Horizon 2020

INVESTMENT COMPONENT | MeHSIP-PPIF

Verification and Validation of Adequacy & Efficiency of Operation of WWTP PROJECTS - Lebanon, Morocco and Tunisia

LEBANON

MeHSIP-PPIF

and

Sustainable Water Integrated Management (SWIM) - Support Mechanism

European Investment Bank

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- *SWIM-SM is undertaken by a Consortium led by LDK Consultants and includes ACWUA, RAED, DHV, GWP-MED, Environmental Agency (Austria), Ministry of Agriculture (Tunisia), Ministry of Energy and Water (Lebanon), Ministry for Environment Energy and Climate Change (Greece).*

Disclaimer

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ABBREVIATIONS

BoQ	Bill of Quantities
CDM	Clean Development Mechanism
EC	European Commission
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
ESIA	Economic and Social Impact Assessment
EU	European Union
FDS	Final Disposal Site
FEMIP	Facility for Euro-Mediterranean Investment and Partnership
FIRR	Financial Internal Rate of Return
FIDIC	Fédération Internationale des Ingénieurs Conseils
FS	Feasibility Study
GIS	Geographic Information Systems
JSC	Joint Service Council
IFI	International Financing Institutions
MeHSIP-PPIF	Mediterranean Hot Spots Investment Programme - Project Preparation and Implementation Facility
MoE	Ministry of Environment
MoMA	Ministry of Municipal Affairs
MoPIC	Ministry of Planning and International Cooperation
MSW	Municipal Solid Waste
NAP	National Action Plan
NGO	Non-Government Organisation
PDD	Project design Document
PIP	Project Implementation Plan
PFS	Project Fact Sheet
PPP	Public Private Partnership
RIAL	Reuse for Industry, Agriculture and Landscaping
SW	Solid Waste
TA	Technical Assistance
ToR	Terms of Reference
USAID	United States Agency for International Development
WAJ	Water Authority Jordan
WW	Wastewater
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Saida WWTP

The Saida WWTP is located on the Lebanese coast in South Lebanon. The plant provides preliminary screening and grit removal for an average 22,000 m3/d of sewage before it is discharged to a 2.2 km long sea outfall. The plant has peak rainfall capacity of 32,000 m3/d

The SAIDA WWTP was constructed in 2005. For the period 2005 to 2012 the plant was treated only 8,000 m3/d due to network deficiencies and a lack of an effective operating and maintenance contract for the network and WWTP. Since September 2012 a new operating contract has been in place. The operations team have improved the network delivery to the point that 22,000 m3/d dry weather flow is now being treated by the WWTP.

The core purpose of the plant, that can be considered as part of the national strategy for protecting Mediterranean Sea water from land based pollution, is to improve the water quality on the Saida Beaches by:

- Removal of large objectionable objects (e.g. plastics and sanitary towels etc.)
- Reduction in Faecal Coliforms by sea dilution and sunlight degradation.

The plant treatment units consist of:

- Coarse Screening (manual cleaning)
- Intake pumping (5 pumps , dry installed)
- Fine Screening (2 tooth raked screens , 6 mm aperture)
- Grit removal using 2 cross flow grit detritus tanks
- Outfall pumping
- Odour control using activated carbon scrubbers
- Standby power generators

The lessons learned for future projects are:

- Planning for future upgrade of treatment, flow expansions, and future sludge disposal strategy must be included in the overall catchment wastewater strategy. The Saida WWTP site selection does not have sufficient foot print available to allow biological treatment upgrade with conventional activated sludge. The hydraulic design does not have sufficient hydraulic profile allowance to allow for future primary settlement without adding another stage of pumping.

- If simple primary settlement were used at the Saida WWTP the sludge generated could be used by the adjacent municipal waste anaerobic digesters to generate biogas which would have generated more than sufficient electrical power for the operation of the WWTP. This is relevant in country that suffers from serious electrical supply shortages.

- When a new WWTP works is planned, the network system must be completed promptly to ensure that the WWTP is used efficiently. This was not the case at Saida WWTP which operated for many years with very reduced sewage flow reaching the WWTP

- Single stage fine screening such as originally installed at Saida WWTP are not mechanically robust for reliable service on combined sewage networks. Two stages of screening should ideally be provided. The first stage should be an automatically raked robust coarse bar screen of approx. 50 mm and the second stage should be a fine screen of 6-10 mm aperture.

- The design for maintenance of the WWTP plants need to incorporate a proper access and lifting review during detailed design and there needs to be included provision to easily drain down all process units.

- Oversized standby generators are very expensive to run. Standby generators should be sized for long sea outfall pumping during dry weather flow conditions. If power failure occurs during wet weather conditions then a gravity overflow should discharge excess screened and degritted flow directly to a shorter outfall.

- A building is not required for the screening plant. Odour control can be effectively provided by covering channels and screens with close fitting covers and extracting the small volumes of air to the odour control unit. This reduces the capital and operation costs and provides more effective odour treatment.

- Using operating management and staff from the local area is advisable. Because the network and WWTP is designed to protect the environment of where they and their families live, they are strongly motivated to ensure that the network issues are resolved and that wastewater from the area achieves best treatment before discharge to the sea.

1 INTRODUCTION

The Saida WWTP is located on the Lebanese coast approximately 3 km from Sidon District in South Lebanon. The plant provides preliminary screening and grit removal for an average 22,000 m^3/d of sewage before it is discharged to a long sea outfall of 2190m length. The Saida WWTP was constructed in 2005 using Japanese funding. In 2012 a new operator was appointed.

For the period of 2005 to 2012, the plant was treating only an average of 8,000 m^3/d of flow , due to defects in the network and network pump stations. These have been resolved by the current O&M contractor.

The WWTP was visited by the following team on 19/09/2013:

- Conor Kenny Wastewater Treatment Technical Expert
- Tim Young Team Leader MeHSIP-PPIF / Horizon 2020
- Georges Akl Institutional Expert MeHSIP-PPIF / Horizon 2020

The operations plant manager Joesph Kassab and the mechanical engineer Hadi Atallah were very helpful in the following ways:

- provided a detailed explanation of the plant processes
- gave a full plant tour
- gave access to all relevant documentation available on site.
- showed the visiting team warm hospitality

The sections in this report referring to Saida WWTP have been written by the Conor Kenny, the wastewater technical expert for the plant visit.

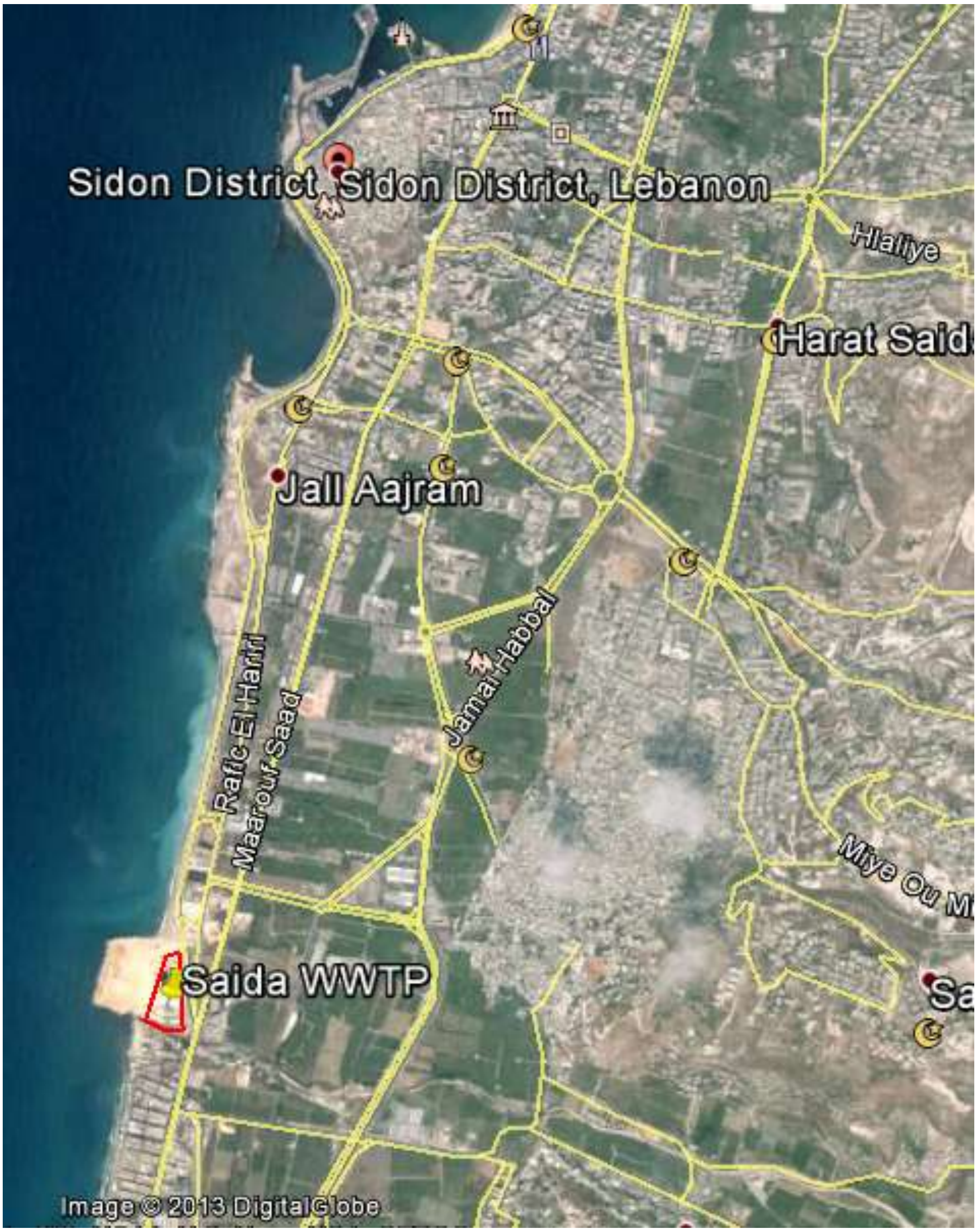

Figure 1 Location of Saida WWTP

2 GENERAL OVERVIEW ON THE PERFORMANCE OF WWTP

The SAIDA WWTP was constructed in 2005. The WWTP plant provides screening and grit removal before the sewage is discharged to a 2190 m long outfall. The plant has been designed with a peak rainfall event capacity of up to 32,000 m^3/d.

For the period 2005 to 2012 the plant was only treating 8,000 m^3/d due to network, and network pump deficiencies and a lack of an effective operating and maintenance contract for the network and WWTP.

Since September 2012 a new operating contract has been in place. The operations team have improved the network delivery to the point that 22,000 m3/d dry weather flow is now being treated by the WWTP with a population equivalent of 290,000.

The plant is not designed to provide removal of Biochemical Oxygen Demand (BOD), Suspended Solids, Nitrogen or Phosphorous.

The core purpose of the plant, that can be considered as part of the national strategy for protecting Med Sea water from land based pollution, is to improve the water quality on the Saida Beaches by:

- Removal of large objectionable objects (e.g. plastics and sanitary towels etc.)
- Reduction in Faecal Coliforms by sea dilution and sunlight degradation.

3 OVERVIEW ON WASTEWATER WORKS

3.1 NETWORK DESCRIPTION

There are four main pump stations M1, M2, M3 & M4and 5 smaller pumps stations (L1, L2, L3,, L5, L10) that discharge into a gravity pipework system. The network consists of 160 km of gravity pipe which discharges to the Saida Coastal Area WWTP. The operations team are responsible for the four main feed pump stations and 160 km of the network.

3.2 INTAKE PUMPING DESCRIPTION

The waste water is discharged from the gravity network to an intake chamber at the WWTP. This chamber has been retrofitted by the operators with two sets of simple mesh screens in series. These screens were found to be essential to protect the downstream intake pumps and the downstream 6 mm fine screen.

The removable mesh grid screens consist of two screens with aperture sizes of 70 mm x 70m and two with an aperture of 50 x 50 mm.

An intake wet well provides a buffer for the intake pumps.

The intake pumps consist of 5 dry installed submersible pumps provided in a covered dry well. The dry well is ventilated by fan to the outside air. The pump regime is duty, assist, assist, assist, standby. The pumped sewage is discharged to dedicated bell-mouths in a feed channel upstream of the intake flat teeth screens. Pipework has been allowed for the future provision of a single additional intake pump.

The pump design flow is 302 l/s at a developed head of 10.7 m, the motor size is 55kW.

Figure 2 Saida Intake pumps station T1

Figure 3 Intake pump discharge bell-mouths

3.3 FINE SCREENS:

Fine screening is provided in preliminary works for the following purposes:

- Prevent discharge of larger sized objects (e.g. plastic packaging etc.) to the sea.
- To prevent blockage of the outfall pumps and outfall diffuser.

There are two fine screening channels each with a width of 2 m and height of 2.25 m.

Two flat teeth fine screens are provided, the screens have an aperture size of 6 mm. The screens and screenings handling equipment are located in a screen house building. The screens are operated as duty/duty.

The design flow capacity of each fine screen is given on drawings as 2730 m^3/hr (758 l/s)

Figure 4 Tooth raked fine screen

A screen bypass channel with a hand raked bar screen (approx. 10 mm aperture) is provided.

Figure 5 Bypass screen

The screenings collected by the fine screens are discharged to a screw conveyor which discharges the screenings to a screw compactor. The screw compactor discharges the screenings to a skip.

The design screenings handling capacity is 1.22 m^3/hr from the 6 mm fine screens.

Figure 6 Screening s screw compactor discharging to a screw conveyor

3.4 GRIT REMOVAL

The screened sewage discharges to a channel that feeds two 6 m diameter cross flow detritus tanks that are used for grit removal. Detritus tanks are usually sized to achieve cross flow velocity of less than 0.3 m/s which causes grit to settle. The 6 m side width and 840 mm liquid depth (from hydraulic profile) of each detritus tanks can achieve less than 0.3 m/s with a flow of 1500 l/s. Therefore in theory the detritus tanks have been sized so that each tank is capable of the full flow intake pump flow.

However site operators have observed that a single detritus tank is hydraulically capable of treating the flow of only 1200 l/s (4 intake pumps operating) and not the full 1500 l/s (5 pumps).

The grit detritus tanks are fitted with scrapers that push the grit to a sump at the side of each detritus tank. From the sump the grit is raked to and then elevated by a classifier which also serves to wash and drain the grit. The grit is washed of organics using wastewater effluent. The washed and drained grit is discharged to the ground from where it is periodically transported by tractor tipper to disposal skips.

The grit removed wastewater gravitates over a broad crested weir to a long buffer tank upstream of the outfall pumps.

Figure 7 Drained Grit Detritus tank

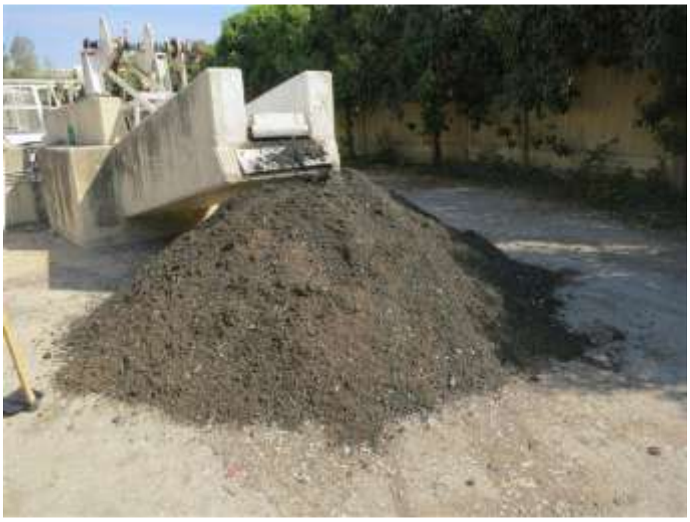

Figure 8 Grit discharged by classifier

3.5 BUFFER TANKS AND OUTFALL PUMPS

The purpose of the buffer tank appears to be to prevent the outfall pumps starting too frequently. Flow measurement using ultrasonic level measurement is carried out at broad crested weirs as the flow leaves each detritus tank. There are two transducers however, only one works.

There are 3 outfall pumps located in the outfall pump building. These pumps are dry installed submersible pumps. The pumps are variable speed and operate as duty/ assist / assist. Each pump has design a flow of 500 l/s and design head of 26 m. with motor size of 185kW.

The outfall is 2190 m long and discharges to the Mediterranean Sea with diffusers provided at the end of the outfall pipe to aid dispersion.

Figure 9 Outfall buffer tank

Figure 10 Outfall pumps

3.6 POWER SUPPLY AND STANDBY GENERATOR

The plant is supplied built with a 1280 kVA diesel electric generator installed in a building but this was found to be oversized and consumes too much fuel. The WWTP has now been equipped with a smaller 500 kVA generator which is located outside the generator building in a kiosk.

The plant only has one operational HV to LV transformer. The cabling to the transformer is not neatly arranged.

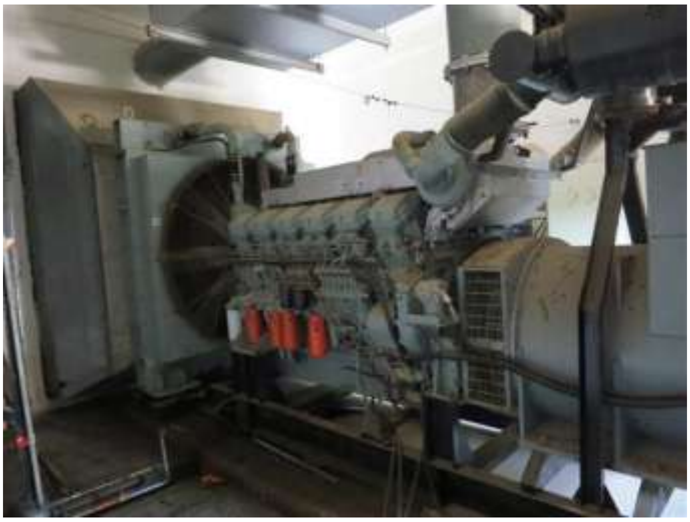

Figure 11 1280kV standby generator

Figure 12 500 kVA generator in kiosk

3.7 ODOUR CONTROL

Three areas of the plant are provided with dedicated odour control systems. These are:

- Intake pump wet well
- Screen house building
- Outfall pump wet well

The odour control for each section listed above consists of extracting the air with a fan, the dab discharges air through an activated carbon bed.

Activated carbon is an expensive substance to replace. The activated carbon systems were designed without air heaters, which results in the effectiveness and life of the activated carbon being reduced by humidity.

The sewage arriving at the works is generally fresh and not septic. Therefore Saida WWTP operations do not operate the odour control system unless there is very strong odour in the sewage. A strong odour can sometimes develop when local meat processing plants flush waste into the sewage.

There is significant odour observable at Saida WWTP site however this is not from the wastewater plant but appears to be from the onsite medical waste incinerator and the adjacent solid waste process facility.

Figure 13 Intake well Odour Control Unit (Activated Carbon)

Figure 14 Screen house odour control (to right of photo)

Figure 15 Outfall wet well Odour Control Unit (Activated Carbon)

3.8 LABORATORY

A Laboratory is provided which has the following equipment:

- High quality drying oven
- High quality furnace oven
- Balance Scales
- Fume cupboard
- Fridge
- Sink

Figure 16 Laboratory

3.9 EQUIPMENT LIST SUMMARY

A summary of the details for the key mechanical plant is presented in the table below:

Description	Type	Number	Regime	Manufacturer	Model	Design Details
Intake Pumps	Fixed Speed Dry Installed Submersible	5	Duty, Assist, Assist, Assist , Assist	Noma	KC7447-GU146	Flow 302 l/s ,Total Head 10.7, Motor 55 kW
Grit and screen Washwater pumps	Fixed speed Submersible	2	Duty/Standby			15 l/s @ 3 bar
Outfall Pumps	Variable Speed Dry Installed Submersible	3	Duty, Assist , Assist	Noma	KR787111-GU336	Flow 500 l/s ,Total Head 26 m , Motor 185 kW
Screens	Belt flat teeth screen	2	Duty/Duty	Sereco	GNPX 20-30-6	Channel Width 2m, Channel Height 2.25 m , Apperture 6 mm 758 l/s
Screw Conveyor			Duty	Sereco	TC11 SAX02-90	
Screening Compactor		1	Duty	Sereco	CTGC	1.22 m3/hr screening capacity
Grit Removal	Cross Flow Detritor	2	Duty/ Duty	?		Each 6 m diameter. Water depth 840 mm
Oufall						2190 m , 900 mm diamter discharge depth 25m
Standby Generator	Over sized not used	1				1280 kVA
Standby Generator		1				500 KVA

3.10 PLANT DESIGN PROBLEMS

Screening has been provided after the intake pumps. This is not good practice because the intake pumps themselves need protection from blockage by large objects. Ideally automatic coarse bar screening should have been designed upstream of the intake pumps.

To protect the intake pump the operator has had to install coarse manual mesh screens upstream of the intake pumps.

The tooth rake fine screen provided is not a robust reliable design, the raking teeth are made from plastic and many have broken. It is a very difficult and laborious job to replace any broken teeth, as all the rake teeth from a row have to be removed to replace just a single broken one.

The operator is considering replacing the rake tooth screens with two 10 mm raked bar screens, which would be located in the intake reception chamber. This solution would protect the intake pumps and be far more operationally reliable.

Figure 17 Fine Screen damaged by large objects

No means has been provided to enable the intake wet wells to be drained down and cleaned. A simple sump chamber with penstock should ideally have been provided next to the intake wet well which would allow full wet well drain down with a temporary submersible pump.

The odour control system uses expensive activated carbon. No air heating system has been provided on the odour control units and his results in the activated carbon being degraded very quickly by moisture. A lower operational cost odour control system should have been considered by the designers for example a simple biological packed tower scrubber, or the use of a hypochlorite scrubber.

The screen house odour control system for the screen house is futile because all the air for the activated carbon is intended to be extracted by a duct system at high level inside the roof of the building. However large side shutter doors of the building are left open to allow easy operator vehicle access, therefore no effective odour control is possible. The building is therefore redundant. A better solution would be to have no building but to have close fitting covers on the screen channels and on the screens and extract the much smaller volume of air under these covers to the odour control unit.

Figure 18 Screen house odour control futile with large open doors

The outfall has not been designed with sufficient consideration to allow a proper calibrated electromagnetic flowmeter to be installed.

The greatest design problem is the lack of design consideration and footprint for future treatment upgrade for primary settlement and for biological treatment. This is further discussed in section 4.1.2.

4 POTENTIAL POLLUTION REDUCTION IMPACT

4.1 EXISTING REMOVAL PERFORMANCE

The existing facilities at SAIDA provide only preliminary treatment of screening and grit removal of the raw sewage before it is pumped to a 2190m outfall.

The plant does not provide any direct load removal for parameters such as BOD, Suspended solids, Ammonia, Total Nitrogen or Phosphorus, and Coliforms. Significant load removal of these parameters requires the provision of primary settlement and by secondary biological treatment.

The purpose of the plant construction was to reduce bacterial and screenings pollution on the beaches in the Saida area. The reduction in beach coliforms is achieved by sea dispersion and by coliform degradation action of sunlight on the dispersed wastewater in the sea.

A single beach water sample is available for each of the years 2007 and 2013. In 2007 only 5000 m^3 of dry weather flow sewage was being screened and de-gritted before discharge to the outfall. By 2013 the new current proactive operator was running the WWTP and the treatment increased to the 14000 m^3/d dry weather flow.

The 2007 sample result is given as 244 faecal coliform (FC)/ 100 ml, while the 2013 sample taken on 12th May 2013 is 50 FC /100 ml. Although this appears to be an improvement there is insufficient data to demonstrate conclusive coliform improvement.

The provision of the screening certainly reduces sea and beach pollution by plastics and debris > 6 mm. The WWTP removes a trolley skip load of screenings every 8 hours during dry weather flow operation.

The WWTP plant removes approx. 1 m^3 of grit per day during dry weather flow conditions. The grit would not have significant environmental impact in the sea however if not removed could cause the outfall pipe to become gradually blocked and lead to additional wear on the outfall pumps.

4.2 CAPACITY FOR PLANT REMOVAL UPGRADE.

The WWTP plant has been constructed without a long term strategy for upgrading the pollution removal achieved by addition of future processes of primary settlement and future biological treatment.

Primary settlement would allow the removal of approx 50 - 60 % of the suspended solids, 25% to 35 % of the BOD and 25 to 75 % of the coliforms.

Secondary Biological treatment will remove 80-95 % of the BOD and a further 90% to 99 % of the coliforms.

The site on which the WWTP is located has a very limited foot print. A medical waste incinerator facility has been already constructed on the site further restricting the available foot print for additional wastewater treatment process facilities.

A large solid waste processing facility has been constructed between the WWTP and the sea. The facility restricted expansion of the WWTP. This facility however appears to have very large anaerobic digesters and generates power form the biogas, these could possibly be used beneficially to process thickened primary and secondary sludge.

The current available foot print will allow only primary settlement to be accommodated. The sludge produced by the primary settlement would need to be stored and thickened or dewatered on site. To reduce foot print demand the sludge would be mechanically thickened with outdoor drum thickeners or dewatered with a centrifuge.

Primary settlement for the full screened flow capacity of 1500 l/s would require settlement velocity of approx. 3 m/hr. A primary settlement area of 1800 m^2 would be required. If 4 circular clarifiers were used then the diameter of each clarifier would be 24 m each. The figure below shows the site foot print available with primary settlement tanks super imposed.

The existing hydraulic profile will not accommodate the addition of primary settlement before the existing outfall pump station. The provision of primary settlement will require lift pumps to return the primary settlement to the existing outfall pump wet well (called T2).

If the thickened primary sludge could be allowed to be anaerobically digested in the existing adjacent digesters then there is the potential to generate approx. 120 kW of electrical power based on the existing sewage flow rates.

Secondary biological treatment would typically use activated sludge with a biological aeration basin and secondary clarifiers for separation of the biomass and the final cleaned effluent. Smaller foot print biological treatment process such as moving bed bioreactors (MBBR) or Sequence batch reactors (SBRs) could also be used.

There will not be sufficient space on the existing available land to achieve biological treatment. Achieving biological treatment will require reclamation of land from the sea or pumped transfer of the screened, degritted and primary settled wastewater to another location.

Figure 19 Existing Site layout showing area for primary settlement tanks

Figure 20 Anaerobic Digesters on Solid waste treatment facility next to WWTP

5 CHALLENGES FACED BY VERIFICATION & VALIDATION EXERCISE

Excellent cooperation was provided by the site operation staff of the Saida WWTP. They made available all the design detail of the plant they had access to and provided the operating records. Site operation staff spent considerable time explaining the plant processes and areas of design weakness.

Unfortunately no design statement was available in the site records from the original designers and no plan for future development and upgrading of the process treatment is evident.

There is only a single seawater analysis result from the local beaches area, which claims that the long sea outfall provides significant reduction in beach pollution but this is difficult to verify.

6 CONTRACTUAL ARRANGEMENTS / PRIVATE SECTOR INVOLVEMENT

SAIDA WWTP was constructed in 2005. The funding for the project was provided by the Japan Bank for International Cooperation (JBIC). The consultants who designed the plant were NJS Consultants joint Venture which comprised Nippon Jogesuido Sekkei and TEI S.P.A.

The civil construction was executed by "The Arab Contractors Osman Ahmad Osman Co" from Egypt. The mechanical work was carried out by Subal Engineering (from Lebanon) and the electrical work carried out by Beta Engineering (from Lebanon).

The contract values for the networks, network pump stations and the treatment plant was approx. $37 Million USD.

The WWTP plant is under a new 3 year operations contract since September 2012 with a Lebanese company called Saba Makhlouf Company. The value of the contact is $2.5 million USD. Under the contract the cost of electricity and equipment is passed through to the Ministry of Energy and Water.

The operations contract consists of managing, operating and maintaining:

- Three network pump stations
- 35 km of sewage network
- WWTP at Saida

The operations team has 45 people working.

The tender documents for the operating contract were prepared by the consultancy GIZ of Germany. This is the first O&M contract paid for by the ministry of Energy and Water, previous O&M contracts were awarded by the Council for Development and Reconstruction (CDR).

The operator demonstrated to the technical expert strong technical competency. An example of the competency was the efforts to improve pump availability by creatively modifying the pump cooling system.

Although the WWTP plant construction was completed in 2005, it was for 7 years only accepting 8,000 m^3/d of sewage due to network deficiencies, WWTP blockages and lack of an effective operating contract. Appointing the Saba Makhlouf company as operator has resulted in the average treatment increasing to 22,000 m^3/d. The increase in treatment flow is largely attributable to the energies of the Saida WWTP plant manager, Joesph Kassab, and his team who investigated and resolved the network issues in cooperation with the Ministry of Water and Electricity with the full support of the South Lebanon Water and Wastewater Establishment and full cooperation of local authorities.

It is important to note that the core motivation for the plant manager Joseph Kassab to sort out the network issues and increase the WWTP treated flow is that he and his team are from Saida and they have a strong personal desire to improve the water quality of the Saida beaches.

7 MAIN LESSONS LEARNT

7.1 LESSON NO. 1: PLANNING FOR TREATMENT UPGRADE

The existing plant WWTP has a restricted foot print for future expansion. The existing hydraulic profile will not accommodate the addition of primary settlement without additional pumping.

When a new WWTP works is designed with only preliminary treatment (screening and grit removal) as a first step provided, then the design should include layout and hydraulic profile with the drawings showing how the plant can be upgraded in the future for primary settlement and biological treatment.

The planning for a WWTP should also include the future strategy for sludge disposal.

7.2 LESSON NO. 2: ADDRESSING NETWORKS

Although the Saida WWTP was constructed in 2005, its treatment capacity was severely restricted by network supply issues and by Saida WWTP blockages due to lack of coarse screening. These were only resolved in 2012 with the appointment of the present O&M contractor. The Saida WWTP will only reach its design capacity when the outline suburbs and villages for the Saida district are connected to the network.

When a new WWTP works is planned, the network system must be completed promptly to ensure that the WWTP is used efficiently.

7.3 LESSON NO. 3: SCREENING SYSTEMS AND LOCATION

The sewer systems in Lebanon are generally combined networks with storm surface water and foul sewage carried in the same sewer. Combined networks have large objects such as bricks, metal parts, and tree branches falling into the sewage system and these can cause damage to delicate screening, fine screening systems and to intake pumps.

The existing Saida WWTP plant has a single stage of fine screening which is frequently damaged by larger objects. The existing screening is located downstream of the intake pumps leaving the intake pumps unprotected.

Two stages of screening should ideally be provided. The first stage should be an automatically raked robust coarse bar screen of approx. 50 mm and the second stage should be a fine screen of 6-10 mm aperture.

7.4 LESSON NO. 4: MAINTENANCE FACILTIES

The existing plant has not been designed with enough consideration for maintenance. Areas that should be addressed by future designs include:

- Ensuring that cranes can reach all the heavy valves of the large pumps and not just the pumps themselves.
- All the large chambers and pump wet wells should have drain down facilities included in the design.

7.5 LESSON NO. 5: STANDBY GENERATOR SIZING

The plant was designed with a stand by generator sized at 1280 kVA, which is the power demand for the full pumping flow of 1500 l/s. Such a large generator sizing results in waste of fuel oil because the standby generator most often will operate at dry weather flow conditions of less than 300 l/s.

The Saida WWTP consumes approx. 9000 litres of fuel per month, costing approx. 9000 US dollars.

In Lebanon the standby generator will be frequently used due to lack of capacity in the power grid.

Standby generators should be sized for dry weather flow conditions. If power failure occurs during wet weather conditions then a gravity overflow should discharge excess flow directly to a nearby short outfall.

7.6 LEESON NO 6: SCREENING BUILDING

A building is not required for the screening plant. Odour control can be effectively provided by covering channels and screens with close fitting covers and extracting the small volumes of air to the odour control unit. This reduces the capital and operation costs and provides more effective odour treatment.

7.7 LESSON NO. 7: LOCAL OPERATORS

Using operating management and staff from the local area is advisable. Because the WWTP is designed to protect the environment of where they and their families live, they are strongly motivated to ensure that the network issues are resolved and that wastewater from the area achieves best treatment before discharge to the sea.

8 CONCLUSIONS & RECOMMENDATIONS

8.1 CONCLUSIONS

The WWTW at SAIDA provides effective preliminary treatment of screening and grit removal of the raw sewage before it is pumped to a 2190m outfall. The purpose of the plant construction was to reduce bacterial and screenings pollution on the beaches in the Saida area.

Although the Saida WWTP was constructed in 2005, its treatment capacity was severely restricted by network supply issues and by Saida WWTP blockages due to lack of coarse screening. These were only resolved in 2012 with the appointment of the present O&M contractor. The Saida WWTP will only reach its design capacity when the outline suburbs and villages for the Saida district are connected to the network.

The existing plant WWTP has a restricted foot print for future expansion. The existing hydraulic profile will not accommodate the addition of primary settlement without additional pumping. There is insufficient footprint allowance for a future conventional activated treatment for the removal of BOD, COD Nitrogen and Phosphorus. Future biological treatment will require land reclamation from the sea.

The existing plant has not been designed with enough consideration for maintenance.

8.2 RECOMMENDATIONS

When a new WWTP works is designed with only preliminary treatment (screening and grit removal) as a first step provided, then the design should include layout and hydraulic profile with the drawings showing how the plant can be upgraded in the future for primary settlement and biological treatment.

When a new WWTP works is planned, the network system must be completed promptly to ensure that the WWTP is used efficiently.

Using operating management and staff from the local area is advisable. Because the WWTP is designed to protect the environment of where they and their families live, they are strongly motivated to ensure that the network issues are resolved and that wastewater from the area achieves best treatment before discharge to the sea.

Two stages of screening should ideally be provided and not single stage screening. The first stage should be an automatically raked robust coarse bar screen of approx. 50 mm and the second stage should be a fine screen of 6-10 mm aperture.

Standby generators should be sized for dry weather flow conditions. If power failure occurs during wet weather conditions then a gravity overflow should discharge excess flow directly to a nearby short outfall.

A requirement for a detailed access and lifting review for all mechanical items of plant should be included in the tender specifications for future wastewater treatment plants.

A building is not required for the screening plant. Odour control can be effectively provided by covering channels and screens with close fitting covers and extracting the small volumes of air to the odour control unit. This reduces the capital and operation costs and provides more effective odour treatment.