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

Funded by the European Union

Implemented by AFD

METERING AND MONITORING OF WATER PRODUCTION AND DISTRIBUTION

November 2022

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AFD	Agence Française de Développement
BMLWE	Beirut and Mount Lebanon Water Establishment
BoQ	Bill of Quantities
BWE	Beqaa Water Establishment
CDR	Council for Development and Reconstruction
DMA	District Metering Area
EU	European Union
EUD	European Union Delegation
GIS	Geographic Information System
GPS	Geographic Positioning System
HR	Human Resources
KE	Key Expert
LRA	Litani River Authority
LTTA	Long Term Technical Assistance
MMS	Metering and Monitoring System
MoEW	Ministry of Energy and Water
NLWE	North Lebanon Water Establishment
NRW	Non-Revenue Water
NWSS	National Water Sector Strategy
RfP	Request for Proposal
SLWE	South Lebanon Water Establishment
TA	Technical Assistance
ToR	Terms of Reference
WE	Water Establishments
WMP	Water Master Plan
WSMP	Water Supply Master Plan
WTP	Water Treatment Plant

1 INTRODUCTION

For whoever wants to manage water resources, at country or water basin scale, it is of importance to have a sound assessment of the available water resources, either surface or groundwater, in order to :

- Properly manage groundwater and avoid over exploitation
- Properly allocate water resources between human and irrigation/other needs

At the Water Establishments' level, it is crucial to properly assess their water production, as more than one major KPI are a function of the volume of water produced, that all directly impact on the tariff calculation and the financial sustainability of a WE. Of which :

- The daily production per capita,
- The cost incurred by the WE for 1 m³ of water delivered to the subscribers
- The rate of NRW,

The WEs in Lebanon do not have accurate estimations of the volumes of water produced and/or distributed because of the lack of operational water metering devices on most of the water production/distribution points. The figures stated by the WEs for their production are to be considered as *operator's best estimate* and are therefore marred by errors the margin of which is difficult to assess.

In fact, measuring the volume of water produced or distributed with an acceptable margin of error is a challenge for the water establishments that falls beyond their financial capacity because the water resources are scattered and in big numbers. This requires not only installing water-measuring equipment at each source, but also implementing an integrated water management system such as SCADA.

In line with the old adage, *you cannot manage what you cannot measure*, it is necessary to have sufficiently accurate assessments of the volumes produced and distributed, in order to properly manage a water establishment.

For that, it is required to have Measuring and Monitoring System (MMS) equipment operational in as much production and distributions centers as possible (ideally all); covering the tapped springs, wells, dams, main transmission and distribution reservoirs, and bulk metering at distribution networks level as needed. In addition, a SCADA system must be implemented to centralize, monitor, and process the acquired data.

Based on lessons learned from previous experiences, manually read flowmeters are never read, and should they be, data is seldom properly entered in the system. Therefore, at this stage it is necessary to clearly define what is meant by MMS:

MMS must me capable of measuring the flow AND sending the data to the WE's SCADA system, automatically, in real time, without human interference.

In order to reach the above target, it is necessary to:

- Set up a comprehensive list of all production and distribution points
- Carry out desk reviews and required site investigations in order to check if the site is already equipped with an operational MMS linked to the WEs SCADA system. If not linked, is it possible to upgrade it in order to link it to the SCADA?
- Set up a detailed list of works to be done in each site,
- Prepare Tender Documents for the implementation of the works.

However, as the number of points to consider is quite elevated (more than 3,500 for all, and around 1,500 for only production points) the present report shall consider only production points of major importance as a first phase for implementing a MMS (see Section 4).

It must be also noted that only production and distribution points owned by the WEs shall be considered.

2 PHASED IMPLEMENTATION OF MMS

Because of the high number of points to be covered for both production and distribution throughout the national territory (more than 3,500, see Table 1 below), MMS cannot be implemented but by phases, as shown on **Error! Reference source not found. Error! Reference source not found.**.

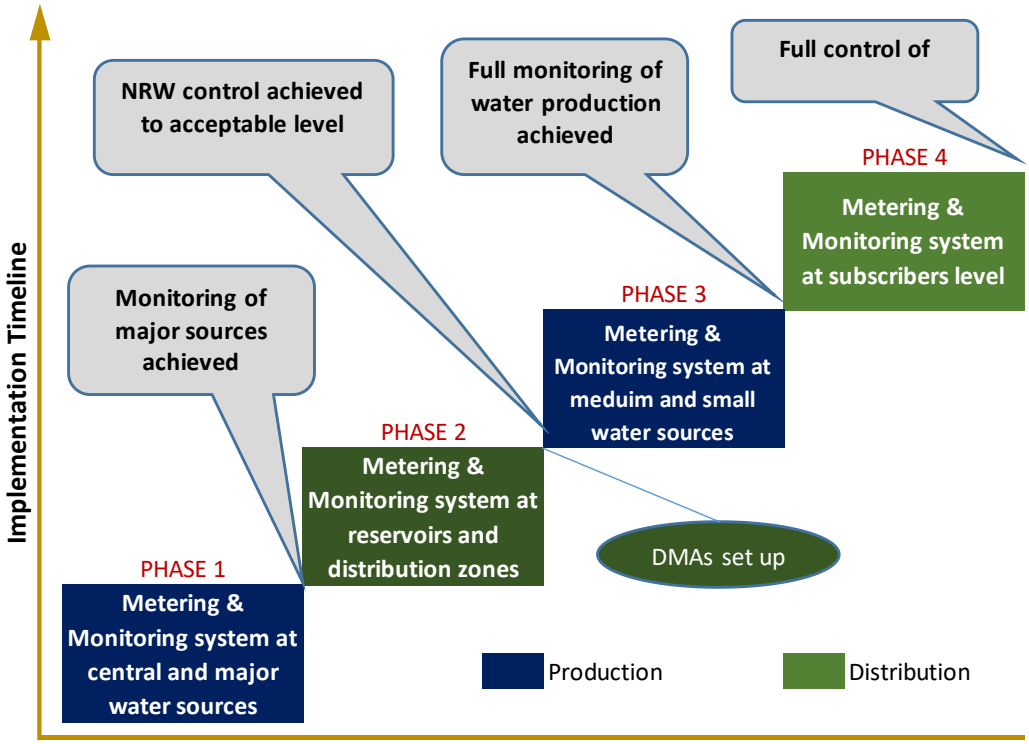

Figure 1 Water management phased implementation

Subject to the availability of funds, the implementation of the above phases may overlap.

Due to the elevated number of distribution points to cover (more than 2,000, see Table 1 below), the present report covers only metering and monitoring the production (phases 1 and 2), which amount to 1,250 points approximately.

3 GENERAL OVERVIEW OF THE CONCERNED SITES

3.1 General

In order to secure a sustainable water management, MMS must be implemented at different levels:

1. For the production:

   At the production points, which are those water sources actually tapped by the WEs and whose volume produced is expected to generate income for them. These are springs, river intakes, wells, and dams providing potable water; but also on WTPs, transmission lines, and in-line pumping stations, if and where deemed required.

   All these points are upstream any distribution reservoir.

   The overwhelming majority of these sources of production are single points such as a well or a spring, as it can be seen on Table 1 below. However, distinction is made with major production sites (see sub-section 3.4)

2. For the distribution
   - Upstream at the distribution reservoirs outlets
   - At the distribution network level, bulk metering at major nodes and DMAs entries.
   - Downstream at consumer's level

   The distribution points considered in this report are in fact the distribution reservoirs. Required district bulk meters and individual subscriber meters are not counted in Table 1 below, as these are beyond the scope of this report.

3.2 Setting out priorities for MMS implementation of production points

In line with the phased implementation shown on Figure 1 above, the production points shall be sorted by priority as follows:

- Priority 1 For main production points or central facilities, producing large volumes of water and therefore serving a significant number of population and potentially providing consistent revenues to the WE.

  Metering and monitoring these points is planned to be implemented in the short term and are covered under the present report.

- Priority 2 All production points that do not fall under Priority 1.

  Metering and monitoring these points is planned to be implemented at a later stage and are NOT covered under the present report.

3.3 Listing of sites to be equipped with MMS

The LTTA set up, for each WE, a comprehensive list of production and distribution points where MMS would be installed in order to provide adequate tool for water management, and deducted from the production list those points that are already operational and linked to the WE's SCADA system (where relevant). A summarized list is given in Table 1 below. Detailed lists are given in the Appendix attached to the present report.

Table 1 Summary count of WEs production and distribution points

	NLWE		BMLWE		SLWE		BWE		TOTAL	
	P 1	P 2	P 1	P 2	P 1	P 2	P 1	P 2	P 1	P 2
Production										
Wells	130	63	92	241	90	273	112	133	424	710
Springs	33	14	25	1	22	11	22	18	102	44
Dams			3						3	
Total	**163**	**77**	**120**	**242**	**112**	**284**	**134**	**151**	**529**	**754**
									1283	
Major sites *	6	- -	1	- -	12	- -	3	- -		
Distribution										
Reservoirs	848		1025		957		686		**3516**	

* *See sub-section 3.4 below*

These points are spread out over the national territory, as shown on Figure 2 below

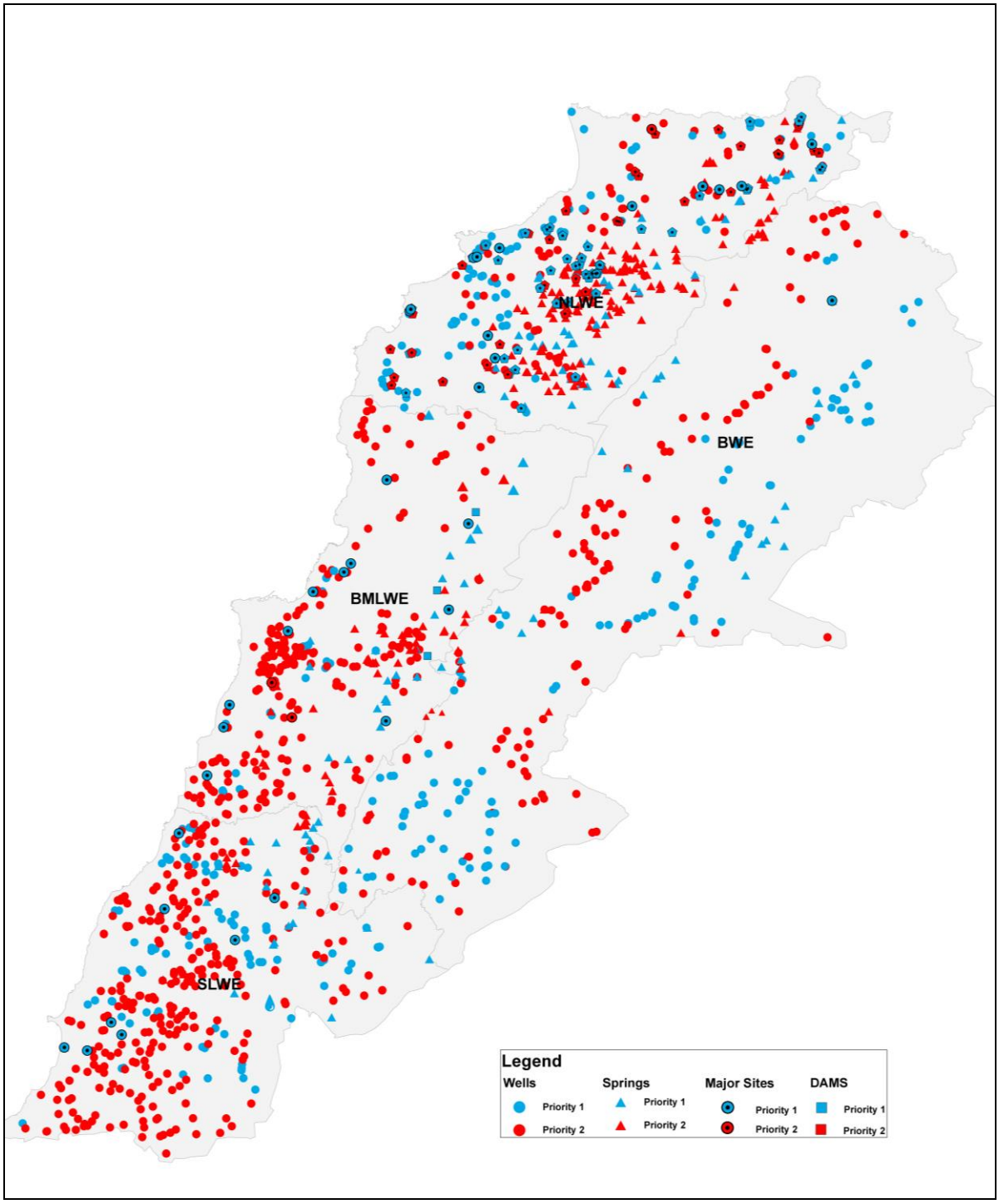

Figure 2 Production points in Lebanon, by priority

3.4 The particular case of major production sites

Major production sites are those production sites that include more than one source and possibly distributing water in more than one direction. They require the installation of more than one flowmeter and a local MMS to control the whole components as one single production scheme.

3.4.1 Major production sites under NLWE

1. Ain Yaacoub wells field
   Including two wells feeding one regional reservoir.

2. Aayoun wells field
   Including three wells feeding one regional reservoir.

3. Bahsas water treatment plant
   Including:
   - Bahsas water treatment plant
   - El Hab spring
   - Abou Halqa spring
   - Four wells

4. Kousba water treatment plant

5. Jradeh (Chekka) wells field
   Including eight wells; regional reservoir and pumping facility

6. Kfar Helda treatment plant

3.4.2 Major production sites under BMLWE

1. Dbayeh water treatment plant

   Including :

   - Dbayeh treatment plant
   - Jeita spring
   - Jeita pumping station (to Qornet el Hamra)
   - Qachqouch spring
   - Fawar antelias spring
   - Jeita wells (3 nbr.)
   - Qachqouch wells (7 nbr.)
   - Mokhada wells (5 nbr)
   - Nahr el Kalb wells(3 nbr.)
   - Antelias wells (3 nbr.)

3.4.3 Major production sites under SLWE

1. Nabeh el Tasseh
   Including :
   - Nabeh el Tasseh spring
   - Nabeh el tasseh pumping station
   - Nabeh el Tasseh wells (5 nbr.)

2. Taybeh treatment plant
   Including the treatment plant and the river intake and pumping station on Litani river.

3. Fakhr el Din wells field
   Including ten wells and a pumping station

4. Teffahta wells field
   Including eight wells and a pumping station

5. Fawar wells field and pumping station
   Including seven wells and a pumping station

6. Serail wells field
   Including five wells and a pumping station

7. Batoulay wells field and pumping station
   Including six wells, regional reservoir, and a pumping station

8. Ouadi Jilo wells field and pumping station
   Including 10 wells, regional reservoirs, and two pumping station

9. Ras el Ain treatment plant

10. El Bas treatment plant

11. Marj el Khawkh wells field and pumping station
    Including three wells and a pumping station

12. Ouadi Slouki wells field
    Including three wells and regional reservoir

3.4.4 Major production sites under BWE

1. Ras el Mal (Baalbek) spring and distribution reservoir

2. Chamsine wells field and pumping station
   Including nine wells, a collection reservoir and a pumping station

3. Loussy wells field and pumping station
   Including three wells, a collection reservoir and a pumping station

4 MMS IMPLEMENTATION METHODOLOGY

4.1 Preparatory phase

In close coordination with the WEs, the LTTA will set out, for each WE, a list of the points to be metered and monitored, and set up the cost estimate for a consultant to carry out the detailed designs and prepare the required tender documents for the implementation of the SMM. This is covered by the present report, which will be submitted for the approval of AFD, mainly concerning the provisional budget for the construction of such a system.

Once the budget set out, the LTTA will prepare accordingly a detailed list of points to be included in the design and have it duly approved by the each concerned WE. Then RfP will be prepared to appoint a consultant to carry out the detailed designs and prepare the TD for the construction of the system.

4.2 Design phase

4.2.1 Preliminary stage

The appointed Consultant will approach the relevant WEs in order to :

- Assess the status of the SCADA system in operation in each WE and check its ability to incorporate the additional data required for monitoring and processing this number of MMS. Accordingly, propose upgrading/modifications to the existing SCADA system as may be required
- Carry out a desk review of the required water points in order confirm, in close collaboration with the WEs the final list of the water points to be covered by the study.

4.2.2 Assessment stage

The Consultant shall carry out site visits to each selected location/facility in order to :

- Assess the status of the facility's civil infrastructure and its suitability to safely host the required equipment. If not, then the required rehabilitation civil works shall be included in his assessment and cost estimate.
- Assess the status of the existing pipework and its suitability for the installation of the required equipment. If not, then the equipment requiring replacement shall be included in his assessment and cost estimate.
- Draw up a topographic plan showing :
  - The present situation of the valve chamber including all equipment and pipework within.
  - Plan views and sections showing where and how to install the flowmeter and the related power and control equipment.
- Draw up a comprehensive list of equipment (pipework, flowmeter, electrical, else) to be installed.

- In general produce all drawings, documents, list of equipment, and else as may be required in order to clearly understand the nature and volume of works to be undertaken, and to closely assess the cost of these works.

4.2.3 Production of construction Tender Documents and BoQ

Once the assessment stage completed and approved, Tender Documents shall be prepared for the construction of the MMS in all selected sites, as follows :

1. One TD for the upgrading of the SCADA systems of the four WEs, if applicable.
2. One TD for the implementation of MMS in all the non major sites,\.
3. One TD for the implementation of MMS in all major sites.

These TD may be split into four lots or more for flexibility in tendering the construction works

The BOQs shall be broken down per locations, covering all required supplies and works identified during the assessment phase, in order to deliver an operational system in each location.

In addition, the BoQ must include provision for an adequate training for the four WEs staff in order to secure sustainability in the operation and monitoring of the installed equipment.

4.3 Implementation phase

The implementation phase is not covered under this report as it depends on the availability of funds for the construction works.

5 DESIGN STUDIES COST ESTIMATES

The total number of production sites to be assessed and for which the appointed consultant shall prepare tender documents for the implementation of a MMS is around 1300 (priority 1 and 2).

Considering :

- An average cost of 600 USD per each non major site;
- Additional cost for the Major Sites, that require from the consultant addition mobilisation at all levels (topography, civil works, electrical and mechanical, …);
- The cost for upgrading the SCADA systems of the four WEs;

The cost against conducting the assessment as described under sub-section 4.2 above is estimated at **1,000,000 USD** (one million).