IESE Business School
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PPP for CITIES
Specialist Centre on PPP in Smart and Sustainable Cities

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PPP FOR CITIES CASE STUDIES

NEW CAIRO WASTEWATER TREATMENT PLANT (EGYPT)

Jordi Salvador, Francesc Trillas,
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With the collaboration of Aqualia
Economic impact assessment by INECO

November 2016

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PPP FOR CITIES

The Specialist Centre on PPPs in Smart and Sustainable Cities (**PPP for Cities**) is a research, innovation and advisory center that aims to provide public administrations throughout the world with support in the organization, management and development of projects involving collaboration between the public and private sectors in the smart cities arena.

It is also a partnership platform between companies and administrations from all over the world where they can further explore the dynamics of public-private partnerships, create guides to good practices and standards and design solutions to the issues facing cities.

The center is led by IESE Business School and is part of the United Nations' International Centre of Excellence on PPPs program. It has the support and sponsorship of Barcelona City Hall and other public administrations and private companies.

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Highlights

Urban wastewater treatment plant with an average daily flow of up to 250,000 m³ per day. Capacity to serve more than 1 million residents, the expected population increase of New Cairo at the time the project was designed.
First successful public-private partnership (PPP) project in Egypt.

A drinking water shortage was identified as a pressing issue in Egypt's environmental sustainability, particularly in very densely populated areas. The existing wastewater treatment infrastructure did not produce water with adequate levels of quality to enable the water to be used to irrigate agricultural and urban green areas, forcing freshwater to be used instead. The government decided to build new infrastructure to reuse urban wastewater for the purposes mentioned, thereby reducing freshwater use. In addition, the project would reduce the water pollutants entering the River Nile.

Awards received by the project:
- Water Deal of the Year, awarded by Global Water Intelligence in 2010
- PPP African Deal of the Year, by Euromoney/Project Finance magazine in 2010
- Bronze Award – Middle East and North Africa, by Emerging Partnerships in 2013

Location: City of New Cairo, Egypt.

Characteristics of the PPP contract

Project type: Large-scale, greenfield urban wastewater treatment plant
Project capacity: Average daily flow of 250,000 m³ per day
Delivery mode: Design, build, finance, operate, transfer (DBFOT)
Private investment:*US$140 million
PPP contract value:**US$482 million for 20-year concession
Final cost: No change compared to the bid price
Expressions of interest request: October 2007
Bidding invitations: December 1, 2008
Publication of final tender documents: February 15, 2009
Bid submission deadline: March 31, 2009
Contract start: June 29, 2009 (Financial closure: February 3, 2010)
Contract end: June 28, 2029
Payment method: Payment based on a sewage treatment charge including a fixed payment coverage (investment, debt, RoE and fixed operating cost) plus variable operating charge based on volume of treated sewage (m³)
Duration: 20 years (construction two years & operation 18 years)
Contracting authority: New Urban Communities Authority (NUCA), www.newcities.gov.eg/english/default.aspx

*Investment in infrastructure construction.

**Total cost of the New Cairo wastewaster treatment plant including operational costs over a 20 year period.

Award-winning company

Award-winning consortium: Orasqualia for the Development of the Wastewater Treatment Plant SAE (hereinafter referred to as “Orasqualia”)
Members: Aqualia New Europe (ANE) (50% share), www.aqualia.es & Orascom Construction Industries SAE (OCI) (50% share), www.orascom.com
EPC* contractor: Aqualia Infraestructuras (50%), www.aqualia-infraestructuras.com & Orascom Construction Industries (50%) www.orascom.com
O&M** contractor: Aqualia (50%) & Orascom Construction Industries (50%)
Lenders & lead arrangers: National Société Générale Bank SAE (NSGB), Commercial International Bank (Egypt) SAE (CIB), Arab African International Bank SAE and Ahli United Bank (Egypt) SAE
Advisory (NUCA): International Finance Corporation (financial and lead adviser), Parsons Brinckerhoff (technical adviser), & Gide Loyrette Nouel (legal adviser)
Advisory (developer and lenders): Baker and McKenzie (Orasqualia) and Zulficar & Partners (project lender)
Facility agent: National Société Générale Bank SAE (NSGB)
Security agent: Commercial International Bank (CIB)

* Engineering, procurement and construction.

** Operations and maintenance.

1. Background of the Project

In 2006, the government of Egypt adopted a new long-term policy to increase the involvement of private firms in the country's economic development as a source of capital financing and know-how. The aim of the new policy was to expand the much-needed investment in infrastructure within the country.

The New Urban Communities Authority (NUCA) was the agency in charge of developing new areas and redistributing the population far from the narrow strip of the Nile valley. The authority led the New Cairo Wastewater Treatment Plant (WWTP) project. The plant was designed to:

- Reduce the use of freshwater for tasks such as irrigating agricultural and urban green areas.
- Limit the volume of polluted water dumped into the river with consequent negative effects on human health and the ecosystem.

Before the New Cairo plant was in operation, wastewater was emptied into the river, which had significant negative effects on the river's ecosystem and public health.

The new infrastructure, as well as improving water treatment and increasing freshwater availability, will allow the compost from the wastewater sludge to be used as agricultural fertilizer.

The PPP project provided private investment capital, reducing the Egyptian government's pressure on public finances.[1] That said, it is important to recall that the government should include liabilities deriving from the project in its balance sheet for payment commitments during the whole project period. PPP frameworks should not be used to hide government liabilities.

To promote the involvement of private companies, Egypt's Ministry of Finance decided to establish the Public-Private Partnership Central Unit.[2]

The project was Egypt's first successful public-private partnership (PPP) project.[3] At that time, Egypt did not have a specific PPP law. Public procurement in Egypt was regulated according to Tender Law No. 89 adopted in 1998 (the public procurement law) and its executive regulations (secondary legislation).[4]

It was not until August 2010 when the government brought in a specific PPP law, Law No. 67, regulating Partnership with the Private Sector in Infrastructure Projects, Services and Public Utilities,[5] that Egypt adopted legislation to provide regulatory and legal support to the parties involved.

The New Cairo Wastewater Treatment Plant (hereinafter referred to as the "Project") is a plant located in New Cairo, a city created in the southeastern part of Cairo in 2000 in a former desert area, to ease problems deriving from an overcrowded capital.

One of the main challenges faced by the new city was the shortage of drinking water due to the harsh environmental conditions.

The purpose of the urban wastewater plant was to treat regular urban wastewater in New Cairo, Madinaty and El Mostakbal.

The New Cairo WWTP operation has two main consequences:

- An increase in the availability of drinking water (since treated water would be used for irrigation purposes instead of freshwater)
- A reduction in the environmental impact of the wastewater discharge into the River Nile (with a direct positive impact on human health and the river's ecology).

The Project company, Orasqualia, was named after the two shareholders of the special purpose vehicle (SPV) – Aqualia (replaced by Aqualia New Europe in February 2015) and Orascom Construction Industries (subsequently renamed OC), each of the shareholders

[1] As a basic rule, the PPP assets are to be classified in the partner's balance sheet and not in the government balance sheet,only if certain stated conditions are met. European Commission (2014). Manual on Government Deficit and Debt – Implementation of ESA 2010. [Online]. Edition 2014. Luxembourg: Publications Office of the European Union, 2014. [4 November 2016]. Available from: http://ec.europa.eu/eurostat/documents/3859598/5937189/KS-GQ-14-010-EN.PDF/

[2] The PPP Central Unit has no executive powers and it has limited influence over decision-making bodies. Available from: www.pppcentralunit.mof.gov.eg/Content/Home/Pages/Home_en.aspx

[3] IFC Advisory Services (2013). New Cairo Wastewater Treatment Plant Is Egypt's First Public-Private Partnership. Stories of Impact series. June 2013. Available from: http://www.ifc.org/wps/wcm/connect/48e1bd0040f6e56c952bff25d54dfab3/StoriesOfImpact_EgyptNewCairoWastewater.pdf?MOD=AJPERES

[4] European Bank for Reconstruction and Development (2012), Commercial Laws of Egypt: An Assessment by the EBRD, October 2012. Available from: http://www.ebrd.com/downloads/sector/legal/egypt.pdf

[5] The law was passed more than one year after the New Cairo WWTP contract was signed. Translation of the Law No. 67 for the year 2010. Promulgating the law regulating Partnership with the Private Sector in Infrastructure Projects, Services and Public Utilities. Available from: http://www.pppcentralunit.mof.gov.eg/Content/Legislation/Documents/LawNo67fortheyear2010.pdf

have 50% of the shares in the consortium. Aqualia New Europe (ANE) is a joint venture between Aqualia (51%) and the European Bank for Reconstruction and Development (EBRD) (49%).

Source: Document provided by Aqualia.

The construction process started in March 2010 and lasted for 26 months, until May 2012. The construction period finished with a delay of only two months despite the turbulent political situation of 2011.

The subsequent delay in the operation period resulted from problems deriving from the quality of the outflow during the commissioning period. During this period, NUCA did not accept, as is the common rule, any discharge of water of a quality outside the parameters established in the contract.

This situation forced Orasqualia to construct (at its own cost) a 2 km pipe with a 1.3 m diameter from the New Cairo WWTP to the Hassan Allam Wastewater Treatment Plant for further treatment during the commissioning period.

Construction on the pipe lasted from April to June 2013, which meant it was ready when the New Cairo WWTP started to operate in July 2013. The plant managed to achieve the outflow in accordance with legal standards after only three months of operations instead of the expected six months.

The plant started its service in October 2013, 16 months after construction finished. However, it was using only one biological treatment line out of the six lines constructed (each of them with a capacity of 41,500 m^3 per day). The reason was that the forecast urban development for New Cairo did not materialize due to several reasons including economic growth moderations and political instability, which limited the sewage water inflows into the plant.

The flow rate reached in the New Cairo WWTP was as follows:

Table 1: Flow rate (m^3 per day)

	AVERAGE	MINIMUM	MAXIMUM
December 2013	34,648	25,944	44,496
December 2014	40,045	30,987	50,678
December 2015	38,899	30,462	43,059
June 2016*	33,625	26,525	41,160

*Latest available data.
Source: Document provided by Orasqualia.

To keep the plant in the right operating conditions during the whole period at the current levels of inflow, every four years Orasqualia changes the line it uses in the treatment process while at the same time it carries out the corresponding preventive maintenance work on all six lines.

2. Tender Process

The government of Egypt invited companies to participate in a tender to design, finance, build and operate the wastewater plant within a PPP framework in which the private company would bear some of the associated risks.

The International Finance Corporation (IFC) of the World Bank worked as an adviser to the Egyptian government in the process.

During the prequalification phase, there were meetings between the contracting authority (NUCA) and the bidders in order to discuss the tender documents and suggest improvements to the tender design. Several suggestions made by the bidding companies were accepted and added to the Amended Tender Documents.[6] The procurement method of the New Cairo WWTP was an international open tender with a previous prequalification stage.

The five qualified bidders were:

All firms participating in the tender had previous experience in wastewater treatment plant PPPs. Orasqualia, the SPV made up of Orascom and Aqualia, was awarded the contract. The bidder ranked number two was the Kuwaiti company Mohammed Abdulmohsin

[6] Instructions to Bidders. Contract for the Availability and Operation of Watstewater treatment Plant in New Cairo through Public Private Partnership. February 15th, 2009 (hereinafter Instructions to bidders) and Contract for the Availability and Operation of Wastewater treatment Plant in New Cairo through Public Private Partnership. June 29th, 2009 (hereinafter PPP Agreement).

Table 2: Qualified bidders

BIDDERS	PREQUALIFIED CONSORTIA	COUNTRY
Bidder 1	Orascom Construction Industries	Egypt
	Aqualia	Spain
	Aqualia Infraestructuras	Spain
Bidder 2	Mohammed Abdulmohsin Al-Kharafi & Sons Company (MAK Group)	Kuwait
Bidder 3	Samcrete	Egypt
	Befesa CTA	Spain
	Emasesa	Spain
	BDDC	Bahrain
Bidder 4	AAW Utilities	Egypt
	Veolia Water	France
	Intech (International Environmental Technologies)	Egypt
Bidder 5	Metito Berlinwasser	Germany & UAE
	Metito Projects	UAE
	ECG (Engineering Consultants Group)	Egypt
	Hassan Allam Sons	Egypt

Source: PPP Central Unit, Egypt's Ministry of Finance. Available from: http://www.pppcentralunit.mof.gov.eg/Content/Projects/Pages/New%20Cairo%20Wastewater%20Treatment%20Plant.aspx, last accessed November 2016.

Al-Kharafi & Sons Company (MAK Group). The latter, at the time of bidding, was already operating a sewage treatment plant in Egypt with a capacity of 12,000 m^3 per day at the resort development of Port Ghalib, completed in 2003.

The main two reasons for Orasqualia's success were:

- The technical proposal complied with all the requirements of the instructions for bidders and its quality was considered to be appropriate.[7]
- The consortium presented the lowest financial proposal with a suitable financial structure.

It was thanks to the two SPV firms' previous experience, not only in Egypt but also in other countries, that both conditions were achieved.

Examples of their expertise were:

- Aqualia: Design, construction and operation of the Arroyo Culebro WWTP in Madrid (130,000 m^3 per day), operation of the Oviedo WWTP (170,000 m^3 day) and that of Río Lagares (Vigo, Spain)
- Orascom: Work on the Hamma Seawater Desalination Plant in Algeria (200,000 m^3 per day), the Greater Cairo Metro line 3 and El Ferdan Double Swing Rail Bridge in Egypt.

Additionally, Orascom Construction's deep knowledge and experience of the Egyptian market contributed to a better project analysis and cost forecast.

Source: Document provided by Aqualia.

[7] This is structured as a "pass/fail" stage of the process with no specific scores.

3. The Project's Internal Characteristics

3.1. Members of the Award-Winning Team

Aqualia

Aqualia started its operations in 1980 and it is a company within the FCC Group. The group's three main business areas are environmental services, water and infrastructure.

Aqualia is the group's water management company. It has a presence in 21 countries, serving more than 22.5 million people in more than 1,100 municipalities. It has 7,764 employees as of September 2016.

The company is the leading company for full water cycle management in Spain, the third-largest such company in Europe and the sixth worldwide. In 2015, Aqualia's revenues amounted to €1.03 billion.

Besides providing services in the municipal market, Aqualia has significant experience and a track record in the EPC and O&M sectors. It has successfully executed more than 700 projects in these sectors in Europe, Latin America, the Middle East and North Africa.

Orascom Construction Industries

Orascom Construction Industries is an engineering and construction contractor company founded in 1950 in Egypt. Now the company is focused on infrastructure, industrial and high-end commercial projects in the Middle East, North Africa, the United States and the Pacific Rim for public and private-sector clients.

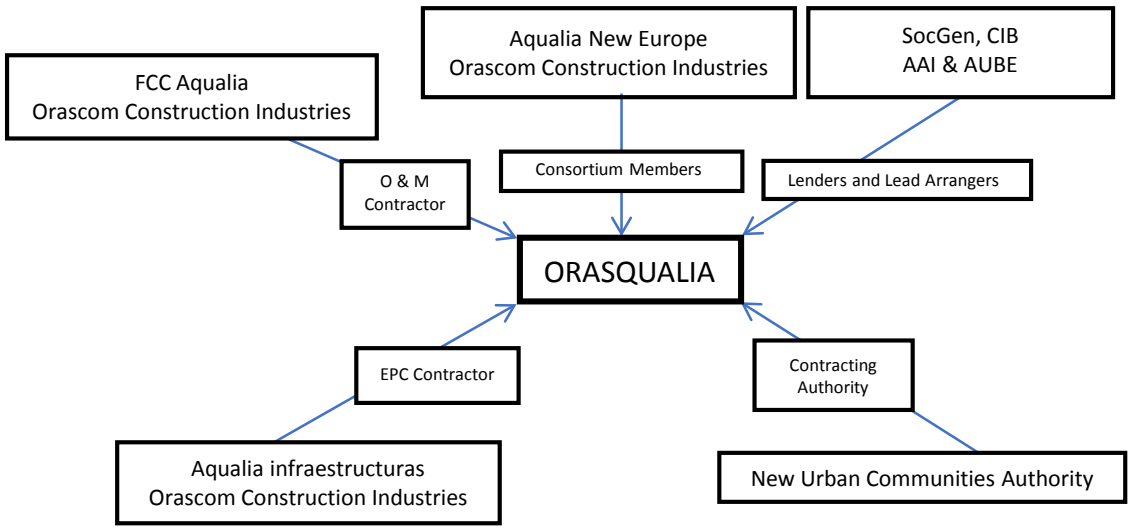
The group is active in different business areas, being the builder, owner and operator of infrastructure assets. The company is focused on infrastructure investment opportunities "to provide recurring cash flows and growth" and secures "funding through nonrecourse project financing, leveraging the group's experience and relationships with local and international financial institutions."

3.2. SPV Created for the Project

Orasqualia is the SPV created for the New Cairo WWTP project. Aqualia and Orascom Construction own it, each of them holding 50% of the shares.

The figure below summarizes the links the SPV established with its partners.

Figure 1: SPV structure



Source: Document provided by Aqualia.

3.3. Finance and Funding

In 2006, the government asked the Public-Private Infrastructure Advisory Facility (PPIAF) for funding of $75,000 to prepare an assessment for the plant procurement method. PPIAF recommended the use of a PPP framework to carry out the project.

Two of the main difficulties experienced by the consortium were derived from the absence of a specific PPP law (one was approved a year after financial closing) and the limited experience of Egypt's public administration in PPPs.

The New Cairo plant mobilized private investments totaling $140 million.

The SPV was created on April 9, 2009, for the PPP agreement with registered capital in Egyptian pounds of E£250,000 ($45,704). The registered capital was increased to E£5,250,000 ($952,813) on September 17, 2009, and to E£59,250,000 ($10,871,560) on December 3, 2009,[8] to satisfy the debt-to-equity ratio required by banks as the debt increased.

On December 31, 2010 the registered capital was 80,250,000 EGP[9] (13,812,392.43 USD) with profits amounting 335.482 EGP (57,742.17USD). On December 31, 2014[10] and 2015 the registered capital was 236,000,000 EGP (33,006,993.01 & 30,140,485.31 USD).

The debt, structured as project finance without recourse, amounted to E£566 million[11] ($103.47 million) in two tranches:

- E£550 million ($100.55 million) in the form of a long-term facility (15 years) to finance up to 70% of the Project's investment cost (EPC cost) (estimated at E£785.2 million, then worth $143.55 million). The remaining 30% was in equity of the SPV.
- E£16 million ($2.93 million) in the form of operation performance letters of guarantee to be issued during the operation period.

The banks acting as lenders were National Société Générale Bank SAE (NSGB)[12] (32.99%), Commercial International Bank (Egypt) SAE (CIB) (32.77%), Arab African International Bank SAE (17.12%) and Ahli United Bank (Egypt) SAE (17.12%).

The banks had a step-in right and a pledge regarding the SPV shares acknowledged in the PPP agreement by all the parties involved under specific circumstances.

The annual interest rate applicable to the first tranche of financing was the corridor rate for overnight deposits announced by the Central Bank of Egypt two business days before the start of each interest period plus three percentage points.

The loan agreement included standard financial covenants for the Project company (e.g., debt-service coverage ratio and debt-to-equity ratio maximum values and restrictions on the distribution of dividends at the Project company level).

3.4. PPP Payment Method

Orasqualia issues a quarterly invoice for the wastewater treatment service, the so-called sewage treatment charge. The invoice is structured with four different payment parameters:

1. Capacity charge – a fixed payment covering:
    a. Total investments made in the design, construction and start-up of the plant and the capital expenditure required during the operational period
    b. Debt service costs including interest payments and any other fees stipulated in the financing agreement
    c. Return on equity
    d. Insurance premium for the required insurance policies
2. Fixed operating charge – a fixed payment covering the operating costs that are not volume-related
3. Variable operating charge – covering variable operating costs per cubic meter (m^3) of effluent (with the exception of the electricity consumption cost)
4. Pass-through charge – reimbursement of the full cost of electricity (up to a maximum electricity consumption proposed in the bid by the award-winning consortium)

Additionally, any applicable sales tax will be charged.

[8] The exchange rate was E£5.47 to the U.S. dollar on April 10, 2009, E£5.51 on September 17, 2009, and E£5.45 on December 4, 2009.

[9] The rate was E£5.81 to the dollar on December 30, 2010.

[10] The rate was E£7.15 to the dollar on December 26, 2014, and E£7.83 to the dollar on December 31, 2015.

[11] Financial closing was February 3, 2010. On February 5, 2010, the exchange rate was E£5.47 to the dollar. On July 28, 2016, it was E£8.89. Source: Google Finance.

[12] Sold to Qatar National Bank by Société Générale on March 28, 2013.

Table 3: Payment structure

Payment System	Concept	Details
Based on volume of treated sewage (m^3)	Variable operation charge	Indexed to inflation (updated annually)
Based on availability	Fixed operating charge (not volume related)	
	Capacity carge (Amortizations of total invetsment and capex, Debt service, RoE & Insurance)	Outstanding debt indexed to interest (every 3 years)

Source: PPP agreement.

Orasqualia won the bid with the following proposed values (baseline values for 250,000 m^3 per day):

- Capacity charge (E£/quarter) = 31,272,591.25
- Fixed operating charge (E£/quarter) = 3,815,625
- Variable operating charge (E£/m^3) = 0.0355
- Maximum electricity consumption (kWh/quarter) = 5,338,254

Table 4: Quarterly fixed payments

Capacity Charge (CCo)(EGP/quarter)	31,272,591.25
Fixed Operating Charge (FCo)(EGP/quarter)	3,815,625
Total quarterly fixed payments	35,088,216.25

Table 5: Variable over fixed revenue

	FLOW AVERAGE M^3 PER DAY	DAYS QUARTER	QUARTERLY FLOW	VARIABLE OPERATING CHARGE (VCO)(EGP/ M^3)	TOTAL X M^3	FIXED + VARIABLE	% VARIABLE /TOTAL
Dec-13	34,648	120	4,157,760.0	0.0355	147,600.48	35,235,816.73	0.42%
Dec-14	40,045	120	4,805,400.00	0.0355	170,591.70	35,258,807.95	0.48%
Dec-15	38,899	120	4,667,880.00	0.0355	165,709.74	35,253,925.99	0.47%
Jun-16	33,625	120	4,035,000.00	0.0355	143,242.50	35,231,458.75	0.41%

The low percentage of the variable revenues over the total revenues[13] is result of the lack of capacity of the SPV to affect the plant's service demand (water inflow).

The invoices are paid by the Egyptian government in Egyptian pounds, a currency that depreciated against the U.S. dollar by 56% from 2009 to 2016.[14]

There are two indexing mechanisms to adjust the price paid by NUCA:

1. Adjustment for inflation:[15] Applicable on an annual basis to the fixed operating charge and the variable operating charge but not to the capacity charge. The capacity charge represents the main portion of revenue for the SPV.

2. Adjustment for interest rate changes: Applicable every three years to reflect changes in Egyptian interest rates on borrowing in Egyptian pounds (applicable to the outstanding senior and subordinated debt of the Project company).

3.5. Risk and Risk Mitigation

As in any PPP project, a proper assessment of the risk was a critical issue for the success of the service. In the literature, it is often said that the risk should be transferred to the party that can deal best with it.

Land and space risk: NUCA obtained the land use concession from the Egyptian army, which owns the area surrounding the Cairo-Ain Sokhna highway. There is a big fenced area around the New Cairo WWTP assigned for the future expansion of the plant's wastewater treatment capacity.

Design and construction risk: This risk was assumed by the Engineering, Procurement and Construction (EPC) joint venture composed of Aqualia Infraestructuras and Orascom. Aqualia had previous experience of many large wastewater treatment plants: Arroyo del Culebro (Spain), Salamanca (Spain), Bengbu (Anhui, China), and Peñasquito (Mexico). Orascom had wide experience of big construction projects in Egypt. These facts mitigated the risk that Orasqualia and consortium members assumed in this area.

Financing risk: This was assumed by Orasqualia, which managed to reach financial closing in seven months.

Inflation risk: The contract allowed for a partial annual adjustment for inflation. While this was applicable to the fixed operating charge and variable operating charge components of the sewage treatment charge, it was not applicable to the main source of revenues for the SPV, the capacity charge. The inflation risk was borne by both agents, Orasqualia & NUCA.

Table 6: Risk assignment

Risk category	Assignment
Land and space	NUCA
Design and construction	EPC joint venture of Aqualia Infraestructuras and Orascom
Financing	Orasqualia
Inflation	NUCA / Orasqualia
Interest rates	Orasqualia
Forex	Orasqualia
Creditworthiness	NUCA
Operations and maintenance	O&M joint venture of Aqualia and Orascom
Supply of utilities	NUCA
Demand	NUCA
Performance	Orasqualia
Politics	NUCA / Orasqualia

[13] Energy costs are not included.

[14] The exchange rate was E£5.64 to the dollar on March 27, 2009, and E£8.80 on March 16, 2016 (–56.02%). Source: Google Finance.

[15] Average consumer prices in Egypt have grown by 9.9% since 2010.

Interest rates risk: Senior and subordinated debt was indexed to three-year certificates of deposit of four "reference" banks every three years.[16]

Forex risk: At the time of signing the contract, the forex risk was not perceived as being any higher than in any other standard developing country. The risk, however, turned out to be very significant when the political instability started.

- March 27, 2009: E£5.64 = $1
- February 5, 2010: E£5.47 = $1 (2.91% apreciation of EGP against USD since March 2009)
- July 26, 2016: E£8.86 = $1 () (36.59% depreciation of EGP against USD since March 2009)
- November 4, 2016[17]: E£13.70 = $1 (63.77% depreciation of EGP against USD since March 2009)

The cost of the local currency depreciation was assumed by Orasqualia. As a result of that, it has been difficult for the SPV companies to sell Egyptian pounds in the international markets. The fact that the private firm has to bear the foreign exchange risk can limit not only the number of international bidders willing to assume the risk, but also the access to cutting edge technology by the administration.

Creditworthiness risk: A direct agreement stipulated that Egypt's Ministry of Finance was to pay the sewage treatment charge if NUCA could not pay it within 30 days of the invoice date.[18]

Operations and maintenance risk: This risk was borne by the O&M joint venture formed by Aqualia and Orascom. One of the main characteristics of PPP contracts is that, by bundling construction and maintenance, incentives are created to minimize the total cost of both tasks.

Supply of utilities: The nonnegligible electricity cost would be paid as a pass-through by NUCA up to a maximum established in the PPP agreement. The electricity cost risk was limited due to the payment of the electricity bill by NUCA.

Demand risk: Despite one small part of the revenues of the SPV depending on the volume of treated sewage, this risk was assumed almost entirely by NUCA as the SPV did not have any influence over water inflows (demand).

Performance risk: The performance indicators were listed in the annexes as part of the contract. Quality standards were defined according to Egyptian law.

They were the basis on which payments were made to Orasqualia. The plant's performance was the responsibility of Orasqualia.

Political risk: This was assumed by NUCA. Any issue deriving from the plant's construction or performance will be raised by residents with the political authorities and may lead to political instability or complaints against the government.

Source: Document provided by Aqualia.

3.6. Technical Elements

The biological treatment process used is conventional and suitable for obtaining the quality requirements of NUCA:

- Pretreatment stage, a screening system, a degritting and degreasing unit and a flowmeter.
- The primary (mechanical) treatment with decanters is designed to remove gross, suspended and floating solids from raw sewage. The so-called sedimentation process is based on density differences.
- The secondary (biological) treatment is designed to remove the dissolved organic matter that escapes primary treatment. This is achieved by microbes consuming the organic matter as food, and converting it to carbon dioxide, water, and energy for their own growth and reproduction.
- The third treatment uses a microscreening process initially and later chloride treatment for disinfection.
- Sludge treatment consists of a gravity thickener and a flotation thickener tank, together with a high-load anaerobic digester and a low-load digester.

[16] Source: PPP agreement.

[17] Egypt Central Bank devaluated the currency by 48% on November 3, 2016.

[18] Source: IFC and Orasqualia, "PPPs in the Water and Sanitation Sector: New Cairo Wastewater Project," October 21, 2014, Geneva.

- The biogas line has a gasholder and a torch. There is an auxiliary emergency fuel-generator system to cover electricity demand in case of operational or source problems.

The most important features of the New Cairo WWTP are the following:[19]

- Water line including fine solids screening (four automatic screens, 1.50 m wide and with a pass of 6 mm), primary clarifiers (four units, 50 m in diameter and 3.60 m high), biological reactor (six units each with a volume of 14,580 m^3), secondary settling tank (six units, 55 m in diameter and 5 m high), microscreeing (10 textile mesh filters 1,374.37m^3/h) and disinfection by chlorine (two chambers with a volume of 1,395 m^3).

- Sludge line with primary sludge screening (2 + 1 rotary screens, each with a capacity of 110 m^3 per hour), thickening of primary sludge (three gravity units, 16 m in diameter and 4.80 m high), thickening of excess sludge (three flotation thickeners, 15 m in diameter and 3 m high), anaerobic digestion (four units, each with a volume of 12,076 m^3), etc.

- Auxiliary services with drinking water system, industrial/service water system, etc.

- Electrical installations with a medium-voltage electrical line to Superconducting cable, transformer center, etc.

The plant has the following capacity:

- Mean daily flow: 250,000 m^3 per day

- Peak daily flow: 312,000 m^3 per day

- Peak instantaneous flow: 4 m^3 per second

After the treatment process, the outflow complies with the limits set by Egyptian law and even with the European Union norm for wastewater even though the water inflows are not always in accordance with the parameters established in the agreement.[20]

3.7. Governance

The main agents involved in the project are:

- The New Urban Communities Authority (NUCA), the contracting authority, whose objective is the creation of new urban centers to achieve community stability and economic prosperity. NUCA is in charge of defending the public administration's interest. It is part of Egypt's Ministry of Housing, Utilities and Urban Development

- Orasqualia, the SPV that was awarded the project to operate the New Cairo WWTP. The company's shareholders are Aqualia and Orascom Construction Industries SAE (OCI) (with 50% of shares each).

- The PPP Central Unit: a unit within the Ministry of Finance that is charged by the government with developing PPP practice and with playing a vital role in the delivery of the initial projects. The unit's lack of executive powers may limit the independent role it should have in the PPP in favor of the administration.

- Committees: PPP governance committees composed of members of the administration and SPV to supervise the correct functioning of the infrastructure and to deal with eventual changes in the circumstances under which the contract was signed.

- Experts: an independent financial expert and an independent technical expert.

The PPP project established two governance committees to supervise how the project was functioning and to deal with unexpected situations that might arise during the contract.

- Partnership Committee: this comprised senior executives of NUCA and Orasqualia for amicable dispute resolution. It had 10 members: five from the NUCA side – NUCA itself, the Construction Authority for Potable Water and Wastewater, the Ministry of Housing, Utilities and Urban Development, the PPP Central Unit and the Egyptian Water Regulatory Agency – and five others from the Orasqualia side.

- Performance Monitoring Committee: this was composed of three members. There was one representative each from NUCA and Orasqualia, as well as one of the experts depending on the nature of the project performance being monitored. Additional representatives from NUCA, Orasqualia and the PPP Central Unit and a representative from the Egyptian Water Regulatory Agency had the right to attend.

In the case of a dispute, if the Partnership Committee fails to reach an agreement, the matter will be referred to the chair of NUCA and the chair of Orasqualia to settle the dispute amicably. As a last resort, in case they fail to reach an agreement, the dispute will be submitted for arbitration in accordance with the rules

[19] Orasqualia consortium technical bid.

[20] More details about inflow and outflow water characteristics can be found in Appendix B.

applied by the Cairo Regional Center for International Commercial Arbitration.[21]

The main problem that the project had to overcome related to the construction of a 2 km pipe. The issue started when, during the commissioning period (from May 2012 onward, after the completion of construction), NUCA did not allow the New Cairo plant to offload partially treated or untreated water, despite this being a regular practice for plants during the start-up period. (Nothing was mentioned in the contract about it.) NUCA required Orasqualia to construct a pipe with a diameter of 1.3 m and a length of 2 km to the next closest water treatment plant (Hassan Allam WWTP) at Orasqualia's own cost. The problem was solved through an amicable agreement on November 24, 2013.

4.The Project's External Characteristics

4.1. Economic Conditions[22]

In 2008-2009, Egypt weathered the impact of the global financial crisis relatively well due to its limited direct exposure to the international financial products affected by the subprime crises and the country's low levels of financial integration.

The economic reforms adopted since 2004 reduced fiscal and monetary vulnerabilities, leaving some room for maneuver regarding the macroeconomic policy response. The government undertook a package of additional expenditure (mainly on infrastructure) to help support economic activity. The Central Bank of Egypt "eased monetary policy appropriately, cutting policy rates four times by a cumulative 250 basis points since early 2009. Economic performance during 2008-2009 was favorable." The deficit target was increased to 8.4% of GDP, "largely as a result of an expected cyclical deterioration in revenues."

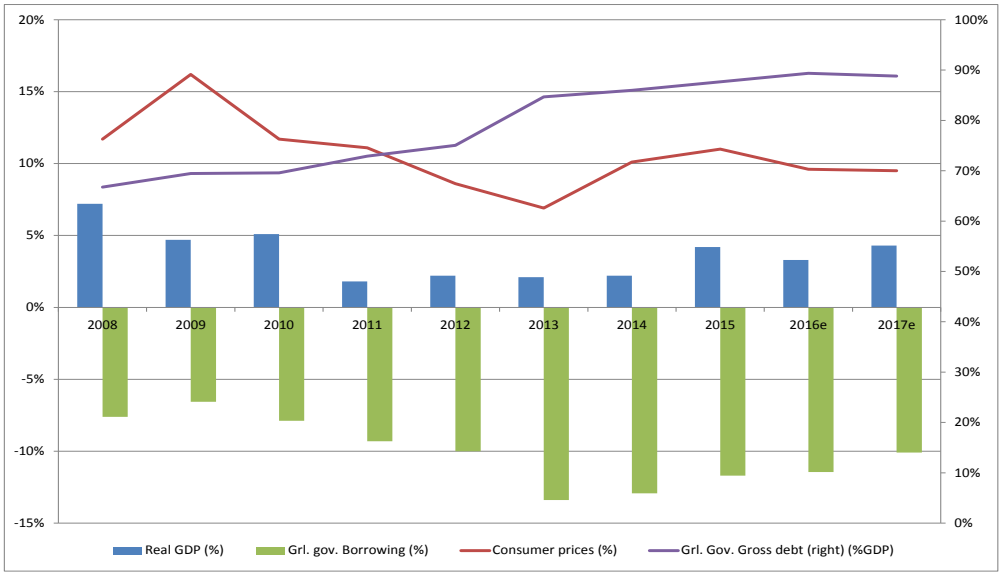
4.2. Legal / Legislative Conditions

At the time the contract was signed for the New Cairo wastewater project, there was no specific PPP legal framework in Egypt. The existing legislation for public procurement was Tender Law No. 89, adopted in 1998. With the purpose of providing regulatory support, the Egyptian government introduced a special law in August 2010, Law No. 67, regulating Partnership with the Private Sector in Infrastructure Projects, Services and Public Utilities.

4.3. Social / Civil Conditions

In the Human Development Index published by the United Nations Development Program in 2015[23], Egypt

Figure 2: Egypt's main economic indicators



Source: Prepared by authors based on IMF (2016). World Economic Outlook. April 2016.

[21] In recent years, it has become common in PPP contracts to choose international arbitration centers such as Paris or Geneva to settle disputes to avoid transferring the risk of legal disputes to the concessionaire.

[22] IMF (2009). *Arab Republic of Egypt – IMF Staff Visit, Concluding Statement* Cairo, July 16, 2009. Available from: www.imf.org/external/np/ms/2009/071609.htm.

[23] UNDP (2015). Human Development Report 2015. Work for Human Development. Available from: http://hdr.undp.org/sites/default/files/2015_human_development_report.pdf

was at position number 108 overall and third in the group of "medium human development" countries. Since 2009 the country had fallen three places in the index.

4.4. Political Conditions

The political situation was affected by social and political instability due to the protest that started on January 25, 2011, in Cairo's Tahrir Square. The protest led onto what became known as the Egyptian revolution or the January 25 revolution, which ended with President Hosni Mubarak being ousted after almost 30 years in power. Following elections in May and June 2012, Mohamed Morsi, the leader of the Freedom and Justice Party, was sworn in on June 30 that year as president of Egypt, a position that he held until July 3, 2013. General Abdel Fattah el-Sisi succeeded him (after interim president Adly Mansour), governing the country until now.

4.5. Environmental Conditions

Environmental regulation in Egypt is based on Law No. 4 of 1994 Promulgating the Environment Law (as amended by Law No. 9 of 2009)[24].

Orasqualia submitted a comprehensive environmental impact assessment (EIA)[25] in accordance with the environmental legislation (Law No. 4 of 1994 and executive regulation 338 of 1995) to the Egyptian Environmental Affairs Agency and obtained approval from it before the start of operations.

In 2013-2014, the Orasqualia O&M joint venture developed the environmental and social plan that eventually led the company to obtain the ISO 9001 and ISO 14001 certification in May 2015.

5. Impacts of the Project*

The project's impact has been mainly on three different agents:

5.1. Administration

New Cairo has a successfully working new infrastructure with cutting-edge technology constructed using private financing. The financial framework limited the pressure on public finances during the construction years.[26] This was challenging considering the political situation the country was going through. The administration also benefited from the transfer of the risk of certain parts of the project to the private operator, as previously stated. Additionally, with the new plant the country reduced the consumption of freshwater by using treated water to irrigate farming and urban green areas.

5.2. Residents

Residents benefited from the project mainly through increased availability of freshwater. The reduction in pollutants dumped into the river led to improved public health. Moreover, the better quality of water used for farming not only increased the quality of products, with direct effects on human health, but might have increased agricultural productivity, fostering economic growth in the region. In terms of employment, the plant provided regular jobs for 63 permanent skilled workers directly, 60 of them being locals.

Table 8: Number of jobs associated with the plant *

New Cairo SPV	5 employees (two Egyptians)
Operations and maintenance	58 employees (100% Egyptians)
EPC (two-year construction period)	1,500 employees and 150 indirect jobs (100% Egyptians)

* Not all of the jobs are newly created posts.

[24] Ministry of Enviroment. Eguphian Enviromental Affairs Agency. 2016. Enviromental Protection Law. [Online]. [Accessed November 2016]. Available from: http://www.eeaa.gov.eg/en-us/laws/envlaw.aspx

[25] An environmental impact assessment is a determination of the likely environmental consequences of proposed projects or activities. The word "impact" implies changes that can be either positive or negative from a desirability standpoint.

[26] The Egyptian government should, however, add the project's financial commitments for the whole period to the balance sheet.

* The appendix A includes a detailed analysis of the macroeconomic impact of the New Cairo WWTP.

Lastly, there was also a design, construction and operation know-how transfer from which Egyptian private firms could benefit. Additionally, Egypt citizens could benefit from cutting-edge technology and reliable operations to tackle environmental and water availability problems at no additional cost. The wastewater collection and treatment cost is covered by the existing water tariff, which did not increase as a result.

The side effects of the plant's construction were very limited due to the plant being located outside built-up urban areas.

5.3. Environment

The plant enabled a reduction in the quantity of pollutants (raw sewage) dumped into the River Nile. This improved the river's water quality, which had positive direct effects on ground pollution levels, fisheries, the river ecosystem and on human health.

An estimated measure of the reduced river pollution with the plant working at full capacity (as of 2016, it is working at one-sixth of the total) would be as follows:

- 94 tons of BOD_5 per day avoided[27]
- 105 tons of TSS per day avoided[28]
- 135 tons of COD_5 per day avoided[29]

5.4. Award-Winning Companies

Aqualia had the opportunity to carry out the first successful PPP project in Egypt, a regional political power in the MENA (Middle East and North Africa) region. The project could be used in other countries as a benchmark project to secure new contracts. Also, for the Egyptian firm Orascom it was a challenge as the New Cairo plant was its biggest wastewater treatment plant at that time.

The New Cairo plant was a flagship project that could be taken as a benchmark for future contract awards in other countries and for the market in general.

[27] BOD_5 means five-day biological oxygen demand.

[28] TSS means total suspended solids.

[29] COD_5 means five-day chemical oxygen demand.

6. Assessments

6.1. PPP Methodology

The conditions related to the project are summarized in Table 9. The New Cairo WWTP is a very interesting PPP that shows the importance of adapting governance for a very unstable political context.

Three features of a good PPP are clearly present in the project:

- Competitive bidding.
- Bundling of construction with operations.
- Importing efficiency through an experienced multinational enterprise in alliance with a local operator. This has benefits not only for efficiency in general but also for public finances.

According to Engel et al. (2014), the public finance gains of a PPP do not come from the fact that private funds are invested initially (they have to be recouped later on) but from the fact that an efficient private operator can build and operate the project at a lower cost, which reduces the tolls or public funds that are needed to cover the project cost.

- There is no cost-benefit analysis before the competitive bidding, which is necessary to make an objective and transparent assessment of the need for the project and of the advantages of a PPP compared to traditional provision.
- The governance of the project is not first-best but the best possible given the political circumstances. In first-best governance, we would have primary legislation that would protect investors and introduce transparency before the project was undertaken. And we would have a clear separation of powers between the contracting unit (NUCA) and the supervising units. However, in a second-best world, it hardly seems inevitable in a very volatile political context that the contractor would find its investment protected in an "amicable" relationship with the contracting unit. Similarly, if the legislation protecting investment returns had been approved prior to the start of the project, perhaps the changes in regime would have seen that legislation quickly overturned. The project may have been something of a harbinger for the law, with the project's benefits possibly helping to secure the approval and stability of the legislation. From a theoretical point of view, when a complete

Table 9: Conditions related to the selection and development of the Aqualia New Europe project

PPP METHODOLOGY	NEW CAIRO WASTEWATER TREATMENT PLANT	
	EXISTING	DETAILS
1. Procurement method & Bidding process		
1.1. Value for Money analysis or CBA*	No	
1.2. Real Competition for the Contract	Yes	5 Bidders
1.3. Tender evaluation committee	Yes	Internal
2. Contractual issues & incentives		
2.1. Bundling	Yes	DBFOT
2.2. Quality verifiable	Yes	via outflow
2.3. Externalities	Yes	Positives
2.4. Duration		20 years
3. Risk, finance & payments		
3.1. Construction & Operation Risk	Transferred	
3.2. Demand Risk	Not transferred	
3.3. Policy & Macroeconomic Risk	Partially transferred	ForEx
3.4. Payment Mechanism	Usage + Availability	
3.5. Special Purpose Vehicle (SPV)s	Yes	Aqualia New Europe & Orascom (50%)
4. Governance		
4.1. Transparency	Yes	
4.2. Participatory decision-making process	Not observed	
4.3. International/External monitoring	Partially	External monitoring during tender and awarding (IFC) and operation (experts)
4.4. Legal framework	Not at the beginning	
4.5. Distribution of tasks	Contracting	NUCA
	Monitoring compliance	NUCA & PPP central unit
	Renegotiation	NUCA
	Regulation	NUCA
	Operation & Quality	NUCA
5. Building process		
5.1. Cost Overrun	Yes	Pipe construction to nearest WWTP
5.2. Delayed deadlines	Not observed	
6. Potential Benefits		
6.1. Possible Price Certainty	Yes	
6.2. Transfer of responsabilities to privates	Yes	
6.3. Scope & Incentives for innovation	Yes	
6.4. Savings in public payments	Yes	Unquantified
6.5. Life-cycle approach	Yes	
6.6. Incentive to be on time	Yes	

(*) Cost-Benefit Analysis

written contract is not feasible, a more "relational contract" is inevitable and desirable if the project has a positive social value.

- Risk sharing seems reasonable: many risks are borne by the operator but demand and the political risk are covered by the public sector because there is nothing that the contractor could do to manage these risks.

- There may be room for improvement regarding the introduction of international arbitration.

6.2. United Nations' Sustainable Development Goals

The New Cairo plant was also aligned with the United Nations' Sustainable Development Goals[30], as follows:

Of all the Sustainable Development Goals, number 6 to be the one with which the New Cairo WWTP has the closest links. As a piece of infrastructure aimed at ensuring the availability of freshwater and improving sanitation systems, the New Cairo WWTP can be said to be in line with the goal of clean water and sanitation. That said, goals 3, 14 and 17 also seem to be greatly implicated in the New Cairo plant's construction, as will be explained below.

When looked at in detail, the New Cairo WWTP can helpachieve most of the different targets for goal 6, such as target 6.2, which is to "achieve access to adequate and equitable sanitation and hygiene for all." The plant can also help with target 6.3 by improving water quality through reduced dumping of untreated wastewater into the river. The achievement of target 6.4, focused on "water-use efficiency across all sectors," looks possible as the New Cairo WWTP is designed to reuse wastewater

Table 10: United Nations' Sustainable Development Goals

SUSTAINABLE DEVELOPMENT GOALS	NEW CAIRO WASTEWATER TREATMENT PLANT	
	HIGH IMPACT	MODERATE IMPACT
1. No Poverty		✓
2. Zero hunger		✓
3. Good Health & Well-being	✓	
4. Quality Education		
5. Gender Equality		
6. Clean water & Sanitation	✓	
7. Affordable & Clean Energy		
8. Decent work & Economic growth		✓
9. Industry, Innovation & Infrastructure		✓
10. Reduced inequalities		✓
11. Sustainable cities & communities		✓
12. Responsible consumption & production		
13. Climate action	✓	
14. Life below water	✓	
15. Life on land	✓	
16. Peace, Justice & Strong Institutions		
17. Partnership for the Goals	✓	

[30] United Nations (2016). Sustainable Development Goals. [Online]. [Accessed 4 November 2016]. Available from: http://www.un.org/sustainabledevelopment/

to irrigate agricultural and urban green areas, avoiding the use of freshwater for such purposes. Target 6.6 is also reachable, thanks to the fact that the wastewater plant can reduce severely the volume of polluted water disposed of, as shown in sections 6.2 and 6.3 of this document (on the impacts of the project on residents and the environment).

However, in addition to goal 6, other Sustainable Development Goals should be taken into account even though they do not have such a direct connection with a wastewater treatment plant. For example, because of the activity of the wastewater plant, progress can be made on goal 3 (good health and well-being) thanks to the plant's effects on public health – in particular, targets 3.1 to 3.3 and especially 3.9. All of these targets are focused on reducing mortality rates and disease, which can be reduced as the water outflow after treatment in the New Cairo WWTP is of much better quality than what was dumped into the River Nile before the plant existed.

Goal 13 on climate action and goals 14 and 15 on life below water and on land would seem to benefit from the WWTP as less dumping of polluted water into the River Nile will have direct consequences on the environment and on the ecosystem protection.

Finally, another attainable goal is goal 17 because of the framework under which the infrastructure was designed, built and operated – that is, through a PPP. A detailed look at some of the targets of goal 17 shows that the financial instruments used in this PPP helped to achieve the following targets:

- 17.1: "strengthen domestic resource mobilization, including through international support to developing countries."
- 17.3: "mobilize additional financial resources for developing countries from multiple sources."
- 17.4: "assist developing countries in attaining long-term debt sustainability."
- 17.17: the plant has clearly achieved its aim in this respect, as this target's purpose is to "encourage and promote" effective public-private partnerships, among other types of partnership.

The New Cairo WWTP can be considered as having a big impact on goals 3, 6, 13, 14, 15 and 17, but the PPP also has an impact on other Sustainable Development Goals, although to a lesser extent. For example, goal 1 (no poverty) and goal 2 (zero hunger) can be seen as achievable thanks to the infrastructure analyzed. It can be deduced that greater availability and a higher quality of water for agricultural purposes can improve agricultural productivity and, therefore, more food (helping achieve goal 2). At the same time, higher productivity can also increase farmers' income (helping achieve goal 1).

Goals 8 (decent work and economic growth), 9 (industry, innovation and infrastructure) and 10 (reduced inequalities) can also benefit from the project. In the case of goal 8, as seen in section 6.2 (impact on residents), the plant has created regular jobs, which may lead to higher domestic consumption and help to increase economic growth. For goal 9, it is clear that a wastewater plant such as the one examined in this case study helps with the building of resilient infrastructure. For goal 10, the creation of regular and stable jobs helps to reduce inequalities.

Finally, goal 11 (sustainable cities and communities) is partially achievable thanks to the WWTP, especially through target 11.6, which aims to "reduce the adverse per capita environmental impact of cities, including by paying special attention to [...] waste management."

In summary, the New Cairo plant is a powerful tool to help achieve some of the Sustainable Development Goals, especially those related to the environment and the economy, thanks to the increased productivity expected in agricultural activities and the regular jobs created[31] in building and operating the infrastructure.

6.3. City Strategy

To consider the project's impact on city development, we use the 10 dimensions of the Cities in Motion model[32] and evaluate the impact for each dimension.

As can be seen in Table 11, the project will have a big impact on the human capital dimension. The project will create many jobs (1,500 direct, 150 indirect) during the construction period, jobs that will last for two years and will help develop the talent pool in the region. The number of jobs during the project's total life cycle would be much fewer but still significant considering that they will be long-term jobs. As shown in Table 8, the total number of jobs associated with the plant are five for the SPV and 58 for the O&M joint venture. Finally, more indirect jobs can be created by the project's economic impact.

The authors of this paper believe that the project will help decrease inequalities in the region and this will

[31] Not necessarily net jobs created.

[32] Available from: http://citiesinmotion.iese.edu/indicecim/

Table 11: Cities in Motion

SMART CITY EVALUATION	NEW CAIRO WASTEWATER TREATMENT PLANT	
	HIGH IMPACT	MODERATE IMPACT
1. Human capital	✓	
2. Social cohesion		✓
3. Economy	✓	
4. Public management		✓
5. Governance		✓
6. Mobility and transportation		
7. Environment	✓	
8. Urban planning	✓	
9. International impact		
10. Technology		✓

have a positive effect on social cohesion. A greater impact on the economy is expected, resulting from different factors. First, the transfer of cutting-edge technology increases the quality of the talent pool in Cairo. Second, the project increases the efficiency of the water treatment, provides more drinking water and decreases prices while improving the overall environment and in particular fishing opportunities. All those factors may help attract new business, increase the efficiency of established companies and generate new business opportunities.

Two dimensions a significant and big impact can be seen are of course the environment and urban planning. The environmental impact was discussed in the section evaluating the Sustainable Development Goals and is the key reason for the whole project. The plant can also be seen as having a big impact on urban planning as the project forces city officials to think in a long-term way about the city's infrastructure development.

Finally, a moderate impact can be seen on public management because of the increased efficiency in the provision of a public service, which water is – both drinking water and nonpotable water. However, the authors believe that the impact on governance will be much greater. There is an important lesson associated with the success of such complex projects where governance issues are very important. Public and private partners should collaborate, develop a legal environment and a context of trust to make this feasible. The relationships established and the trust developed constitute a key capability when it comes to facing similar projects in the future.

7. Conclusions

The case of the New Cairo Wastewater Treatment Plant is a very interesting PPP project as it brings qualitative and quantitative information about good practices on PPP to implement in future collaborations between public and private partners.

One of the first interesting elements is the very fact that this project is the first successful PPP project in Egypt. Related to this is how the legislation was adapted. The new Egyptian law on PPP adopted lessons learned from the New Cairo project.

Another fact of interest is the bidding process. External and international advisers helped plan the bidding process, and the autonomous PPP Central Unit was created inside the Ministry of Finance. Related to the bidding process, there may be two areas for improvement: a previous cost-benefit analysis or a value-for-money analysis, and a participatory process in the design of the location and urban planning related to the infrastructure. There are no signs that either of these tasks was performed before the bidding process.

The business strategy between the two firms that created the SPV is also interesting. Both firms are multinationals with competitive advantages that complement each other. Aqualia has a high level of technological knowledge concerning wastewater treatment and Orascom has in-depth knowledge of the Egyptian market. This complementarity of knowledge, correctly managed inside the firms, would give them higher added value for future projects.

It was thanks to the strength and experience of the companies involved in the project and the existence of the PPP Central Unit that the project managed to overcome the political situation that the country was going through during the construction period. This success was achieved despite the PPP Central Unit's lack of executive powers. The political situation became very unstable, with three changes of president in a short period, with the profound consequences for government strategy and daily administration that these events had. Despite the social and political instability experienced in Egypt during these years, the governance system and the proactive attitude of the partners involved in the contract managed to move the project forward. As is shown in the assessments section, it can be said that the existing governance model is not the first-best according to the theoretical models[33] but it seems to be the most suitable considering Egypt's institutional framework and political reality. All of this led the project to be the first successful PPP project in Egypt.

Finally, from the point of view of the PPP methodology, the project has a correct payment mechanism, which ensures both financial stability for the private partner and revenue for the public partner. It should be highlighted how both partners distributed the inflation, financial cost and foreign exchange-rate risks. While the first two risks did not present any problems for any of the partners, the same cannot be said of the foreign exchange risk. Orasqualia had to assume a high cost due to the Egyptian pound's depreciation and this had very negative consequences for the company's balance sheet[34]. That said, it is important to highlight that the complete transfer of foreign exchange risk to the firm may limit the number of international bidders and consequently the technology transfer, particularly to developing countries.

The project had several outcomes. On the one hand, it is clear that the project allows the transfer of risk to the private partner and, on the other hand, it guarantees revenue for the public authorities. The payment process ensures innovation in the search for improvements to keep wastewater treatment costs at optimal levels.

Egyptian citizens benefited from both permanent and temporary jobs. Regarding the permanent jobs, there are 63 workers doing managerial and O&M tasks, while during the construction period around 1,500 workers worked on the plant. Even the job creation during the construction process can be considered a positive sign in an economy in need of formal jobs as Egypt's economy was because, despite having only temporary contracts, those workers could gain experience for future jobs. Elsewhere on the economic spectrum, it follows that an improved quality of the water emptied into the River Nile will give higher economic returns to farmers, either in terms of performance or crop quality.

Beyond the economic benefits, surely the most interesting benefit is the improved public health of the people of New Cairo. As the data in Appendix B show, it is clear that the new plant will generate higher-quality water.

In terms of achieving the United Nations' Sustainable Development Goals, the project is very interesting as it has a big impact on six goals 3, 6, 13, 14, 15 and 17, some of them as important as good health and well-being (goal 3) and climate action (goal 13).

Finally, the project is interesting because it puts the city of New Cairo in a stronger position to deal with future challenges. The transfer of knowledge and technology that the project represents, with the resultant improved water quality and therefore better quality of life for residents, can make the city better able to attract talent and new business opportunities, while contributing to fight against climate change. The project also strengthens the governance of public administration, due to the fact that public administrations have acquired a high degree of knowledge during the bidding process, including drafting the supervision contract for the works and their subsequent operation, and this knowledge may contribute to future governance situations.

In short, the New Cairo WWTP is a good people-first PPP project. It must be shared with other public administrations and private actors who want to accomplish projects of a similar size.

[33] In a first-best governance model, there would be, as previously stated, a clear separation of powers between the contracting unit (NUCA) and supervising units.

[34] Egyptian Pound dropped 48% after Egyptian Central Bank allowed for the free float of the currency. Al Jazeera News And Agencies. 2016. Egypt Central Bank devalues currency by 48 percent. *Al Jazeera*. Online]. 3 November 2016. [Accessed 4 November 2016]. Available from: http://www.aljazeera.com/news/2016/11/egypt-central-bank-devalues-currency-48-percent-161103084641123.html

Appendix A. An Assessment of the Broad Economic Impact of the New Cairo Wastewater Treatment Plant on the Egyptian Economy

The economic impact assessment of the New Cairo Wastewater Treatment Plant (WWTP) has been written by Ineco (www.ineco.com), a transport engineering and consultancy firm and a general member of PPP for Cities. Ineco carried out the analysis based on previous work on the impact of a new railway on the Egyptian economy. The company used the 2010/2011 social accounting matrix (SAM) for Egypt published by the country's Central Agency for Public Mobilization and Statistics (CAPMAS) in August 2015. The analysis and results in this appendix, including any errors or omissions, are the sole responsibility of Ineco and do not necessarily reflect the opinions of the authors of this study.

The WWTP mobilized a significant amount of resources. This investment had an important impact on the evolution of the Egyptian economy. That impact can be estimated according to the time when the effects were noted in the national economy, making a distinction between short and long-term effects.

In this document, an ex post analysis has been undertaken of the economic impact of the New Cairo plant on GDP in the short term. There were short-term effects from the construction itself through the mobilization of the factors of production (labor and capital) needed to implement the project and generate economic activity. These effects are measured by their impact on:

- The construction industry (direct)
- Other business sectors (indirect)
- Consumption generated (induced)

The study estimates that, during the construction phase (March 2010 to May 2012), through the mobilization of the factors of production the New Cairo Wastewater Treatment Plant helped increase the total production of goods and services by US$395 million through direct, indirect and induced effects. The WWTP generated a gross domestic product (GDP) increase of 0.12% at factor cost. So $1 of investment during the construction phase generated $1.39 in GDP.

Methodology

How has the *2010/2011 social accounting matrix* been used to assess the New Cairo Wastewater Treatment Plant's impact on the Egyptian economy?

The **social accounting matrix**[1] (hereinafter called **SAM**) represents the interrelationships and economic transactions among the different sectors of the economy. The Central Agency for Public Mobilization and Statistics (CAPMAS) of the Arab Republic of Egypt published the SAM for the Egyptian economy in August 2015.[2]

CAPMAS presented input-output tables for the year 2010/2011 in accordance with the methodologies and definitions recommended in the System of National Accounts 1993 and its modification for 2008 (SNA 1993, 2008), based on the compilation of supply and use tables conducted by CAPMAS.

The compilation of supply and use tables depends on data obtained from many periodic bulletins issued by CAPMAS for different economic activities, as well as the results of periodic and nonperiodic surveys that CAPMAS conducted or took part in such as income and expenditure surveys and labor force surveys. In addition, the compilation includes data published by other relevant authorities, the most important being: the general government final statement, the balance of payments issued by the Central Bank of Egypt, and the national accounts bulletin issued by the Ministry of Planning.

[1] United Nations Department of Economic and Social Affairs' Statistics Division (1999). *Handbook of National Accounting: Handbook of Input-Output Table Compilation and Analysis*. New York: United Nations.

[2] CAPMAS. *Social Accounting Matrix for the Egyptian Economy 2010/2011*. Reference No.: 2015/2240173. http://www.capmas.gov.eg/.

The SAM allows the abovementioned effects (direct, indirect and induced) to be quantified in terms of output and value added. The tables provide macroeconomic data that can be used to analyze and evaluate macroeconomic performance and rationalize the process of economic policy-making. Table 1 shows the basic structure of the matrix.

Table 1: Basic structure of the SAM

	S.A.M	1 Activities	2 Commodities	3 Factors of Production	4 Households & Other Domestic Institutions	5 Government	6 Taxes	7 Savings/ Investment	8 Rest of the world	9 Total
1	Activities		Domestic supply							Activity income
2	Commodities	Intermediate demand			Consumption spending (C)	Recurrent spending (G)		Investment Demand (I)	Exports (E)	Total demand
3	Factors of production	Value added							Factor income from abroad	Total factor Income
4	Households & other domestic institutions			Factor payments		Transfers			Worker's remittances	Households and other domestic institutions Income
5	Government				Transferred surplus		Net tax revenue [1]		Foreign grants & loans	Total government revenue
6	Taxes		Indirect taxes + tariffs less subsidies		Personal income tax					Total net tax revenue
7	Savings/Investment				Private savings	Fiscal balance			Current account balance	Total savings
8	Rest of the world		Imports (M)	Factor income to the rest of the world	Transfer payment from the HH sector	Transfers from the government				Foreign exchange outflow
9	Total	Gross output	Total supply	Total factor spending	Total other sector spending	Total government spending	Total net tax	Total investment spending	Foreign exchange inflow	

This account includes; net indirect taxes on goods and services (where subsidies are netted out), customs duties, and direct taxes (income and property income taxes).

Source: Ineco, based on Central Agency for Public Mobilization and Statistics of the Arab Republic of Egypt. *A Social Accounting Matrix for the Egyptian Economy 2010/2011*. August 2015, Reference No.: 2015/22401-73.

The matrix is designed to reflect a wider structure of the Egyptian economy than the basic macroeconomic data. The SAM distinguishes between activities and commodities. Activities are what produce goods and services, and commodities are the goods and services produced by activities. The two are separated because sometimes an activity produces more than one kind of commodity and, on the other hand, commodities can be produced by more than one kind of activity. The classification of activities used follows the International Standard Industrial Classification of All Economic Activities revision 4.

Activities and commodities are numbered by sector in Table 2.

Table 2: Activities and commodities by sector 2010/2011

Sectors	Number of Activities	Number of Commodities
Agriculture, forestry and fisheries	2	17
Mining	4	5
Manufacturing	24	27
Services	20	26
Electricity, water and sewage	2	2
Construction	1	1

Source: Ineco, based on Central Agency for Public Mobilization and Statistics of the Arab Republic of Egypt. *A Social Accounting Matrix for the Egyptian Economy 2010/2011*. August 2015, Reference No.: 2015/22401-73.

The starting point for modeling the socioeconomic impacts is a matrix of 53 columns corresponding to the 53 activities, and 78 rows that correspond to the 78 disaggregated commodities.

The static input-output system of Wassily Leontief has been followed. This is a linear model based on Leontief production function and a given vector of final demand. The objective is to calculate the unknown activity (output) levels for the sectors as endogenous variables for the given final demand as an exogenous variable.

We assume that all sectors produce with linear Leontief production function. All inputs (intermediates, capital, labor, and land) are used in fixed proportions in relation to output. It is assumed that it is impossible to substitute inputs. Therefore, changing factor prices have no influence on the technical input coefficients in matrix A:

$$a_{ij} = x_{ij} x_j$$

Once the technical coefficients are calculated, the Leontief equation system is simply a set of linear equations with unknown output levels with the vector of final demand. The objective is to derive the activity levels of industries for the given level of demand. In matrix terms, we can outline Ax + y = x, resulting in y = (I – A)x.

Solving this linear equation obtains the variations in output levels according to changes in final demand from the system:

x = (I – A) – 1y

A = matrix of input coefficients for intermediates (matrix of technology coefficients)

I = unit matrix

(I – A) = Leontief matrix

(I – A) – 1 = Leontief inverse

y = vector of final demand

x = vector of output

As explained previously, vector x reflects the requirements of intermediates, while vector y represents the exogenous aggregate final demand. Matrix (I – A) is called the Leontief matrix. On the diagonal of this matrix, the net output is given for each sector with positive coefficients while the rest of the matrix covers the input requirements with negative coefficients.

The Leontief inverse (I – A) – 1 reflects matrix B, which contains the parameters bij. Matrix B represents the multiplier of the total production (final + intermediate) of the whole national economy by increasing final demand in some of its industries. To calculate the multiplier (direct + indirect) of the total output of the construction industry, it is necessary to add the technological coefficients (bij) of the column corresponding to the construction sector.

The induced effects have also been calculated. For this estimation, the household sector must be included as a productive sector.

Analysis

What was the overall economic impact of the wastewater treatment plant's construction phase?

There would be short-term effects from the construction itself through the mobilization of the factors of production needed to implement the project and thus generate economic activity.

Therefore, the New Cairo plant's macroeconomic impact in the short term has been estimated on the basis of the **Egyptian social accounting matrix** (Egyptian **SAM**). The reference period for the results are the years 2010 and 2011: 2011 for the government and public business sector, and 2010 for the private sector.

The SAM has enabled quantification of the macroeconomic effects in terms of **gross output and value added**, the latter understood as the contribution of an industrial activity to overall GDP.

As previously mentioned, three types of short-term impact have been identified and evaluated:

- **Direct effects** are impacts that affect the construction industry, through increased demand for its output.
- **Indirect effects** are the impacts of the construction investment on other business sectors.
- **Induced effects** are the consequences for consumption generated by the direct and indirect effects.

The matrix methodology gives a simplified view of how the change in demand resulting from the construction of the New Cairo plant affected the entire economy. The analysis indicates that $140 million of investment generated $264 million of gross output through direct and indirect effects and $131 million through induced effects during the construction phase. The plant generated a 0.12% increase in GDP at factor cost (factors of production: land, capital, and labor). So $1 of investment during the construction phase generated $1.39 in GDP.

Data (Thousand LE - Egyptian Pound)

Below are the most relevant data from the Egypt SAM that have been used to calculate the final economic impact.

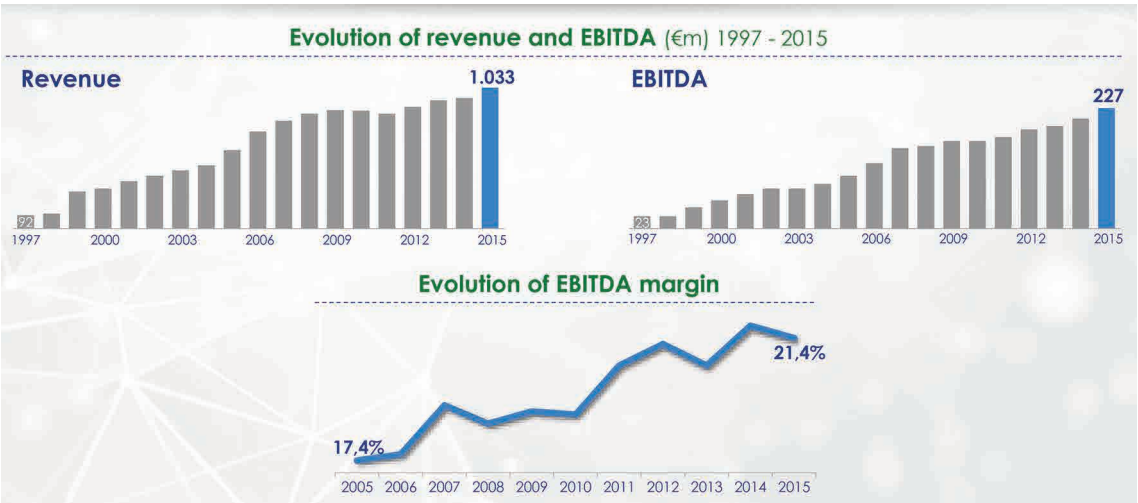
132	Factor of production	Labor	21,522,443	1,597,658	3,017,985	72,279
133		Capital	92,848,952	11,606,669	174,578,331	1,748,103
134		Land	22,995,194	0	0	0
135	Sectors	Institutional sectors except government	0	0	0	0
136		Government	0	0	0	0
137	dtax	Direct tax	0	0	0	0
138	stax	Indirect tax	0	0	0	0
139	atax	Subsidies on products	0	0	0	0
140	mtax	Tariffs	0	0	0	0
141	s-i	Saving/gross capital formation	0	0	0	0
142	row	Rest of the world	0	0	0	0
143	Mg	Transportation and trade margins	0	0	0	0
144	Total		195,303,322	14,494,633	185,226,000	1,912,815

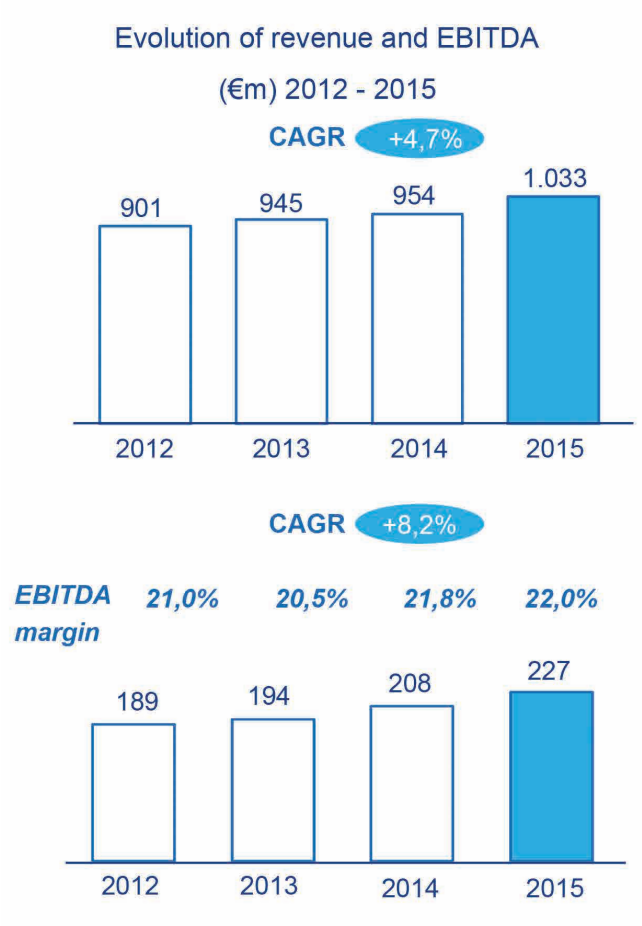
Intermediate demand	57,936,733.06			
Intermediate consumption = intermediate demand + public spending + gross capital formation + stock variation	57,936,733.06			
Production = intermediate consumption + wages + gross operating surplus + tax	195,303,322.33	13,204,327.00	177,596,315.82	1,820,381.80
Added value at market value = employees' wages + gross operating surplus + taxes (subventions not included)	137,366,589.27			

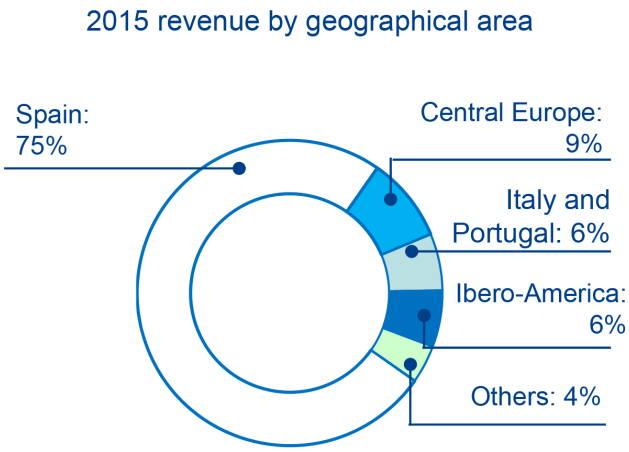
Source: Ineco, using data from CAPMAS. http://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5104&Year=23041, last accessed November 2016.

Appendix B. Financial Information

Aqualia Financial Information







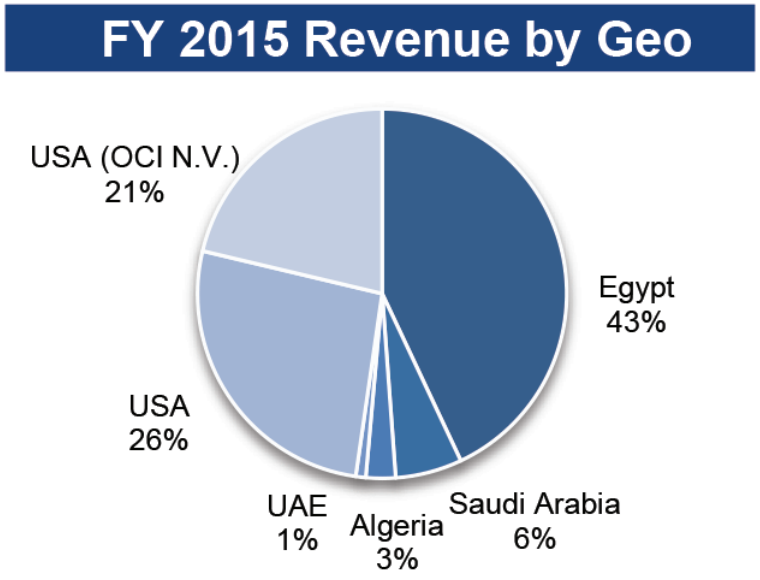
Appendix B. Financial Information

Orascom Construction Financial Information

Summary Income Statement		FY 2015	
USD million	MENA	USA	Total
Revenue	2,030.2	1,852.2	3,882.4
EBITDA	312.5	(614.9)	(302.4)
Margin	*15.4%*	*(33.2%)*	*(7.8%)*
BESIX	-	-	(0.4)
Net income to shareholders	175.8	(523.2)	(347.8)
Margin	*8.7%*	*(28.2%)*	*(9.0%)*

Summary Balance Sheet	31-Dec-15	1-Jan-15	Change
USD million			
Cash and cash equivalents	574.9	368.9	*55.8%*
Total debt	439.4	466.0	*(5.7%)*
Total equity	560.5	804.4	*(30.3%)*
Net debt (cash)	(135.5)	97.1	*(239.5%)*

Source: Orascom Construction, *FY 2015 Results Presentation.*



Source: Orascom Construction, *FY 2015 Results Presentation.*

Appendix C. Water Inflow and Outflow

As can be observed in the table below, the parameters of the inflow water have not been always within the limits established in the PPP agreement:

- Minimum concentrations of suspended solids (SS), BOD_5 and COD
- Maximum concentration of oils and grease, and hydrogen sulfide

Inflows

	Average (mg/l)					Minimum (mg/l)					Maximum (mg/l)				
PARAMETER	Dec-2013	Dec-2014	Dec-2015	Jun-2016	PPP Agreement	Dec-2013	Dec-2014	Dec-2015	Jun-2016	PPP Agreement	Dec-2013	Dec-2014	Dec-2015	Jun-2016	PPP Agreement
pH	7.77	7.71	7.51	7.30	**7,4**	7.48	7.36	7.18	7.1	**6,5**	8.09	7.97	7.69	7.45	**8,2**
SS	185,0	247,0	225,0	208,0	**310,0**	96,0	198,0	170,0	164,0	**185,0**	282,0	374,0	470,0	268,0	**440,0**
BOD_5	151,0	198,0	177,0	177,0	**300,0**	100,0	180,0	162,0	159,0	**205,0**	280,0	225,0	195,0	193,0	**400,0**
COD	321,0	380,0	367,0	378,0	**490,0**	193,0	262,0	330,0	330,0	**328,0**	530,0	513,0	440,0	420,0	**588,0**
N_{TOTAL}	33.6	43.7	40.6	40.0	**21,5**	29.3	40.2	36,0	36,0	**7,0**	39.4	55,0	44,0	50,0	**25,6**
Fats &Oil and grease	13.76	28.46	26.5	30.0	**10,0**	11.20	27.00	24.5	28.0	**5,0**	15.20	30.10	28.0	32.0	**14,0**
Sulfide	6.18	8.37	4.23	4.43	**2,8**	5.10	7.60	3.70	3.90	**1,0**	8.10	9.93	5.00	5.00	**6,5**

Outflows

	Average				Minimum				Maximum				
PARAMETER	Dec-2013	Dec-2014	Dec-2015	Jun-2016	Dec-2013	Dec-2014	Dec-2015	Jun-2016	Dec-2013	Dec-2014	Dec-2015	Jun-2016	PPP Agreement
pH	7.69	7,31	6,95	7,01	7.23	7,12	6,77	6,85	8.06	7,55	7,55	7,50	**6,0-9,0**
SS (mg/l)	10.62	11.7	7.1	7.6	6.8	8.4	5.2	4.8	12.4	14.8	9.2	10,00	**20,00**
$BOD_{5\ (mg/l)}$	10.14	11.1	9.0	10.0	6.75	8.8	7.32	6.6	13.4	14,00	10.24	13.52	**20,00**
COD (mg/l)	30.10	35.9	29.9	28.9	18.3	28.5	28.5	26,00	38.6	39.9	32,00	33,00	**40,00**
$P_{TOTAL\ (mg/l)}$	0.48	1,21	0,30	0,73	0.40	1,10	0,10	0,30	0.60	1,40	0,23	1,10	**2,00**
$N\text{-}NH_{4\ (mg/l)}$	0.46	0,06	0,79	0,61	0.08	0,03	0,52	0,44	1.22	0,24	1,10	0,84	**2,50**
$N_{TOTAL\ (mg/l)}$	12.23	13,08	11,40	11,66	10.30	11,00	10,40	9,50	13.70	14,80	12,20	13,00	**15,00**
Fats &Oil and grease (mg/l)	1.00	2,06	1,43	1,33	0.40	1,80	1,30	1,00	1.50	2,40	1,60	1,80	**5,00**
Fecal Coliforms (cfu/100ml)		8,00	0,00	25,00		5,00	0,00	0,00		10,00	0,00	100,00	**200,00**
Enteric Nematoda (qty/l)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	**1,00**
Iron (mg/l)	0,15	0,05	0,08	0,17	0,02	0,03	0,05	0,07	0,30	0,08	0,10	0,30	**5,00**
Chlorine Residual (mg/l)		0,50	0,48	0,50		0,39	0,40	0,40		0,60	0,56	0,55	**0,50**
Sludge solids concentration (%)		23,2%	23,4%	23,3%		23,0%	23,1%	23,0%		23,4%	23,9%	23,5%	**≥ 23%**

Appendix D. Timeline

2006

Egyptian government's new economic reform agenda: emphasis on the promotion of PPPs across infrastructure sectors

June: PPP Central Unit was set up in the Ministry of Finance

2008

January: Public-Private Infrastructure Advisory Facility assistance program report

2009

Announcement of the New Cairo Wastewater Treatment Plant contract

June 29: Contract started

2010

February 4: Financial closure

February: Construction began

May: PPP law (Law No. 67 of 2010, regulating Partnership with the Private Sector in Infrastructure Projects, Services, and Public Utilities)

December: Orasqualia had completed nearly 40% of the New Cairo plant

2011

January 25: Protest started at Cairo's Tahrir Square

February 11: President Hosni Moubarak ousted

2012

February: Construction deadline

May: Construction finished

June 30: Mohamed Morsi sworn in as president of Egypt following elections in May and June

2013

July 3: General Abdel Fattah el-Sisi becomes new Egyptian president

October: The plant started operations after a three-month commissioning period

2029

June 28: The contract is due to end

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28023 Madrid, Spain
(+34) 91 211 30 00

New York
165 W. 57th Street
New York,
NY 10019-2201 USA
(+1) 646 346 8850

Munich
Maria-Theresia-Straße 15
81675 Munich, Germany
(+49) 89 24 20 97 90

Sao Paulo
Rua Martiniano de
Carvalho, 573
Bela Vista
01321001 Sao Paulo,
Brazil
(+55) 11 3177 8221