high quality treated water
for agriculture
and renewal energy solutions

As Samra

wastewater treatment plant

a major asset for Jordan

ready for the resource revolution

SUEZ

a cornerstone of Jordan's water strategy

Population growth, water scarcity and increases in energy cost are a challenge for Jordan. To face these constraints, local authorities knew they needed to produce reused high-quality treated water for irrigation with a crucial on optimizing energy consumption.

The As Samra Waste Water Treatment Plant (WWTP) project meets these objectives; it is a success story in terms of wastewater treatment technologies, renewable energy, transfer of know-how, expertise, and above all, life improvement for the future generations in Jordan.

Awarded in 2003 through a competitive international tender and completed in 2008, the initial As Samra WWTP (Phase 1) was designed to treat the wastewater of 2.3 million inhabitants of Amman and its surrounding areas.

This extremely modern plant replaced the old polluted system of waste stabilization ponds, dramatically improving both the quantity and the quality of water available to the downstream agricultural areas up to the Jordan valley that rely heavily on treated water for irrigation purposes. What was once heavily polluted water just a few years ago, has now become one of the cleanest rivers in Jordan!

To address the needs of an ever-increasing population growth, the Government of Jordan decided in 2009 to expand the plant. The Ministry of Water and Irrigation awarded a new 25-year Build, Operate and Transfer (BOT) contract for the expansion of the As Samra WWTP. The contract entered into force on July 18, 2012 and the expanded plant is expected to meet the wastewater treatment needs of 3.5 million inhabitants of Greater Amman and surrounding areas.

an innovative project

- **Plant size**
  364,000 m³ per day, the largest wastewater treatment plant in Jordan
- **Public-Private-Partnership (PPP) / BOT**
  1st BOT co-financed project with private sector, in which USAID* (2003) and MCC** (2012) have ever taken part
- **Local banks**
  20-year commercial loan: the longest maturity that Jordanian banks have ever offered to-date for a Jordanian Dinar-denominated limited-recourse loan
- **Environment**
  1st fully environmental project including transport, wastewater treatment, reuse of wastewater related resources (water, sludge, biogas, hydro energy)
- **Energy efficiency**
  1st wastewater treatment plant close to be fully energy sufficient in the world

* United States Agency for International Development
** MCC is a US foreign aid agency that provides large scale grants to fund sustainable economic growth and poverty reduction.

a sound and sustainable project

70 %
of the wastewater treated in Jordan
The plant treats more than 70% of the total wastewater treated in Jordan and the discharge from numerous septic tankers unloading in the Ain Ghazal pre-treatment plant.

80 %
energy self sufficiency
Through hydro energy and biogas production, the WWTP has an energy potential recovery of 80% of its needs, only 20% is drawn from the national grid.

300,000
tons
of CO_2 saved per year thanks to production of renewal energies.

10 %
of water consumption in agriculture come from the WWTP
The plant produces reusable treated wastewater for agriculture usage which represents approximately 10% of the water consumption in Jordan, freeing up fresh water for more valuable uses.

133
million m³ per year of high-quality water produced
A very high-quality water is produced in compliance with international effluent standards through professional operation and maintenance.

230,000
kWh
of green energy produced per day.

a success story at a glance

- **As Samra WWTP Phase I**
  - 25-year BOT contract signed in 2003 with the Government of Jordan
  - Plant capacity 267,000 m³/day
  - Construction completed in 2008
- **As Samra expansion (Phase II)**
  Extension contract signed in 2012
  - Water line capacity increased by 37% : bringing the total capacity at 364,000m³/day
  - Sludge line capacity increased by 80% + mechanical dewatering for phase I & II
  - Extend its operation until July 2037
- **project benefits**
  - complete financing from local banks
  - stable and optimized tariff
  - non recourse financing in local currency
  - differed payment after construction
  - full control for the customer
  - operational efficiency due to endogenous energy production
  - reduction of toxic gases emission
  - protection of ground water
  - local employment

the Plant

designed with the latest degremont® technologies and know-how

Wastewater produced by Amman Russeifa-Zarqa Basin is conveyed to As Samra WWTP through 3 units: Ain Ghazal pretreatment plant, West and East Zarqa pumping stations.

1- Raw water inlet
2- Primary settling
3- Biological treatment
4- Clarification
5- Final disinfection
6- Primary sludge thickening
7- Activated sludge flotation
8- Anaerobic digestion
9- Mechanical dewatering system
10- Biogas holders
11- Gas power generation
12- Odor control

water treatment line

raw water inlet (1)

- The raw water from Ain Ghazal pretreatment facility flows through a Ø 1,500 mm pipe into two Pelton turbines to produce electricity. The net head between Ain Ghazal and As Samra is around 78 m
- The turbines outlet joins the incoming wastewater from Zarqa and Hashimiyya pumping stations. The flow is distributed into two grit and sulfide removal tanks

pretreatment & primary settling (2)

- Two grit removal tanks (19.6 m x 13.0 m) with a unit volume of 1,535 m³ and an average hydraulic residence time (HRT) of 16 minutes
- Two sulphide removal tanks, each tank consisting of two aerated zones in series, each zone has a capacity of 2,300 m³. Ferric chloride is injected as a catalyst for sulphide removal
- A primary settling into five tanks
  > four tanks of 67 m x 25 m each
  > one tank of 80 m x 25 m

biological treatment (3)

Eleven biological reactors (26,200 m³ each) consisting of three different treatment zones (two oxic* zones and one anoxic** zone):

- Denitrification in the anoxic zone
- Carbon removal and nitrification in the oxic zone 1
- Nitrification in the oxic zone 2

* Oxic zone = in presence of oxygen (aeration)
** Anoxic zone = absence of oxygen

clarification (4)

- The effluent of the activated sludge process is distributed into eleven secondary clarifiers, of Ø 54 m each. Biomass and suspended solids settle. Biomass and suspended solids are settled, and recirculated to aeration tanks. Excess sludge is pumped to flotation units for thickening

chlorination (5)

- The clarified effluent of the secondary settling tanks flows to nine plug flow chlorine-contact tanks for its final disinfection

WATER QUALITY			
Inlet		Outlet	
BOD_5	637 mg/l	BOD_5	5-30 mg/l
TSS	649 mg/l	TSS	15-30 mg/l
TN	100 mg/l	TN	15-30 mg/l

sludge treatment line

thickening

- Primary sludge from the primary settling tanks is thickened in six covered circular thickeners, Ø 23 m each **(6)**
- Biological sludge from the aeration tanks is thickened in five covered Dissolved Air Flotation (DAF) units, Ø 18 m each **(7)**

digestion

The two types of thickened sludge are mixed in two covered tanks of 98 m³ volume before to be pumped and introduced in seven anaerobic digesters of a capacity of 15,900 m³ each. **(8)**
In the digesters, the sludge is mixed thoroughly by Cannon®mixers using the recycled compressed biogas. The sludge stays three weeks at 35°C in the digesters. Heating is done by hot water recovered from the cooling of the engines in a shell-Tube heat exchanger

dewatering

- The sludge is then dewatered on sixteen belt-filters press (18% dry solids) **(9)**

drying

- The dewatered sludge is transported to 18 solar drying beds to reach 50% dry solids

biogas production

The Biogas produced in the digesters is stored in four gas holders: **(10)**

- 2 gas holders of 5,000 m³ capacity each
- 2 gas holders of 4,000 m³ capacity each

It undergoes H2S removal before being used in 10 Biogas engine generators set for the production of electricity. **(11)**

odour control

The plant is designed to ensure that no odor nuisance occurs at the site boundary. Odors are extracted from different places of the plant preventing the emission of unpleasant smells and providing satisfactory working conditions.
The polluted air is treated in a gas scrubber system **(12)** containing a special inert medium, the Biolite, on which naturally present bacteria are fixed. The air to be treated is pulverized with water on the top of the chamber and percolates on the Biolite. The fixed bacteria purify the air using the air pollutants in their metabolism.

power production

The wastewater passes through Pelton turbines at the inlet of the plant and Francis turbines at the outlet. Thanks to these hydraulic turbines, the available hydraulic potential energy is converted into mechanical energy and then into electrical power.
Close to 80% of the plant's energy requirements are met using the endogenous energy resources:

- Inlet Pelton turbines / 1.7 MW
- Outlet Francis turbines / 2.5 MW
- Biogas power generator / 9.5 MW

because health, safety and environment matter, the As Samra WWTP achieved

4 certifications

OHSAS 18001 (Health and Safety)

Certification obtained in 2013
As the safety of the public and staff is a top priority, the best industrial practices are applied to reduce and mitigate the residual risks associated with treatment activities. Methods and management aim to ensure and promote a safety culture for everyone.

ISO 50001 (Energy)

Certification obtained in 2014
This approach enables to limit the economic impact of the sharp increase in the price of electricity in Jordan (+15% annually until 2017) by working both on reducing electricity consumption and on optimizing production (the plant produces energy through the biogas system and hydraulic turbines).

ISO 14001 (Environment)

Certification obtained in 2013
The very nature of SUEZ's activities means it is a key player in protecting the environment. The group has chosen to make this challenge a key driving force for its development. Faced with the increasing scarcity of water resources and risk of pollution to them, it supports its customers in a continuous improvement process, with a view to providing them with sustainable and economically viable solutions.

ISO 9001 (Quality Management System)

Certification obtained in 2009
The principle of continuous improvement relies on a single mechanism defined at every level of the company, enables a concrete assessment to be made in terms of know-how and potential. In this way, it is a vehicle for rapid progress, which is completely consistent with the market's needs and the Group's strategic vision.

a major asset

The As Samra WWTP is part of a global strategy, aimed to support the development of Jordan's economy. This project will undoubtedly help Jordan to propel itself into the third industrial revolution era. At the time that resources scarcity has to be taken into account in the new global economy, SUEZ and its partners act as pioneers at the dawn of this new era.

Tangible benefits for Jordanians:

controlled recycling water for irrigation

high-quality of treated water reused for irrigation
The As Samra WWTP provides high-quality treated water which relieves the natural resource flows for crops for irrigation in the Jordan Valley, which are recognized for their quality. Besides, the recovery of potential biosolids by-products of the plant is also one of the targets of the Jordanian authorities.

employment & transfer of know-how

local individuals are promoted
The Samra Project Company recruits staff almost exclusively from Jordan, giving priority to those in local communities. Careers are closely monitored and all employees attend targeted skill improvement programs. This guarantees the highest expertise level for its operations.

tariff affordability

the low cost treatment is part of the strategy to boost the economy
The participation of international donors and the Millennium Challenge Corporation, together with the innovative financing and the plant's energy recovery features, contribute to make the treatment cost more affordable for the country.
The total cost of treatment per cubic meter is the lowest in Jordan.

210
permanent local employees

Up to 2,500 employees during construction phases

Fish is back to Zarqa river

The restoration of the Zarqa River quality is a top priority for Jordan's Ministry of Environment and a key element of the country's long-term water resource management strategy.
The Zarqa river quality was significantly improved since the commissioning of the As Samra WWTP. The plant has a positive effect on the irrigation practices and on the enhancement of wildlife and its habitats.
Now fish is back! which is as a sign of water quality improvement.

SUEZ

Since mid 2015, Degrémont, Ondeo IS and all the companies of the Group have changed brand to SUEZ.
Hence, from now on, SUEZ designs, builds and operates for its municipal and industrial customers, degremont® plants, systems, process and technologies.

a valuable partner structuring a successful project

SUEZ's water treatment specialists create the best technological, commercial, financial and contractual solutions to address its clients' requirements.

Project management professional team

Having wastewater treatment experts in design, build, equipment and operation, SUEZ is able to draw on the particular skills of its employees for each project to:

- provide adequate partnerships and contractual frameworks
- achieve good management of complex long term contracts combining the interests of an asset owner, a construction company and a plant operator
- sensitively manage stakeholders in a long and complex process of designing, financing, building and operating major infrastructure projects.

Operation & Maintenance legitimacy

The operation and maintenance of a wastewater treatment plant such as As Samra WWTP, requires skills of top-level specialists. The Samra Project Company benefits from global expertise of its sponsors in various fields like: management, water treatment technologies, funding, community relations and communication, health and safety, quality, crisis management, etc..., these knowledges constitute the legacy of more than half a century of operations around the world.

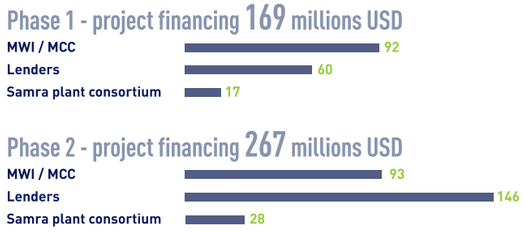
Shared value for customer and local stakeholders

SUEZ always puts customers and stakeholders needs at the heart of the process.
To meet the As Samra project needs, SUEZ's teams implemented original solutions – not only from a technological, but also a financial, contractual and logistical standpoint. Thanks to their expertises, the As Samra WWTP is now a reference in termes of:

- a high performance service
- an affordable tariff for the country and the community
- attractive deal for the banks

Viability Gap Funding

The As Samra WWTP is the first wastewater treatment facility in the Middle East to use a combination of private, local government and donor financing. Closing the financing of the expansion proved the feasibility and demonstrated the significant benefits of combining private sector financing with grand funding in a scheme referred to as Viability Gap Funding
By bringing down the capital costs, the grant funding enabled the project to be financially viable, thus benefiting the government and local rate-payers, without subsidizing the private sector
Recognized by several international financial organizations, the As Samra innovative financing has set-up a new template for Viability Gap Funding. This new mechanism provides a significant leverage to the financial assistance of international donors



presence in Jordan

It all started back in the 1950s. At that time, the city of Amman witnessed a population growth of over 2.9% per year. This sustained growth gradually led to 60% of the Jordanian population settling in Greater Amman; and where there is population growth, there is an increased need for water and sanitation.
Another fact that worsened the prevailing outlook at the time was that Jordan could only access 145 cubic metres of water per person per year.
In this tense climate, with a glaring imbalance between the nature of sanitation facilities, water distribution and urban growth, the first steps toward cooperation between SUEZ and the Hashemite Kingdom were taken.
From that perspective, 1997 was an undisputed milestone, marking a before and after in the history of the Transjordan region. SUEZ won the call for tender launched by the Jordanian government to modernise and manage the capital's public water distribution and sanitation services, via a management contract. It was the start of a long-standing collaboration, filled with successive challenges and repeated success stories.
As the 20th century neared its end, a great challenge lay ahead: to supply the capital with water and improve water distribution against a background of water stress, water scarcity and population growth.
Between 1999 and 2006, SUEZ was responsible for managing the distribution of water in the Amman region through its subsidiary LEMA.
At the end of the contract with the Jordanian Water Authority in December 2006, the results achieved by SUEZ spoke volumes: improved quality and reliability of water supply and the full transfer of the water service operator's management. But in such a harsh environment, the major challenge faced by SUEZ is to fully harness the potential of water treatment with a view to its reuse in agriculture; from this perspective wastewater recycling is an essential part of the water system in Jordan. Designed to treated water of excellent quality so as to reduce the use of drinking water in the agricultural and industrial sectors, the As Samra WWTP is almost self-sufficient in energy.

DISI (Amman water supply project)

- **Extraction and conveyance of water** from Dubaydib aquifer (South of Jordan) to Greater Amman
- **BOT contract** started in 2009
  - Design and Build (DB) by DIWACO (GAMA Turkish Group & General Electric) – 4 years
  - Operation & Maintenance (O&M) by DAOM (SUEZ) since 2014 – 25 years
- **2 main sites:** Madaba Bridge Site (MBS) and Mudawarra Site (MUS)
- **A key project for Amman**
  - 100 million m3 conveyed per year to Amman
  - 60 staff members (58 Jordanians) and 180 staff members from full-time subcontractors

Wadi Ma'in desalination plant

Design-Build-Operate Contract
The Wadi Ma'in, Zara, and Mujib Water Treatment Plant and Conveyance Project, was considered as a very critical project by the government of Jordan, as people in Amman may use tap water only one day per week. This brackish water RO plant has a capacity of 128.000 m³/d, one of the largest in the world. The plant is located near the Dead Sea, the treated water is conveyed via a 40-kilometer pipeline and multiple pump stations to Amman.
This contract awarded in 2003 to the Consortium SUEZ (Infilco Degremont), The Morganti Group, Inc and Metcalf & Eddy, was successfully completed in 2007.

key stakeholders

- **Client**
  Government of Jordan represented by the Ministry of Water and Irrigation

- **Project companies**
  Samra Wastewater Treatment Plant Company and Samra Plant Operation and Maintenance Company

- **Sponsors**
  SUEZ and the Morganti Group – Consolidated Company

- **Donors**
  USAID: the lead U.S. Government agency that works to end extreme global poverty and enable resilient, democratic societies to realize their potential.
  Millennium Challenge Corporation (MCC): an innovative and independent US foreign aid agency that is helping lead the fight against global poverty.

- **Lenders**
  Lender syndicate of ten local banks led by Arab Bank

- **Beneficiaries**
  Amma, Zarqa and Al Hashimiyya populations, as well as farmers irrigation crops with King Talal Reservoir water and along Wadi Zarqa

contacts

www.degremont.com

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