of personnel by education.

Variable	Unit	Type	SLWE
University degree personnel	No.	Employee	76
Basic education personnel	No.		43
Other qualification personnel	No.		87
Unknown	No.		-
University degree personnel	No.	Contracted	61
Basic education personnel	No.		150
Other qualification personnel	No.		471
Unknown	No.		184
University degree personnel	No.	Total	137
Basic education personnel	No.		193
Other qualification personnel	No.		558
Unknown	No.		184

Looking at the latest staff information, there is a varying level of education that cannot be interpreted positively or negatively without setting clear job descriptions and minimum required qualifications. This and the need for transparency stress the need for clear hiring criteria and job descriptions.

Table B 1-7 Performance indicators of personnel education.

Variable	Unit	Type	SLWE
University degree personnel	%	Employee	37%
Basic education personnel	%		21%
Other qualification personnel	%		42%
Unknown	%		0%
University degree personnel	%	Contracted	7%
Basic education personnel	%		17%
Other qualification personnel	%		54%
Unknown	%		21%
University degree personnel	%	Total	13%
Basic education personnel	%		18%
Other qualification personnel	%		52%
Unknown	%		17%

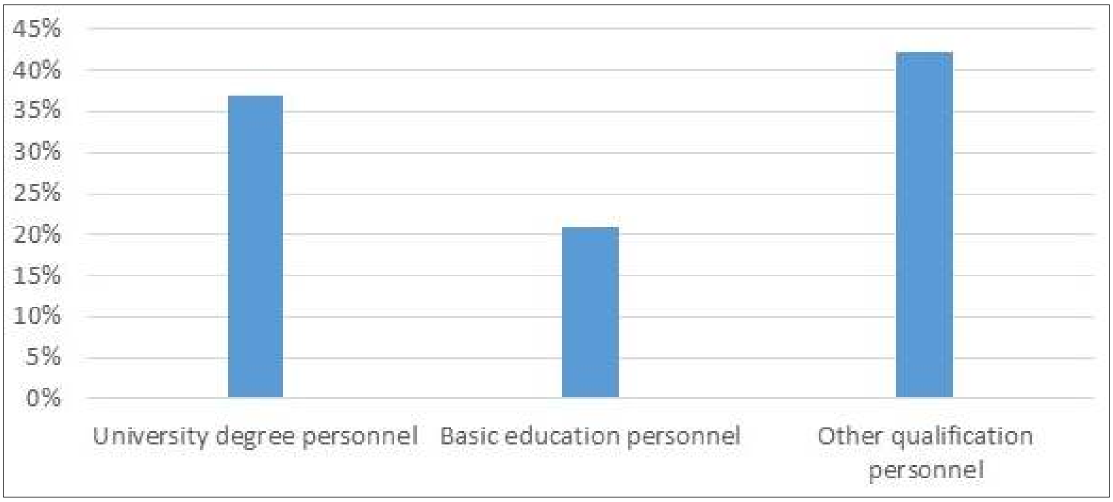

Figure B 1-13 Education level of employees.

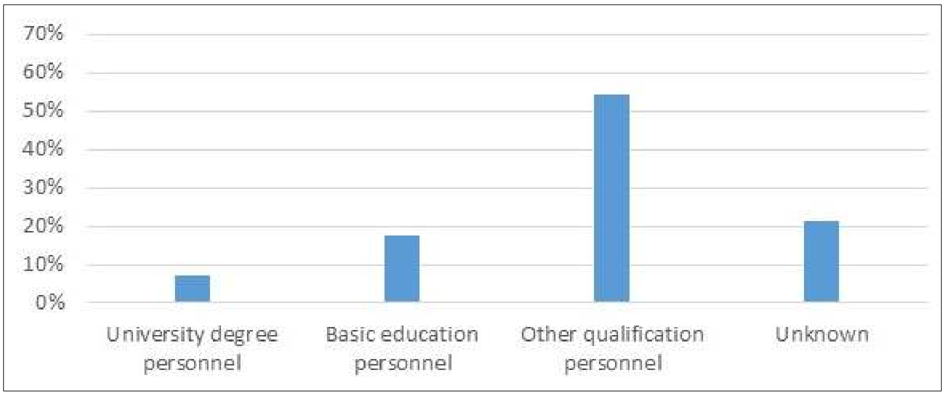

Figure B 1-14 Education level of contracted staff.

B.1.5 Training

No data in relation with the total number of training hours is delivered to the TA from SLWE.

Table B 1-8 Training variables.

Variable	Unit	Type	SLWE
Training	Hours/employee	Employee	

Table B 1-9 Training performance indicators.

Variable	Unit	Type	SLWE
Training	Hours/employee	Employee	

B.1.6 Employee health and productivity

No information was provided in relation with employee health and productivty.

Table B 1-10 Training performance indicators.

Variable	Unit	SLWE
Working accidents	No.	
Absenteeism	days	
Absenteeism due to accidents or illness at work	days	
Absenteeism due to other reasons	days	
Overtime work	hours	

Due to the absence of data, the indicators in relation with productivity was not calculated. It is of great importance to ask the WE to establish a data base in relation with the necessary data to calculate the productivity of staff.

Table B 1-11 Employee health and productivity performance indicators.

Variable	Unit	SLWE
Working accidents	No./100 employees	
Absenteeism	days/employee	
Absenteeism due to accidents or illness at work	days/employee	
Absenteeism due to other reasons	days/employee	
Overtime work	%	

B.1.7 Diagnosis of challenges

To assess the factors leading to low performance on in personnel management, including difficulties in producing the needed data, we attempt at portraying the situation using a SWOT analysis that considers at PESTEL external factors.

Strengths

1. Trial and error using on-demand staffing contracts and seconded staff helped provide a better assessment of the needed specialties and number of staff for each.
2. ERP system allows the integration of an HR model with the payroll.

Weaknesses

1. No job descriptions, clear assignment of responsibilities, or clear criteria for health and safety.
2. Dysfunctional employee evaluation process.
3. No or outdated or insufficient written procedures increase the demand on the knowledge of key staff members.
4. Higher level positions assigned to employees without expected qualifications.
5. Contracted staff expecting a place in a new WE set up.
6. The scope of training is often restricted to a few employees due to the age of and positions assigned to employees.
7. WE is restricted in investing in personnel improvements given that most functional staff is contracted.

Opportunities

1. Economically and socially attractive job opportunities.
2. Technological opportunities in training and distant learning.

Threats

1. Political environment does not support hiring.
2. Current by-laws do not support WEs in acquiring the needed functions, specialties, and relative number of staff for each.

B.1.8 Recommended actions

This sub-section is about recommended actions for the improvement of performance in personnel management

The shape of reformed water establishments translates directly into its organisation and its staff. Among the gaps found during the assessment with regard to the by-laws are the following

- A mixture of detailed and generic job descriptions at the level of the organisation units, and the complete lack of job descriptions and responsibilities at the level of individual positions.
- Outdated unit job responsibilities that lack sufficient consideration if at all for some of the major functions such as GIS as a central database for assets and subscribers, widespread metering and meter reading, IT system management, central call centre and command centre, among others.
- Little correspondence between the decreed number of staff and the size of the function.

On the staffing side, major issues have led to the accumulation of hurdles and difficulties for any restructuring attempt. Some of the main issues on the staffing side are:

- With the current restrictions on hiring and firing, there is a high dependence on personnel contracts and donor-funded seconded staff, some of them may not have been able to work at the WE even if the hiring doors were open due to their positions not existing in the by-laws, the number in the by-laws being lower than the actual needs, but most importantly having to qualify through the public hiring system.
- Most leadership positions are filled by assignment and often with personnel who have not been officially qualified for the positions. Upon restructuring these individuals may be treated unjustly and may harbour resentment if their service in their assigned roles is was ignored. At the same time, most of the cases found cannot possibly find a normal path to qualify to the jobs currently fill by assignment.

To improve the organization structure and staff's performance, it is recommended to:

- Assess the pertinence of the present Organisation Chart in light of today's challenges the WE is facing, mainly but not only in the fields of wastewater, data acquisition and processing, water quality, and else; in addition to the fields of management and development
  Propose a new Organization Chart in line with the above, including job description and qualification requirements for each staff member down to the level of first line supervisors
- Set up a staff's performance monitoring body/system based on specific targets to achieve and performance indicators.
- Initiate necessary legal steps in order to implement this new organisation chart, and to allow the WE to fill in the vacant positions.
- Identify staff capacity building needs and set up an adequate training program to bring staff's performance to a satisfactory level in terms of the services to provide.

B.2. WATER LOSS

The procedure for assessing of water loss performance is a process that has been developed while inherently considering that the nature of the problem is rife with unknown. However, the challenge posed in Lebanon may stress this procedure beyond its normal shape. The assessment of water loss can proceed in two directions, top-down and bottom-up.

B.2.1 Top-down assessment

Top-down assessment of water loss starts with the measurement, calculation, and/or estimation of the total water loss using system input water volume and the billed authorised consumption during the period. Secondly, estimations are made for each kind of apparent loss, i.e., customer meter under-registration, unauthorised consumption, and data acquisition and handling errors. Starting with the calculation of the total non-revenue water we have the following data from 2020:

Table B 2-1 System input volume calculation, for the year 2020.

Quantity	Unit	SLWE
Water produced	m^3	135,440,184
Water imported	m^3	0
Water exported	m^3	0
System input volume	m^3	135,440,184

The net system input is the same as the production estimates since SLWE claimed no import or export of potable water across establishment lines. However, and due to the existence of local operating municipalities and comities, this may not be the case. That is since the WE ideally has ownership and responsible for bulk water production throughout its service areas. Such relationship therefore may be seen as that of water export.

The accuracy of the production quantity is not known. The production estimates are subject to several issues such as:

- Almost all quantities are based on estimates of production performance and approximate working hours.
- When the source is metered, the meter is often dysfunctional or incorrectly installed.
- When the meter is functional, most readings are not based on regular reading of the source meters but on multiplying the instantaneous flow measured by the estimated operating hours.
- The estimates may not consider all sources or update sources that were dysfunctional for a large portion of the duration.
- Most importantly, the extent of each of the problems listed above is neither known nor can be estimated by the WE.

For SLWE, bulk metering is used to an extent, but without similar information, there is no way to verify their level of accuracy without performing an audit and a revision of the estimation of water production based on consistent procedures for:

- Identifying the volumes of metered sources and estimates based on metering.
- Identifying metered quantities based on different meter technologies and conditions.
- Surveying and verifying the readings and flow rates for metered sources.
- Documenting and calculating the hours of operation.
- Assignment of error values and the calculation of the overall accuracy.

Therefore, and given all the unknowns, an estimate of ±20% uncertainty will be used for SLWE.

Table B 2-2 System input volume error range at 95%, for the year 2020.

Quantity	Unit	SLWE
System input volume mean	m^3	135,440,184
Metered	%	-
Uncertainty	%	20%
Uncertainty	m^3	27,088,037
System input volume min	m^3	108,352,147
System input volume max	m^3	162,528,221

Looking at the billed authorised consumption, the main issue encountered is that metering is not a common practice and the actual water consumed by the customers cannot therefore be known at high accuracy.

Table B 2-3 Quantity billed, for the year 2020.

Quantity	Unit	SLWE
Billed authorized consumption	m^3	71,476,855
Billed and metered	m^3	-
Billed and unmetered	m^3	71,476,855
% quantity "metered"	%	0%
Metered subscribers	No.	N/A
Avg. consumption for metered	m^3/day	N/A

To alleviate the issue of low customer metering, we looked at the customers labelled as “metered” and the average metered consumption. It must be noted that without an auditing of the metering practices the percentage of actual metering quantities based on real readings cannot be determined.

Moreover, and as can be seen in Table B 3-4, when assuming the average consumption of metered customers as 1. If this figure was to be used as the actual consumption for the average subscriber, the quantities consumed are below the production quantities. Additionnally, if considering the actual consumption for the illegal connections and illegal units the result would be always below the estimated production quantities.

Table B 2-4 A test of the plausibility of average metered consumption as a representative quantity, for the year 2020.

Quantity	Unit	SLWE
Avg. consumption for metered	m^3/day	(assume 1)
Estimated residential units	No.	300,000
Total consumption (test)	m^3	109,500,000
Water produced	m^3	135,440,184
Real losses (test)	m^3	25,940,184
Plausibility	m^3	Plausible

It is unfortunate that SLWE has installed customer meters for subscribers in Jezzine and Bint Jbail yet the results are not available. In any case, and assuming the production quantities are within the assumed 20% error range, or reasonable, it would also be reasonable to assume that the true average consumption is less that 1 m^3/day/subscriber until better data is available.

This value can be assumed anything from 0.5-1.0 cubic meters per day, with no indicator on where should the average estimate lie. Also, this value could be significantly different to other WEs. This makes the top-down estimate unbalanced. Moreover, of this stresses that to achieve systematic and sufficient knowledge about the actual customer demand and consumption and therefore the extent and type of water loss, the following actions are needed:

- Auditing of metering practicing and determination of the extent of using real readings.
- Investigation of the type of subscription and the average consumption for each type such as residential, commercial, etc.
- Collection of a representative sample of temporary customer metering of randomly selected group of unmetered customers using high accuracy static meters.
- Study of metering accuracy and issues faced such as meter aging, air, and intermittent supply by the temporary installation of using high accuracy static meters in series.
- Collection of municipal registration numbers for different units for each region and conducting a study on the extent of unauthorized consumption.

B.2.2 Bottom-up assessment

Attempting to tackle the issue from the other direction, we ought to visit the different factors used for understanding real losses, mainly physical leakage, specifically in the local context.

B. 2.2.1 Estimation of real losses based on DMAs field measurements.

The bottom-up estimate of real losses is ideally conducted on the level of a District Metered Area (DMA), where the night flowrates provide an estimate of the leakage, and the different pressure values help find the average daily leakage. However, this may not be applicable to the local context because :

1. Continuously supplied DMAs only exist in a few areas in Lebanon that are far from being representative.
2. Assuming that night flowrates do reflect leakage rates because there is no water consumption at the consumers' level may not be correct in the absence of continuous supply. Due to water rationing, the individual water tanks in each and every house in Lebanon may not be full at dusk because of water cut-offs during the day, and fill up through night time water supply.

In any case, real losses estimation based on field investigation at the level of DMAs are not available in Lebanon. It is therefore necessary to resort to another method to estimate these losses.

B. 2.2.2 Estimation of real losses based on leakage indicators.

IWA approach to real losses calculation based on plausible ranges of leakage indicators, is as follows :

$$\textit{Real loss} = \textit{UARL} \times \textit{ILI}$$

Where : *Real Loss* is the volume of water lost per year
UARL is the Unavoidable Annual Real Loss indicator
ILI is the Infrastructure Leakage Indicator

B.2.2.2.1 Calculating the UARL volume

The UARL volume is given by the following formula :

$$UARL\ (l/d) = P \times (18 \times Lm + 0.8 \times Nc + 25 \times Lp)^{1}$$

Where : P = Average operating pressure.
Lm = Length of main, in Km.
Nc = Total number of connections
Lp = Total lengths from property limit to private gauge/meter, in m
For Lebanon, it is considered that Lp = 0 as all gauges/meters are close to the property limit.

The average operating pressure is the need for local throttling to ensure higher areas receive water. Network topographies are steep and elevation differences may often reach and exceed the recommended limits such as 50 – 70 meters, therefore causing large pressure variations. The average pressure at any given point is estimated at between 30±5 meters as a rough

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[1] *Source : IWA*

estimation at one standard deviation, or 30±10 m at 95% confidence limit. Therefore an average value of ***P = 30 m*** will be adopted fo rthe calculation.

The length of main is obtained from SLWE's GIS system : ***LM = 8 000 km***.

The number of service connections is calculated based on the estimated total number of housing units in the jurisdiction of SLWE (300 000) and the estimated number of connections per housing unit (4), which gives a ***Nc = 75 000***

Therefore, the UARL can be calculated as follows:

Average pressure	30 m
Length of mains	8 000 km
№ of connections	75 000

UARL = 6 120 m³/day
UARL = 2 233 800 m³/year

B.2.2.2.2 Estimating the Infrastructure Leakage Indicator (ILI)

The ILI is the choice indicator for real loss benchmarking and making comparisons given its high sensitivity to performance and low sensitivity to local conditions. It is still impossible to guess the ILI without real data. It has a defined lower limit of 1 and considered ideal for developing countries at 2, which means that the actual real losses are twice the UARL.

Figure 3-1 below shows average values of ILI for a number of cities in Europe and Australia, ranging from 1 to 10. As a comparison, the ILI values of some utilities in the Balkan, as given by the *Leaks Suite Library*, range from around 4 to 19.

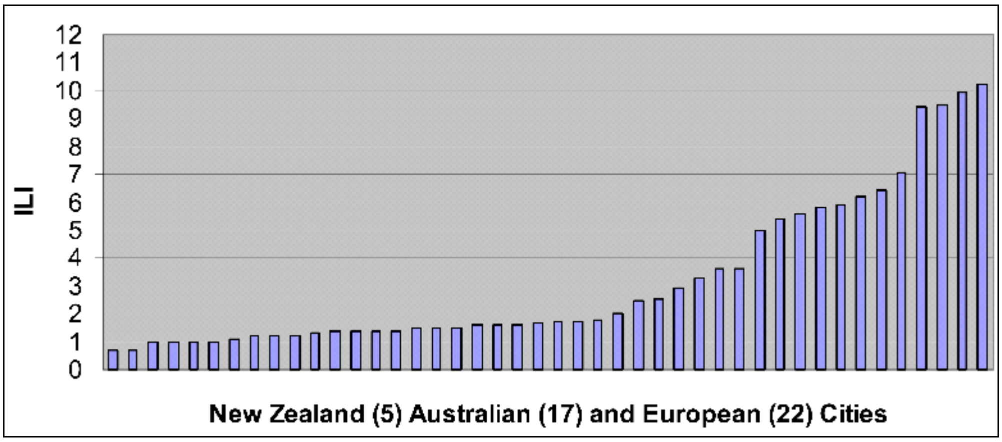

Figure 2-1 Average ILI values for various cities[2]

For the case of Lebanon in general, given that networks' material is mostly Ductile Iron or HDPE, with low leakage risk, and given the intermittent water supply conditions coupled to the

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[2] *Source: A. Lambert & R. Mckenzie.*

financial situation the WEs are facing, an ***ILI of 8*** is a plausible as a general assumption at this stage.

B.2.2.2.3 Calculating the Real Losses

Based on the above, the Real Losses are calculated as follows :

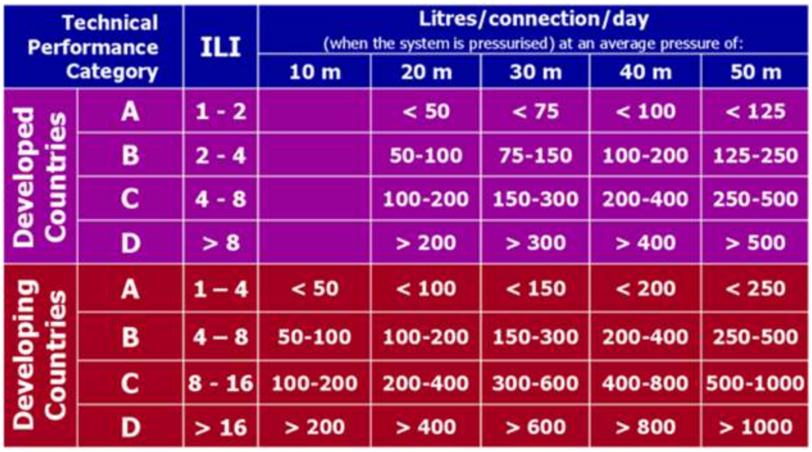
Real losses = UARL x ILI = 2 233 800 x 8 = 17 870 400 m³/year

The above is for a 24h continuous supply, which isn't the case. Assuming a 10 hours supply per day, we have :

UARL for 10 hours supply per day : 17 790 400 x 10 / 24 = 7 446 000 m³/year

The yearly production of SLWE being 135 440 184 m³ the real losses amount to 5% of the production.

Assuming supply is continuous, the losses per connection are approximately 600 to 700 l/connection/day. Referring to Figure 3-2 below, and for 30 meters of pressure, the performance is at level D, which is plausible.



Technical Performance Category		ILI	Litres/connection/day (when the system is pressurised) at an average pressure of:				
			10 m	20 m	30 m	40 m	50 m
Developed Countries	A	1 - 2		< 50	< 75	< 100	< 125
	B	2 - 4		50-100	75-150	100-200	125-250
	C	4 - 8		100-200	150-300	200-400	250-500
	D	> 8		> 200	> 300	> 400	> 500
Developing Countries	A	1 – 4	< 50	< 100	< 150	< 200	< 250
	B	4 – 8	50-100	100-200	150-300	200-400	250-500
	C	8 - 16	100-200	200-400	300-600	400-800	500-1000
	D	> 16	> 200	> 400	> 600	> 800	> 1000

Figure 2-2 General guideline for real loss performance levels[3]

Also calculating the cubic meters per kilometre, which would be a more relevant performance indicator given the low estimated connection density which amounts to approximately 6 cubic meters per kilometre per day for SLWE when the system is pressurised, which is low.

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[3] *Source: Liemberger, R. and R. Mckenzie. “Accuracy Limitations of the ILI - Is it an Appropriate Indicator for Developing Countries?” (2005).*

Table B 2-5 Estimating the real losses for an ILI of 8 for SLWE.

Quantity	Unit	SLWE
UARL	m^3/y	2,233,800
Supply continuity	Hour	10
ILI		8
Real losses	m^3	7,446,000
Real losses if continuous supply	l/connection/day	272
Real losses (w.s.p)	l/connection/day	653
Real losses if continuous supply	m^3/km/day	2.6
Real losses (w.s.p)	m^3/km/day (w.s.p)	6.1

Attempting to calculate the accuracy limits for the above estimates would result in a very high range and therefore these figures provide a guidance towards further investigation.

Proceeding to estimate the unauthorized consumption, and based on this result for real losses, we proceed by estimating the average consumption for all units, then subtracting the consumption for the legal customers. Given the low real metering rates the apparent losses from meter under-registration and data acquisition errors were considered negligible.

Table B 2-6 Estimating the apparent losses for an ILI of 8

Quantity	Unit	SLWE
System input volume	m^3	135,440,184
Real losses	m^3	7,446,000
Consumption	m^3	127,994,184
Consumption	m^3/day	350,669
Consumption per unit	m^3/day	1.17
Authorized consumption	m^3	77,402,350
Unauthorized consumption	m^3	50,591,834
Water loss	m^3	58,037,834

The results were found very sensitive to the number of connections, which are estimated at a plausible range of ±30%. In any case, this analysis cannot reach a better conclusion with the current data. To be able to proceed further with more accurate bottom-up analysis based on the knowledge of network size and operation the following is need:

- Study of connection density based on customer building information.
- Field survey of different networks for evaluating the average operating pressure.
- Development of distribution reports showing number of hours supplied to each network.
- Desktop and field evaluation of the extent of network GIS completion especially at the distribution network level.

B.2.3 Performance Indicators

As presented, the selected performance indicators for the area of water loss have been calculated. Revisiting the confidence limits, and to illustrate the lack of accuracy, the following are the calculations for the uncertainty for the NRW values that are based on the fewest estimations for the WE.

Table B 2-7 Estimation uncertainty for the NRW variables.

Variables	Unit	Value	± % Error	Reliability	Est. Err.	Std. Err.	Variance
System input volume	m^3	135,440,184	20%	Low	3.E+07	1.E+07	2.E+14
Billed authorized consumption	m^3	71,476,855	2%	High	1.E+06	7.E+05	5.E+11
Non-Revenue Water	m^3	63,963,329	**42%**	Low	3.E+07	1.E+07	2.E+14

And calculating the uncertainty for the percentage, the errors are generally high.

Table B 2-8 Estimation uncertainty for the NRW performance indicator.

Performance indicator	Unit	Value	± % Error
Non-Revenue Water	%	47%	47%

Therefore, when assessing accuracy bands, and given the issues with data accuracy and reliability, the safe approach is to assume the lowest band for both accuracy and reliability until systematic auditing is implemented.

Table B 2-9 Water loss performance indicators with applicable benchmarks.

Quantity	Unit	SLWE	Benchmark	Accuracy	Reliability
Non-Revenue water	%	47%	N/A	42% - 105%	Low
Water loss	%	43%	N/A	27% - 64%	Low
Water losses per connection	l/c/d	2,120	N/A	47% - 67%	Low
Water losses per mains length	m^3/km/day	20	N/A	32% - 57%	Low
Apparent loss index (ALI)	N/A	14	1.0	23% - 69%	Low
Real loss per connection	l/c/d (w.s.p)	653	N/A	80% - 86%	Low
Real loss per mains length	m^3/km/day (w.s.p)	6.1	N/A	73% - 79%	Low
ILI (assumes)	N/A	8	2.0	50%	Low

In detail, the assessment of accuracy was conducted for SLWE as the following tables illustrate.

Table B 2-10 SLWE Water loss analysis with accuracy calculation.

Variables	Unit	Value	± % Error	Value min	Value max	Reliability	Est. Err.	Std. Err.	Variance
Length of mains	km	8,000	20%	6,400	9,600	Mid	2.E+03	8.E+02	7.E+05
Units	No.	300,000	10%	270,000	330,000	Low	3.E+04	2.E+04	2.E+08
Units per connection	No./No.	4	33%	3	5	Low	1.E+00	7.E-01	5.E-01
Connections	No.	75,000	40%	45,103	104,897	Low	3.E+04	2.E+04	2.E+08
Avg. Pressure	No.	30	33%	20	40	Low	1.E+01	5.E+00	3.E+01
UARL	m^3/day	6,120	55%	2,725	9,515	Low	3.E+03	2.E+03	3.E+06
ILI (assumed)	N/A	8	50%	4	12	Low	4.E+00	2.E+00	4.E+00
Supply continuity	Hour	10	10%	9	11	Low	1.E+00	5.E-01	3.E-01
Real losses	m^3/day	20,400	75%	5,028	35,772	Low	2.E+04	8.E+03	6.E+07
System input volume	m^3/day	258,888	9%	235,588	282,188	Low	2.E+04	1.E+04	1.E+08
Consumption (SIV-RL)	m^3/day	238,488	12%	210,574	266,401	Low	3.E+04	1.E+04	2.E+08
Unit consumption	m^3/day	0.79	15%	0.67	0.92	Low	1.E-01	6.E-02	4.E-03
Subscribers	No.	181,420	1%	179,606	183,234	High	2.E+03	9.E+02	9.E+05
Legal consumption	m^3/day	144,221	15%	121,972	166,471	Low	2.E+04	1.E+04	1.E+08
Illegal consumption	m^3/day	94,266	38%	58,570	129,962	Low	4.E+04	2.E+04	3.E+08
Water loss (RL+AL)	m^3/day	114,666	34%	75,801	153,531	Low	4.E+04	2.E+04	4.E+08
Water loss	%	44%	35%	29%	60%	Low	2.E-01	8.E-02	6.E-03
Water losses per connection	l/c/d	1,529	53%	717	2,341	Low	8.E+02	4.E+02	2.E+05
Water losses per mains length	m^3/km/day	14	40%	9	20	Low	6.E+00	3.E+00	9.E+00
Billed authorized consumption	m^3/day	195,827	2%	191,910	199,744	High	4.E+03	2.E+03	4.E+06
Apparent loss index (ALI)	- -	10	38%	6	13	Low	4.E+00	2.E+00	3.E+00
Real loss per connection	l/c/d (w.s.p)	653	86%	92	1,213	Low	6.E+02	3.E+02	8.E+04
Real loss per mains length	m^3/km/day (w.s.p)	6	79%	1	11	Low	5.E+00	2.E+00	6.E+00

B.2.4 Diagnosis of challenges

To assess the factors leading to low performance on in water loss management, including difficulties in producing the needed data, we attempt at portraying the situation using a SWOT analysis that considers at PESTEL external factors.

Strengths

1. Pilot projects have been introduced in SLWE to reduce physical losses using good water distribution practices.

Weaknesses

1. No clear roles for water loss assessment, planning, and reduction at the WE.
2. WE own distribution personnel perform water distribution independently from the best interest of the WE.
3. Distribution network information is largely missing from GIS in many areas.

Opportunities

1. Interest in NRW project funding.

Threats

1. No supervisory or regulatory accountancy by the Ministry on the WE to reduce NRW.
2. With the currency crises the financial feasibility of reducing NRW is diminished.
3. Social resistance against legal subscriptions especially without fair metering.
4. Social resistance against customer metering by high volume consumers.
5. No centralised and consolidated data for parcels, buildings, and units to aid in illegal use management and no recent aerial images.
6. Mountainous topography and large differences in elevations complicate and increase the cost of good water distribution design practices.

B.2.5 Recommended actions

The goal was to find better estimates of water loss variables by conducting the exercise done above at the level of water system, regional department, as well as the entire WE. That would have allowed us to consider a set of water systems or regions as having more accurate data than others, and therefore help make better estimates at the wider level. However, as presented, much of the data needed is not found even at the level of the water establishment.

Therefore, in summary, it is recommended the following:

B. 2.5.1 Pilot Area

Identify, in close coordination with the WE, one pilot area to convert into DMA and carry out within this area detailed studies for:

- Detailed customers census in order to assess the consumption needs and its geographic repartition.
- Detailed distribution network survey followed by a hydraulic modelling.
- Installation of bulk flow meters on strategic locations, and water meters on a number of house connections (if not all).
- Assessing the water losses.

B. 2.5.2 Non Revenue water studies

The lack of data coupled with absence of DMAs impacted the accuracy and quality of the NRW results. Given this finding, the following actions are recommended:

- Implement low cost high impact intervention, the so-called “quick wins” typically the commercial/apparent loss reduction measures instead of the more capital-intensive reduction measures targeting the physical/real loss. The activities consist of customer database update through door-to-door surveys to identify illegal practices, leaks on the service connections, and improved meter management, …
- Implement DMAs for demonstration and trial purposes. The DMAs are used as a diagnostic tool in quantifying physical losses (through bottom-up assessment), and to validate the results of the NRW assessment (top-down assessment).
- Prepare a NRW Reduction Strategy/Plan based on pilot projects outcome and set the NRW targets with the required budget.
- Promote the NRW problem ownership and introduce organizational measures such as working groups, NRW units to boost the implementation capacity.

B. 2.5.3 Shifting to metred consumption policy

Metered consumption is the end key for reducing NRW, Opex, and overall water consumption. In fact, the residential meters installed in Jezzine and Bint Jbeil are not officially used for billing as in other WEs.

However, based on lessons learned from past experiences in other WEs, it appears that this is not a top priority and a number of prerequisites are to be implemented before systematically installing water meters, out of which:

- Setting up a team to operate and manage meters maintenance and reading.
- Selecting the most adequate meter type based on the adopted reading policy.

- Securing continuous supply in the areas where the meters shall be installed, in order to encourage the consumers to subscribe and accept the idea of water metering.

Water metering projects may be systematically implemented over the whole jurisdiction once the above is implemented and running smooth.

B.3. ENERGY

While energy cost data was possible to collect, energy use in energy units was more complicated. In the case of SLWE the TA conducted an estimate using the amount billed by the power utility, also for 2019.

Table B 3-1 Estimation of the energy use to calculate the energy use performance indicator.

Variable	Unit	SLWE
Energy consumed from grid	kWh	174,510,243
Energy generated from fuel	kWh	
Renewable energy generation	kWh	
Energy recovery	kWh	

The calculated unit energy consumption for SLWE does not therefore include all energy costs but only grid energy.

Table B 3-2 Energy use performance indicator.

Performance indicator	Unit	SLWE	Benchmark
Unit energy consumption	kWh/m³	1.22	Lower is better
Energy consumed from grid	%		Comparative
Energy generated from fuel	%		Lower is better
Renewable energy generation	%		Higher is better
Energy recovery	%		Higher is better

The energy performance is a complex issue that became more complex with the increasing fuel shortages. SLWE has adapted their pumping schedules to align best with grid energy availability, and therefore the extent of the problem would not be realised by calculating the use of each energy source.

An increase in energy availability could on one hand lead to:

- Increased service delivery and longer supply hours.
- Decreased water quality issues due to less cross-contamination during network emptying.
- Decreased need for network resizing in terms of pipe diameters and storage volumes.
- Simpler water distribution and less dependence on local water distribution operators.
- Decreased expenditure on fuel and generators.
- Decreased station and network repairs due to decreased water hammering and vacuum conditions.

But on the other hand, and at least in during the transition could lead to:

- Increased energy costs due to longer working hours.
- Increased water consumption and therefore greater apparent losses.
- Increased real losses due to improved supply continuity.

Therefore, the general impact would be positive if measures were taken to control water losses and improve energy efficiency through better design and regulation of pumping.

To assess the factors leading to low performance on in energy use and management, including difficulties in producing the needed data, we attempt at portraying the situation using a SWOT analysis that considers at PESTEL external factors.

Strengths

1. Pilot projects for energy generations have been implemented, and projects for energy recovery have been discussed.

Weaknesses

1. No records of energy use at WE requiring EDL to share this data.
2. No assessment of energy use using local fuel generators.
3. Most pumping lines lack a study for energy reduction potential.
4. Incomplete knowledge of the system and the relationship between pumping locations and the quantities supplied.

Opportunities

1. Interest in energy efficiency project funding.

Threats

1. No supervisory or regulatory accountancy by the Ministry on the WEs to improve energy use efficiency.
2. With unpaid EDL invoices the financial feasibility of reducing energy use is diminished.
3. Mountainous topography and political water availability increases the difficulty for reducing energy use.

Due to the limitations in data availability, technical analysis of energy use becomes guesswork. While financially the records for the cost of energy use for both grid energy and fuel are available, there were no estimates of fuel consumption in terms of energy units.

Therefore, the needed improvements include:

- Identification and continuous update of discrete water supply systems as they exist in their actual current form.

- General asset survey and identification of billed grid locations and functions.
- Field study of generator energy use using samples of different sizes of generators.
- Developing a procedure for documenting fuel use and operating hours of generators.

These actions can be integrated with efforts taken in the areas of water loss and water systems.

B.4. WATER SYSTEMS

The assessment of water systems will no doubt be compromised by the quality of data available. The data provided from SLWE generally showed:

- Lack of completion and comprehensiveness.
- Lack of completion or regular update regarding the status of assets whether they are planned, under construction, awaiting hand-over, in use, or out of service.
- Lack of completion regarding asset ownership, who it is operated by, and which water system it serves.
- Lack of a primary central data system for producing asset information and the reliance on various sources and personal knowledge.
- No standard asset types or asset hierarchy, even if work has been done for creating these standards.

B.4.1 Water resources

The assessment of water resources looks at production, treatment, and reuse. The indicators look at the WE level due to the lack of more granular data given that:

- Surplus in water production capacity at the WE level does not mean sufficiency of water resources at the local level.
- The topography of current water systems is not documented. The NWSS proposed and defined water systems as a strategic water security measure but the actual situation does not correspond to that proposal.
- Resources at the regional departments at the WE may geographically be located in one region but supplying other regions. Until the water systems are documented and the quantities crossing from one region to another are estimated regional assessment cannot be concluded.

Table B 4-1 Water production and treatment assets.

Variable	Unit	SLWE
Number of water supply systems	No.	
Wells	No.	364
Springs	No.	13
Dams	No.	-
Treatment plants	No.	3

Moreover, when examining the production capacity, the following assumptions have to be made:

- Maximum operating hours, and whether the capacity reported is artificially reduced due to the shortage of electricity.
- The current safe yield and whether the capacity reported pertains to theoretical or outdated levels.

With these limitations in mind and proceeding to look at the available data, the estimates given or calculated for water production capacity for SLWE are as follows:

Table B 4-2 Water resource variables.

Variable	Unit	SLWE
Wells daily production capacity	m^3/day	
Springs daily production capacity	m^3/day	
Dams daily production capacity	m^3/day	
Total daily production capacity	m^3/day	
Daily treatment capacity	m^3/day	
Maximum water treated daily	m^3/day	
System input volume	m^3/day	371,069

For the WE to be able to accurately assess supply sufficiency, the following studies are needed:

- Technical assessment of current source safe yields and maximum working hours.
- Assessment of source water quality and the sufficiency of the current level of water treatment.
- Mapping of supply topography and definition and update of supply systems.
- Evaluation of the current and future demand for distribution zones.

B.4.2 Storage

Storage capacity at the level of the WE may not reflect local water storage sufficiency but provides a quick insight in some cases.

Table B 4-3 Water storage variables.

Variable	Unit	
Number of transmission and distribution storage tanks	No.	878
Treated water storage capacity	m^3	276,231
Transmission and distribution storage capacity	days	0.74

For the WE to be able to accurately assess storage capacity, the following studies are needed:

- Completion and auditing of reservoir storage capacity information.
- Mapping of storage topography and definition and update of supply systems as well as distribution zones supplied by each reservoir.
- Evaluation of the current and future demand for distribution zones.

B.4.3 Metering

B. 4.3.1 Present suituation

Presently (2020) there is 60,979 domestic water meters installed in the jurisdiction of SLWE. The rate of metered subscriptions is 47%, which is high.

However, to date meters are not read and processed same as gauged subscriptions

B. 4.3.2 Metering needs

To estimate the size of bulk metering needed, we look first at the production and transmission bulk metering that applies to sources, reservoirs, and pump station. The number would not match exactly the actual need of bulk meters but could provide a minimum benchmark that one bulk meter is installed in every location at minimum. To calculate the number of plants, we add the number of sources and reservoirs given above to the estimated number of pump stations.

Table B 4-4 Pumping stations and pumps.

Variable	Unit	SLWE
Pumping stations	No.	344
Pumps	No.	527

Therefore, we have the bases for the performance indicators as follows:

Table B 4-5 Metering base variables.

Variable	Unit	SLWE
Total plants (sources, PSs, TPs, Reservoirs)	No.	1,602
Connections	No.	75,000
Subscribers	No.	181,420

The actual performance in metering for each kind is estimated form the data gathered where possible as follows:

Table B 4-6 Metering performance variables.

Variable	Unit	SLWE
Production and transmission meters	No.	297
District meters	No.	44
Subscriber meters	No.	

Therefore, the metering performance in SLWE can be calculated.

Table B 4-7 Metering performance indicators.

Performance indicator	Unit	SLWE	Benchmark
Production and transmission meter density	No./plant	19%	100%
District meter density	No./1000 connections	59%	100%
Customer metering	%		100%

Metering is vital for measuring some of the most vital water establishment metrics in NRW and energy use. Given that the benchmark is to reach 100% or complete metering of all sources, plants, districts, and customers, the implementation could be gradual and slow. To be able to better strategies about, invest in, track, and evaluate the performance in metering, the following are needed:

- Survey of water production, treatment, storage, and pumping facilities and transmission systems and the evaluation of bulk metering needs.
- Bulk meter survey and calibration to determine conditions and maintenance needs.
- Survey of customer meters and evaluation of their condition as to re-evaluate the current level of performance based on active and functional meters.
- Development of meter management modules and procedures.
- Investigation of private sector opportunities for the specialised maintenance of advanced metering equipment.

B.4.4 SCADA

The evaluation aims at evaluating the level of automation and remote monitoring and control of water facilities. This has been initiated in SLWE where a number of facilities of concern has been chosen as a proxy for the number of control units, and the level of automation and remote control.

Table B 4-8 SCADA variables.

Variable	Unit	SLWE
Control units	No.	
Automated facilities	No.	
Remotely controlled units	No.	-

The level of performance in implementing SCADA system is currently null:

Table B 4-9 SCADA performance indicators.

Performance indicator	Unit	SLWE
Facility automation degree	%	
Facility remote control degree	%	

Ideally, control units should be used to represent points of on the production and transition system such as pump control panels, reservoir inlet and outlet valves, and other critical system valves. To improve the management of the automation efforts the following are needed:

- Survey of facilities to define control units of interest.
- Evaluation of each control unit's criticality within the framework of safety planning and crises mitigation as well as instrumentation and metering needs.
- Investigation of private sector opportunities for the specialised maintenance of SCADA systems.

B.4.5 Diagnosis of challenges

To assess the factors leading to low performance on in water system management, including difficulties in producing the needed data, we attempt at portraying the situation using a SWOT analysis that considers at PESTEL external factors.

Strengths

1. Focus on water resource sufficiency and storage capacity expansion across the WE.
2. SCADA and automation have been initiated in SLWE and should be implemented.

Weaknesses

1. The level of water treatment cannot be assured especially at small disperse sources.
2. WE does not have the capacity to manage large numbers of bulk and customer meters.
3. Information about facilities is rarely updated, highly dubious, and incomplete on GIS.
4. Distribution networks layouts are largely missing.
5. As a rule, small water resources are unmetered, or meters are dysfunctional.

Opportunities

1. Funding opportunities focus on water resources, storage, and associated measurement and control technologies.
2. Investment in customer meter is interesting to funding agencies.

Threats

1. Many small production and transmission facilities increase the complexity of asset management and the cost of SCADA.

B.4.6 Recommended actions

In summary, and with many common actions recommended across technical areas, the following recommendations can be made for the Development of a systematic facility and asset status update mechanism to eliminate the constant need for repeating surveys. This includes the following:

B. 4.6.1 Master plan / Strategy

SLWE appointed three consultants to review and update the master plan in line with its 5-year strategy.

Therefore, it is necessary to assess the relevance of existing Master Plans as follows:

- Conduct a cost benefit analysis for the capital investment projects needed in the near term for improved decision making
- Prioritize infrastructure projects based on a standard analysis grid

In addition, the 2020-2025 Strategy developed by SLWE has to be assessed and updated in line with the prevailing economic crisis, in particular in view of the impact of the new situation on the status of the WE's human resources and the ability to implement the set targets.

Estimated duration : 8 Months

B. 4.6.2 Digitalisation

The various data whether financial or technical should be centralized in one data centre or digital platform, therefore it is necessary to:

- Carry out an assessment of all data acquisition/processing systems in use at the WE and design a new data centre, to be implemented by steps, in the view of a central digitalization system for the whole WE. Based on the outcome of this assessment, the below steps would be carried out, in all or partially.
- Carry out studies for the improvement/replacement - if deemed necessary - of the existing ERP system, with the view of future integration within a central digitalization system; and prepare Tender Documents for the implementation of such a system, including WE's staff training and capacity building.
- Carry out studies for the improvement and extension - if deemed necessary - of the existing GIS system to cover the acquisition of all technical data, with the view of future integration within a central digitalization system; and prepare Tender Documents for the implementation of such a system, including WE's staff training and capacity building.
- Carry out studies for the design of a data acquisition and processing system to cover the monitoring and management of the production and distribution flows; with the view of future integration within a central digitalization system; and prepare Tender Documents for the implementation of such a system, including WE's staff training and capacity building. Supply and installation of the required remote sensors for the operation of the systems shall not be part of these Tender Documents.
- Implementation of the digitalization system.

B. 4.6.3 Water production – Available water resources

Presently, the water production is not adequately monitored; the production figures provided by SLWE are based on operators' *best estimate*.

Therefore, it is necessary to:

- Carry out a general survey of all water sources presently in service; assess the status of the existing flow measurement equipment if any;
- Prepare Tender Documents for the implementation of flow/yield measurement equipment on all water sources, linked to the central production data center.
  Because the cost for installing measurement equipment on all the water sources presently in service is expected to be high, these Tender Documents shall be divided into separate Lots, as may be required.

B. 4.6.4 Water distribution

Here again, the distributed flow provided by the WE is an operator's *best estimate*, due to the lack flow measurement at the level of the distribution centres or reservoirs.

Therefore, it is necessary to:

- Carry out a general survey of all distribution zones and identify the feeding point(s) of each, and assess the status of the existing flow measurement equipment at each feeding point, if any
- Prepare Tender Documents for the implementation of flow/consumption measurement equipment on each feeding point of each distribution zone, linked to the central production data center.
  Because the cost for installing measurement equipment on all the distribution zones is expected to be high, these Tender Documents shall be divided into separate Lots, as may be required.
- Identify existing DMAs and/or areas that could possibly be turned into DMAs, and identify possible locations for the installation of bulk flow/consumption meters on the distribution network, linked to the central production data center; and prepare Tender Documents for the supply and installation of such equipment.
  Because the cost for installing measurement equipment on all the distribution zones is expected to be high, these Tender Documents shall be divided into separate Lots, as may be required.

B. 4.6.5 Production cost optimization

With the present financial situation, energy has become the major component of production cost, nearing 90 %.

SLWE's strategy is to implement renewable energy sources such as hydroelectric or solar, in addition to shifting from underground to surface water sources, where possible. However, there is no comprehensive view on the subject: How efficient would this strategy be? How far could one go in power saving? What are the required investments and would it be cost effective? What is the realistic timeframe for implementation?

Therefore, it is necessary to carry out a general *Cost Optimisation Master Plan* covering in details all the available options over the WE's jurisdiction, and setting up the upper threshold of what could be possibly achieved regarding cost optimisation.

B. 4.6.6 Taking over the wastewater sector

SLWE is reluctant to take over the wastewater sector for reasons detailed before in section A.

In the meantime, financing must be provided from sources other than SLWE own funds (GoL or donors) to:

- Outsource the operation and maintenance of each treatment plant and related network to private operators via performance-based contracts.
- Hire a sewage treatment expert seconded to the WE in order to oversee the execution of these contracts

B.5. OPERATION AND MAINTENANCE

One of the areas suffering from the most data shortage is operation and maintenance. While asset information can be recovered to an extent in the future, the records of today's work will be lost if not documented within a short space of time. Moreover, the practice to record daily work is often adequate when the management is trying to constantly diagnose the problems, find weak areas, and strive to improve performance in with a long-term vision and a continuous strive for achieving success. On the other hand, when the establishment is weakened by various external and internal factors, the management process may get broken and simple requests such as filling out a work order may become impossible to fulfil.

B.5.1 Inspection and calibration

As expected, no records were available on inspection and calibration activities. SLWE has been developing a maintenance system that would detail these work orders in the future however currently the data is not available.

The suggested benchmark is a preliminary one and will require specialised input in both asset type-related and facility-related considerations. One reported value came from SLWE that reported the cleaning of 250 cubic meter reservoir which amounts to 0.1% of the total storage capacity. Other values remain unknown.

Table B 5-1 Inspection and calibration performance indicators.

Performance indicator	Unit	SLWE	Benchmark
Pump inspection	%		100%
System valve inspection	%		100%
Control valve inspection	%		100%
Reservoir cleaning	%	0.1%	100%
Network inspection	%		100%
Service connection inspection	%		100%
Instrument and inspection and calibration	%		100%
System flow meters calibration	%		100%
Pressure meters calibration	%		100%
Water level meters calibration	%		100%
Water quality sensor calibration	%		100%
Control unit inspection and calibration	%		100%
Electrical panel inspection	%		100%

The importance of preventive and predictive inspection of system assets as well as the calibration of instruments are vital for avoiding the collapse of service quality and sustaining resilience. Moreover, the ability of the public sector to maintain quality control over an operational contract is empowered by requesting and auditing daily inspection activities instead of waiting until a failure occurs -often due to the lack of inspection and preventive maintenance.

Currently, these processes may not be performed regularly and sufficiently, however, every establishment performs a varying level inspection activity through its operators and technicians at the production plants and pumping stations and sometimes daily. To be able to monitor and improve the performance in this area, the following is needed:

- Assessment of preventative maintenance needs and schedules for each asset type and specifically for each facility.
- Establishing procedures for updating the preventative maintenance plan when needed.
- Investigation of private-sector opportunities for providing specialized regular scheduled inspections and calibrations when the WE cannot.
- Adoption of standard reporting practices to be applicable with the WE's maintenance system.

B.5.2 Rehabilitation and replacement

Rehabilitation and replacement in general, including corrective maintenance produced during rehabilitation efforts, are often the last resort for a failing segment of the system. Therefore, an exceedingly high level of rehabilitation and replacement is not ideal. They are still a necessary fact that some parts of the system will need rehabilitation and therefore a WE should demonstrate investment in that area.

Due to often requiring external contracts, data exists, if not by any means reliably comprehensive.

Table B 5-2 Rehabilitation and replacement variables.

Variable	Unit	SLWE
Mains rehabilitation and replacement	km	
Service connection rehabilitation and replacement	No.	
System valve rehabilitation and replacement	No.	32
Control valve rehabilitation and replacement	No.	
Pump rehabilitation and replacement	No.	4
System flowmeter rehabilitation and replacement	No.	-
Customer flowmeter rehabilitation and replacement	No.	-
Leaks repaired	No.	157

More precise information is needed which can be achieved by regular and systematic work documentation in digital format.

Table B 5-3 Rehabilitation and replacement performance indicators.

Performance indicator	Unit	SLWE
Mains rehabilitation and replacement	%	
Service connection rehabilitation and replacement	%	
System valve rehabilitation and replacement	%	
Control valve rehabilitation and replacement	%	
Pump rehabilitation and replacement	%	1%
System flowmeter rehabilitation and replacement	%	
Customer flowmeter rehabilitation and replacement	%	
Leaks repaired	No./100 km	2.0

SLWE also showed that it replaced about 30% of its pumps every year before 2020.

B.5.3 Vehicles

Vehicle availability is vital for establishing field presence and traversing the service areas to operate and maintain assets.

Table B 5-4 Vehicle availability variables.

Variable	Unit	SLWE
Operating vehicles	No.	143
Length of mains	km	8,000
Subscribers	No.	181,420

Table B 5-5 Vehicle availability performance indicators.

Performance indicator	Unit	SLWE
Vehicle availability	No./100	1.8
Vehicle availability	No./100	0.8

B.5.4 Customer metering

Asides from owning the needed customer meter assets, the use of customer meters for calculating quantities and billing amounts are needed.

Table B 5-6 Customer metering variables.

Variable	Unit	SLWE
Customer meter read	No.	
Customers billed based on metering	No.	
Customer meters	No.	-

The data was not provided by SLWE and the performance indicator in relation with the customer metering was not calculated.

Table B 5-7 Customer metering performance indicators.

Performance indicator	Unit	SLWE	Benchmark
Customer meter reading efficiency	%		100%
Customers billed based on metering	%		100%

B.5.5 Water quality testing

Table B 5-8 Water quality testing variables.

Variable	Unit	SLWE
Required treated water quality tests	No.	
Required aesthetic tests	No.	
Required microbiological tests	No.	
Required physical-chemical tests	No.	
Required radioactivity tests	No.	
Required water quality tests carried out	No.	
Aesthetic tests carried out	No.	
Microbiological tests carried out	No.	3,629
Physical-chemical tests carried out	No.	
Radioactivity tests carried out	No.	

Table B 5-9 Water quality testing performance indicators.

Performance indicator	Unit	SLWE
Aesthetic tests carried out	%	
Microbiological tests carried out	%	
Physical-chemical tests carried out	%	
Radioactivity tests carried out	%	

B.5.6 Diagnosis of challenges

To assess the factors leading to low performance on in operation and maintenance, including difficulties in producing the needed data, we attempt at portraying the situation using a SWOT analysis that considers at PESTEL external factors.

Strengths

1. Experience in and attempt at designing or acquiring maintenance management and quality management systems at SLWE.

Weaknesses

1. Requests and work orders affecting financial decisions such as material requests are required to be paper based and manually signed, limiting the application of maintenance systems.
2. Difficulty in narrowing down the assets requiring preventive maintenance, inspection, or calibration and the required maintenance for each.
3. Difficulty in assessing the sampling and quality testing of sources and networks according to the Lebanese standards.
4. Maintenance information is often lacking, and when available focus to major contracted works at facilities.
5. No records of network failures that may aid in assessing the condition of network assets.
6. WE has no capacity to perform acceptable levels of regular maintenance.

Opportunities

1. Technology is available that enables the implementation of comprehensive management and control over operations and maintenances with minor overhead.

Threats

1. Reliance on external contractors weakens the ability to closely monitor and manage maintenance activities.

B.5.7 Recommended actions

Similar to previously mentioned points in the area of systems, with the additional focus on water quality and meter management systems and systematic update. Primarily, a work order system that works across the office and the field and based on GIS is key for planning, implementing, and evaluating operation and maintenance practices and related costs. Specifically:

1. Study of the scheduled maintenance needs for each asset type and development of a maintenance program. This will also help develop the needs of staffing and vehicles for each WE.
2. Completion of and standardisation of maintenance forms for SLWE, review of existing systems, and planning revisions and development of capable maintenance management system upgrade and the integration with mobile applications for field functions.

3. Study of and update of the water sampling and testing needs for SLWE. This will also help develop the needs of staffing and vehicles for SLWE.
4. Review of existing water quality systems, reporting capability, regulatory compliance, and planning revisions and development of capable water quality system upgrade and the integration with mobile applications for field functions.
5. Study of the cost and benefit of customer metering for both simple flow meters and smart static meters with remote reading capabilities. This will also help develop the needs of staffing and vehicles for SLWE.
6. Development and enforcement of a criteria for inspecting and assessing the quality of water mains and service connections and the development of a replacement strategy that minimises pipe replacement before all attempts at maintenance have been taken, and where replacement proves to be a more cost-effective solution.

In order to enhance efficiency and reduce the cost of O&M, it is necessary to design a modern preventive/corrective maintenance system, and implement it in the view of central digitalization system for the whole WE.

B.6. QUALITY OF SERVICE

B.6.1 Service coverage

Supply coverage is a key performance indicator. Determining the coverage ratio in cases where 100% cannot be assumed requires information about the total number of units. In the case of Lebanon, the total number of units is more often estimated using utility data, so we chose rough estimates of the number of units for the purpose of this assessment.

A better estimation can be made by assuming that the number of units served by the WE is equal to the total number of subscriptions.

Table B 6-1 Service coverage variables.

Variable	Unit	SLWE
Units	No.	300,000
Subscribers	No.	181,420
Unit supplied legally by WE	No.	181,420
Unit supplied by other entities	No.	Low
Unit supplied by illegal connections	No.	

It therefore remains that service coverage cannot be determined, especially since the expected coverage by all entities and means is expected to be close to 100%. The ratio of illegally connected units can still be estimated, if with a large margin of uncertainty coming from estimating the total number of units.

Table B 6-2 Service coverage performance indicators.

Performance indicator	Unit	SLWE
Service coverage	%	
Unit supply coverage legally by WE	%	60%
Unit supply coverage by other entities	%	
Unit supply coverage by illegal connections	%	40%

B.6.2 Supply continuity

Supply continuity is a key performance indicator. Continuity often means good level of service, more satisfied customers, fewer water quality risks, and longer asset life. The performance is usually affected by bad maintenance and shortage in water resources. In the case of Lebanon, continuity is primarily affected by power availability, therefore also storage capacity. Local power generation is possible, and some sources can be operated for extended periods, yet it is not feasible for the WE to always generate power in all locations when power supply from the grid is not available.

Given the imposing situation beyond the control of WE, the issue of continuity has often remained in the background. The hours of supply are still not known, and previous estimates focused more on source operating hours not distribution supply hours.

Table B 6-3 Supply continuity variables.

Variable	Unit	SLWE
Avg. supply duration	h/day	
Listed number of networks	No.	
Network with 23 h/day or more	No.	
Estimated customers with continuous supply	%	

The resulting performance can not be therefore calculated for SLWE. Given the importance of this key performance indicator, supply continuity was estimated for the SLWE as 40% as an initial figure, based on an average of approximately 10 hours per day.

Table B 6-4 Supply continuity performance indicators.

Variable	Unit	SLWE	Benchmark
Supply continuity	%	~ 40%	100%
Population receiving continuous supply	%	Low	100%

B.6.3 Water quality compliance

Assessment of water quality compliance requires clear standards and transparent reporting. The number of potable water tests carried out were estimated for SLWE from raw data.

Table B 6-5 Water quality compliance base variables.

Variable	Unit	SLWE
Treated water quality tests carried out	No.	
Aesthetic tests carried out	No.	
Microbiological tests carried out	No.	3,629
Physical-chemical tests carried out	No.	
Radioactivity tests carried out	No.	

Data was provided by SLWE for the microbiological tests, however no estimates was given for the compliance level of these tests. It should be stated that the compliance percentages should apply to the required samples by regulation.

Table B 6-6 Water quality compliance performance variables.

Variable	Unit	SLWE
Quality of supplied water	No.	
Aesthetic tests compliance	No.	
Microbiological tests compliance	No.	
Physical-chemical tests compliance	No.	
Radioactivity tests compliance	No.	

The resulting compliance levels therefore cannot be taken without the review of the standards and requirements for sampling and testing, covered under the technical part.

Table B 6-7 Water quality compliance performance indicators.

Performance indicator	Unit	SLWE	Benchmark
Quality of supplied water	%		100%
Aesthetic tests compliance	%		100%
Microbiological tests compliance	%		100%
Physical-chemical tests compliance	%		100%
Radioactivity tests compliance	%		100%

B.6.4 Response speed

Improving customer service depends on improving the speed of performing the services, especially in the case of Lebanese WE, where encouraging users to legally subscribe and install a meter can be hampered by long waiting time, especially for new users.

Unfortunately, the speed of service data could not be collected, and to our best knowledge is in some cases difficult to consolidate from the systems and paperwork, and in other cases impossible.

Table B 6-8 Response speed performance indicators.

Performance indicator	Unit	SLWE	Benchmark
Average response time to customer complaints	Hours		48
New connection establishment time	days		14
Time to install a customer meter/gauge	days	< 21	14
Connection repair time	days		1

The suggested benchmark is indicative and should be revised by the supervisory body or regulator.

Therefore, to improve the measurement -and therefore management- of response speed the following is needed:

- Completion of the digitisation of customer transactions, especially in remote offices and where systems are prone to power failures.
- Design of reports in the customer management systems that capture time of request instigation and time of completion.
- Use of mobile application for distribution departments that include customer service requests and work orders.

B.6.5 Customer complaints

Reducing the need for customer complaints and the time to respond to customer complaints are essential part of the mission of any water utility. However, in the case of Lebanon, the number of recorded complaints is abnormally low. Moreover, the number of complaints is generally higher in the better served larger cities and towns than remote villages. If anything, the numbers record the extent in which customers interact officially with the WEs, as opposed to submitting complaints informally to a WE staff member, not having a legal subscription to allow complaining, or not expecting a response from a WE, especially in the remote areas.

We summarised an estimate of the needed variables from the data provided as follows:

Table B 6-9 Customer complaints variables.

Variable	Unit	SLWE
Billing complaints and queries	No.	
Service complaints	No.	966
Pressure complaints	No.	
Continuity and interruption complaints	No.	784
Water quality complaints	No.	

The results show that SLWE has relative high recorded number of complaints.

Table B 6-10 Customer complaints performance indicators.

Performance indicator	Unit	SLWE
Billing complaints and queries	No./1000 customer	
Service complaints per connections	No./1000 customer	5.3
Pressure complaints	No./1000 customer	-
Continuity and interruption complaints	No./1000 customer	4.3
Water quality complaints	No./1000 customer	-

SLWE has initiated one or more systems of documenting complaints over the years, with some of them being integrated with the ERP of the WE. However, common issues are seen such as:

- Incomplete campaigning for centralising a call centre and a centralised operations command to allow centralised control. Otherwise, local centres operating using the same system and procedures can perform similarly.
- Incomplete internal capacity and internal management of staff to re-route customer requests through the call centre.
- Inconsistent attribution of complaint types.
- No separation between claims and reports of incidents such as leaks and service complaints.
- No method for documenting billing complaints.

Therefore, and to allow for improved receiving and handling of customer complaints the following are needed:

- Standardisation of report types and definitions, including the separation of incident reports and service complaints.
- Development of a standardised customer application to enhance customer communication, to be managed by the WE.

B.6.6 Diagnosis of challenges

To assess the factors leading to low performance on in service quality, including difficulties in producing the needed data, we attempt at portraying the situation using a SWOT analysis that considers at PESTEL external factors.

Strengths

1. Expected high levels of service coverage, if precluded by prevalence of illegal connection to the network in SLWE.

Weaknesses

1. No sufficient capacity for responding to all customer complaints.
2. Large volumes of customer complaints remain to be processed outside of official channels.

Opportunities

1. Mobile applications provide a technological solution for saving cost and staff needed to achieve wider communication with customers.
2. Relaunching of WEs with new campaigns, while maintaining good performance, may help establish trust and cooperation with users.

Threats

1. Other than in Saida, water users have not developed the habit of contacting the call centre to report service complaints.
2. Power shortages keep supply continuity an unachievable goal.

B.6.7 Recommended actions

A strong customer service function that looks into both technical and administrative issues related to service delivery is key. Some work has been attempted by UNICEF and USAID have stumbled against the lack of data. Initialising subscriber data is therefore key and an element that has proven to be beyond simple interventions and beyond WE's own resources. That, and with the current widespread use of mobile applications in Lebanon, managing water subscription should not be more difficult than managing a mobile data plan, and complaining about service quality should be as easy as ordering delivery meals. Building strong communication with customers is a low hanging fruit for establishing change and good will for better water services and increased responsibility over bill payment by the customer.

With the aforementioned improvements needed for identifying system components and managing operations and maintenance, on the customer side, the following is recommended:

- Investment in a standardise if not necessarily centralised customer application that allows for:
    - 24/7 reporting of complaints and observations such as leakage or water theft.
    - Live tracking of the status of their reports.
    - Immediate update of scheduled or unscheduled water interruptions, source quality issues, and any general announcements.
    - Calculation of complaint types, average response times, size of backlog.
- Promotion of the call centres or call desks into 23/7 complaint and command/control centres. Available SCADA as well as minor investments in remote monitoring of pressure and flow can assist the centre perform more informed decisions.
- Targeted promotion of legal subscription in areas where improved WE capacity, asset conditions, and resource sufficiency can be ensured.
- Phone and web surveys of statistically representative random sample of users to assess concerns and reporting of anonymous subscription statuses across all regions.
- Study for evaluating of the size and capacity of fields units needed in each regional department for performing satisfactory complaint handling to achieve improved service delivery.

APPENDICES

APPENDIX 1. Selection of performanc indicators

The IWA's performance Indicators for water supply services offer a rich selection of performance indicators that capture different areas of interest for monitoring the performance of water establishments. However, for the case of Lebanon, not all these indicators are relevant, pressing, or even sufficient.

Several issues of special interest to Lebanon include:

- The personnel assessment assumed for most water utilities depends on the permanently employed personnel. While there are often other sources for the work force such as daily labor or operating contracts, they are usually small and of less interest than official employees. In the case of Lebanese WEs, and due to difficulty of securing government approvals for the hiring of new employees, most of working staff has been composed of contracted people with no official employment status. Monitoring the evolution of the staff profile is therefore of great interest.
- Subscribers represent a fraction of served connections. Using the number of legal subscribers to size the system therefore would negate the strategic goal of improving subscriptions and therefore collections. Also of interest is that even if the service area and responsibilities of WEs are well defined, many municipalities and committees have taken over the role of water and wastewater utility management and provide to their own districts or in mixed districts -a state that may not continue if the WEs have the needed capacity to take over. The actual size of the service area and the monitoring of illegal use and supply by other entities are of great interest in Lebanon.
- Customer metering has become a normal method of operation in water utilities, yet in Lebanon it remains the exception. That and the high prevalence of illegal connections, the assessment of non-revenue water based on billed amounts becomes much less effective and much more uncertain. Moreover, the information about metered production quantities is almost non-existent even for the few metered bulk sources. Therefore, it is of great interest to estimate the actual legal consumption as well as the illegal use as a first step in water loss evaluation.
- Power supply for pumping is an intricate issue that includes grid power intermittency, bureaucracy in getting approvals for subscriptions, using less cost-efficient local generators that depend on the availability of fossil fuels. The assessment and monitoring of power sources and their effects on supply continuity is therefore of great interest in Lebanon.
- The IWA performance Indicators assume a situation with clearly defined treatment plants and bulk water imports being the main sources of water, while in many parts of the region a large array of water sources includes wells, springs, dams, sizes small and

large, treated by many local chlorination machines or large treatment plants. It is therefore of great interest to monitor the type and quality of different kinds of supply sources.

We will now present the original performance indicators as sourced from the IWA reference and the proposed indicators for use for this assessment. At a later stage, and based on dedicated work for setting up a performance monitoring system, a final set of indicators will be defined. The IWA performance indicators for personnel supply services include a section on personnel, as shown in Table B 1-1 below.

Table B 6-11 Appendix to Section B - Performance indicators in the area of personnel.

Code	Area	Performance indicator	Unit
Pe1	Total personnel	Employees per connection	No./1000 connections
Pe2		Employees per water produced	No./(10^6m^3)
Pe3	Personnel per main function	General management personnel	%
Pe4		Human resources management personnel	%
Pe5		Financial and commercial personnel	%
Pe6		Customer services personnel	%
Pe7		Technical service personnel	%
Pe8		Planning & construction personnel	%
Pe9		Operations & maintenance personnel	%
Pe10	Technical services personnel per activity	Water resources and catchment management personnel	No./(10^6m^3)
Pe11		Water resources and catchment management personnel	No./(10^6m^3)
Pe12		Transmission, storage and distribution personnel	No./100 km
Pe13		Water quality monitoring personnel	No. /1000 tests
Pe14		Meter management personnel	No. /1000 meters
Pe15		Support service personnel	%
Pe16	Personnel qualification	University degree personnel	%
Pe17		Basic education personnel	%
Pe18		Other qualification personnel	%
Pe19	Personnel training	Total training	Hours / employee
Pe20		Internal training	Hours / employee
Pe21		External training	Hours / employee
Pe22	Personnel health and safety	Working accidents	No./100 employees
Pe23		Absenteeism	days / employee
Pe24		Absenteeism due to accidents or illness at work	days / employee
Pe25		Absenteeism due to other reasons	days / employee
Pe26	Overtime	Overtime work	%

We are proposing using more detailed classifications due to the emphasis on comparing personnel business areas from different WEs where departments are less comparable. Also for comparing where the shortage of staff is affecting how the WEs are adhering to the organisational by-laws, detailed job types were used.

Table B 6-12 Appendix to Section B – Proposed performance indicators in the area of personnel.

Area	Performance indicator	Unit
Total personnel	Employees per connection	No./1000 connections
	Employees per customer	No./1000 customers
	Employees per water produced	No./(10^6m^3)
	Permanent employees	%
Personnel per business area	Customer service	No./1000 connections
	Distribution	No./(10^6m^3)
	Engineering	%
	Facilities	No./(10^6m^3)
	Finance	%
	General	%
	HR	%
	Water quality	%
Personnel per job type	Auxiliary - Clerical	No./(10^6m^3)
	Auxiliary - Driver	%
	Auxiliary - Guard	%
	Auxiliary - Office boy	%
	Collector / Reader	No./1000 meters
	Customer service	No./1000 customers
	Financial / Administrative	%
	Management	%
	Management (Eng.)	%
	Technical - Driver	%
	Technical - Engineer	%
	Technical - Laborer	%
	Technical - Other	%
	Technical - Water quality	No./1000 samples
Personnel qualification	University degree personnel	%
	Basic education personnel	%
	Other qualification personnel	%
Personnel	Training	Hours / employee
Personnel health and safety	Working accidents	No./100 employees
	Absenteeism	days / employee
	Absenteeism due to accidents or illness at work	days / employee
	Absenteeism due to other reasons	days / employee
Overtime	Overtime work	%

The IWA performance indicators for water supply services also include a section on water resources, physical systems, and operations as shown in Table B 1-3, Table B 1-4 and Table B 1-5.

Table B 6-13 Appendix to Section B - IWA performance indicators in the area of water resources.

Code	Area	Performance indicator	Unit
WR1	Water resources	Inefficiency of use of water resources	%
WR2		Water resources availability	%
WR3		Own water resources availability	%
WR4		Reuse supplied water	%

Table B 6-14 Appendix to Section B - IWA performance indicators in the area of physical systems.

Code	Area	Performance indicator	days
Ph1	Treatment	Treatment plant utilisation	%
Ph2	Storage	Raw water storage capacity	days
Ph3		Transmission and distribution storage capacity	days
Ph4	Pumping	Pumping utilization	%
Ph5		Standard energy consumption	$kWh/m^3/100m$
Ph6		Reactive energy consumption	%
Ph7		Energy recovery	%
Ph8	Transmission and distribution	Valve density	No./km
Ph9		Hydrant density	No./km
Ph10	Meters	District meter density	No./1000 connections
Ph11		Customer meter density	No./connections
Ph12		Metered customers	No./customer
Ph13		Metered residential customers	No./customer
Ph14	Automation and control	Automation degree	%
Ph15		Remote control degree	%

Table B 6-15 Appendix to Section B - IWA performance indicators in the area of operation.

Code	Area	Performance indicator	Unit
Op1	Inspection and maintenance of physical assets	Pump inspection	%
Op2		Storage tank cleaning	%
Op3		Network inspection	%
Op4		Leakage control	%
Op5		Active leakage control repairs	No./100 km
Op6		Hydrant inspection	%
Op7	Instrumentation calibration	System flow meters calibration	%
Op8		Meter replacement	%
Op9		Pressure meters calibration	%
Op10		Water level meters calibration	%
Op11		On-line water quality monitoring equipment calibration	%
Op12	Electrical and signal transmission	Emergency power systems inspection	%
Op13		Signal transmission equipment inspection	%
Op14		Electrical switchgear equipment inspection	%
Op15	Vehicles	Vehicle availability	No./100 km
Op16	Mains, valves and service connection rehabilitation	Mains rehabilitation	%
Op17		Mains renovation	%
Op18		Mains replacement	%
Op19		Replaced valves	%
Op20		Service connection rehabilitation	%
Op21	Pump rehabilitation	Pump refurbishment	%
Op22		Pump replacement	%
Op23	Operational water losses	Water losses per connection	m^3/connection
Op24		Water losses per mains length	m^3/km/day
Op25		Apparent losses	%
Op26		Apparent losses per system input volume	%
Op27		Real losses per connection	l/c/d (w.s.p)
Op28		Real losses per mains length	l/c/d (w.s.p)
Op29		Infrastructure leakage index	N/A
Op30	Failure	Pump failures	days/pump
Op31		Mains failures	No.100km
Op32		Service connection failures	No./1000 connections
Op33		Hydrant failures	No./1000 hydrants
Op34		Power failures	hours/pumping stations
Op35		Water point failures	No./water points
Op36	Water metering	Customer reading efficiency	%
Op37		Residential customer reading efficiency	%
Op38		Operational meters	%
Op39		Unmetered water	%
Op40	Water quality monitoring	Test carried out	%
Op41		Aesthetic tests carried out	%
Op42		Microbiological tests carried out	%
Op43		Physical-chemical tests carried out	%
Op44		Radioactivity tests carried out	%

We propose a redesign and emphasis in a similar way but in ways more relevant to the situation in Lebanon. One section combines indicators for water loss as shown in Table B 1-6 below.

Table B 6-16 Appendix to Section B - Proposed water loss performance indicators.

Performance indicator	Unit
Non-revenue water	%
Water loss	%
Water losses per connection	l/c/d
Water losses per mains length	m^3/km/day
Apparent loss index (ALI)	N/A
Real loss per connection	l/c/d (w.s.p)
Real loss per mains length	m^3/km/day (w.s.p)
Infrastructure leakage index (ILI)	N/A

Where water loss here is used specifically for this context to represent the difference between the estimated system input and authorized consumption, while non-revenue water is used for the difference between the system input and the billed amounts.

One section details energy indicators relevant to the situation of Lebanon as shown in Table B 1-7 below.

Table B 6-17 Appendix to Section B - Proposed energy performance indicators.

Performance indicator	Unit
Unit energy consumption	kWh/m^3
Energy consumed from grid	%
Energy generated from fuel	%
Renewable energy generation	%
Energy recovery	%

One section details system indicators relevant for Lebanon as shown in Table B 1-8.

Table B 6-18 Appendix to Section B - Proposed performance indicators in the area of water systems.

Area	Performance indicator	Unit
Resources	Water production capacity utilisation	%
	Treatment plant capacity utilisation	%
	Reuse supplied water	%
Storage	Raw water storage capacity	days
	Transmission and distribution storage capacity	days
Metering	Production and transmission meter density	No./plants
	District meter density	No./1000 connections
	Customer metering	%
SCADA	Facility automation degree	%
	Facility remote control degree	%

One section details remaining operations and additional maintenance indicators relevant for as shown in Table B 1-9 below.

Table B 6-19 Appendix to Section B - Proposed performance indicators In the area of operations and maintenance.

Area	Performance indicator	Unit
Inspection and calibration	Pump inspection	%
	System valve inspection	%
	Reservoir cleaning	%
	Control valve inspection	%
	Network inspection	%
	Service connection inspection	%
	Instrument and inspection and calibration	%
	Systems flow meters calibration	%
	Pressure meters calibration	%
	Water level meters calibration	%
	Water quality sensor calibration	%
	Control unit inspection and calibration	%
	Electrical panel inspection	%
Rehabilitation and replacement	Mains rehabilitation and replacement	%
	Service connection rehabilitation and replacement	%
	System valve rehabilitation and replacement	%
	Control valve rehabilitation and replacement	%
	Pump rehabilitation and replacement	%
	System flowmeter rehabilitation and replacement	%
	Customer flowmeter rehabilitation and replacement	%
	Leaks repaired	No./100 km
Vehicles	Vehicle availability	No./100 km
	Vehicle availability	No./1000 customer
Customer metering	Customer meter reading efficiency	%
	Customers billed based on metering	%
Quality monitoring	Aesthetic tests carried out	%
	Microbiological tests carried out	%
	Physical-chemical tests carried out	%
	Radioactivity tests carried out	%

Of great importance, the IWA performance indicators for water supply services include a section on the quality of service as shown in Table B 1-10 below.

Table B 6-20 Appendix to Section B - IWA performance indicators in the area of quality of service.

Code	Area	Performance indicator	Unit
QS01	Service coverage	Households and business supply coverage	%
QS02		Buildings supply coverage	%
QS03		Population coverage	%
QS04		Population coverage with service connections	%
QS05		Population coverage with public taps or standpipes	%
QS06	Public taps and standpipes	Operational water points	%
QS07		Average distance from waterpoints to households	m
QS08		Per capita water consumed in public taps and standpipes	l/person/day
QS09		Population per public tap or standpipe	persons/day
QS10	Pressure and continuity of supply	Pressure of supply adequacy	%
QS11		Bulk supply adequacy	%
QS12		Continuity of supply	%
QS13		Water interruptions	%
QS14		Interruptions per connection	No./1000 connections
QS15		Bulk supply interruptions	No./delivery point
QS16		Population experiencing restrictions to water service	%
QS17		Days with restrictions to water service	%
QS18	Quality of supplied water	Quality of supplied water	%
QS19		Aesthetic tests compliance	%
QS20		Microbiological tests compliance	%
QS21		Physical-chemical tests compliance	%
QS22		Radioactivity tests compliance	%
QS23	Service connection and meter	New connection efficiency	days
QS24		Time to install a customer meter	days
QS25		Connection repair time	days
QS26	Customer complaints	Service complaints per connections	No./1000 connections
QS27		Service complaints per customer	No./customer
QS28		Pressure complaints	%
QS29		Continuity complaints	%
QS30		Water quality complaints	%
QS31		Interruption complaints	%
QS32		Billing complaints and queries	No./customer
QS33		Other complaints and queries	No./customer
QS34		Response to written complaints	%

And similarly, we propose a simpler section more relevant for the case of Lebanon as shown in Table B 1-11.

Table B 6-21 Appendix to Section B - Proposed performance indicators in the area of quality of service.

Area	Performance indicator	Unit
Coverage	Service coverage	%
	Unit supply coverage legally by WE	%
	Unit supply coverage by other entities	%
	Unit supply coverage by illegal connections	%
Continuity	Supply continuity	%
	Population receiving continuous supply	%
Water quality	Quality of supplied water	%
	Aesthetic tests compliance	%
	Microbiological tests compliance	%
	Physical-chemical tests compliance	%
	Radioactivity tests compliance	%
Response speed	Average response time to customer complaint	Hours
	New connection establishment time	days
	Time to install a customer meter	days
	Connection repair time	days
Customer complaints	Billing complaints and queries	No./1000 customer
	Service complaints per connections	No./1000 customer
	Pressure complaints	No./1000 customer
	Continuity and interruption complaints	No./1000 customer
	Water quality complaints	No./1000 customer

While not all these indicators will be relevant to decision makers at high levels, or can be currently calculated with sufficient accuracy, the offer a broad overview of the establishments needed for the sake of this assessment. A selected list of Key Performance Indicators can then be extracted at the upcoming activity.

APPENDIX 2. Selection of assessment benchmarks

Benchmarks are needed to give the performance indicators meaning and value. When selecting benchmarks for different performance indicators and given that in most cases there remains a general lack of internationally approved standards giving exact figures to follow. Some exceptions may exist at this stage such as the following:

2. Staff to connections:
   Tynan and Kingdom (2002) studied water utilities of different levels of performance and found that a staff size of 5 per 1000 connections was achievable by the top group of utilities. Since then, this figure has been adopted, and sometimes increased to express the size for utilities running both water and wastewater services.
3. Non-Revenue Water as a ratio of system input volume (% NRW):

While the IWA, AWWA, and the EU recommend against using this indicator as a target or a benchmark, Tynan and Kingdom found that 23% or less represents the performance level of the top performing utilities. We assess that a percentage can be used as a target when guided by other indicators such as ILI and ALI but not based on ad-hoc percentages. Also the percentage of NRW cannot be used to compare utility performance.

4. Infrastructure Leakage Index (ILI):
   The ILI is recommended by the IWA, AWWA, and the EU as the indicator for benchmarking performance on physical (or real) loss performance. This indicator assesses the condition of leakage of infrastructure operating at a certain water pressure given its characteristics, and therefore assesses physical assets condition as well as the speed of repair of leaks, yet does not assess the performance in pressure management. Moreover, the results of ILI will vary widely based on assumptions about supply continuity and pressure in networks, neither of which are currently recorded in Lebanese WEs. Still, and since ILI is based on deviation from an ideal, the ideal of ILI for developed countries is the Unavoidable Annual Real Loss (UARL), while the ideal for developing countries is twice the UARL.
5. Apparent Loss Index (ALI):
   The ALI is a simple indicator to calculate and is the ratio of commercial (or apparent) loss to 5% of the billed authorised consumption, here 5% representing the ideal for developed countries. For developing countries 10% is used, meaning that the target for commercial losses should be less than 10% of the billed quantities.
6. Supply continuity:
   A major KPI, supply continuity is agreed to be a required objective by the international water organisations, and also referenced by Tynan and Kingdom. A 24/7 supply is an agreed-upon target, and fewer supply hours will jeopardise risk for both the conditions of the physical network assets and the health of the customer.
7. Number of water quality samples from distribution networks:
   The Lebanese water quality standards provides detailed requirements for water quality testing. These tests can differ in the number of samples. The WHO on the other hand recommends one monthly sample for every 10,000 people serviced plus 10 additional samples. For a utility serving one million people this amounts to 1320 samples annually.

Otherwise, we followed the following principles:

- A benchmark can be more ambitious than an improvement target which is more concrete and can be used for accountability.
- A benchmark can start as a high ideal if impossible to achieve (e.g. 0% or 100%)
- A general direction of higher or lower may be used instead of a fixed value.
- Performance of basic tasks is expected to occur at least annually.

Strategically, more or less strict standards may need to be adopted as in the case of sensitive electronics used in SCADA may require stricter and more frequent control compared to regular network isolation valves. In either case and given the status of maintenance that is expected in Lebanese WEs, any reference standard that can be established is preferable to the lack of one.

In some cases the performance indicators are not immediately tied to the efforts of the establishment or controlled by them. An example is the number of failures where better operation could indeed lead to fewer cases of failures, yet the number of cases will not be fully dependent on the level of effort and failures will manage to occur regardless.

The resulting benchmarks can therefore either be set as an ideal goal the WEs should aspire to reach, or a comparative assessment of achievement that can be compared between WEs or regions within the WE and will evolve with the evolution of performance.

SECTION C
FINANCIAL PERFORMANCE DIAGNOSIS

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C. 1 INTRODUCTION

Water utilities in Lebanon are public establishments created in year 2000, under Law 221, and fully implemented in 2005, that merged regional water authorities and committees into four water establishments.

By law, these establishments are independent, state owned water utilities, responsible for production, distribution, and billing for water, wastewater, and irrigation services, under the tutelage of the ministry of energy and water, that formulates policy and regulates fees.

As such, these establishments have to produce, ahead of each year, a balanced budget, to be approved by the ministry, and present externally audited financial results at the end of the year. In order to present a balanced budget, most establishments would overestimate revenues, and understate expenditures.

The water code law 77 – 2018 amended by law 192 – 2020, and still pending proposes a commercial approach to service delivery by separating water, waste water, and irrigation operations both technically and financially, and allowing for contracting service providers in limited areas within each territory : private operators, municipalities, or water committees.

If and when implemented, the water code would require modifications to the organizational structure of the establishments, and the adoption of generally accepted accounting principles, standards, and procedures, away from the currently used public accounting system.

To this end, many attempts have been made since 2005, mainly:

- To map, assess and evaluate fixed assets (identification, ownership, valuation, replacement cost, amortization…)
- Review and amendments to organization charts adopted in 2005.
- Implement a commercial accounting system : SAFEGE, X7/PIMS (2005-2009), USAID, ERP Microsoft Navision (2011 – to date).
- Tariff analysis that require the calculation of “cost of goods sold” was limited by determination of production volumes by water source, manpower and operation and maintenance costs corresponding to production facilities, and actual water consumption by billed customers.
- Survey of residents, beneficiaries, illegal connections.
- Pilot projects to address NRW : Bulk, district, and household water meters, SCADA system.

Not withstanding above, financial results of the water establishment has been reviewed with actual numbers provided, and constitute a starting point for planning for future activities.

Additionally, a cost recovery study has been performed using the numbers of the year 2019 as base values (before the economic crisis) to simulate the impact of the hyperinflation on the opex cost.

Therefore, section C is organized upon two main chapters:

- The first chapter presents a review of the actual financial numbers and figures of the WE where results will constitute the basis for planning for future activities.
- The second chapter summarises the main findings and key recommendations resulted from the cost recovery study.

C. 2 REVIEW OF THE FINANCIAL SITUATION

C. 2.1 Book keeping and related matters

Book keeping is a matter of concern with some WEs far in advance and following good practices and due accounting principles, while others are not up to standards. For the latest, data are somehow unstable and confusing.

As far as financial reporting is concerned, the situation is somehow confusing with WEs maintaining in parallel two systems. The first is a requirement of the MoEW and is an administrative budget with authorization for payments and associated budgets. The second is more business oriented trying to meet financial commercial reporting standards.

The flaw is that the admin system is extremely time and effort consuming preventing the finance department to concentrate on the financial & commercial reporting systems.

The second flaw is sometimes financial reports are extracted from the admin budget and sometimes from the commercial ledgers. The two systems are not compatible and reconciliation of the two systems is cumbersome.

When it comes to financial data capture, the double entry principle is required for commercial ledgers but not for the budget presentation required by the ministry.

Meanwhile some WEs are in line with International Financial Reporting Standards (IFRS).

Table C 2-1 Balance sheet and statement of revenues and expenditures

	NLWE	SLWE	BWE	BMLWE
Balance sheet (Assets & liabilities)	Partial[1]	Yes	No	Yes[2]
Statement of revenues and expenditures	Yes	Yes	Yes[3]	Yes[4]

While only 2 WEs have a balance sheet recording assets and liabilities, other have partial records with assets registry incomplete or statement of revenues not properly recorded. The same applies to stock management and control. For instance, current revenues of a year might also include collected arrears from previous years.

Due to the dual accounting systems, the statement of revenues and expenditures is also unstable and questionable with some WE (BWE) not recording some key expenditures (Energy, taxes, out-sourced activities etc.). The same applies to subsidies which are included or not into the revenues.

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[1] Asset inventory not completed
[2] No free access to the balance sheet was given to the technical assistance
[3] Subject to clarification
[4] Subject to clarification

In addition, it is worth mentioning that the grants of some donors are not, or improperly recorded in the books leading to a distorted vision of the situation. Many inconsistencies were detected with confusion between accrued and cash revenues and confusion between opex and capex. In the same line of thought, payments of previous years are recorded in the current year conducting to inaccurate collection rate. The same applies to irrigation which is sometimes included in the revenues and opex and sometimes excluded.

Each WE has developed its own info system with no standards proposed/imposed by the MoEW. Thus comparisons, benchmarking, exchange of information, reconciliation and production of standard reports are questionable. At this point, it is worth mentioning that there is a tendency to use the Enterprise Resource Planning (ERP) which is an integrated package addressing the billing, collection, the accounting and assets management etc. Such package has been made available through USAID; however, this software has not been fully implemented, and sometimes produces doubtful reports.

Bookkeeping policy and procedures manuals are not available and financial statements are not audited except by the *National Audit Court*, which concentrates on formal administrative issues and not on the core business and financial aspects. In other words, and despite a legal requirement, no chartered accountant is hired for the provision of auditing and ascertaining the accuracy and regularity of the financial statements.

On the organizational side, the customer management or commercial issue is not yet identified as a must and the billing/collecting is falling under the responsibility of the administrative/finance manager or HR department. Such statement does not apply in the specific case of SLWE where a customer's affairs department is officially displayed in the organization chart.

Annual reports are produced by some WEs but no on a standardized form, with long delays in publication. Generally speaking, the annual report is a mix between existing situation, yearly activities and results, and future projects.

As a conclusion, the combination of incomplete and fuzzy commercial records and financial statements not up to standards does not allow to have a crystal-clear vision of the financial situation of the WEs. Such opinion is to be adjusted on a case-by-case basis.

Meanwhile, for the purpose of this exercise, the consultant has used its best endeavour in order to clarify and depict a reasonable financial & commercial situation of the WEs.

As a consequence, all figures, ratios and calculations displayed in the report reflect "our best estimates".

C. 2.2 Methodology used

For the purpose of this exercise, our methodology is based on the collection and display of key data encompassing technical, commercial and financial pieces of information. The objective is to combine these data, produce some relevant ratios for displaying a clear picture of the situation of the WE.

Table C 2-2 Key figures

Key figures	Unit
Nbr. of customers	Nbr.
Of whom water meters	"
Volume produced & entering into the system	m^3/year
Volume billed/subscribed	m^3/year
Est. NRW rate	%
Accrued revenues (including Irrigation)	LBP
Annual collection rate	%
Actual revenues of the year	LBP
Operating cost	"
Operating result (EBITDA)	"
EBITDA in %	%
Operating result while taking the collection rate (EBITDA)	LBP
EBITDA in % while taking the collection rate	%
Cash situation end of the year	LBP
Receivables end of the year	"
Est. Amortization	"
Average selling price/m^3	LBP
Average collected /m^3	"
Operating cost /m^3	"

Subject to availability of the data, all pieces of information are to be collected throughout many fiscal years for trend identification purpose.

Table C 2-3 Fiscal years for each WE

	Fiscal years
BMLWE	2016 - 2020
BWE	2008 - 2020
SLWE	2017 - 2020
NLWE	2017 - 2020

Meanwhile, throughout this exercise, we will highlight the particulars of the WE and stress strengths and weaknesses. Whenever relevant, explanatory graphs are displayed.

On the financial side, we concentrated on profitability, liquidity and solvency of the WE. A particular attention is paid to the EBITDA (Earnings Before Interest, Tax, Depreciation & Amortization) which reflects the profitability of the business together with the capacity to produce sufficient cash-flow. Such concept refers more or less to the French “Marge Brute”.

C. 2.3 Results of the financial review

C. 2.3.1 Opinion on quality, accuracy and consistency of data collected

All information and data collected were exhaustive including the balance sheets. All elements and documents are extracted from the commercial info system and not from the admin budget. From this point of view, the SLWE should be regarded as an example to be followed by other WEs.

C. 2.3.2 Key figures

In the following, we present the key figures we collected from SLWE for the period between the year 2017 and the year 2020.

The key figures as collected from SLWE are as follow:

- Number of customers
- Customers with water meters
- Volume produced
- Volume billed
- Non-Revenue water (NRW)
- Accrued revenues (turn over)
- Annual collection rate
- Actual revenues
- Operating cost
- Operating result
- Cash situation
- Receivables end of the year
- Amortization.

The table below includes, in addition to the above, some calculated figures as the average selling price of m^3, the average collected per m^3, and the operating cost per m^3 .

Table C 2-4 Key figures for SLWE

		2017	2018	2019	2020
		(year ends December 31)			
Subscribers, production, NRW					
Total number of customers		155 888	168 097	177 653	181 418
of whom water meters (but not read)		20 751	21 177	30 709	34 461
Volume produced entering into the system	m^3/year	108 995 570	113 016 410	142 614 041	135 440 327
Volume billed/subscribed	m^3 /year	61 374 385	66 233 995	69 971 595	71 476 855
Estimated NRW rate		43.7%	41.4%	50.9%	47.2%
Revenues; Collection rate; Operating cost					
Accrued revenues	LBP	45 135 018 325	52 182 958 125	52 034 994 644	
Actual revenues	LBP	21 213 458 613	31 831 604 456	25 497 147 376	
Annual collection rate		47%	61%	49%	
Operating cost	LBP	51 924 743 836	55 292 132 461	59 667 256 380	
Operating result, EBITDA					
EBITDA in case 100% collection rate	LBP	-6 789 725 511 (-15%)	-3 109 174 336 (-6%)	-7 632 261 736 (-15%)	
Actual EBITDA considering actual collection rate	LBP	-30 711 285 223 (-145%)	-23 460 528 005 (-74%)	-34 170 109 004 (-134%)	
Cash situation					
Cash situation	LBP	4 938 000 000	13 829 000 000	9 107 000 000	
Account Receivables	LBP	185 356 000 000	192 509 000 000	211 088 000 000	
Estimated Amortization			12 374 159 148	8 014 609 350	
Rates for 1 m^3					
Nominal selling price (based on accrued revenues)	LBP/m^3	735	788	744	
Actual selling price (based on actual collection)	LBP/m^3	346	481	364	
Nominal operating cost (based on volume produced)	LBP/m^3	476	835	853	
Actual operating cost (based on volume billed)	LBP/m^3	846	835	853	

C. 2.3.3 Comments on key figures

- Generally speaking, the SLWE is in a bad financial situation whereas revenues not meeting the O & M cost and the situation is deteriorating year after year as shown hereunder for year 2019.

Table C 2-5 Situation of SLWE

	SLWE year 2019	
	Accrued	**Actual**
Turn over	52,034,994,644	25,497,147,376
Total actual revenues	52,034,994,644	25,497,147,376
Other Operating cost	- 34,205,386,048	- 34,205,386,048
Personnel	- 18,302,403,052	- 18,302,403,052
EBITDA	- 472,794,456	- 27,010,641,724
Amortization	- 8,014,609,350	- 8,014,609,350
Operating result	**- 8,487,403,806**	**- 35, 025,251,074**
Other revenues/expenditures	Not available	
Cost of debt		
Net result	- 8,487,403,806	- 35,025,251,074

- Operating result in 2019 is a loss amounting 16% of the accrued revenues with in both cases an EBITA in the negative territory. In other words, even with a 100% collection rate, the gross margin is negative.
- As a consequence, the WE is suffering of treasury problems and due to a low collection rate (50% In average), the accounts receivables are accumulating. In 2019, Accounts receivables by the end of the year is 4 times the annual turnover and the trend is not favourable. On the long run, such accumulation of bad debts will require a provision for unpaid bill.

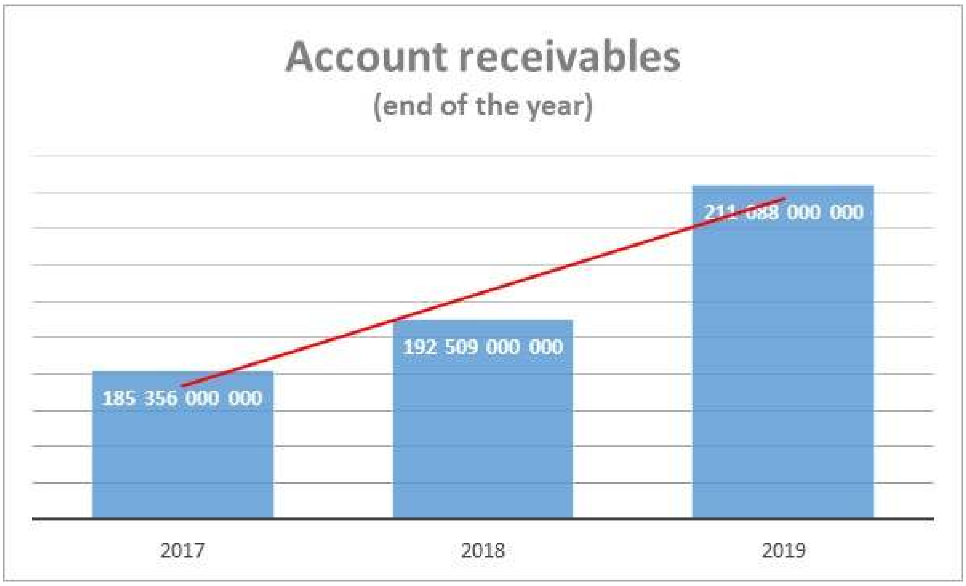

Figure C 2-1 Account receivables in SLWE

- Major cause for such bad situation is the low level of the tariff as shown hereunder with an unchanged tariff while O & M are increasing.

Figure C 2-2 SLWE price & cost for 1 m³

- We are in a situation where O & M cost is higher than the official tariff level and the situation is worst while considering the 50% collection rate. In other words, even with a 100% collection rate, the WE is experiencing losses. Such situation is not sustainable and must be addressed urgently.
- Surprisingly, 19% of customers are presently registered in the database as having water meters, but the number of customer meters installed is lower and not compatible with the records. In addition, the reading is not effective and customers are charged on a flat rate basis.

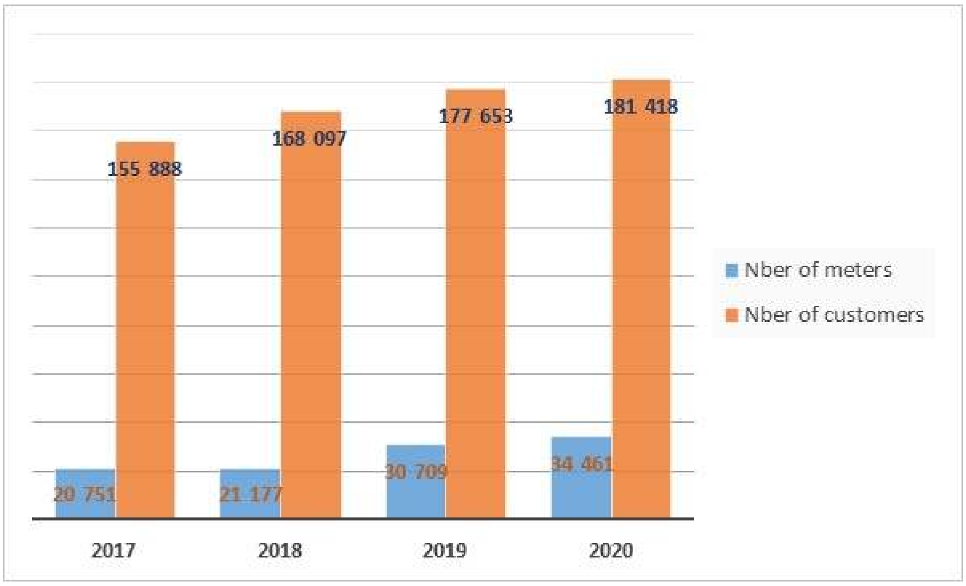

Figure C 2-3 SLWE number of meters and customers

C. 3 COST RECOVERY

C. 3.1 Definition

Cost recovery is the ratio of expenses over cash flow.

Expenses include all operational expenditures (Opex), asset depreciation expenditures, and new investments (Capex). However, under this study, depreciation expenditures and Capex are not considered because :

- No data is available about the asset value of any of the four WE. This is one of the issues to be addressed in the future.
- Due to the present financial situation, the WEs are pretty much far from achieving Opex recovery. Their major challenge is to be able (and get the means) to implement required measures to gradually improve cost recovery, in order to achieve balance in the coming five or six years.

Therefore, in this study by *Cost Recovery* it is meant *Opex Cost recovery*.

C. 3.2 Cost recovery and the impact of the financial crisis

Table C 3-1 below shows the cost recovery ratios based on the financial situation that was prevailing in 2019, when the exchange rate USD/LBP was stable, and based on the water tariff in force then.

It can be seen that SLWE was achieving 45% Opex recovery. Opex balance would have been achieved if the Collection and the Revenue Water rates were brought up to 80%.

Table C 3-1 Opex recovery analysis (2019 financial situation)

Operational Revenues : 49 918 M LBP	Cash Flow : 26 956 M LBP	Total OPEX : 59 866 M LBP

Financial Indicators (Base value)

Exchange Rate :	1 500	LBP/USD
Fuel :	850	LBP/l
Gazoline :	25 000	LBP/20 l
Transportation :	8 000	LBP/day
EDL/Gen. % :	96%	EDL
EDL increase factor :	1.00	
CPI :	115	
Salaries increase factor :	1.00	
Including new WWTPs :	No	
Tariff increase factor :	1.00	
(Avg. bill amount : 305 000 LBP)		

Collection rate assessment

Invoiced :	49 918 M LBP
Collected :	26 956 M LBP
Collection Rate	54%
Cost recovery	45%

Revenue Water assessment

Volume Produced	143 000 K m³	
Volume Billed	70 000 K m³	
Technical losses	5%	(ILI = 8)
Revenue Water	52%	
Potential invoicing	96 665 M LBP	

OPEX Breakdown

HR	25 152 M LBP
Power	29 110 M LBP
EDL	27 474 M LBP
Generators	1 636 M LBP
Donations	0 M LBP
Consumables	531 M LBP
Paid by WE	431 M LBP
Donations	100 M LBP
O&M	4 387 M LBP
Paid by WE	3 935 M LBP
Donations	336 M LBP
Administrative	686 M LBP

TOTAL OPEX RECOVERY RATE
Amount to recover : 59 866 M LBP

Revenue Water	COLLECTION RATE															
	54%	**57%**	**60%**	**63%**	**66%**	**69%**	**72%**	**75%**	**79%**	**82%**	**85%**	**88%**	**91%**	**94%**	**97%**	**100%**
52%	45%	48%	50%	53%	55%	58%	60%	63%	65%	68%	71%	73%	76%	78%	81%	83%
55%	48%	51%	53%	56%	59%	62%	64%	67%	70%	73%	75%	78%	81%	84%	**86%**	**89%**
59%	51%	54%	57%	60%	63%	66%	68%	71%	74%	77%	80%	83%	**86%**	**89%**	**92%**	**95%**
62%	54%	57%	60%	63%	66%	69%	72%	76%	79%	82%	**85%**	**88%**	**91%**	**94%**	**97%**	**100%**
65%	57%	60%	64%	67%	70%	73%	77%	80%	83%	**86%**	**89%**	**93%**	**96%**	**99%**	**102%**	**106%**
69%	60%	63%	67%	70%	74%	77%	81%	84%	**87%**	**91%**	**94%**	**98%**	**101%**	**104%**	**108%**	**111%**
72%	63%	67%	70%	74%	77%	81%	**85%**	**88%**	**92%**	**95%**	**99%**	**103%**	**106%**	**110%**	**113%**	**117%**
76%	66%	70%	74%	77%	81%	**85%**	**89%**	**92%**	**96%**	**100%**	**104%**	**107%**	**111%**	**115%**	**119%**	**122%**
79%	69%	73%	77%	81%	**85%**	**89%**	**93%**	**97%**	**101%**	**104%**	**108%**	**112%**	**116%**	**120%**	**124%**	**128%**
83%	72%	76%	80%	84%	**89%**	**93%**	**97%**	**101%**	**105%**	**109%**	**113%**	**117%**	**121%**	**125%**	**129%**	**134%**
86%	75%	79%	84%	**88%**	**92%**	**96%**	**101%**	**105%**	**109%**	**114%**	**118%**	**122%**	**126%**	**131%**	**135%**	**139%**
90%	78%	83%	**87%**	**91%**	**96%**	**100%**	**105%**	**109%**	**114%**	**118%**	**123%**	**127%**	**131%**	**136%**	**140%**	**145%**
93%	81%	**86%**	**90%**	95%	**100%**	**104%**	**109%**	**113%**	**118%**	**123%**	**127%**	**132%**	**136%**	**141%**	**146%**	**150%**
97%	84%	**89%**	**94%**	**99%**	**103%**	**108%**	**113%**	**118%**	**122%**	**127%**	**132%**	**137%**	**142%**	**146%**	**151%**	**156%**
100%	**87%**	**92%**	**97%**	**102%**	**107%**	**112%**	**117%**	**122%**	**127%**	**132%**	**137%**	**142%**	**147%**	**152%**	**157%**	**161%**

However, everything has changed since. The financial crisis had major impact on Opex while revenues are still the same as no tariff adjustment is made to date.

Table C 3-2 below shows the cost recovery analysis based on the financial indicators of 2022.

The EDL tariff of 2019 is multiplied by 13 in 2022. This figure is calculated based on the following assumptions :

- EDL tariff in 2019 : 170 LBP/kWh. this is the average rate charged by EDL for the WEs, including subscriptions and else, but not including VAT.
- EDL tariff for the first six months of 2022 will remain unchanged (same as 2019)
- EDL tariff for the second half of2022 will be raised to 0.21USD (according to a verbal communication from MoEW)
- Exchange rate + 20 000 LBP/USD as per *Manassa*h platform.

Table C 3-2 Opex recovery analysis (2022 financial situation)

Operational Revenues : 49 918 M LBP	Cash Flow : 26 956 M LBP	Total OPEX : 545 732 M LBP

Financial Indicators (Typical 2022)

Exchange Rate (base = 1 500) :	20 000	LBP/USD
Fuel (base = 850) :	19 700	LBP/l
Gazoline (base = 25 000) :	375 000	LBP/20 l
Transportation (base = 8 000) :	64 000	LBP/day
EDL/Gen. % (base = 96%) :	96%	EDL
EDL increase factor :	13.00	
CPI (base = 115) :	700	
Salaries increase factor :	2.00	
Including new WWTPs :	Yes	
Tariff increase factor :	1.00	
(Avg. bill amount : 305 000 LBP)		

Collection rate assessment

Invoiced :	49 918 M LBP
Collected :	26 956 M LBP
Collection Rate	54%
Cost recovery	5%

Subscriptions rate assessment

Volume Produced	143 000 K m³	
Volume Billed	70 000 K m³	
Technical losses	5%	(ILI = 8)
Revenue Water	52%	
Potential invoicing	96 665 M LBP	

OPEX Breakdown

HR	63 640 M LBP
Power	417 565 M LBP
EDL	359 780 M LBP
Generators	57 786 M LBP
Donations	0 M LBP
Consumables	10 243 M LBP
Paid by WE	10 143 M LBP
Donations	100 M LBP
O&M	50 108 M LBP
Paid by WE	46 359 M LBP
Donations	2 787 M LBP
Administrative	4 176 M LBP

TOTAL OPEX RECOVERY RATE

Amount to recover : 545 732 M LBP

REVENUE WATER	COLLECTION RATE															
	54%	**57%**	**60%**	**63%**	**66%**	**69%**	**72%**	**75%**	**79%**	**82%**	**85%**	**88%**	**91%**	**94%**	**97%**	**100%**
52%	5%	5%	6%	6%	6%	6%	7%	7%	7%	7%	8%	8%	8%	9%	9%	9%
55%	5%	6%	6%	6%	6%	7%	7%	7%	8%	8%	8%	9%	9%	9%	9%	10%
59%	6%	6%	6%	7%	7%	7%	8%	8%	8%	8%	9%	9%	9%	10%	10%	10%
62%	6%	6%	7%	7%	7%	8%	8%	8%	9%	9%	9%	10%	10%	10%	11%	11%
65%	6%	7%	7%	7%	8%	8%	8%	9%	9%	9%	10%	10%	11%	11%	11%	12%
69%	7%	7%	7%	8%	8%	8%	9%	9%	10%	10%	10%	11%	11%	11%	12%	12%
72%	7%	7%	8%	8%	8%	9%	9%	10%	10%	10%	11%	11%	12%	12%	12%	13%
76%	7%	8%	8%	8%	9%	9%	10%	10%	11%	11%	11%	12%	12%	13%	13%	13%
79%	8%	8%	8%	9%	9%	10%	10%	11%	11%	11%	12%	12%	13%	13%	14%	14%
83%	8%	8%	9%	9%	10%	10%	11%	11%	12%	12%	12%	13%	13%	14%	14%	15%
86%	8%	9%	9%	10%	10%	11%	11%	12%	12%	12%	13%	13%	14%	14%	15%	15%
90%	9%	9%	10%	10%	11%	11%	11%	12%	12%	13%	13%	14%	14%	15%	15%	16%
93%	9%	9%	10%	10%	11%	11%	12%	12%	13%	13%	14%	14%	15%	15%	16%	16%
97%	9%	10%	10%	11%	11%	12%	12%	13%	13%	14%	14%	15%	16%	16%	17%	17%
100%	10%	10%	11%	11%	12%	12%	13%	13%	14%	14%	15%	16%	16%	17%	17%	18%

The financial situation of SLWE – yet not comfortable in 2019 – is now critical.

It is mandatory to adopt a realistic tariffs policy, together with the necessary efforts to improve the Revenue Water and Collection rates. Table C 3-3 below shows the required tariff for Opex recovery, for various scenarios.

Table C 3-3 Required tariff revision

IMPACT OF TARIFF INCREASE ON COST RECOVERY RATE

Assuming unchanged Collection and Subscriptions rates

Cost recovery rate	3%	10%	18%	25%	33%	40%	48%	55%	63%	70%	78%	85%	93%	**100%**
Tariff increase factor	1	3.74	6.49	9.23	11.98	14.72	17.46	20.21	22.95	25.70	28.44	31.18	33.93	**36.67**

Required bill amount for 100% Cost recovery : 10 670 000 LBP

Assuming 100% Collection; Subscriptions unchanged

Cost recovery rate	5%	12%	20%	27%	34%	42%	49%	56%	63%	71%	78%	85%	93%	**100%**
Tariff increase factor	1	2.45	3.89	5.34	6.79	8.23	9.68	11.12	12.57	14.02	15.46	16.91	18.36	**19.80**

Required bill amount for 100% Cost recovery : 5 760 000 LBP

Assuming 100% Collection and Subscriptions

Cost recovery rate	10%	17%	24%	31%	38%	44%	51%	58%	65%	72%	79%	86%	93%	**100%**
Tariff increase factor	1	1.71	2.42	3.13	3.84	4.55	5.26	5.97	6.68	7.39	8.10	8.81	9.52	**10.23**

Required bill amount for 100% Cost recovery : 2 980 000 LBP

C. 3.3 Action for Opex recovery

Due to the present social and financial situation, it is a fact that the WEs cannot achieve much in regard to improving the Collection and Revenue Water rates.

Figure C 3-1 below gives a possible (and plausible) progress that SLWE can undertake regarding Collection and Revenue water improvement, in addition to tariff increase, in order to achieve Opex balance within the coming 5 years.

The proposed figures for progressive improvement in Collection and Revenue Water are set after discussion with the financial and technical departments of the WE. These, in their opinion, are realistic figures to be achieved.

Tariff increase requires political consensus in order for the WE to be allowed to gradually increase the tariff to the adequate level.

		Simulated, based on Dec. 2021 financial data (see table below)					
	2019	2021	2022	2023	2024	2025	2026
Collection rate	54%	40.00%	45% (+5%)	51% (+6%)	59% (+8%)	67% (+8%)	75% (+8%)
Subscriptions rate	52%	52%	56% (+4%)	60% (+4%)	64% (+4%)	68% (+4%)	72% (+4%)
Tariff increase factor	1.00	1.00	5.00 (+400%)	6.00 (+20%)	7.20 (+20%)	8.64 (+20%)	10.37 (+20%)
Bill amount (for 1 m³/day, gauged)	**308 000 LBP**	**291 000 LBP**	**1 455 000 LBP**	**1 746 000 LBP**	**2 095 200 LBP**	**2 514 240 LBP**	**3 017 088 LBP**
2019 Revenue increase factor	1.00	1.00	6.06	8.84	13.09	18.96	26.97
Cost Recovery	45%	3.66%	22%	32%	48%	69%	99%
Cash flow/Opex Balance	**-32 910 M LBP** (-21.9 M$)	**-525 765 M LBP** (-26.3 M$)	**-424 716 M LBP** (-21.2 M$)	**-369 319 M LBP** (-18.5 M$)	**-284 404 M LBP** (-14.2 M$)	**-167 234 M LBP** (-8.4 M$)	**-7 235 M LBP** (-0.4 M$)
Cash flow/Opex Balance in case unchanged collection and subscription rates	**-32 910 M LBP** (-21.9 M$)	**-525 765 M LBP** (-26.3 M$)	**-445 896 M LBP** (-22.3 M$)	**-425 929 M LBP** (-21.3 M$)	**-401 968 M LBP** (-20.1 M$)	**-373 215 M LBP** (-18.7 M$)	**-338 712 M LBP** (-16.9 M$)

	Financial data	
	2019	2022
Exchange Rate :	1 500 LBP/USD	20 000 LBP/USD
Diesel cost	850 LBP/litre	19 700 LBP/litre
gazoline cost	25 000 LBP/20 litre	375 000 LBP/20 litre
Transportation :	8 000 LBP/day	64 000 LBP/day
Energy produced from EDL	96% EDL	96% EDL
EDL increase factor :	--	13.0 x 2019 rate
CPI	115	700
Salaries increase factor :	--	2.0 x 2019 rate
OPEX		**545 732 M LBP**

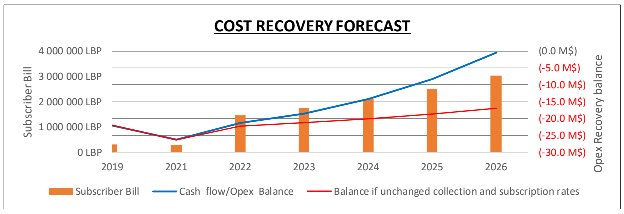

Figure C 3-1 Plausible gradual improvement in order to achieve Opex balance

C. 4 MAJOR RECOMMENDATIONS

In 2021 in the context of hyperinflation, the picture has deteriorated with revenues declining and O&M costs up rising.

Financially there is a risk that the public utility to be squeezed and quality of the service deteriorating.

The recovery of the WEs is at stake with, first of all, an adjustment to the tariff level and this is to be addressed urgently.

As a result of the financial performance diagnosis, the WE shall take into consideration the following recommendations :

C. 4.1.1 Short term

There is an urgent need to adjust the water tariff level in 2022 to ensure that the WE remain operational in 2022. It is likely that due to the high rate of inflation in 2021, and the exchange rate on equipment and spare parts, operating costs will increase to a level the WEs cannot afford.

- Tariff level adjustment should target the operating cost while accounting for collection rate and NRW.
- Such tariff adjustment should also include an automatic adjustment formula that would not require a formal authorization/clearance from the Ministry for being applied. Such formula should take into account (among others) the cost of energy, the cost of chemicals and other consumables.
- An urgent review for the provision of increase of the tariff level for matching the O & M cost. Such review is to be made through a quick review of the 2021 financial statements. Such action can be made either through the TA or appoint a specific consultant for that particular purpose. The key issue being; the process has to be quick and accepted by the Ministry and WEs.
- Introduce a task force within the WE for addressing the key issue of declining collection rates for corrective action starting with information campaigns and ending with disconnections threats.
- Prepare a plan for recovery of outstanding debts. Such issue is to be addressed through an internal task force with possibility to compromise and reduce the debt against a down final payment. Such action’s objective is to provide cash to the WE. This will require to produce an historical listing of all debtors and sort them by category and prepare an action plan for that particular purpose. Such difficult action can be made with internal resources of the WE or it can be outsourced.
- Conduct a study to assess the weak collection efficiency and the inadequate customer records with focus on the reliance on contractual collectors (contract terms, remuneration, number of collectors and performance targets)

- Carry out studies for the assessment of the existing billing and payment processing system and the possibility of the introduction of improved billing technologies, with the view of future integration within a central digitalization system.
- Strengthen the geographic information system mapping to cover the subscribers' data and the records of properties showing all potential water customers.
- Undertake an economic analysis of production and cost taking into consideration the short-run and long-run to allow for a comprehensive pricing strategy that would allow to gradually recover the operational costs and eventually any future capacity expansion.
- Establish a tariff setting scheme and tariff reforms with mechanisms for obtaining the information on present and future costs of operation and mechanisms of indexation to adjust tariffs by inflation, energy prices and other items that are part of the cost schedule of SLWE.

C. 4.1.2 Mid/long term

- Prepare a standardized format for the annual report for the WE. The design and template should be made available through the TA and a consulting firm is to assist for implementation.
- Review and streamline all financial & bookkeeping procedures and standard chart of accounts through the WE with a long-term view to have the utilities audited by a first rank auditing firm.
- Reinforce in the WE the concept of NRW monitoring together with generalization of production/district metering.

SECTION D
DATA COLLECTED

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D.1 BASIS OF PERFORMANCE DIAGNOSIS

The goal of this assessment is beyond performance evaluation or data collection as it also includes the simulation of a supervisory or regulatory audit and answer the following questions:

- How easily can an audit take place?
- What data is available and what data is not and therefore requires capacity building for improving?
- Which systems are producing good data and which systems need improvement?
- Can the WEs be benchmarked against each other and against international standards?
- Can the sub-regional department within the WE be used as bases of comparison?

Therefore, the process takes the shape of data collection but also investigates:

- Data sources available and systems producing data.
- Reliability and completion of said data.
- Accuracy in producing good targets and performance indicators for the supervisor or regulator.

The range period targeted was mainly the past five years from 2016-2020. However, when possible, data ranges from 2015 were taken. Often the only available information was the current 2021 which sometimes can be used as an estimate for 2020.

Although rarely, some information was available or could be calculated as an annual trend. This trend containing the years 2020 and/or 2021, and given that these years witnessed health and currency crises affecting revenues, power availability, data quality, and even human resources, these years would provide useful information but not one that can represent the past or future of the water establishments.

In the subsequent sub-sections are detailed some common methods used for data collection in different areas.

D.1.1 HUMAN RESOURCES

Human resources and personnel data is vital for evaluating the current performance and planning improvements. However, the WE under examination, the current staffing arrangements do not reflect a normal mode of operation. The WE hasn’t been able to freely hire or fire personnel and make up for this deficiency by promoting the responsibilities of current staff to fill the gap in authority to approve and conduct transactions, while procuring on-demand services to cover the shortage in manpower. Therefore, the analysis would benefit from both evaluating the current personnel situation as well as the situation that was envisioned in the WE by-laws.

The basis for data collection was the IWA water utility performance indicators and the needed variables. To prepare for the analysis in the field of human resources, we set out by seeking at the following data variables as needed for the IWA performance indicators for water supply services as follows:

Table D 1-1 IWA recommended variables related to personnel

Code	Variable	Unit
B1	Total personnel	No.
B2	General management personnel	No.
B3	Human resource management personnel	No.
B4	Financial and commercial personnel	No.
B5	Customer service personnel	No.
B6	Technical service personnel	No.
B7	Planning and construction personnel	No.
B8	Operations and maintenance personnel	No.
B9	Water resources and catchment management personnel	No.
B10	Abstraction and treatment personnel	No.
B11	Transmission, storage and distribution personnel	No.
B12	Water quality monitoring personnel	No.
B13	Meter management personnel	No.
B15	University degree personnel	No.
B16	Basic education personnel	No.
B17	Other qualification personnel	No.
B18	Total training time	Hours
B19	Internal training time	Hours
B20	External training time	Hours
B21	Working accidents	No.
B22	Absenteeism	Days
B23	Absenteeism due to accidents or illness at work	Days
B24	Absenteeism due to other reasons	Days
B25	Working time	Hours
B26	Overtime work	Hours

However, due to the specific situation of the Lebanese WEs, the adjusted table, more in line with the local context, was produced (see Table D 0-2 below).

Since the current personnel situation in the WE is abnormal due to restrictions on hiring, many of the employees are being assigned different jobs than those they were hired for. Reliance on personnel contracts, the by-laws detailing the staff for the WE provide most information that can be assessed to answer the question of: Is the official organizational diagram in accordance to the needs of service and performance?

Table D 1-2 Revised variables related to personnel

Variable	Unit
Total personnel	No.
By business	
Customer services	No.
Distribution	No.
Engineering	No.
Facilities	No.
Finance	No.
General	No.
HR	No.
Water quality	No.
By job type	
Auxiliary - Clerical	No.
Auxiliary - Driver	No.
Auxiliary - Office boy	No.
Auxiliary - Guard	No.
Collector / Reader	No.
Customer Service	No.
Financial / Administrative	No.
Management	No.
Management (Eng.)	No.
Technical - Driver	No.
Technical - Engineer	No.
Technical - Labourer	No.
Technical - Other	No.
Technical - Water Quality	No.

D.1.2 TECHNICAL DATA

Technical data needed relates to water system assets as well as operational variable related to water loss, energy use, and water quality. The basis for data collection was again the IWA water utility performance indicators and the needed variables. However, changes were made to accommodate the lack of data as well as the particulars of the situation in Lebanon. We set out to collect variables from several categories.

D.1.2.1 Water resources

One category of interest is water resources, which lists variable recommended by IWA (see Table D 0-3 below)

Also related is the group of physical asset variables related to water systems (see Table D 0-4 below)

Table D 1-3 IWA recommended variables related to water resources.

Code	Variable	Unit
A01	Annual yield capacity of own resources	m^3
A02	Maximum allowance of raw and treated water importation	m^3
A03	System input volume	m^3
A04	Maximum water treated daily	m^3/day
A05	Exported raw water	m^3
A06	Water produced	m^3
A07	Exported treated water	m^3
A08	Billed metered consumption	m^3
A09	Billed unmetered consumption	m^3
A10	Billed authorised consumption	m^3
A11	Unbilled metered consumption	m^3
A12	Unbilled unmetered consumption	m^3
A13	Unbilled authorised consumption	m^3
A14	Authorised consumption	m^3
A15	Water losses	m^3
A16	Unauthorised consumption	m^3
A17	Metering inaccuracies water losses	m^3
A18	Apparent losses	m^3
A19	Real losses	m^3
A20	Revenue water	m^3
A21	Non-Revenue water	m^3
A22	Reuse supplied water	m^3

Table D 1-4 IWA recommended variables related to physical water assets.

Code	Variable	Unit
C01	Raw water storage capacity	m^3
C02	Treated water storage capacity	m^3
C03	Daily treatment capacity	m^3
C04	Pumps	No.
C05	Pumping stations	No.
C06	Pumping stations capacity	kW
C08	Mains length	km
C09	Distribution main length	km
C10	System flow meters	No.
C11	District meters	No.
C12	Pressure meters	No.
C13	Water level meters	No.
C14	On-line water quality monitoring instruments	No.
C15	Control units	No.
C16	Automated control units	No.
C17	Remotely controlled units	No.
C18	Emergency power systems	No.
C19	Signal transmission equipment	kW
C20	Electrical switchgear	No.
C21	Main valves	No.
C22	Isolating valves	No.
C23	Hydrants	No.
C24	Service connections	No.
C25	Average service connection length	m

For the situation at hand, the proposed variables highly match the needs of technical assessment, yet additional details were needed for these categories which is due to its importance for the assessment and the Lebanese WEs and not from any assumptions about the availability of such details.

Table D 1-5 Additional variables related to water resources & water resource assets.

Variable	Unit
Number of water supply systems	No.
Wells	No.
Springs	No.
Dams	No.
Treatment plants	No.
Wells daily production capacity	m^3
Springs daily production capacity	m^3
Dams daily production capacity	m^3

D.1.2.2 Operation

For the operations side, already partially covered, Table D 0-6 shows the IWA recommended variables related to energy. Yet a simpler and more relevant set of variables was adopted (Table D 0-7

Table D 1-6 IWA recommended variables related to energy

Code	Variable	Unit
D01	Pumping energy consumption	kWh
D02	Maximum daily pumping energy consumption	kWh
D03	Standardisation factor	m^3x100m
D04	Reactive energy consumption	kVar
D05	Energy recovery	Wh

Table D 1-7 Proposed variables related to energy use

Performance Indicator	Unit
Pumping energy consumption	kWh
Energy consumed from grid	kWh
Energy generated from fuel	kWh
Renewable energy generation	kWh
Energy recovery	kWh

In terms of inspection and maintenance, Table D 0-8 shows the IWA recommended set of variables; while Table D 0-9 shows the and more relevant set adopted.

Table D 1-8 IWA recommended variables related to Inspection & Maintenance

Code	Variable	Unit
D06	Pumping inspection (power of inspected pumps)	kWh
D07	Storage tank cleaning (volume of cleaned tanks)	m^3
D08	Network inspection	km
D09	Leakage control (Length of network in DMAs)	km
D10	Leaks repairs due to active leakage control	No.
D11	Hydrant inspection	No.
D12	System flow meter calibration	No.
D13	Pressure meter calibration	No.
D14	Water level meter calibration	No.
D15	On-line water quality monitoring equipment calibrations	No.
D16	Emergency power systems inspection	kW
D17	Signal transmission equipment inspection	No.
D18	Electrical switchgear inspection	No.
D19	Permanent vehicles	No.
D20	Mains rehabilitation	km
D21	Mains renovation	km
D22	Mains replacement	km
D23	Replaced valves	No.
D24	Service connection rehabilitation	No.
D25	Pumps overhaul (power of overhauled pumps)	kW
D26	Pump replacement	kW
D27	Pump failures	days
D28	Mains failures	No.
D29	Service connection failures	No.
D30	Hydrant failures	No.
D31	Power failures	hour
D32	Water-point failures	No.

Table D 1-9 Proposed variables for inspection and maintenance

Variable	Unit
Pump inspection	No.
System valve inspection	No.
Control valve inspection	No.
Reservoir cleaning	m^3
Network inspection	km
Service connection inspection	No.
Instrument and inspection and calibration	No.
Replaced valves	No.
Mains rehabilitation and replacement	km
Service connection rehabilitation and replacement	No.
System valve rehabilitation and replacement	No.
Control valve rehabilitation and replacement	No.
Pump rehabilitation and replacement	No.
System flowmeter rehabilitation and replacement	No.
Customer flowmeter rehabilitation and replacement	No.
Leaks repaired	No.

D.1.2.3 Water Quality

The IWA recommended variables related to water quality are highly reverent for this assessment and future performance evaluation. One missing issue is the required number of samples; but this may be set on due time, based on the number of water quality personnel.

Table D 1-10 IWA recommended variables related to water quality

Code	Variable	Unit
D46	Required treated water quality tests carried out	No.
D47	Required aesthetic tests carried out	No.
D48	Required microbiological tests carried out	No.
D49	Required physical-chemical tests carried out	No.
D50	Required radioactivity tests carried out	No.
D51	Treated water quality tests carried out	No.
D52	Water quality tests carried out	No.
D53	Aesthetic tests carried out	No.
D54	Microbiological tests carried out	No.
D55	Physical-chemical tests carried out	No.
D56	Radioactivity tests carried out	No.
D57	Water quality tests required	No.
D58	Aesthetic tests required	No.
D59	Microbiological tests required	No.
D60	Physical-chemical tests required	No.
D61	Radioactivity tests required	No.
D62	Compliance of aesthetic tests	No.
D63	Compliance of microbiological tests	No.
D64	Compliance of physical-chemical tests	No.
D65	Compliance of radioactivity tests	No.

In general, and given the centrality of technical data for the water establishments, estimates were made where possible and useful, and will be indicated as such. For the case of the water balance inputs, a water balance exercise is needed beyond simple calculations to establish reasonable estimates based on different approaches during the analysis.

D.1.3 CUSTOMER SERVICE DATA

Quality of service data covers service continuity, coverage, complaints, speed of service and the like. The quality of service is expected to be the main motivation and mission of the WEs and more generally the public sector as a whole.

The basis for data collection is the IWA water utility performance indicators and the needed variables. However, changes were made to accommodate the lack of data as well as the local specificities. We set out to collect variables from two categories: quality of service and demography.

Table D 1-11 IWA recommended variables related to quality of service

Code	Variable	Unit
F1	Population supplied	person
F2	Population supplied with service pipes	person
F3	Population served by public taps or standpipes	person
F4	Distance from water points to households	m
F5	Public taps and standpipes consumption	m^3
F6	Water points	No.
F7	Operational water-points	No.
F8	Public taps and standpipes	No.
F9	New connections establishment time	day
F10	New connections established	No.
F11	Customer meter installation time	day
F12	New customer meters installed	No.
F13	Connection repair time	day
F14	Connections repaired	No.
F15	Service complaints	No.
F16	Pressure complaints	No.
F17	Continuity complaints	No.
F18	Water quality complaints	No.
F19	Complaints on interruptions	No.
F20	Billing complaints and queries	No.
F21	Other complaints and queries	No.
F22	Written responses	No.

Table D 1-12 IWA recommended variables related to demography

Code	Variable	Unit
E1	Households and business supplied	No.
E2	Buildings supplied	No.
E3	Households and businesses	No.
E4	Buildings	No.
E5	Resident population	person
E6	Direct customer meters	No.
E7	Residential customer meters	No.
E8	Industrial customer meters	No.
E9	Bulk customer meters	No.
E10	Registered customers	customer
E11	Residential registered customers	customer

Also, some operational variables related to customers were recommended yet may not be applicable to the general situation in Lebanon as currently water metering is low.

Table D 1-13 IWA recommended variables related to operation of customer meters

Code	Variable	Unit
D39	Residential customer meter reading frequency	No. / meter
D40	Non-Residential customer meter reading frequency	No. / meter
D41	Bulk customer meter reading frequency	No. / meter
D42	Customer meter readings	No.
D43	Residential customer meter readings	No.
D44	Operational meters	No.
D45	Meter replacement	No.

However, to be better aligned with the objectives of this assessment and the local situation, the following table was selected to represent different aspects of service and the service area.

Table D 1-14 Revised variables related to service

Variable	Unit
Households and businesses (Units)	No.
Resident population	person
Units supplied legally by WE	No.
Units supplied by other entities	No.
Units supplied by illegal connections	No.
Population receiving continuous supply	No.
Time system is pressurised	No.
Average operating pressure	No.
Compliant response time	No.
New connections establishment time	No.
New connections establishment time	No.
Customer meter installation time	No.
Connection repair time	No.
Complaint response time	No.
Billing complaints and queries	No.
Service complaints	No.
Pressure complaints	No.
Continuity and interruption complaints	No.
Water quality complaints	No.
Metered customers	No.

The data collection will rely heavily on systems such as the billing system, client management system, which have been invested in heavily by donors and NGOs

D.1.4 ORGANISATIONAL UNIT RESPONSIBILITY FULFILMENT QUESTIONNAIRE

To assess and compare the outlined work responsibilities for the WE as per their organisational by-laws, a questionnaire was made in Arabic, tailored to the WE situation (See below a sample), that asks each unit if they implement the assigned tasks; and if not or not fully, then explain the perceived reasons.

No.	المسؤوليات	تحت التطبيق؟	الأسباب والنواقص
	مصلحة الموارد البشرية والمشتركين		
	دائرة الموارد البشرية		
	قسم شؤون المستخدمين والتدريب		
1	.درس حاجات المؤسسة من الموارد البشرية.		
2	.اقتراح شروط الاستخدام وسلسلة الرتب والرواتب وملاك المؤسسة, وتعديلاتها بالتنسيق مع سائر وحدات المؤسسة.		
3	.تنظيم المباريات والامتحانات واجرائها.		
4	.تحضير ملفات الاستخدام والترفيع وكل المعاملات العائدة لها.		
5	.تنظيم الملفات الشخصية وتبويبها.		
6	.مسك الاحصاءات العائدة للعاملين في المؤسسة وتحضير معاملات النقل والمكافآت والتأديب وانتهاء الخدمة وسائر المعاملات المتعلقة بشؤونهم الذاتية.		
7	.درس أوضاع المستخدمين وشؤونهم واحتياجاتهم من التدريب المتخصص بما فيها تلك المتعلقة بالحوافز التشجيعية.		
8	.استلام الاجازات الإدارية والمرضية العائدة لكافة المراكز واجراء الاحصاءات المرضية وتسجيلها وحفظها ومتابعتها.		
9	.تحضير جداول اسمية بدوام العاملين وايداعها المديرية العامة.		
10	.وضع جداول بالحضور الفعلي للعاملين وايداعها قسم الرواتب والأجور.		
11	.اصدار نشرات دورية تتضمن المعلومات الفنية والقواعد المتبعة في مراكز المؤسسة وتعميمها عليها.		
12	.إدارة مراكز التدريب والاشراف عليها.		
13	.تنظيم دورات على استعمال أجهزة الوقاية بالتنسيق مع مصلحتي المحطات والمشاريع والتوزيع والصيانة والاستثمار والسهر على صلاحية هذه الأجهزة وفعاليتها.		
14	.اعداد المستخدمين الجدد على ممارسة مهام وظائفهم في ضوء أهداف المؤسسة وطبيعة أعمالها بما في ذلك التدريب على تقديم الاسعافات الأولية.		
15	.تصميم برامج تدريبية متخصصة وإقامة دورات تدريبية دورية للعاملين في المؤسسة بالتنسيق مع كافة الوحدات.		
16	.تأمين معاملات التدريب في الخارج مع مراجع المختصة.		
17	.إدارة وتنظيم مكتبة مركزية لكافة المراجع تتضمن الكتب والمجلات والمطبوعات والمنشورات والأنظمة والبرامج المعلوماتية بالتنسيق مع كافة وحدات المؤسسة.		
18	.متابعة مصادر المعلومات المتعلقة بمهام المؤسسة واقتراح ما هو ملائم ومفيد.		

Figure D 1-1 An example of the organizational job responsibility questionnaire

Since the results of this questionnaire cannot be parametrized, it will serve as information gathering for later stages of the project and for truth-testing proposed improvements and interventions.

D.1.5 ACCOUNTING SYSTEM AND FINANCIAL DATA COLLECTION

D.1.5.1 Major sources of data for financial analysis: The Trial balance

Many financial, budget, accounting data have been collected from the WE, but it was decided to present the data collected from the *General Ledger* point of view, because these sources are the most detailed source of data for the WE.

All Opex and Revenues of the WE presented in this section were collected from the General Ledger, which represents the record-keeping system for the WE transaction data, with debit and credit account records validated by a trial balance.

A trial balance is a report that lists the balances of all General Ledger accounts of a company at a certain point in time. The accounts reflected on a trial balance are related to all major accounting items, including assets, liabilities, equity, revenues, expenses, gains, and losses. It is primarily used to identify the balance of debits and credits entries from the transactions recorded in the General Ledger at a certain point in time.

The trial balance serves to detect any mathematical errors that occurred in the double-entry accounting system.

The trial balance collected, when fully filled, provide a record of each transaction that took place during the life of the WE. It holds account information that is needed to prepare the financial statements. The WE was asked to provide the last 6 years of data, from 2015 to 2020, in order to make a significant analysis and evaluate the sustainability of the WE based on several historical data.

Transaction data are disaggregated, by type, into accounts for assets, liabilities, owners' equity, revenues, and expenses as listed in the table below

Table D 1-15 Data accounts as per GAAP

1 Assets
11000 Cash
13100 Accounts Receivable
14000 Inventory
14600 Goods Issued Not invoiced
17200 Buildings
17800 Accumulated Depreciation
19000 Deferred Tax assets
2 Liabilities
21000 Accounts Payable
22300 Deferred revenue
23000 Goods Received not purchased
26200 Deferred tax liabilities
3 Equity
31000 Common Stock
4 Revenue
41000 Goods
42000 Services
5 Expenses
51100 Cost of Goods Sold
52500 Other operating expenses
53000 Price difference

It seems that this accounting system were developed some years ago with the USAID, but nobody has been able to confirm it.

The WE is expected to provide the following three major financial statements, as required under GAAP:

- The income statement
  It recaps the revenue earned by a company during the reporting period, along with any corresponding expenses; this includes revenue from operating and non-operating activities, allowing auditors, market analysts, investors, lenders, regulators, and any other stakeholders, to evaluate the company's financial cycle and results. It is sometimes referred to as the Profit and Loss (P&L) statement.

- The Balance Sheet
  It summarizes assets and sets them equal to liabilities and shareholder's equity. The balance sheet is an open snapshot of a company's assets and liabilities at a specific point in time.
  Balance sheets of the WEs do not summarize assets correctly, so that even if it is balanced with liabilities, it gives a biased snapshot of the WEs.

- The Cash Flow Statement
  It acts as a record of cash as it enters and leaves the company. The cash flow statement is crucial because the income statement and balance sheet are constructed using the accrual basis of accounting, which largely ignores real cash flow. Investors and lenders can see how effectively a company maintains liquidity, makes investments, and collects its receivables.
  The incoming and outgoing cash-flow of the WE seem to be correctly recorded, since WE accounting recording are sometimes audited. WE has to submit an annual budget, in which expenditures are authorized to a maximum amount.

D.1.5.2 Administrative and budget organisation of the WEs

WE is subject to the following legal obligations.

- Administrative budget, showing:
- Expenses as approved by the budget, divided in two chapter
  - Normal expenditure (chapter 1 of the budget, literally translated and referring to Opex)
  - Investment expenditure (chapter 2 of the budget, literally translated and referring to Capex)
- Revenues
  - Operating revenues
  - Non-operating revenues
- The cash balance
- Accounting corrections

- A technical evaluation and a financial evaluation of the establishment's assets,
- A Trial Balance or General Ledger based on accounting system according to GAAP principles
- An annual technical and financial report submitted to the Ministry, approximately in April each year.

D.1.5.3 General note about Operational Expenditures

Opex are recorder in the Trial Balance under account №5, sorted by type.

However, a number of Opex are not recorded in the accounting system of the WE. This is the case of subsidies (never in cash) from donors and humanitarian associations in the form of supplies (i.e. repairing or replacement of equipment) or consumables (i.e. fuel for generators) to address emergency situations resulting from the current financial crisis and the inability of the WE to perform proper O&M.

As a result, the financial presentation performed herein after for the WE would be biased by these lacks.

D.1.5.4 Auditing of the WE

The accounts of the WEs are subject to:

- Annual internal and external audits. The latter are carried out by third party auditing companies.
- Random Central Inspection controls, coverings technical, administrative and financial aspects. This control has a regulatory dimension, as it concerns the legality of procedures.
- Court of Auditors control, essentially concerning the finances of the establishment.

D.1.6 LEGAL

Law № 221/2000 dated 26 May 2000, rectified by law № 241/2000 dated 7 August 2000 and amended by law № 377 dated 14 Dec 2001, restructured the water sector in Lebanon.

The law created four Regional Water Establishments (based in Beirut, Tripoli, Zahle and Saida) to consolidate numerous smaller water authorities, having moral personality and financial and administrative independence with the following prerogatives:

1. Each of the Water Establishment handles the following within its field of utilization and competence:
    - Studying, implementing, exploiting, maintaining and renewing water projects to distribute poTable Dnd irrigation water and collecting, treating and getting rid of used water, according to the master plan for water and wastewater or upon previous approval by the

Ministry to use public water resources or wastewater plant locations or discharge locations for wastewater.

- Suggesting tariffs for potable and irrigation water and discharging wastewater, while taking into consideration the general socio-economic conditions.
- Monitoring the quality of distributed potable and irrigation water and the quality of wastewater on outfalls and waste water discharges.

2. Each WE has his own regulations. The mentioned institutions shall conclude contracts with an auditing company that is in charge of drafting a report on financial statements, closing accounts and internal control system adopted within the institution.

On the administrative level, Article 5 of Law 221/2000 and its amendments states that the public water exploitation establishments are governed by a Board of Directors, including a CEO and six members appointed by decree. The Board is entrusted with establishing all the internal regulations.

The adoption of the Law 221 in 2000 led to the promulgation of a number of by-laws in 2005 for SLWE as follows:

- Decree 14600 of 14/6/2005 – Rules of procedure
- Decree 14601 of 14/6/2005 – Operating rules amended by Decree 1758 of 16/4/2009
- Decree 14638 of 16/6/2005 – Financial regulations
- Decree 14876 of 1/7/2005 – Staff rules and regulations
- Decree 14914 of 5/7/2005 – Administrative organization

The regulations that were promulgated are identical for the four public establishments, namely: the rules of procedure financial regulations and staff rules and regulations.

The operating rules are the same for the public water establishments of the Bekaa, Beirut and Mount Lebanon, and North Lebanon, the only exception being the operating rules of SLWE. Articles 56 to 86 in the operating rules were not incorporated into the operating rules of SLWE. These articles specifically concern the classification of land, irrigation water users, administrative provisions relating to subscription, contract and duration, delimitation of irrigation perimeters, the increase or reduction of such perimeters, equipment, and the required infrastructure. This is obviously explained by the need to avoid encroaching on the prerogatives of the Litani River Authority in charge of irrigation in certain regions of South Lebanon.

The administrative organization of the public water establishments as promulgated in the decrees differs from one decree to another and is, therefore, not identical.

D.2 COLLECTED DATA

D.2.1.1 Human Resources

D.2.1.2 Summary of data collected

Understanding staffing level gives a quick guide to the extent of any over-manning in a water utility.

According to decree 14914 dated 2005, SLWE total employees should be 872 out of which 206 are filled positions representing 76% vacancy in the organization chart.

With non-recruitment policy, private contractors are used by SLWE to fill not only operational but also administrative and development assignments. The associated assignments are done by temporary staff (aka. on-demand). However, this gap filling weighs on the quality of services and the core values and mission of the water establishment.

SLWE has two contracts of temporary staffing services:

- The on-demand personnel contract
- The plant operation contract

The on-demand contracted personnel accounted for 682 staff as of 2020 and the plant operation contract accounted for 184 staff for the same year. Total temporary staff number is 866.

Reassessment of the organization structure is necessary to achieve scale economies where possible, and to establish for a modernized water and wastewater utility.

The below tables summarize the current personnel situation versus situation that was envisioned in the WE by-laws as needed for the IWA performance indicators of water supply services:

Table D 2-1 Staff Distribution by job type according to by-laws

Job Type	Employees By-Law 14914	Employees Year 2020	Vacancy Percentage
Auxiliary - Clerical	63	28	56%
Auxiliary - Driver	50	1	98%
Auxiliary - Guard	44	0	100%
Auxiliary - Office boy	24	6	75%
Collector/Reader	56	8	86%
Customer Service	21	11	48%
Financial / Administrative	38	25	34%
Management	16	15	6%
Management (Eng.)	19	6	68%
Technical - Driver	17	4	76%
Technical - Engineer	22	3	86%
Technical - Labourer	87	0	100%
Technical - Other	395	90	77%
Technical - Water quality	20	9	55%
Grand Total	**872**	**206**	**76%**

Table D 2-2 Staff distribution by business area according to by-laws

Business	Employees By-Law 14914	Employees Year 2020	Vacancy Percentage
Customer Services	28	9	68%
Distribution	308	105	66%
Engineering	21	9	57%
Facilities	418	19	95%
Finance*	31	34	-10%
General	50	18	64%
HR	8	5	38%
Water Quality	8	7	13%
Grand Total	**872**	**206**	**76%**

* Actual 2020 is higher due to allocation of staff from other business area

Further details regarding the classification and education of staff are explained hereafter.

D.2.1.3 Human Resources as per By-Law 14914

Bylaw 14914/5 July 2005 (*The Organisation of South Lebanon Water Establishment and the Specification of its employees, grades, salary scale, and hiring conditions*) specifies an organisational set-up that can be summarised by the diagram below.

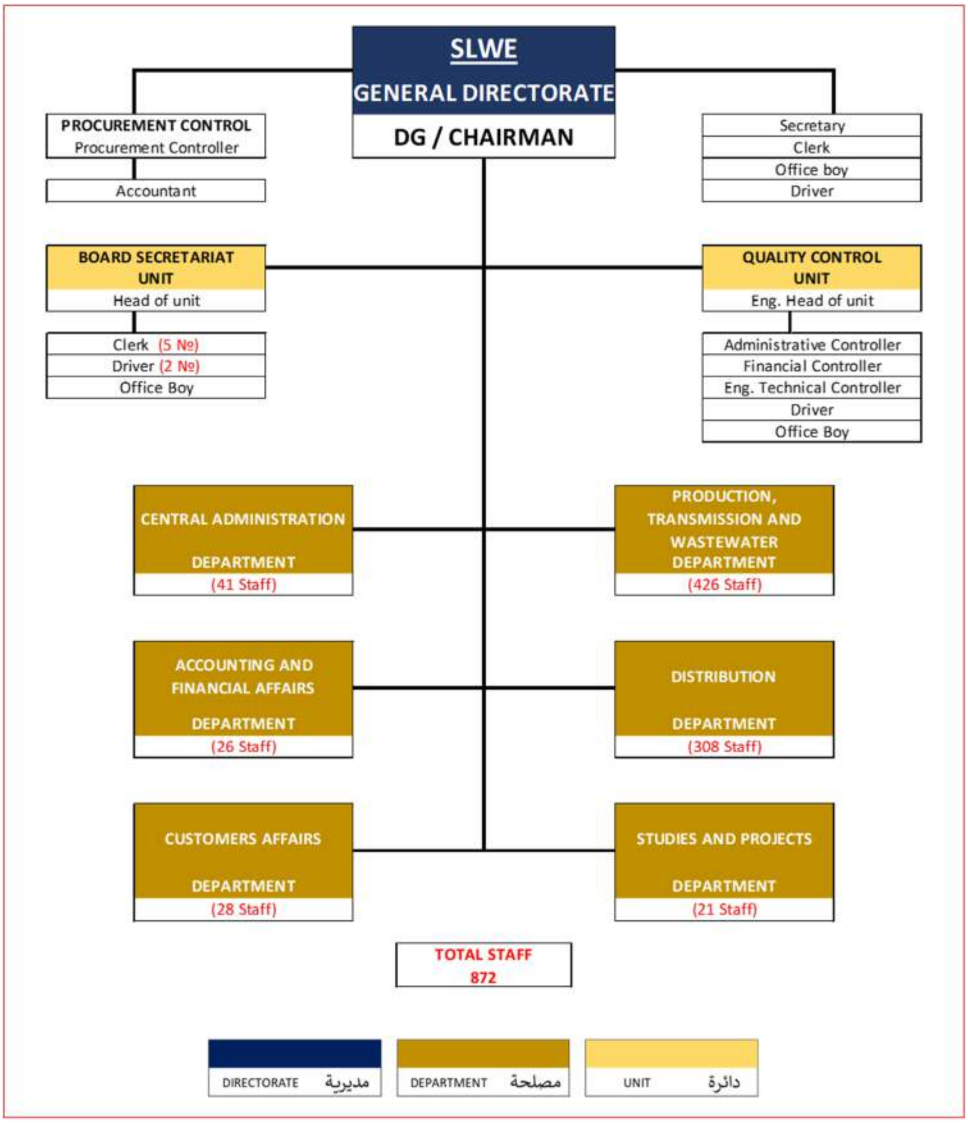

Figure D 2-1 SLWE General Organigram

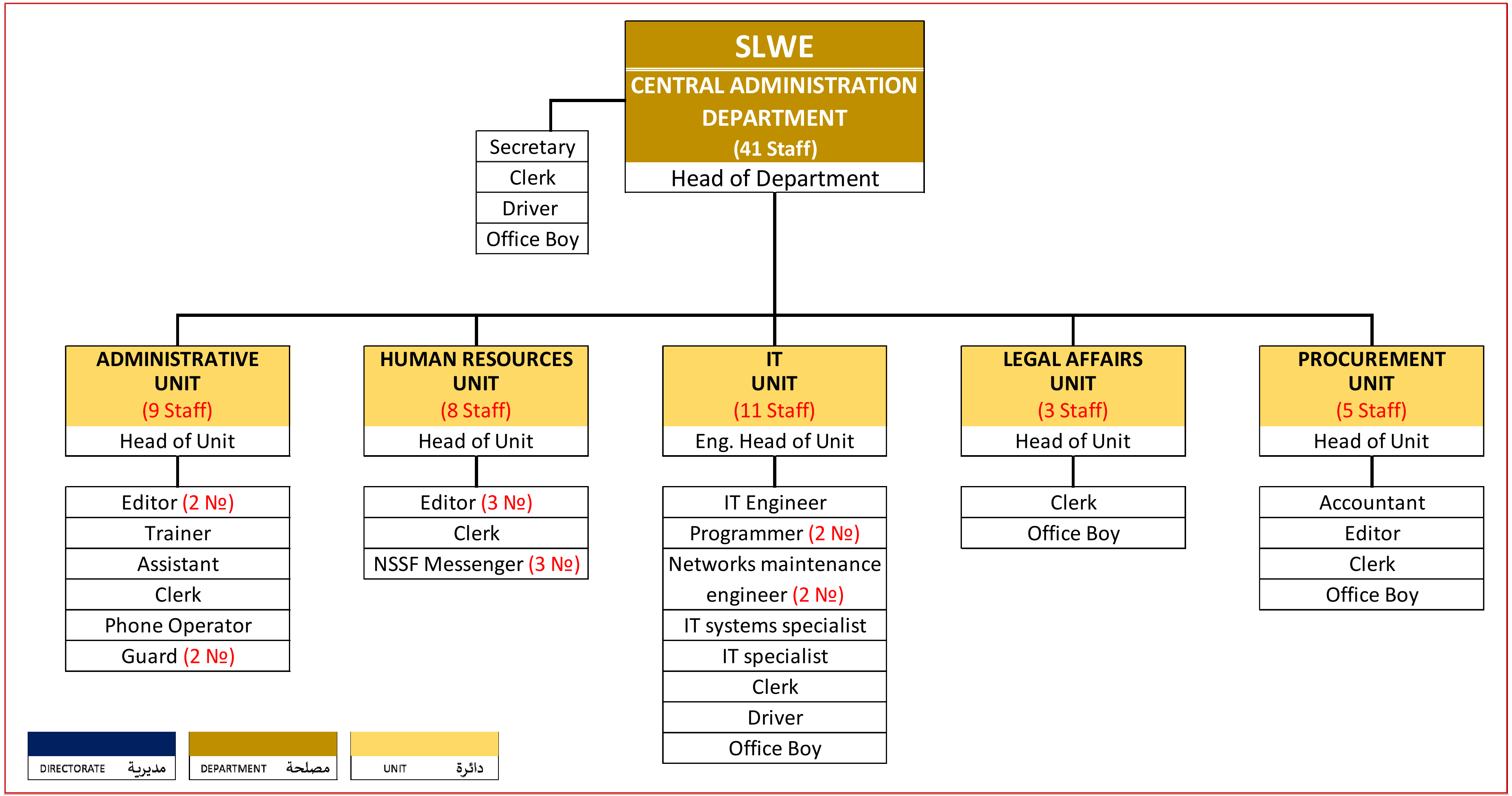

Figure D 2-2 Central Administration Organigram

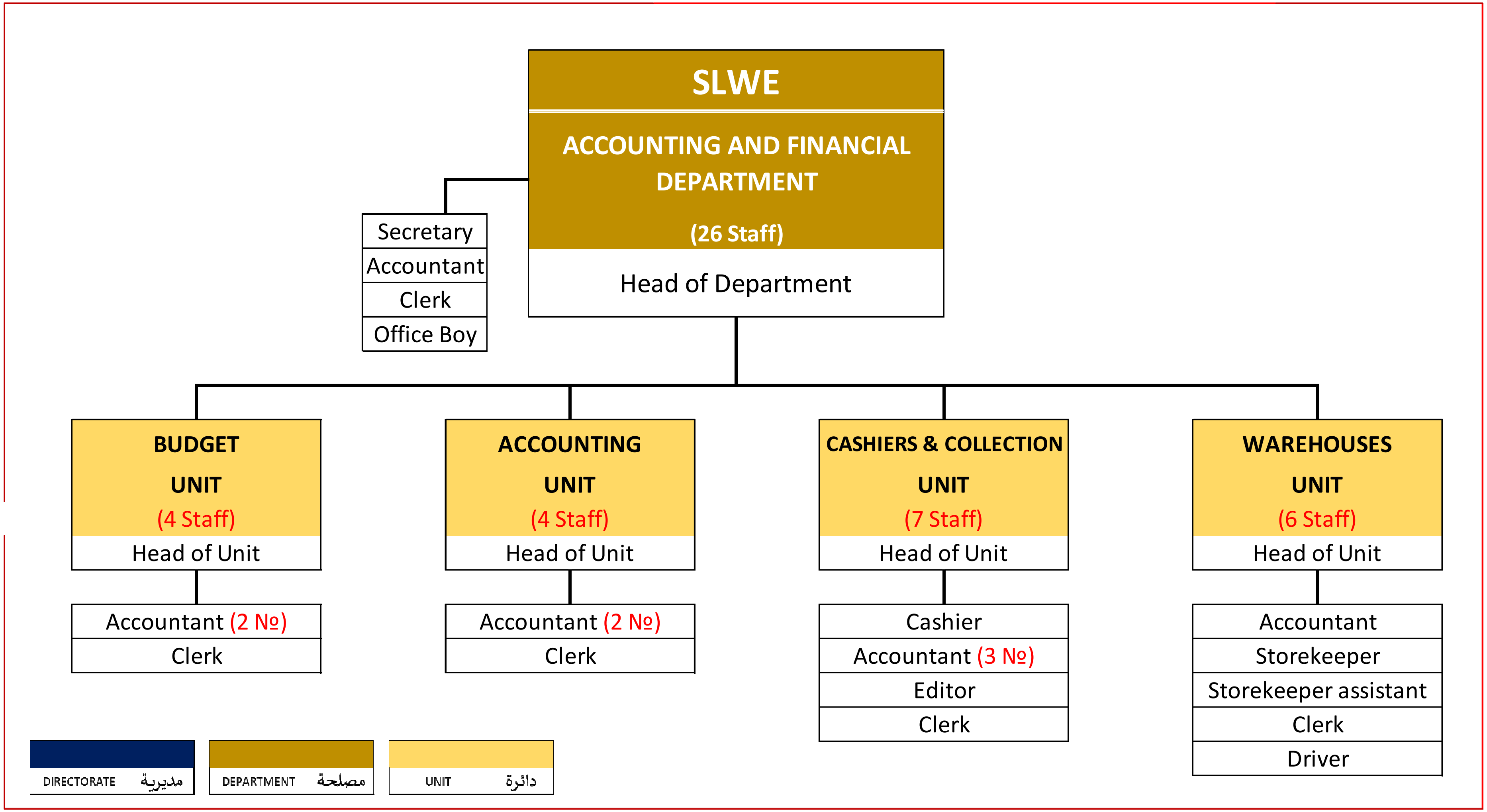

Figure D 2-3 Accounting and financial department Organigram

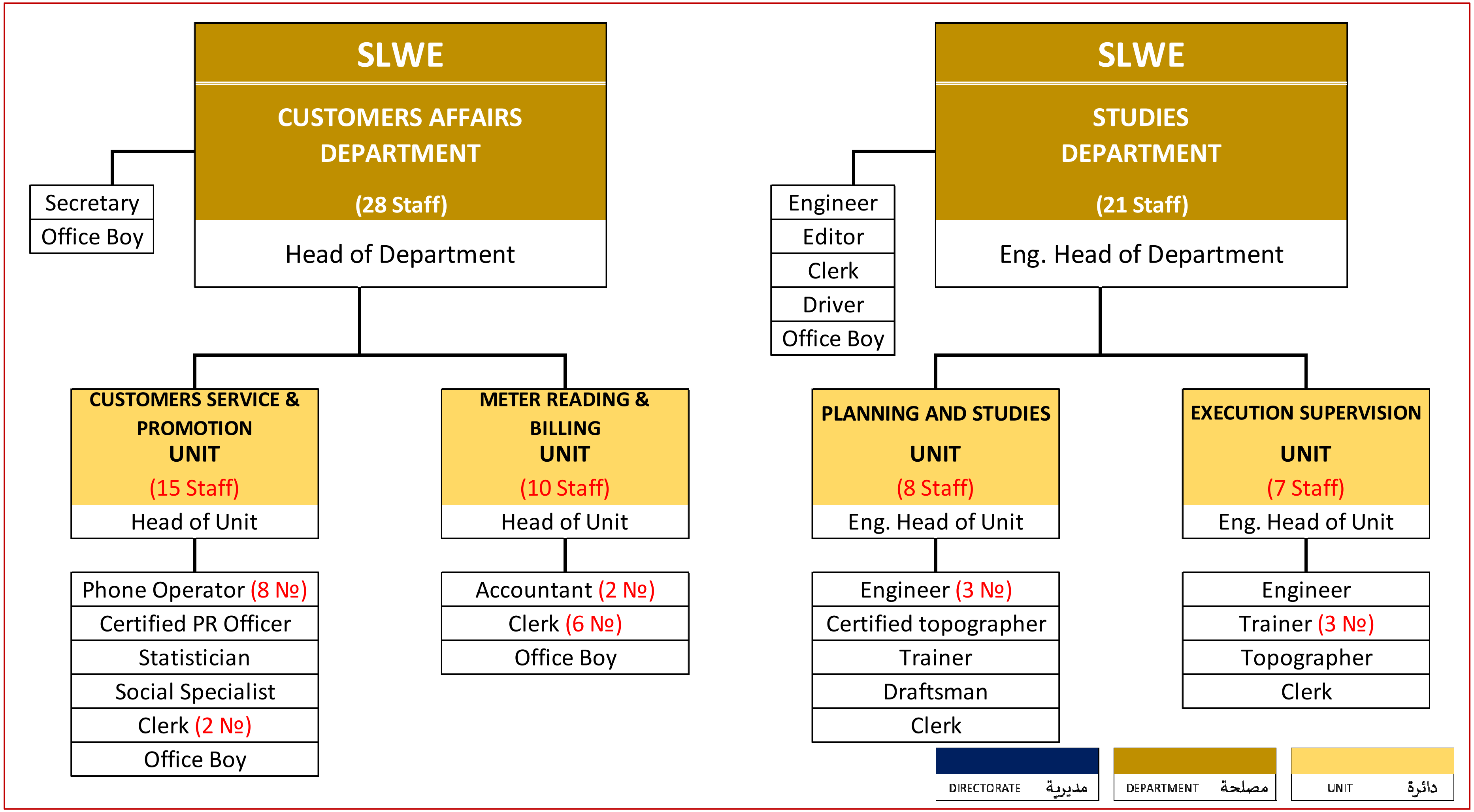

Figure D 2-4 Customers and studies department Organigram

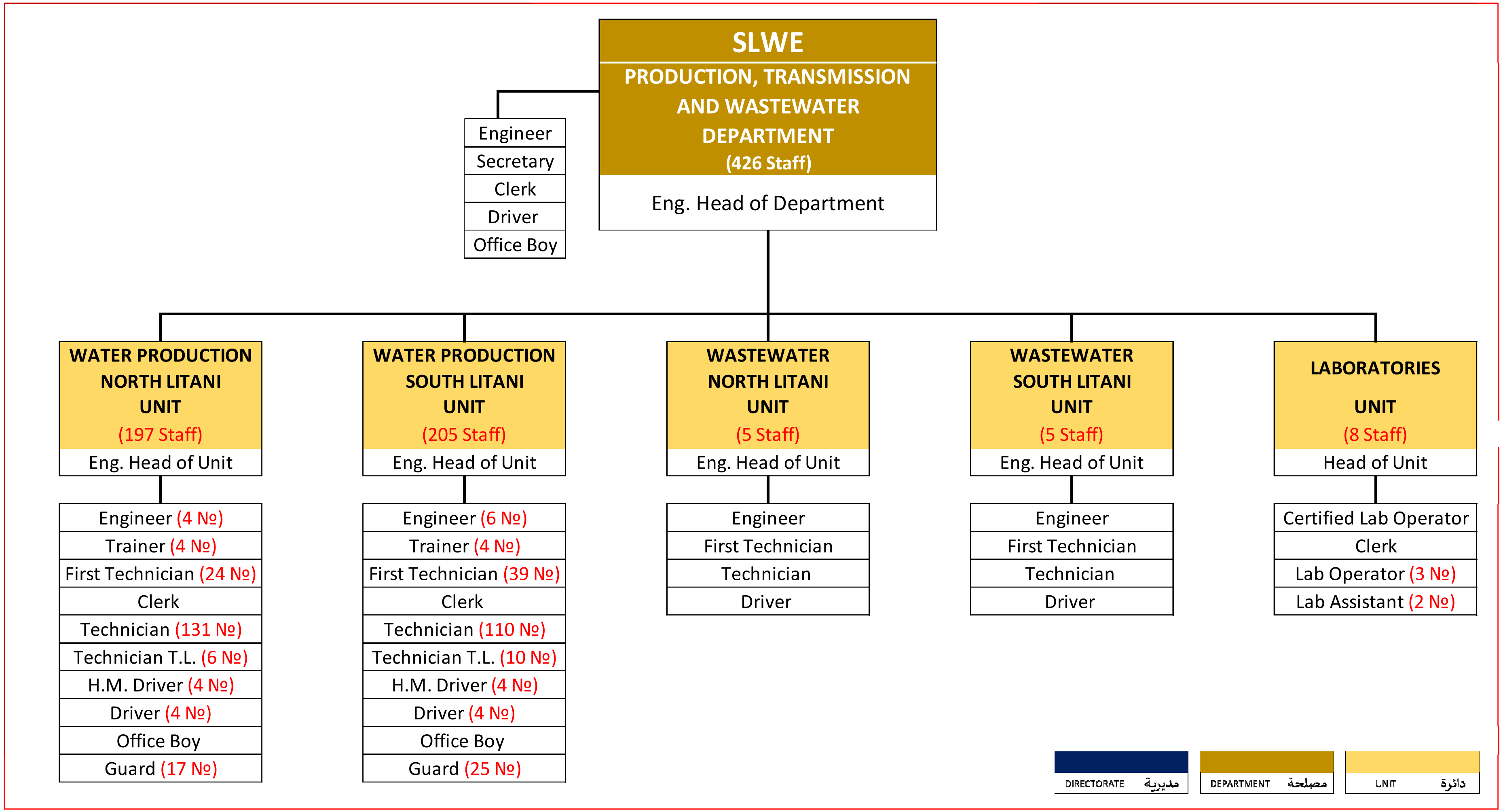

Figure D 2-5 Production, transmission and wastewater department Organigram

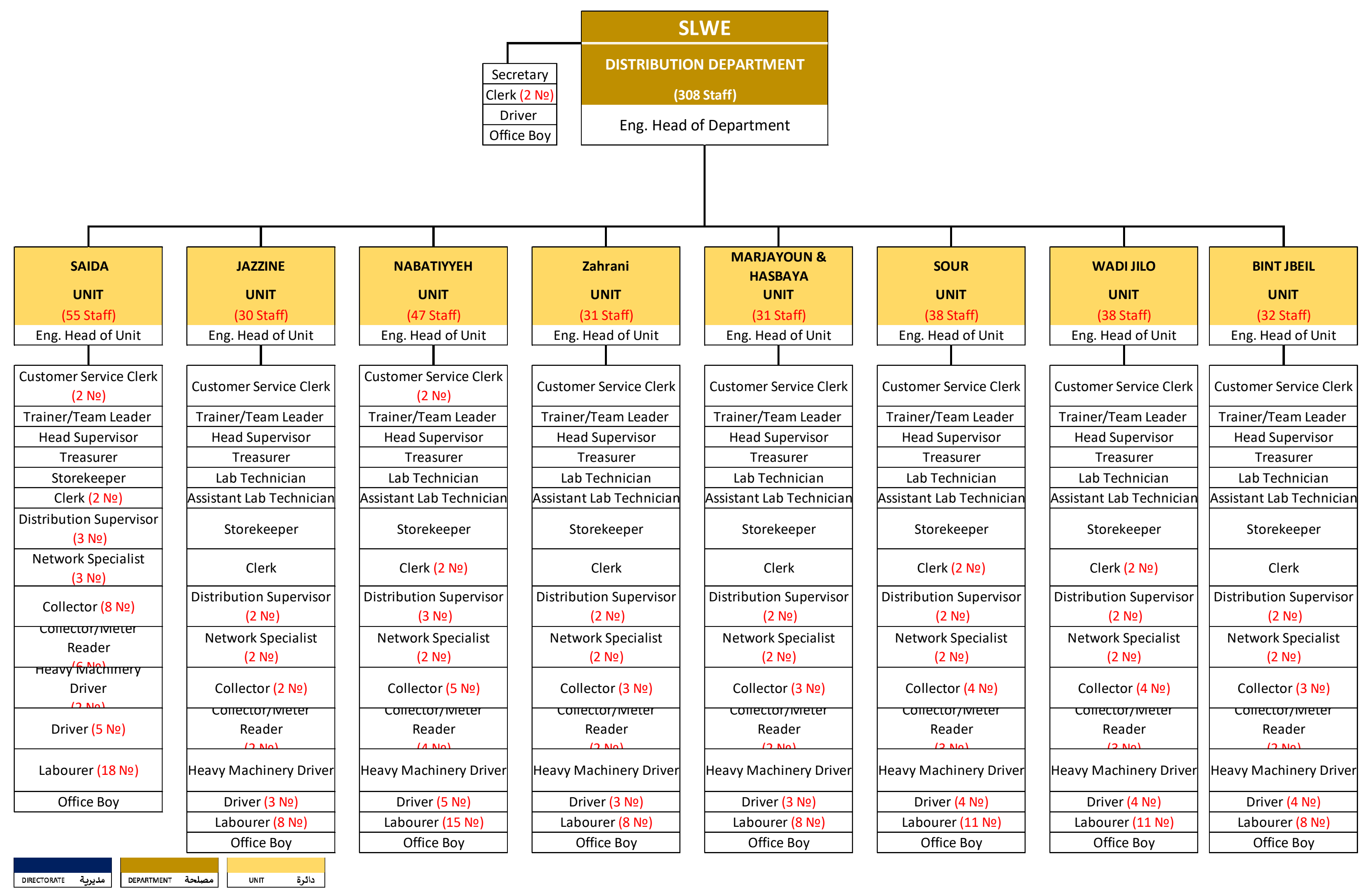

Figure D 2-6 Distribution department Organigram

Of great interest is the number of staff assigned for each business function, regional department, and job type. This would allow the examination of how the envisioned organizational diagram can serve each and find areas that deviate from optimality. The required numbers of each job title are specified in the attached Table 1 of the by-law where the title and number of each position have been provided for SLWE.

Table D 2-3 Staff distribution by business area as per by-laws

Business	Central	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	North Litani	Saida	Sour	South Litani	Wadi Jilo	Zahrani	Grand Total
Customer service	28											**28**
Distribution	6	32	30	31	47		55	38		38	31	**308**
Engineering	21											**21**
Facilities	6					206			206			**418**
Finance	31											**31**
General	50											**50**
HR	8											**8**
Water quality	8											**8**
Grand Total	**158**	**32**	**30**	**31**	**47**	**206**	**55**	**38**	**206**	**38**	**31**	**872**

One limitation was that facility management is described in terms of North Litani and South Litani without specifying the region with the same detail as the distribution. If considered as central, the result would be as follows:

Table D 2-4 Adjusted staff distribution by business area as per by-laws

Business	Central	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	Saida	Sour	Wadi Jilo	Zahrani	Grand Total
Customer service	28									**28**
Distribution	6	32	30	31	47	55	38	38	31	**308**
Engineering	21									**21**
Facilities	418									**418**
Finance	31									**31**
General	50									**50**
HR	8									**8**
Water quality	8									**8**
Grand Total	**570**	**32**	**30**	**31**	**47**	**55**	**38**	**38**	**31**	**872**

Similarly, when classifying the staff by job type, the regional distribution can be presented as follows:

Table D 2-5 Staff Distribution by job type according to SLWE organizational by-laws

Job Type	Central	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	North Litani	Saida	Sour	South Litani	Wadi Jilo	Zahrani	Grand Total
Auxiliary - Clerical	49	1	1	1	2	1	2	2	1	2	1	**63**
Auxiliary - Driver	9	4	3	3	5	5	5	4	5	4	3	**50**
Auxiliary - Guard	2					17			25			**44**
Auxiliary - Office boy	14	1	1	1	1	1	1	1	1	1	1	**24**
Collector/Reader		5	4	5	9		14	7		7	5	**56**
Customer Service	11	1	1	1	2		2	1		1	1	**21**
Financial / Administrative	22	2	2	2	2		2	2		2	2	**38**
Management	16											**16**
Management (Eng.)	7	1	1	1	1	2	1	1	2	1	1	**19**
Technical - Driver		1	1	1	1	4	2	1	4	1	1	**17**
Technical - Engineer	10					5			7			**22**
Technical - Labourer		8	8	8	15		18	11		11	8	**87**
Technical - Other	12	6	6	6	7	171	8	6	161	6	6	**395**
Technical - Water quality	6	2	2	2	2			2		2	2	**20**
Grand Total	**158**	**32**	**30**	**31**	**47**	**206**	**55**	**38**	**206**	**38**	**31**	**872**

Table D 2-6 Adjusted staff Distribution by job type as per by-law

Job Type	Central	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	Saida	Sour	Wadi Jilo	Zahrani	Grand Total
Auxiliary - Clerical	51	1	1	1	2	2	2	2	1	**63**
Auxiliary - Driver	19	4	3	3	5	5	4	4	3	**50**
Auxiliary - Guard	44									**44**
Auxiliary - Office boy	16	1	1	1	1	1	1	1	1	**24**
Collector/Reader	0	5	4	5	9	14	7	7	5	**56**
Customer Service	11	1	1	1	2	2	1	1	1	**21**
Financial / Administrative	22	2	2	2	2	2	2	2	2	**38**
Management	16									**16**
Management (Eng.)	11	1	1	1	1	1	1	1	1	**19**
Technical - Driver	8	1	1	1	1	2	1	1	1	**17**
Technical - Engineer	22									**22**
Technical - Labourer	0	8	8	8	15	18	11	11	8	**87**
Technical - Other	344	6	6	6	7	8	6	6	6	**395**
Technical - Water quality	6	2	2	2	2		2	2	2	**20**
Grand Total	**570**	**32**	**30**	**31**	**47**	**55**	**38**	**38**	**31**	**872**

The extracted information will enable the analysis of the allocation of staff with comparison to the system size and customers for each regional department as well as SLWE as a whole.

D.2.1.4 Human Resources data as collected from SLWE

Different data was provided by SLWE's personnel when approached by the consultant:

D.2.1.4.1 On demand personnel summary table

A simple table that shows the number of contracted staff for the on-demand annual contracts by job type was provided. The provided job types cannot be consolidated in the current analysis. A simplified summary of the provided data was made.

Table D 2-7 SLWE job details for on-demand contracted personnel

Job Types	2018	2019	2020
University graduates	13	20	19
Technical, laboratorian , data entry	113	117	117
Labourers, guards, cleaners and drivers	362	369	384
Technical worker, driver	80	89	87
Engineers, communication and customer service	37	26	40
Drawing, electrical, generator and treatment technicians	10	15	12
Customer relations	1	1	1
Control technician	0	0	1
Engineer	18	19	19
Hydraulic engineer	0	0	0
GIS and geological engineer	1	1	1
Mechatronic/electrical engineer	3	2	1
Total	638	659	682

Based on this interpretation, the following numbers were calculated to show the approximate level of education. SLWE also has another contract for operation personnel that is not represented by these figures which only represent numbers for the on-demand contract.

Table D 2-8 SLWE on-demand contracted personnel by education.

Education	2018	2019	2020
University Education	59	48	61
Basic Education	137	153	150
Other Education	442	458	471
Total	638	659	682

D.2.1.4.2 General personnel summary file 2020

This file provides the level of education for the on-demand contracted staff. The file also provides a list of 11 permanent engineers at SLWE in 2020. The education of the on-demand staff was given.

Table D 2-9 SLWE on-demand contracted personnel by education.

Education	No.
Engineering	46
University	501
Bt Ts	79
High school	10
No certificate	46
Total	682

The on-demand contracted staff are also divided by department as follows. This division may not fully correspond with the “business” category we are using to compare the different WEs regardless of different organizational structures. Specifically, the number of contracted personnel working on Water Quality and HR cannot be determined.

Table D 2-10 SLWE on-demand contracted personnel by department.

Department	No.
General directorate	7
Central administration	16
Accounting	15
Subscribers	4
Production	84
Distribution	522
Studies	34
Total	682

Approximately, and without separating HR or Water quality, the distribution of on-demand contracted staff by business is estimated as follows.

Table D 2-11 SLWE on-demand contracted personnel by business area.

Business	No.
Customer Service	4
Distribution	522
Engineering	34
Facilities and water quality	84
Finance	15
General	23
Total	682

D.2.1.4.3 Employee table

The employee table is one of the main ways SLWE uses to manage personnel. The table provided was not complete and at least the name of the employee was removed. Unfortunately, the location of each employee in the organisational diagram was only given at the level of department, and the department information has not been updated in the last six years. The ERP HR module has been attempted in 2014 but not adopted due to issues faced SLWE remains using spreadsheet files instead.

The approximate distribution of SLWE employees by business is based on the high-level department. Since section information were not given, the number HR staff have been requested from SLWE and subtracted from the General category.

Table D 2-12 SLWE employees by business area

Business	Central	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
Customer Service	9								9
Distribution		20	4	12	26	19	10	14	105
Engineering	9								9
Facilities	19								19
Finance	34								34
General	18								18
HR	5								5
Water Quality	7								7
Grand Total	**101**	**20**	**4**	**12**	**26**	**19**	**10**	**14**	**206**

The approximate distribution by job type based on the available information. The files are said to not been updated with the new job titles.

Table D 2-13 SLWE employees by job type

Job Type	Central	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
Auxilliary - Clerical	23	2			1	1	1		**28**
Auxilliary - Driver		1							**1**
Auxilliary - Office boy	3		1		1			1	**6**
Collector/Reader	4	1		1				2	**8**
Customer Service	5	1		2	1	2			**11**
Financial / Administrative	18	2	1		2		1	1	**25**
Management	13					2			**15**
Management (Eng.)	4			1				1	**6**
Technical - Driver	2				1	1			**4**
Technical - Engineer	3								**3**
Tehcnical - Other	21	12	2	8	18	13	7	9	**90**
Tehchnical - Water quality	5	1			2		1		**9**
Grand Total	**101**	**20**	**4**	**12**	**26**	**19**	**10**	**14**	**206**

Education level can be concluded with greater accuracy given that the information is less prone to change than the job details.

Table D 2-14 SLWE employees by education

Education	Central	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
University	24	13	4	2	19	5	7	2	**76**
Basic	20	7		3	4	3	3	3	**43**
Other	57			7	3	11		9	**87**
Grand Total	**101**	**20**	**4**	**12**	**26**	**19**	**10**	**14**	**206**

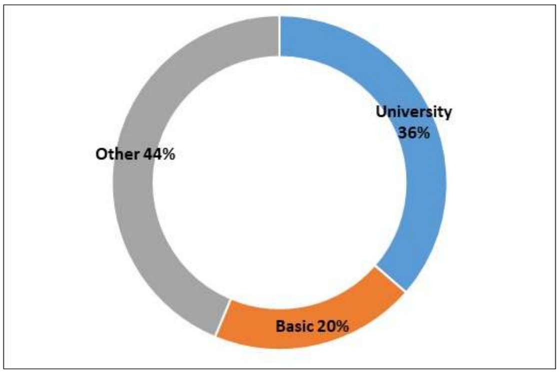

Figure D 2-7 Permanent staff – Education level

D.2.1.4.4 Plant operation contracts

SLWE uses private operators to supply manpower for the operation of the major WTP. In 2019, the number of staff provided under such contracts was 184. No further details were provided by the WE.

D.2.2 TECHNICAL DATA

D.2.2.1 Water production and transmission

D.2.2.1.1 Water production data from Production Department

SLWE production department maintained an updated estimate of quantities produced. The engineer who prepared the analysis is no longer available and the exact method of calculation cannot be elucidated. It is expected that the figures are the results of different ways of estimations that may or may not use actual metered quantities, instantaneous flow rates, estimated supply hours, theoretical pump capacities, and/or historical trends. Given that the same value isn't simply repeated from one year to another, it is expected that the data is of medium reliability and based on aggregation of local estimates. The uncertainty will remain high however due to the potential for high systematic error.

Table D 2-15 SLWE daily average water produced

Year	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Tyr	Zahrani	Grand Total
2017	22,301	5,923	25,663	36,022	90,059	92,016	26,634	**298,618**
2018	21,442	5,984	28,000	43,000	91,500	92,987	26,721	**309,634**
2019	32,648	9,292	29,362	45,602	144,310	99,595	29,914	**390,723**
2020	23,051	10,276	27,886	44,297	137,394	99,139	29,026	**371,069**

Table D 2-16 SLWE annual water produced

Year	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
2017	8,139,865	2,161,895	9,366,995	13,148,030	32,871,535	33,585,840	9,721,410	**108,995,570**
2018	7,826,330	2,184,160	10,220,000	15,695,000	33,397,500	33,940,255	9,753,165	**113,016,410**
2019	11,916,520	3,391,726	10,717,130	16,644,730	52,673,150	36,352,175	10,918,610	**142,614,041**
2020	8,413,710	3,750,920	10,178,339	16,168,452	50,148,825	36,185,760	10,594,319	**135,440,327**

D.2.2.1.2 Water production tables

The production quantity estimates included a breakdown of different production assets for the years 2019 and 2020. The type of station was not stated in this breakdown, but we asked SLWE for an approximate labelling which resulted in the table below.

Table D 2-17 SLWE number of production and transmission facilities.

Year	Type	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
2019	PS	5	2				6		**13**
	Spring		5		1	2			**8**
	Well	29	11	19	67	84	77	40	**327**
	WTP	1					2		**3**
	Total	**35**	**18**	**19**	**68**	**86**	**85**	**40**	**351**
2020	PS	5	2				6		**13**
	Spring		5		1	2			**8**
	Well	29	18	25	70	86	93	42	**363**
	WTP	1					2		**3**
	Total	**35**	**25**	**25**	**71**	**88**	**101**	**42**	**387**

D.2.2.1.3 Systems data collected from technical departments

The production department provided the following different data points as requested by the TA directly. The data is reliable but does not cover the entire system nor is it updated continuously. Therefore, accuracy may be highly lost.

Table D 2-18 SLWE water pumping stations.

Pumping stations	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	Saida	Sour	Zahrani	Grand Total
2019	34	17	22	61	67	90	35	326
2020	34	24	22	63	68	98	35	344

Table D 2-19 SLWE wells.

Wells	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	Saida	Sour	Zahrani	Grand Total
2019	29	11	22	67	80	91	39	339
2020	29	18	22	69	82	105	39	364

The production department as well as the GIS unit provided some of the following additional details:

Table D 2-20 SLWE water system asset quantities for 2020.

Variables	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
Springs (No.)	1	5	2	1	2	2	-	13
Treatment plants (No.)	1	-	-	-	-	2	-	3
Storage tanks (No.)	208	116	79	124	118	168	65	878
Storage capacity (m³)	72,170	23,112	23,090	37,290	27,443	77,656	15,470	276,231
Pumps (No.)	99	34	40	65	94	150	45	527
Transmission mains (km)	433	171	195	323	340	414	146	2,022
Distribution mains (km)	818	94	268	610	637	703	337	3,467
System flow meters (No.)	26	26	29	39	77	67	33	297
Manholes (No.)	485	58	236	638	559	82	192	2,250
Isolating valves (No.)								2,795

Of particular importance was the attempt to estimate the coverage of GIS, but no estimates were given beyond the expression of doubt regarding the level of GIS coverage of especially the distribution networks.

The distribution department could not provide estimates for the numbers of valves, legal, or illegal service connections. The number of bulk meters on districts was estimated to reach 44 after the LWP Jezzine project is handed over. Currently, SLWE does not use any active, functional bulk district meters even if bulk meters may have been installed previously in one or more pilot areas. Still, the number of system bulk meters indicates that a large portion of resources is metered.

D.2.2.2 Energy

D.2.2.2.1 EDL Invoices

The financial department provided historical data of EDL invoices summarized in excel spreadsheets for the years 2013 to 2019 for the existing subscriptions. However, the records were not complete; the consumed energy for the period was not specified, in addition to other useful information such as the KVA rating, service center.

Table D 2-21 EDL invoices in Millions LBP by region

Year	Bent Jbeil	Jezzine	Marj-Hasb	Nabatieh	Saida	Tyr	Zahrani	Grand Total
2013	2,559	403	1,853	3,599	3,444	8,224	1,915	**21,997**
2014	2,541	386	1,669	3,028	3,805	7,329	1,756	**20,514**
2015	2,909	553	2,209	3,674	3,496	7,325	1,988	**22,155**
2016	3,406	430	2,235	3,995	4,144	9,290	2,628	**26,129**
2017	3,391	519	2,720	3,790	4,309	9,646	1,001	**25,376**
2018	3,737	546	2,411	4,615	5,058	9,838	3,322	**29,527**
2019	3,712	449	2,417	4,011	3,906	11,420	1,280	**27,195**

Therefore, an exercise was made by the TA to calculate the kWh based on the EDL tariff components with respect to KVA rating and Kwh unit rate for each station/subscription. The data was consolidated after receiving the missing information from SLWE’s staff. The results are summarized below for the reported years. Also, SLWE reported no energy production, and no measure was available of reactive energy.

Table D 2-22 Calculated electricity consumption by region- Thousand KWh

Year	Bent Jbeil	Jezzine	Marj-Hasb	Nabatieh	Saida	Tyr	Zahrani	Grand Total
2013	16,073	2,557	11,990	23,398	22,171	53,159	12,402	**141,749**
2014	15,602	2,444	10,715	19,368	24,649	46,837	11,299	**130,914**
2015	18,121	3,600	14,462	23,563	22,298	46,737	12,877	**141,658**
2016	21,170	2,714	14,509	25,753	26,637	60,230	17,277	**168,291**
2017	20,835	3,334	17,868	24,230	27,747	62,598	6,000	**162,612**
2018	23,234	3,515	15,728	29,897	32,868	63,798	22,086	**191,126**
2019	23,025	2,846	15,702	25,582	24,857	74,572	7,926	**174,510**

D.2.2.2.2 Fuel Costs

The fuel costs related to generators were concluded from the collected financial statements and operating expenditures. Historical and detailed data related to the consumption of each generator were not available.

D.2.2.3 Operations and Maintenance

D.2.2.3.1 Data from Production Department

The production department provided the following results for operations and maintenance. Records were not kept for the distribution department. The data was kept in improvised spreadsheets, but during the last years SLWE was working on a centralized maintenance management system especially for the Production Department and planned other systems for the needs of the distribution department. At this date none of these systems has been either finished or populated with data.

The number of working vehicles was provided by the production department which represents the entire fleet of SLWE.

Table D 2-23 SLWE working vehicles.

Year	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	Saida	Sour	Zahrani	Central	Grand Total
2019	11	8	9	14	17	17	9	58	143
2020	11	8	9	14	17	17	9	58	143

The production department kept a record of pump repairs and replacements over the years since 2016. The figures appear to be reliable and generally complete, but there was no way to audit or verify the data. The reliability is due to these actions being taken by contractors and therefore paperwork is well kept.

Table D 2-24 SLWE production department pump repair work orders.

Year	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
2016	43	12	24	86	74	134	47	420
2017	44	11	26	83	83	136	36	419
2018	58	21	24	104	99	129	39	474
2019	38	17	16	108	89	152	20	440
2020	31	15	15	47	55	80	25	268

Table D 2-25 SLWE production department pump replacements.

Row Labels	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
2016	-	2	1	8	7	18	6	42
2017	10	-	5	11	12	32	6	76
2018	6	2	1	5	5	7	3	29
2019	1	-	-	5	2	-	-	8
2020	-	-	-	2	-	2	-	4

The production department provided estimates of pump failures. These estimates cannot be correct for all years and may be reliable for 2020. They also do not proportionally reflect the reported pump overhauls and replacements.

Table D 2-26 SLWE estimated pump failures.

Row Labels	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
2020	7	5	7	5	5	5	5	6

Records of replaced valves were kept for 2020 at the production department and does not represent the replaced valves for distribution where the value is not available.

Table D 2-27 SLWE valve replacements.

Row Labels	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
2020	2	-	-	5	1	-	24	32

The production department also recorded that in 2020, 250 cubic meters of storage were cleaned. Due to the low frequency of reservoir cleaning the value could be accurate.

Table D 2-28 SLWE volume of cleaned storage

Year	Bint Jbeil	Jezzine	Marj. And Hasb.	Nabatiyyeh	Saida	Sour	Zahrani	Grand Total
2020	-	-	-	-	250	-	-	250

D.2.2.3.2 Distribution Department data

As with valve replacements, the distribution department had no count of pipe bursts, leaks, pipe replacements, or main rehabilitation. However, in 2020 leak repairs were partially recorded.

Table D 2-29 SLWE valve replacements.

Row Labels	Bint Jbeil	Jezzine	Marj-Hasb	Nabatiyyeh	Saida	Sour	Zahrani	Grand total
2020	7	5	4	52	68	13	8	157

D.2.2.4 Water Quality

D.2.2.4.1 SLWE water quality system-export

SLWE developed a water quality system for managing water sampling and laboratory work orders and testing. Moreover, it was integrated with a GIS-based dashboard for displaying water quality data.

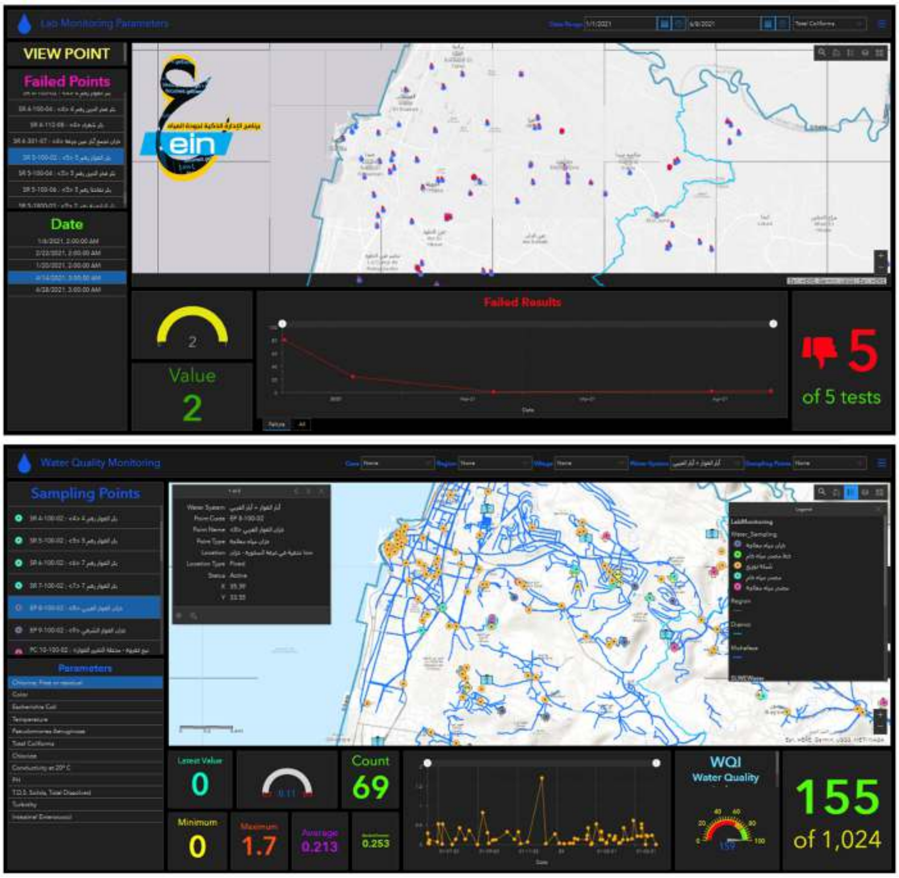

Figure D 2-8 Screenshots of SLWE water quality smart management application.

The system contained information about samples taken from 2017 to 2020. More recent samples have been coded in a standard format for better recordkeeping.

The passing and failure results were not provided but upon assessing the results of the total coliforms the following can be concluded.

Table D 2-30 Overall number of samples and results for total coliforms in 2020 for a mixture of raw and treated water and a mixture of samples from SLWE and private customer

Month	Pass	Threshold	Fail	Not tested	Grand Total
1	267	4	240	11	522
2	279	5	156	5	445
3	161	6	86	1	254
4	57	2	57	3	119
5	43	1	59	3	106
6	179	3	166	8	356
7	139	3	128		270
8	180	11	155		346
9	173	18	170	4	365
10	207	11	133	9	360
11	139	3	94	2	238
12	159	2	133		294
Grand Total	1,983	69	1,577	46	3,675

The system shows many other biological and physical-chemical test results yet the interpretation from the given data was not possible. Overall, it is not possible to easily conclude the number of different kinds of tests conducted based on the provided data.

D.2.3 CUSTOMER SERVICE

D.2.3.1 Billing system report

The automatically generated output report from the billing system gives the detailed number of customers and billed amount for each village. Combining the results, the following tables were calculated.

We classified different use types to residential and non-residential as can be seen in the table below.

Table D 2-31 SLWE subscribers by region and use type.

Department	Use	2015	2016	2017	2018	2019	2020
Bint Jbeil	Non-Residential	92	99	102	113	118	119
	Residential	22,462	22,921	23,626	25,579	26,948	27,916
	Total	**22,554**	**23,020**	**23,728**	**25,692**	**27,066**	**28,035**
Jezzine	Non-Residential	62	71	84	102	111	136
	Residential	3,863	4,010	4,165	4,776	5,715	6,111
	Total	**3,925**	**4,081**	**4,249**	**4,878**	**5,826**	**6,247**
Marjeyoun Hasbaya	Non-Residential	91	99	107	121	129	133
	Residential	11,792	12,236	12,505	13,032	13,397	13,680
	Total	**11,883**	**12,335**	**12,612**	**13,153**	**13,526**	**13,813**
Nabatiyyeh	Non-Residential	196	232	268	391	470	492
	Residential	28,057	28,821	29,595	31,554	32,979	33,599
	Total	**28,253**	**29,053**	**29,863**	**31,945**	**33,449**	**34,091**
Saida	Non-Residential	461	551	616	804	928	960
	Residential	46,699	47,591	48,341	50,447	51,778	52,256
	Total	**47,160**	**48,142**	**48,957**	**51,251**	**52,706**	**53,216**
Sour	Non-Residential	143	144	144	148	152	155
	Residential	23,784	24,154	24,858	27,974	30,947	31,418
	Total	**23,927**	**24,298**	**25,002**	**28,122**	**31,099**	**31,573**
Zahrani	Non-Residential	57	79	99	133	176	186
	Residential	10,772	11,091	11,378	12,923	13,805	14,257
	Total	**10,829**	**11,170**	**11,477**	**13,056**	**13,981**	**14,443**
Grand Total		**148,531**	**152,099**	**155,888**	**168,097**	**177,653**	**181,418**

Table D 2-32 SLWE subscribers by type of use.

Use	Type	2015	2016	2017	2018	2019	2020
Non-Residential	Commercial	61	211	328	669	901	958
	Construction	484	498	519	553	575	611
	Governmental	535	544	551	568	585	588
	International Forces	7	7	7	7	8	8
	Refugees	15	15	15	15	15	16
	Total	**1,102**	**1,275**	**1,420**	**1,812**	**2,084**	**2,181**
Residential	Employee				9	10	10
	Local committees					1433	1592
	Owned	1402	1403	1403	1403	1683	1688
	Residential	146027	149421	153065	164873	172443	175947
	Total	**147,429**	**150,824**	**154,468**	**166,285**	**175,569**	**179,237**
Grand Total		**148,531**	**152,099**	**155,888**	**168,097**	**177,653**	**181,418**

Table D 2-33 SLWE quantities billed by region and use type.

Department	Use	2015	2016	2017	2018	2019	2020
Bint Jbeil	Non-Residential	337	344	347	364	370	372
	Residential	23,079.5	23,555.5	24,285.5	26,332.5	27,740.5	28,731.5
	Total	**23,416.5**	**23,899.5**	**24,632.5**	**26,696.5**	**28,110.5**	**29,103.5**
Jezzine	Non-Residential	346	380	410	485	520	596
	Residential	4,330	4,507	4,687	5,334	6,327	6,753
	Total	**4,676**	**4,887**	**5,097**	**5,819**	**6,847**	**7,349**
Marjeyoun Hasbaya	Non-Residential	332	346	357	385	397	405
	Residential	12,422	12,889	13,172	13,736	14,116	14,415
	Total	**12,754**	**13,235**	**13,529**	**14,121**	**14,513**	**14,820**
Nabatiyyeh	Non-Residential	780	819	876	1,047	1,160	1,195
	Residential	29,735.5	30,548.5	31,361.5	33,432.5	34,949.5	35,619.5
	Total	**30,515.5**	**31,367.5**	**32,237.5**	**34,479.5**	**36,109.5**	**36,814.5**
Saida	Non-Residential	1,506.5	1,656.5	1,790.5	2,130.5	2,295.5	2,363.5
	Residential	49,143.5	50,128.5	50,924.5	53,153.5	54,531.5	55,034.5
	Total	**50,650**	**51,785**	**52,715**	**55,284**	**56,827**	**57,398**
Sour	Non-Residential	814.5	815.5	815.5	864.5	883.5	899.5
	Residential	25,682.5	26,161.5	26,929.5	30,284.5	33,554.5	34,085.5
	Total	**26,497**	**26,977**	**27,745**	**31,149**	**34,438**	**34,985**
Zahrani	Non-Residential	146	181	209	272	317	330
	Residential	11,314	11,666	11,984	13,642	14,541	15,027
	Total	**11,460**	**11,847**	**12,193**	**13,914**	**14,858**	**15,357**
Grand Total		**159,969**	**163,998**	**168,149**	**181,463**	**191,703**	**195,827**

Table D 2-34 SLWE quantities billed by use type.

Use	Use	2015	2016	2017	2018	2019	2020
Non Residential	Commercial	79	274	430	925	1,184	1,258
	Construction	1,855	1,929	2,028	2,240	2,344	2,471
	Governmental	1,928	1,939	1,947	1,983	2,014	2,029
	International Forces	300	300	300	300	301	301
	Refugees	100	100	100	100	100	102
	Total	**4,262**	**4,542**	**4,805**	**5,548**	**5,943**	**6,161**
Residential	Employee				9	10	10
	Local committees					1,557	1,718
	Owned	1,756	1,758	1,758	1,758	2,048	2,053
	Residential	153,951	157,698	161,586	174,148	182,145	185,885
	Total	**155,707**	**159,456**	**163,344**	**175,915**	**185,760**	**189,666**
Grand Total		**159,969**	**163,998**	**168,149**	**181,463**	**191,703**	**195,827**

From the data provided it can be concluded that the results are both highly reliable and accurate. One issue that needs to be resolved is how to consider the 24,000 customers flagged as status “70” that appear to be inactive yet are billed the fixed amount.

D.2.3.2 Funded customer metering projects

3942 residential meters were installed by LWP in Jezzine and 782 meters installed in Bent Jbeil out of planned 2500 residential smart meters by Miyahcon project. These meters are not officially used for billing like in BMLWE and NLWE.

After initial attempts to collect detailed project results no data has been yet collected.

D.2.3.3 Quality of Service

D.2.3.3.1 Subscriber department

The subscriber department informed us that the maximum new connection establishment time is estimated at three weeks, yet the average time is not recorded.

D.2.3.3.2 Client management system complaint reports

The number of recorded complaints in the CMS do not represent the actual complaints as most are conducted directly with the local operators. The annual results were given as follows:

Table D 2-35 SLWE customer complaints by type.

Complaint Type	2016	2017	2018	2019	2020
Continuity complaints	5	1	4	10	5
Complaints on interruptions	473	483	878	653	779
Other service complaints	194	147	260	136	182
Other complaints and queries	33	21	73	17	18

D.2.3.4 Service Coverage

D.2.3.4.1 The Distribution Department

The distribution department provided that SLWE covers the entire service area with some exceptions as follows:

Table D 2-36 Villages within SLWE service areas supplied by other entities.

Region	Villages supplied by others
Saida	• Jbaa
Jezzine	• Nabeh Jezzine • Part of Jezzine
Nabatiyeh	• Kfar Sir
Zahrani	• Zarrarieh
Marjeyoun/Hasbaya	• Kfeir • Maimas • Shebaa
Sour	• Burj Shmali
Bint Jbeil	• None, but some local wells are operated by the municipalities in Maroun el Ras, Baraachit, Bani Hayyan, Chakra, Aita Echaab, Yaroun, and Deir Ntar.

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Upon SLWE's verbal reporting the population and units covered by other entities is not available but considered to be marginal.

D.2.4 ECONOMIC AND FINANCIAL DATA

D.2.4.1 General

For the purpose of the financial performance diagnosis, key data encompassing technical, commercial and financial pieces of information was collected from SLWE. SLWE provided the requested data for the period between 2015 to 2020 from the following financial and accounting data sources:

- The tariffs
- Trial balance
- The financial statements including Profit and Loss, Balance sheets, and Income statements

The table below lists the data provided by SLWE.

Table D 2-37 List of data collected from SLWE

	2015	2016	2017	2018	2019	2020
Tariffs of water and sanitation						x
Bank Cash Flow	x	x	x	x	x	x
Revenues	x	x	x	x	x	x
Balance sheet	x	x	x	x	x	x
Billing and rate of collection	x	x	x	x	x	x
Trial balance with activities	x	x	x	x	x	x
Customers details						x
EDL invoices	x	x	x	x	x	
Average daily water production			x	x	x	x
Opex gathered from the general balance accounting system	x	x	x	x	x	x

It is of great interest that the data was provided in editable format. We note that the trial balance collected from SLWE are for years from 2015 to 2020 and data for the year 2020 will not be used in the analysis since accounting data for this year has not been audited yet.

D.2.4.2 Operational Expenditures

Expenses covers mainly cost of operation and maintenance that were extracted from the accounting system. These expenses include variables costs as energy and consumables while fixed costs cover the human resources, maintenance of the network, the equipment and the buildings, administrative and office expenditures, and financial expenses.

All Opex are registered in the accounting system of SLWE, account number 5, and displayed by type. It has to be noted that before 2018, some Opex and Capex were not registered in the accounting system of SLWE. After 2018, the accounting system have been reviewed and SLWE began to record all financing support from donors.

Expenses include variables costs as energy and consumables while fixed costs cover the human resources, maintenance of the network, the equipment and the buildings, administrative and office expenditures.

Variable costs are those of Energy and Consumables.

- Energy is provided from two different sources:
  EDL (invoices partly paid by SLWE)
  Generators (sensitive to availability/price of fuel)
- Consumables in SLWE are fuel for vehicles

Fixed Costs are all costs that do not fall under variable Costs. Fixed Costs are made of all other costs, i.e.

- Human resources are made up of Permanent and Non-Permanent staff,
- Maintenance of the network, the equipment and the buildings
- Administrative and office expenditures

The following table presents the Opex for years 2015 to 2019. The accounting data of year 2020 has not been audited yet, and is not considered below.

Table D 2-38 SLWE Opex from year 2015 to year 2019

	2015	2016	2017	2018	2019
Energy					
Energy - EDL	22,172,046,000	26,985,915,456	24,958,301,902	25,800,045,000	27,473,966,000
Generator	384,212,477	756,229,610	209,044,500	1,413,003,592	1,635,740,146
HR Expenditure	17,578,987,432	18,302,403,052	21,365,244,203	23,767,180,049	25,151,895,627
Maintenance	3,642,800,813	5,484,914,006	4,528,314,984	3,546,082,230	4,387,661,539
Other expenses					
Administrative & Office	515,684,233	700,700,298	586,299,603	468,219,263	686,112,806
Consumables	286,130,077	277,626,678	277,538,644	297,602,327	331,880,262
Grand Total	**44,579,861,032**	**52,507,789,100**	**51,924,743,836**	**55,292,132,461**	**59,667,256,380**

The 2 main components of the costs structure are the Human resources and the Energy, with respectively 40%, and 48% of the total Opex. The total of these components represent 88% of the total O&M costs. Maintenance costs is around 8%. Moreover, fixed and variable costs are equally expended.

D.2.4.3 Capital expenditures

Data in relation with Capex were collected and gathered from the bank cash flow of SLWE. The Capex's data given by SLWE are for the period from 2016 to 2019. It can be observed that Capex varies between 1.5 MLBP and 3.6 MLP 35.9 MLBP.

Table D 2-39 Capex of SLWE from 2016 to 2019 in M LBP

Expense	2016	2017	2018 (M LBP)	2019
Capex	2,535	2,992	1,594	3,688

D.2.4.4 Assets valuation and depreciation

SLWE asset valuation was undertaken starting 2015 under a USAID funded program (yet not all assets were assessed), and starting 2018 asset depreciation was recorded under account № 515 101 010.

Table D 2-40 Asset Depreciation 2018 & 2019

	Depreciation of physical assets (LBP)
2019	8,014,609,350
2018	12,374,159,148

However, SLWE does not have a complete and accurate valuation of the assets, and therefore it is accepted that the above figures only represent an approximate of the actual asset depreciation.

D.2.4.5 Revenues

SLWE collect revenues water subscriptions and maintenance services, grants from various sources; recorded in the accounting system starting 2018, and other revenues such as fees for new subscription, fines and penalties. The table below summarizes the data in relation with revenues for the period from the year 2015 up to the year 2019 broken down by type of revenues.

Table D 2-41 SLWE Revenues for 2015 to 2019 (Source: SLWE General Ledger)

	2015	2016	2017 (LBP)	2018	2019
Subscriptions and maintenance services					
Pricing / Subscription	35,899,483,000	36,507,241,000	35,760,312,000	38,314,709,530	39,951,843,349
Maintenance service	7,083,566,000	8,176,977,000	8,062,775,430	8,808,907,216	8,159,093,039
	42,983,049,000	44,684,218,000	43,823,087,430	47,123,616,746	48,110,936,388
Other revenues					
Fines	480,097,958	545,562,104	472,078,805	796,985,949	702,093,092
Admin & Subscription fees	161,700,000	186,795,000	193,680,000	591,757,230	175,236,650
Other services	464,500,000	538,509,272	646,172,090	1,898,575,000	930,052,504
	1,106,297,958	1,270,866,376	1,311,930,895	3,287,318,179	1,807,382,246
Grants					
Grants from carious non private donors				1,635,023,200	264,000,000
Grants from UNICEF				-	155,000,000
Grants from private donors				137,000,000	1,697,676,010
	0	0	0	1,772,023,200	2,116,676,010
Grand Total	**44,089,346,958**	**45,955,084,376**	**45,135,018,325**	**52,182,958,125**	**52,034,994,644**

Revenues from water pricing, which include Subscription and Maintenance, generate on average 92% of the total recurring revenues of SLWE. Other revenues come from fees for new subscriptions, fines and penalties.

D.2.4.6 Tariffs

Only one tariff is applied in SLWE, with a small difference on the maintenance charged, depending on whether the subscribers is connected or not connected to wastewater.

Table D 2-42 SLWE tariff (2019)

	TARIFF (LBP/year)			
	Not connected to WW		**Connected to WW**	
	Metered	**Not-metered**	**Metered**	**Not-metered**
Water subscription	216,000	216,000	216,000	216,000
Maintenance	35,000	25,000	35,000	25,000
Waste Water	15,000	15,000	30,000	30,000
Computerization	5,000	5,000	5,000	5,000
	271,000	**261,000**	**286,000**	**276,000**
VAT (11%)	29,810	28,710	31,460	30,360
Stamp	1,000	1,000	1,000	1,000
Rounding	190	290	540	640
Bill /Year	**302,000**	**291,000**	**319,000**	**308,000**

D.2.4.7 Billing

D.2.4.7.1 Billing Rate

Billings for the water and sanitation services are issued on a yearly cycle (once a year). Customer may pay the dues in instalments provided the council of board has taken the decision and approved it by the ministry of water and energy. Payments not received by the due dates are charged a late payment charge (2% of invoice amount per month as per decree no 14601).

D.2.4.7.2 Billing method

Current charges are itemized for each service and other items as prescribed by the administration:

- Water Subscription charge is uniform among all customer types =216,000 LBP/m3.
- Maintenance charge is 25,000 LBP by unmetered subscriber and 35,000 LBP by metered subscriber.
- Sanitation treatment charge= 30,000 LBP/m3 by customer defined as connected to wastewater network and 15,000 LBP/m3 by customer categorized as disconnected from network.
- Other items include the computerization charge (5000 LBP), stamp (1000 LBP), fines,

It is worth noting that the ERP database indicates that the subscribers are classified by connection type (metered or unmetered) but all customers are charged for the volume subscribed based on flat tariff irrespective of the amount of water consumed. Tariff structure has barely changed since the inception of the water establishment and this is largely the result of a unique policy situation.

Table D 2-43 Billing and subscribers available data

Year	**Subscribers (Nbr.)**	**Water Sales (m^3/day)**
2015	148,531	159,969
2016	152,099	163,998
2017	155,888	168,149
2018	168,097	181,463
2019	177,653	191,703
2020	181,420	195,827

D.2.4.8 Collection

D.2.4.8.1 Collection Method

All charges for utility services are due upon an announcement made by SLWE and are payable as per the following options:

- To Collectors: The collectors are responsible for the collected money and they must dispatch it to the cashier periodically without exceeding the cash limit set by the rules with respect to their deposited guarantee. The collectors can make more than 2 visits to their assigned subscribers to collect the bills which adversely affect the collection efficiency especially reaching out to customers with debt and in distant villages.
- To Cashiers in branch offices in the following regions: Saida, Jezzine, Zahrani, Nabatiyyeh, Tyre, Bint Jbeil and Marjeyoun/Hasbaya.

Until few years ago, the payment options were limited to the above two, but ever since the appointment of the DG in 2018 and in order to improve the efficiency of collection, SLWE added the online payment option with debit/credit cards and made agreements with OMT and Cash United to offer the customers the possibility of settling their dues through their offices in Lebanon. Those multiple payment options allow the customers to save time and effort and find more locations with the widespread network of OMT and Cash United.

D.2.4.8.2 Collection Rate

The below table illustrates the collection efficiency in the seven regions where SLWE has branches.

Table D 2-44 Collection rate for year without arrears

	Bint Jbeil	Jezzine	Zahrani	Sour	Saida	Marj-Hasb	Nabatiyyeh
				Rate %			
2015	39%	87%	53%	45%	62%	32%	40%
2016	37%	78%	51%	44%	59%	34%	38%
2017	37%	77%	50%	43%	59%	35%	39%
2018	55%	89%	65%	60%	64%	64%	53%
2019	43%	88%	66%	48%	51%	43%	39%
2020	42%	65%	58%	46%	47%	42%	39%

Below table shows the elevated rate of arrears for the last years and the low revenue collection rate when the arrears are accounted in the collection rate.

Table D 2-45 Yearly Rate of collection

	Revenue Collection	
	Rate % (Current year)	**Rate % (incl. Arrears)**
2015	50%	17%
2016	47%	15%
2017	47%	14%
2018	61%	15%
2019	49%	12%
2020	46%	12%

D.2.4.9 ERP System

SLWE is using Microsoft Dynamics NAV 2013, which is an enterprise resource planning (ERP) from Microsoft. Dynamics NAV enables the water utility to manage its business and to connect its sales, purchasing, accounting, stock management…

The ERP system provides a business management solution on premise, rich with features and adaptable to the business needs of the water establishment. It was deployed and implemented by USAID funded program.

As revealed by the survey during the data collection phase, SLWE is highly dependent on the technical assistance of external programmers to maintain the ERP especially the accounting module, which is causing delays in closing its financial statements due to some occurring errors.

D.2.4.10 Financial statement

The Financial statements collected from SLWE are the following:

D.2.4.10.1 Income statement

Table D 2-46 SLWE Income statement (2015 to 2019)

	2015	2016	2017 (M LBP)	2018	2019
Revenues water subscriptions	42,983	44,684	43,823	47,124	48,111
Other revenues	1,106	1,271	1,312	5,059	3,924
Total revenues	**44,089**	**45,955**	**45,135**	**52,183**	**52,035**
Directs charges	-43,778	-51,529	-51,061	-51,526	-58,649
Administrative and general expenditure	-802	-978	-864	-766	-1,018
Financial Profit/losses	311	-5,574	-5,926	-2,343	-6,614
Assets Depreciation				-12,374	-8,015
Results	**-491**	**-6,553**	**-6,790**	**-15,483**	**-15,647**

D.2.4.10.2 Cash flow statement

The cash flow statement and the balance sheet are given in the below tables

Table D 2-47 SLWE Cash Flow statement

	2016	2017	2018	2019
		(M LBP)		
Opening balance (Bank)	3,132	6,272	4,916	13,794
Opening balance (Funds)	9	18	22	35
Income	35,157	32,881	43,288	34,935
Expenditure	32,009	34,233	34,397	39,662
Closing balance (bank)	6,272	4,916	13,794	9,069
Closing balance (Funds)	18	22	35	33
Closing balance (Total)	**6,290**	**4,938**	**13,829**	**9,102**

Table D 2-48 SLWE Balance sheet

	2019	2018	2017	2016	2015
			(M LBP)		
			Assets		
Cash	9,107	13,829	4,938	6,290	3,141
Account receivable	211,088	192,509	185,356	169,523	153,344
Inventories	5,397	4,490	5,146	3,557	1,947
Others receivable account	695	682	682	691	691
Total of current assets	**226,288**	**211,511**	**196,122**	**180,061**	**159,123**
Fixed (long term) Assets	209,331	213,439	6,536	4,219	37
Total Assets	**435,619**	**424,951**	**202,658**	**184,279**	**162,798**
			Liabilities		
Account payable suppliers	262,257	205,270	192,678	179,805	153,435
Other current liabilities	1,053	979	869	917	946
Liabilities for public institutions	5,107	5,115	3,481	2,989	2,660
Expenditures		25,798	12,666		
Total current liabilities	**268,417**	**237,165**	**209,694**	**183,711**	**157,041**
Compensation end of work	203			224	643
Total Liabilities	**268,620**	**237,165**	**209,694**	**183,936**	**157,685**
Cumulated results	182,646	203,269	(246)	6,897	5,604
Profit/Losses	(15,647)	(15,483)	(6,790)	(6,553)	(491)
Net capital	166,999	187,786	(7,036)	344	5,114
Total Liabilities	**435,619**	**424,951**	**202,658**	**184,279**	**162,798**

D.2.4.11 Financial KPI

Basic KPIs are being monitored such as collection efficiency by village, collection efficiency by district, overall collection efficiency, revenue growth, profit margin in addition to other financial KPIs when requested by the MoEW.