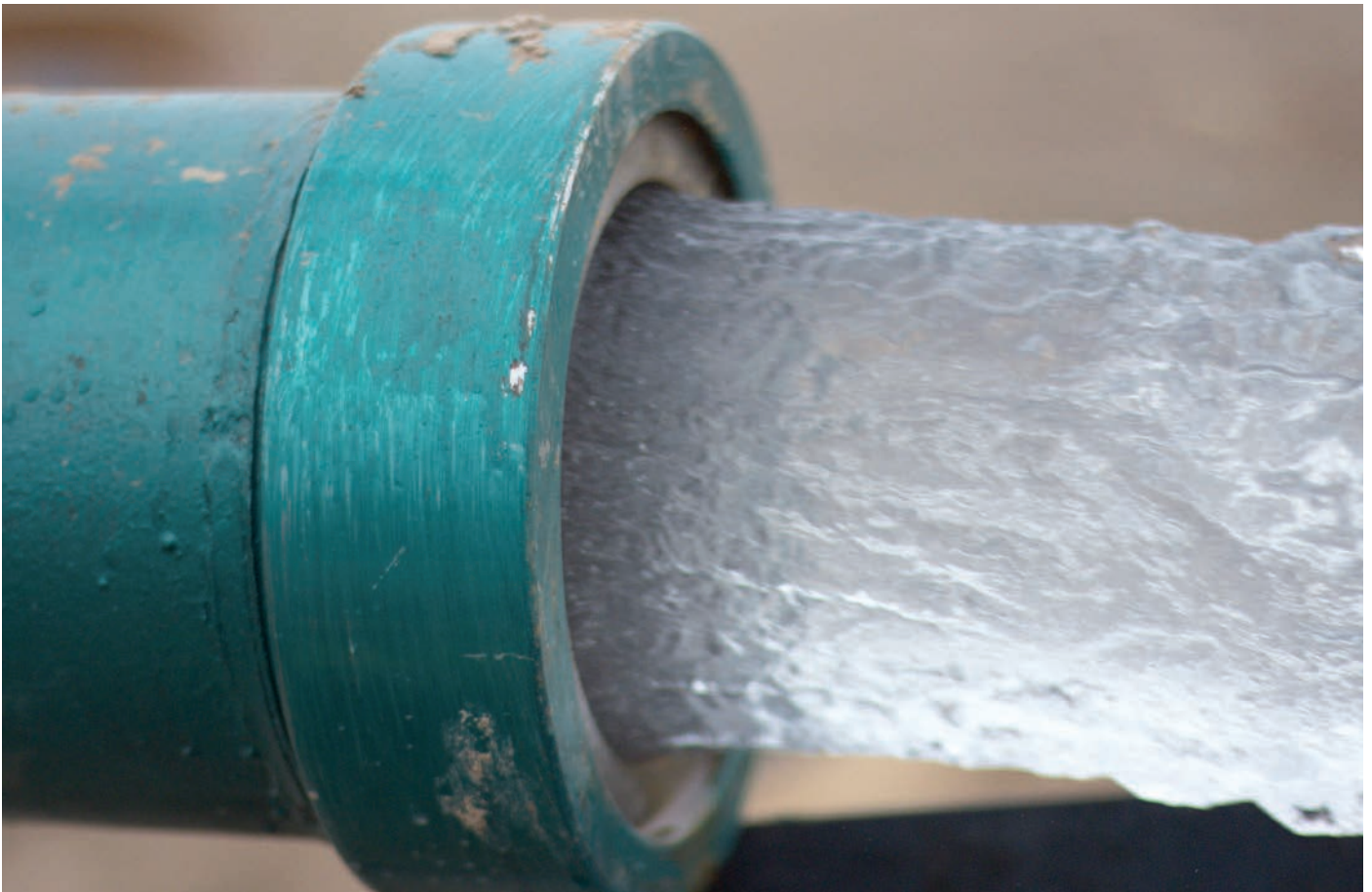


## CASE STUDY: PPP FOR CITIES

---

# EL REALITO AQUEDUCT (MEXICO)



Jordi Salvador, Joan Enric Ricart, Francesc Trillas and Miquel Rodríguez

In collaboration with Aqualia

March 2018

WITH SUPPORT FROM:





# EL REALITO AQUEDUCT (MEXICO)

Jordi Salvador, Joan Enric Ricart, Francesc Trillas and Miquel Rodríguez

## PPP FOR CITIES

The Specialist Center on PPPs in Smart and Sustainable Cities (PPP for Cities) is a research, innovation and advisory center whose purpose is to provide government agencies around the world with support in the organization, management and development of collaborative projects between the public and private sectors, in the field of smart cities.

It is also a platform for partnerships between companies and agencies at a global level where they can thoroughly explore the dynamics of public-private partnerships, create guides on best practices and standards, and design solutions to the problems faced by cities.

The center is run by IESE Business School and is part of the PPP program of the United Nations International Center of Excellence (UNECE). It has the support and sponsorship of the City of Barcelona and other government agencies, as well as private companies.

This paper was prepared by the Specialist Center on PPP in Smart and Sustainable Cities, as a document of interest for the study of PPPs; it is not intended to illustrate proper or improper management by the agents.

This paper was prepared with information provided by Aqualia.

No part of this publication may be reproduced, saved, stored in a retrieval system, used in a spreadsheet, or transmitted in any form or system by any means—electronic, mechanical, photocopying, recording or otherwise—without the written permission of the author.



---

## TABLE OF CONTENTS

<b>Introduction</b>	<b>9</b>
<b>1. Project background</b>	<b>10</b>
1.1 Institutional	10
1.2 Environmental conditions	10
<b>2. The project</b>	<b>12</b>
<b>3. Water delivery contracts</b>	<b>14</b>
<b>4. The bidding process</b>	<b>16</b>
<b>5. Internal characteristics of the project</b>	<b>19</b>
5.1 Consortium or special purpose vehicle (SPV)	19
5.2 Main members of the winning consortium	19
5.3 Structure	20
5.4 Financing	20
5.5 Trust structure	21
5.6 Fee structure of the PPP	25
5.7 Risk: management and mitigation	26
5.8 Technical elements	28
5.9 Governance	28
<b>6. External characteristics of the project</b>	<b>29</b>
6.1 Economic/financial conditions	29
6.2 Legislative context, regulations and technical support	32
6.3 Political conditions	33
<b>7. Impacts of the project</b>	<b>33</b>
7.1 Administration	33
7.2 Residents	34
7.3 Environment	34
<b>8. Evaluation</b>	<b>34</b>
8.1 PPP methodology	34
8.2 United Nations Sustainable Development Goals	37
8.3 City strategy	38
<b>9. Conclusions</b>	<b>40</b>
<b>References</b>	<b>42</b>
<b>Exhibit A. Analysis of economic impact of El Realito aqueduct PPP project on national GDP</b>	<b>43</b>
<b>Exhibit B. Trust system</b>	<b>45</b>
<b>Exhibit C. Financial information</b>	<b>47</b>
<b>Timeline</b>	<b>48</b>

## List of abbreviations and acronyms

**PPP:** public-private partnership

**Banobras:** Banco Nacional de Obras y Servicios Públicos

**CEA-SLP:** Comisión Estatal del Agua de San Luis Potosí

**Coepris:** Comisión Estatal para la Protección contra Riesgos Sanitarios

**Conagua:** Comisión Nacional del Agua

**Finfra/FNI:** Fondo de Inversión en Infraestructuras / Fondo Nacional de Infraestructura

**Interapas:** inter-municipal metropolitan organization responsible for drinking water, sewage, sanitation and related services for the municipalities of Cerro de San Pedro, San Luis Potosí and Soledad de Graciano Sánchez

**MXP:** Mexican pesos

**MDG:** Millennium Development Goals

**SC:** Service contract

**SDG:** United Nations Sustainable Development Goals

**PDAL:** Promotora del Desarrollo de América Latina, S.A. de C.V.

**USD:** U.S. dollars

**ZMSLP:** Zona Metropolitana de San Luis Potosí

## Summary

The El Realito aqueduct was designed for delivering and purifying water from the El Realito dam (on the Santa María River) to the metropolitan area of San Luis Potosí (ZMSLP), in Mexico. The area had around 850,000 inhabitants in 2005, and more than 1.2 million ten years later, in 2015. The infrastructure has the capacity to deliver 1 m<sup>3</sup>/s from the dam to the water treatment plant and, finally, to the receiving tanks located in the city of San Luis Potosí, from which drinking water is distributed to residents of the town and neighboring areas.

This aqueduct was built to counteract the overexploitation of aquifers (up to that point, the source of up to 90% of the water consumed in ZMSLP<sup>1</sup>) and to improve the balance of extraction—charging of aquifers, limiting the risks of earthworks in the city and avoiding the problems derived from the extraction of deep waters (subsidence, appearance of polluting elements and increased costs).

The project is structured as a public-private partnership (PPP), in which the payment to the concessionaire and the banks is made through trusts, a system of contracts that mitigates the risks and consequently reduces project costs.

### Awards received for the project:

- Water Deal of the Year in Latam, by Project Finance of Euromoney, in 2011
- Nominated for the “Water Deal of the Year” by Global Water Awards for its innovative financial structure in 2012
- Top 3 in the League Tables of Project Finance

**Location:** between the north of the state of Guanajuato, where the El Realito dam is located, and the state of San Luis Potosí, where the water is delivered to the tanks.

## Characteristics of the PPP contract

**Project type:** greenfield project for untreated water<sup>2</sup> delivery that includes the preparation of the executive project and engineering, financing, construction of 132 kilometers of pipeline, 46 of access roads, 9 of transmission lines, 1 water treatment plant with 1 m<sup>3</sup>/s capacity, 1 head water chamber, 3 pumping stations, 6 receiving tanks and operation and management for a period of 23 years.

**Project capacity:** 1 m<sup>3</sup>/s.

**Delivery model:** design, finance, build, operate, maintain and transfer (DFBOMT).

**Project cost:** 2,169,451,491 Mexican pesos (MXP) net (152,729,384 USD<sup>3</sup>). This amount does not include insurance or costs associated with the bidding or financing.

<sup>1</sup> The remaining 10% of the water was provisioned by the dams of San José, El Peaje and El Potosino.

<sup>2</sup> In general terms, “untreated” drinking water is defined as the segment between the collection of raw water and the delivery to distribution tanks (generally municipal). As such, it includes the water purification process.

<sup>3</sup> Exchange rate on project tender date (February 5, 2009): 1 MXP = 0.0704 USD.

## Characteristics of the PPP contract (continued)

**Construction guarantee:** 20% of the project cost as guarantee during construction (for the eventual payment of conventional penalties); guarantee of 20% of the annual payment of operating costs ( $T2_n T3_n$ ) during the operation.

**Investment<sup>4</sup>:** 2,382,463,909 pesos net (167,125,459 USD).

**Duration of contract:** 300 months (24 construction + 276 operation) = 25 years.

**Structure of investment financing:** 22.8% private venture capital; 39% debt; 38.2% support from Finfra/FNI (Fondo Nacional de Infraestructura, coordination vehicle of the Mexican government for the development of infrastructure in the communications, transportation, water, environment and tourism sectors). The percentages are calculated based on the value of the investment.

**Publication of the bidding rules:** February 5, 2009 (No. 53112001-001-09).

**Deadline for submitting the offer:** May 15, 2009.

**Award decision:** June 18, 2009.

**Contract for water reception of CEA-SLP and Interapas<sup>5</sup>:** June 29, 2009.

**Winning consortium:** AQUOS El Realito, S.A. de C.V., (created May 29, 2009).

**Signing of contract:** July 3, 2009.

**Official start of construction:** June 24, 2011.

**Official completion of construction:** September 25, 2014.

**Official start of operation and management:** January 9, 2015.

**End of contract:** July 2, 2034.

**Payment method:** availability + variable.

**Contracting authority:** CEA-SLP. Depends directly on the government of the State of San Luis Potosí.

**Water and sanitation distributor in the municipality of San Luis Potosí:** inter-municipal metropolitan organization responsible for drinking water, sewage, sanitation and related services for the municipalities of Cerro de San Pedro, San Luis Potosí and Soledad de Graciano Sánchez (a.k.a. Interapas).

**Other institutions:** National Water Commission (Conagua), founded in 1989 to manage and preserve national waters to achieve sustainable use.

## Winning company

**Name of the consortium:** AQUOS El Realito, S.A. de C.V. (hereinafter, AQUOS El Realito).

Members of the winning consortium (SPV): Aqualia, Gestión Integral del Agua, S.A. (44%), Aqualia Infraestructuras, S.A. (5%), Controladora de Operaciones de Infraestructura, S.A. de C.V. (Conoisa) (50.999%) y Servicios de Agua Trident, S.A. de C.V. (0.001%).

**EPC contractor<sup>6</sup>:** Constructora de Infraestructura de Aguas de Potosí, S.A. de CV (Ciapsa). Formed by Aqualia Infraestructuras (24.5%), FCC Construcción (24.5%) and ICA (51%).

**O&M contractor<sup>7</sup>:** Aqualia (15%), ICA (15%) and Proactiva Medio Ambiente México (70%).

**Financing banks:** Banco Santander (Mexico), Banco Nacional de Obras and Servicios Públicos, S.N.C. (Banobras) and Banco Mercantil del Norte (Banorte).

**Agent bank:** Banco Santander (Mexico).

<sup>4</sup> The total investment, beyond the building costs of the project, includes a single payment to CEA-SLP for project design (48,000,000 pesos); trust administration fees (2,000,000 pesos); fees for letters of credit and insurance (21,000,000 pesos); and financing fees (141,000,000 pesos). There would also be 80,000,000 pesos in interest, which all adds up to 2,463,155,565 pesos.

<sup>5</sup> Interapas, the local water operator, agrees to receive water from CEA-SLP, through the concessionaire, in the ZMSLP receiving tanks, as well as paying for the service and signing a line of credit to secure the payment of the operation fee.

<sup>6</sup> Engineering, procurement and construction (EPC).

<sup>7</sup> Operation and management (O&M).



# Introduction

Figure 1 and Figure 2 show the location of El Realito aqueduct. To contextualize the project before starting the analysis, Figure 3 shows the process of water from the perspective of the institutions and organizations responsible for each of the sections. Initially, AQUOS

El Realito takes the water from the El Realito dam, makes it drinkable and delivers it on behalf of CEA-SLP (the public authority responsible for supplying water to citizens) to Interapas, the water distribution company in the metropolitan area.

**Figure 1. Location of state of San Luis Potosí**



Note: (State of Guanajuato—dam/south, and state of San Luis Potosí—receiving tanks/north).

Source: Wikipedia, [https://es.wikipedia.org/wiki/San\\_Luis\\_Potos%C3%AD](https://es.wikipedia.org/wiki/San_Luis_Potos%C3%AD), last accessed February 2018.

**Figure 2. Sections of El Realito aqueduct**



Source: Document provided by Aqualia.

**Figure 3. Water process by institutional responsibility**



Source: Prepared by the authors.

- AQUOS El Realito (concessionaire of El Realito aqueduct project) obtains water from El Realito dam for subsequent purification and delivery to the tanks in the ZMSLP. In fact, it performs these tasks on commission from CEA-SLP<sup>8</sup>.
- The institutional mission of the CEA-SLP is to supply water to the inhabitants of the state, to discharge and subsequently treat wastewater, and reuse the water in case of scarcity. It signed a contract with Interapas to guarantee the delivery of drinking water to Interapas, which would distribute it after being treated<sup>9</sup>.
- Interapas is the company providing water, sewage and sanitation services in ZMSLP. It is responsible for the distribution of water in the metropolitan area.

## 1. Project background

We will now examine the background of the institutional project and environmental conditions.

### 1.1. Institutional

Water management in Mexico is regulated by the federal act known as Ley de Aguas Nacionales<sup>10</sup>. This law confers to Mexico's water commission (Conagua), created in 1989, the management, regulation, control and protection of national waters.

One of the tasks assigned to Conagua is the design of the national water policy included in the National Information System, one of its main tools for analyzing the quantity, quality, uses and conservation of water (National Information System on the Quantity, Quality, Uses and Conservation of Water [SINA]).

Mexico is divided into 13 different water management regions known as RHA (regiones hidrológico-administrativas), in which Conagua carries out its tasks.

The El Realito aqueduct is located between the following RHA:

- Cuencas Centrales del Norte (VII) (states of Coahuila, Durango and San Luis Potosí).
- Lerma - Santiago - Pacific (VIII) (Mexican states [9.8%], Querétaro [2.8%], Guanajuato [43.8%], Michoacán [30.2%] and Jalisco [13.4%]).
- Golfo Norte (IX) (states of Guanajuato, Hidalgo, Querétaro, San Luis Potosí, Tamaulipas and Veracruz).

### 1.2. Environmental conditions

Mexico is a country with multiple climates. The northwest and central regions, which occupy 67% of the country and include the states of Guanajuato and San Luis Potosí<sup>11</sup>, are arid or semi-arid and have less than 500 millimeters of annual rainfall. In contrast, the southeast covers the remaining 33% of the geography and is a humid region with annual rainfall of over 2,000 millimeters.

As for the distribution of renewable water in the country, although the north and central regions only receive around one third of the total, they make up four fifths of the population and the GDP.

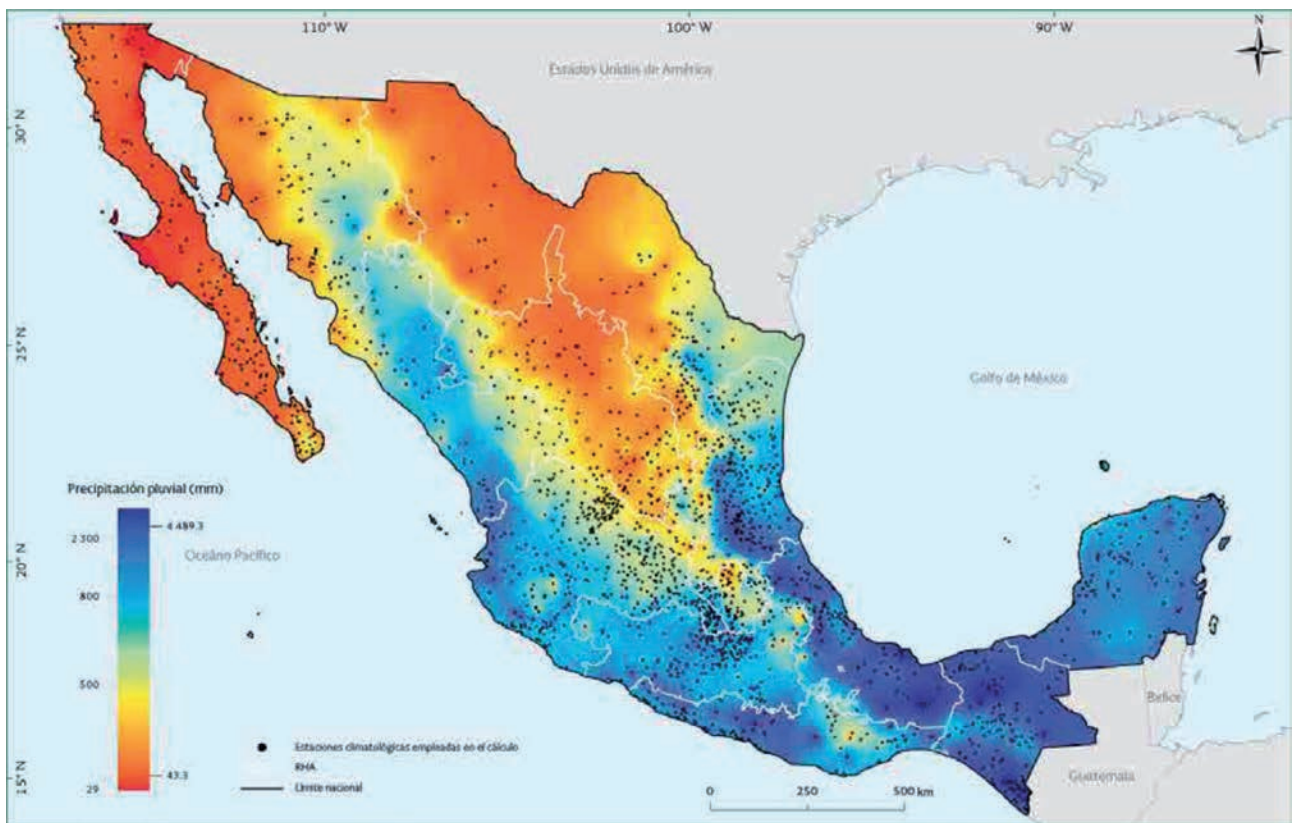
<sup>8</sup> The tasks assigned to CEA-SLP, included in section 5 of article 8 of the water act for the State of San Luis Potosí (LASLP) are to: coordinate with local and federal authorities, engage in the planning, programming, design, construction, control and evaluation of the hydraulic works, in accordance with the Law on Planning of the State and Municipalities of San Luis Potosí.

<sup>9</sup> Drinking water distribution in urban area.

<sup>10</sup> [www.diputados.gob.mx/LeyesBiblio/pdf/16\\_240316.pdf](http://www.diputados.gob.mx/LeyesBiblio/pdf/16_240316.pdf), last accessed February 2018.

<sup>11</sup> Conagua (2015), *Estadísticas del Agua en México*, pp. 259-272 ([www.conagua.gob.mx/CONAGUA07/Publicaciones/Publicaciones/EAM2015.pdf](http://www.conagua.gob.mx/CONAGUA07/Publicaciones/Publicaciones/EAM2015.pdf)) and Exhibit A.

**Figure 4. Distribution of annual rainfall (1981 - 2010)**



Source: Conagua (2015), *Atlas del Agua en México*.

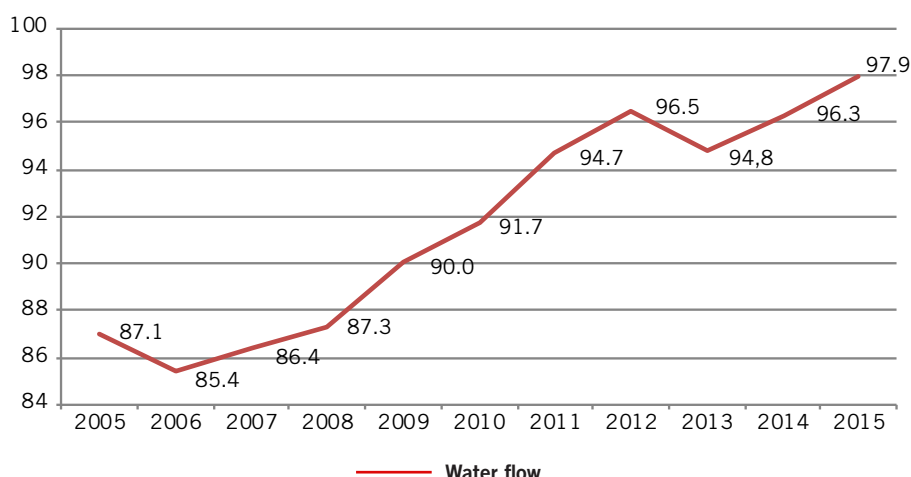
Therefore, in the north, the northeast and the central region, the low availability of water requires efficient use of the resource, better conservation and promoting reuse to prevent sustainability issues.

The Conagua publication *Atlas del Agua en México* also warns of the special risk of overexploitation of groundwater. In fact, in addition to lowering groundwater levels and wells—which affects the safety of buildings—it also harms ecosystems and the quality of the water extracted. Despite these drawbacks, the population in some rural areas is highly dependent on groundwater, which, in some arid zones, is the only alternative.

This pressure has risen due to the accelerated growth of the urban population, which has put further stress on the environment. One illustration of this urbanization is that the 35 population centers of over 500,000 inhabitants are home to 52.5% of the country's population.

To address the problematic overexploitation of the wells and increased costs of extraction and water pollution derived from this overuse, the country has been progressively increasing the use of water from the 874 municipal water treatment plants in operation (2015). These plants aim to improve the water quality of surface and/or underground sources to adapt them to urban public use.

**Figure 5. Amount of drinking water in Mexico, in m<sup>3</sup>/s (2005-2015)**



Source: Conagua (2016), *Atlas del Agua en México*.

Today, Mexico has 5,163 dams with a capacity of around 150 billion cubic meters, with the aim of guaranteeing the water supply for its citizens<sup>12</sup>.

The construction of the aqueduct to deliver water to San Luis Potosí required an existing infrastructure, as well as a dam from which to collect water for purification and transportation to ZMSLP. This dam was covered in an earlier contract fulfilled by the company Carso Infraestructura y Construcción.

The construction of El Realito dam on the Santa María River, located in the northern part of Guanajuato state, in the municipality of San Luis de la Paz<sup>13</sup>, was completed on October 9, 2012<sup>14</sup>.

It has two pipelines for delivering water to:

- The municipal area of San Luis Potosí, 1 m<sup>3</sup>/s (1<sup>st</sup> phase), beginning January 22, 2015.
- Celaya (Guanajuato), 1 m<sup>3</sup>/s (2<sup>nd</sup> phase), not evaluated in this paper.

<sup>12</sup> Conagua (2015), *Atlas del Agua en México*.

<sup>13</sup> L. Meléndez (2008), «La construcción de la presa El Realito, una alternativa viable para lograr la recuperación del acuífero del Valle de San Luis Potosí», *Boletín del Archivo Histórico del Agua*, 40; 78–82.

<sup>14</sup> Construction of the aqueduct began in September 2008 and was to be completed in August 2011, according to the contract (23 months of construction, 1 month testing). However, the dam, which provided water to the aqueduct, was not ready until October 2012.

Thus, the construction of the dam and the subsequent delivery of water would help compensate the restoration of the hydrological balance of national waters in cases of overexploitation, thanks to the recovery of aquifers, the reduction of land subsidence instances in cities and the extraction of water from wells with pollutants such as fluoride.

## 2. The project

The company AQUOS El Realito S.A. de C.V. won the contract to design, finance, build, operate and, ultimately, transfer the aqueduct to the CEA-SLP. This institution is responsible for coordinating with federal entities and local authorities on the planning, design, construction, control and evaluation of hydraulic works in that state.

The project is structured as a public-private partnership (PPP) in which AQUOS El Realito, the concessionaire, contributes capital and seeks financing (debt), while the public sector provides a subsidy through Apoyo Fonadín (authorized by Finfra/FNI). Meanwhile, the latter offers guarantees to mitigate the risk associated with payments to the concessionaire for the availability and volume of treated water.

These guarantees were structured through the creation of different trusts. A trust is a contract by which one or several public and/or private agents (trustors) transfer

**Figure 6. Mitigation of risks with payments through trusts**



Source: Prepared by the authors.

amounts of money to a third party, usually a financial institution (fiduciary), so that it manages the resources and guarantees the payments to the trustee (beneficiary), in this case, to the concessionaire AQUOS El Realito and to the banks financing the operation (see Figure 6).

These additional guarantees reduce the risks of nonpayment by the public authority and, therefore, encourage the participation of private companies in the tender, which encourages competition and ultimately reduces the cost of the infrastructure.

The concession agreement (or service contract [SC]) for the El Realito aqueduct consists of:

- a. The design of the executive project (delivery to the CEA-SLP within 6 months after the signing of the SC).
- b. The construction and testing period (23+1 months).
- c. Operation, conservation and management for 276 months.
- d. Financing of the project.

The project includes the following infrastructures:

- Pipeline; the aqueduct has a total length of 132 km.
- 3 pumping stations with a cumulative height difference of 957 meters (1m<sup>3</sup>/s).
- Head water chamber with capacity for 1,000 m<sup>3</sup>.
- Water treatment plant with a nominal capacity of 1 m<sup>3</sup>/s.
- 6 receiving tanks with an accumulated capacity of 16,000 m<sup>3</sup>.

In addition to the hydraulic works, the contract also includes the construction of about 46 kilometers of asphalted service roads, substations, main electrical connections (9km) and a remote management system.

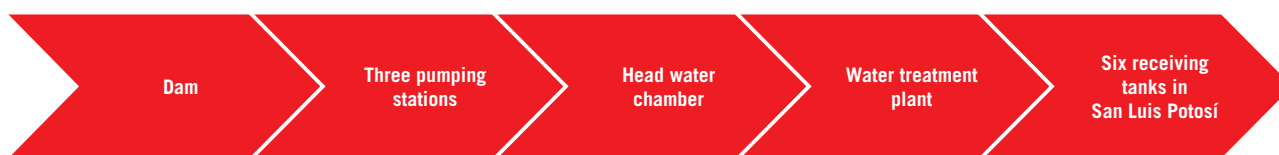
The SC was signed on July 3, 2009, although the start of construction did not happen until June 24, 2011. The nearly two-year delay at the start of the contract was mainly due to problems that were the responsibility of the Administration, such as:

- Delays in the release of the land for pumping plant #1, occupied by the construction of El Realito dam under another contract, which began on October 9, 2012.
- Interruptions/delay in the release of rights of way throughout the construction.
- Lack of timely approval of the pumps by the Administration.
- Modification of the right of way on the Querétaro-San Luis Potosí highway.
- Late completion of power lines at the pumping stations.

After completing construction of the infrastructure and receiving approval by the supervising authority, it was functioning according to the capacity established in the SC after the corresponding guarantee period. That is when the CEA-SLP released the construction guarantee provided by the concessionaire. Hence, the aqueduct became operational in January 2015.

See how water travels through the infrastructure in Figure 7.

**Figure 7. Water treatment path**



Source: Prepared by the authors.

### 3. Water delivery contracts

The El Realito aqueduct project is part of the water delivery contract signed on June 29, 2009 by the CEA-SLP and Interapas, the water distributor in the municipalities of San Luis Potosí, Soledad de Graciano de Sánchez and Cerro de San Pedro, all of which are in the state of San Luis Potosí. In it, the latter agrees to receive from the former the water delivered and treated in the six delivery and regulating tanks, through the AQUOS concessionaire.

In return, the CEA-SLP would receive financial compensation (consideration) to be made effective through the trust:

- To the concessionaire, compensation for the fixed and variable costs of operation and management (fees T2 and T3, respectively); and for the capital invested in the project (fee T1R).
- To the banks, compensation for the structured financing of the project (fee T1C).

Said payments are made through the El Realito Administration trust, which is responsible for managing all the resources and making the payments to the aforementioned entities based on the stipulated objectives.

Regarding the water prices that the CEA-SLP pays to AQUOS El Realito through the trust, these are included in the SC at 9.4925 pesos/m<sup>3</sup> (T1 + T2 + T3). This fee already deducted the contribution made by FNI through the subsidy for building the plant (910,689,743 pesos). If the subsidy had not been included, the cost fee would have been 10.6475 pesos/m<sup>3</sup> (9.4925 + 1.155).

According to information published in the press<sup>15</sup>, a citizen pays just 5 pesos/m<sup>3</sup>, i.e., approximately 47% of the total cost.

With regard to quality, the water delivered must meet the criteria established by the Official Mexican Standard 127SSA1-1994, i.e., water for human use and consumption. These criteria are reflected in key performance indicators (KPI) that AQUOS El Realito must comply with. If not, the concessionaire will be penalized.

Since the infrastructure was put in operation, the volume of water delivered by the El Realito aqueduct has trended upward, as shown in the following table:

<sup>15</sup> [www.elexpres.com/2015/nota.php?story\\_id=96567](http://www.elexpres.com/2015/nota.php?story_id=96567), last accessed February 2018.



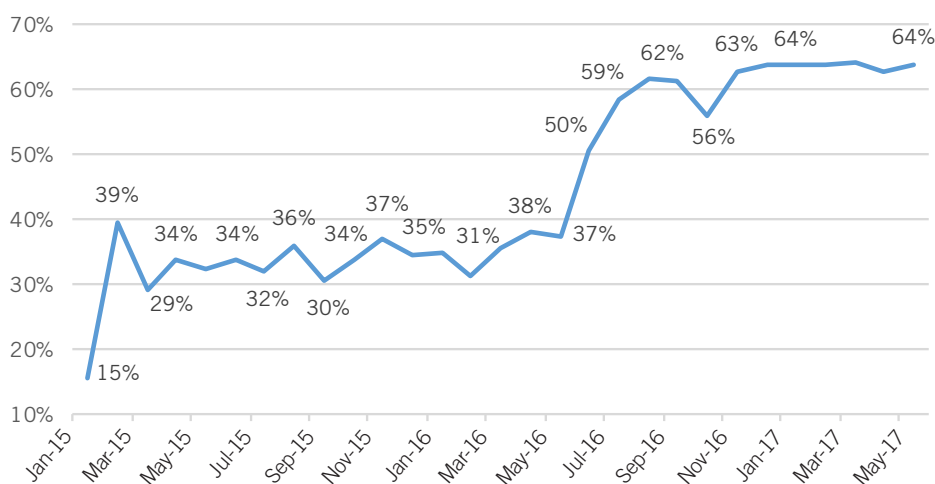
**Table 1. Water delivered**

Vol (m/month)	2015	Daily ave. 2015	% of capacity	Var. vs. prev. month	2016	Daily ave. 2016	% of capacity	Var. vs. prev. month	2017	Daily ave. 2017	% of capacity	Var. vs. prev. month
Jan	414,906	13,384	15.5%		931,770	30,057	34.8%	0.38%	1,705,108	55,003	63.7%	-0.3%
Feb	989,659	34,126	39.5%	138.5%	784,081	27,037	31.3%	-15.9%	1,544,297	55,153	63.8%	-9.4%
Mar	781,362	25,205	29.2%	-21.0%	955,338	30,817	35.7%	21.8%	1,714,785	55,316	64.0%	11.0%
Apr	870,660	29,022	33.6%	11.4%	982,931	32,764	37.9%	2.9%	1,626,231	54,208	62.7%	-5.2%
May	870,122	28,068	32.5%	-0.1%	996,483	32,145	37.2%	1.4%	1,709,597	55,148	63.8%	5.1%
Jun	873,561	29,119	33.7%	0.4%	1,307,260	43,575	50.4%	31.2%				
Jul	853,511	27,533	31.9%	-2.3%	1,568,369	50,593	58.6%	20.0%				
Aug	959,770	30,960	35.8%	12.4%	1,654,772	53,380	61.8%	5.5%				
Sep	788,595	26,287	30.4%	-17.8%	1,585,170	52,839	61.2%	-4.2%				
Oct	903,233	29,137	33.7%	14.5%	1,495,614	48,246	55.8%	-5.6%				
Nov	956,778	31,893	36.9%	5.9%	1,626,153	54,205	62.7%	8.7%				
Dec	928,251	29,944	34.7%	-3.0%	1,709,597	55,148	63.8%	5.1%				
<b>Annual Total</b>	<b>10,190,408</b>	<b>27,890</b>	<b>32%</b>		<b>15,597,538</b>	<b>42,567</b>	<b>49%</b>		<b>8,300,018</b>	<b>54,966</b>	<b>64%</b>	

Source: Document provided by AQUOS El Realito.

However, the volumes of treated water are below the total capacity of the plant, which is around 1 m<sup>3</sup>/second (86,400 m<sup>3</sup>/ day), i.e., the daily water flow agreed upon in the contract<sup>16</sup>.

**Figure 8. Operating capacity**



Source: Prepared by the authors with data provided by AQUOS El Realito.

<sup>16</sup> The plant's volume of operation had to be defined in a coordinated manner between the concessionaire and Interapas, which received the treated water.

## 4. The bidding process

The bidding process was started by the CEA-SLP as national public tender no. 53112001-001-009.

It also invited companies to participate in the process to design, finance, build and operate the aqueduct under a PPP contract, in which the company would take on,

partially, the risk of designing, financing, building, operating and maintaining the project, as well as the demand. The operation of the infrastructure would be transferred to the CEA-SLP, the contracting authority, at the end of the contract.

The El Realito aqueduct project had an open, international bidding process with prior prequalification.

**Table 2. Pre-qualified consortia**

Name of the consortium / Main firm in the consortium	Other consortium members
Consortio AQUOS El Realito / Controladora de Operaciones de Infraestructura, S.A. de C.V. (Conoisa)	<ul style="list-style-type: none"> <li>- Aqualia Gestión Integral del Agua, S.A.</li> <li>- Aqualia Infraestructuras, S.A.</li> <li>- Servicios de Agua Trident, S.A. de C.V.</li> </ul>
Abengoa México, S.A. de C.V.	<ul style="list-style-type: none"> <li>- Befesa Agua, S.A.</li> </ul>
Promotora del Desarrollo de América Latina, S.A. de C.V. (PDAL)	<ul style="list-style-type: none"> <li>- Carso Infraestructura y Construcción, S.A. B. de C. V.</li> <li>- Operadora Cicsa, S.A. de C.V.</li> <li>- Proyectos y Construcciones Urisa, S.A. de C.V.</li> <li>- Degremont, S.A.</li> </ul>
Constructora Makro, S.A. de C.V.	<ul style="list-style-type: none"> <li>- Ingeniería de Bombas y Controles, S.A. de C.V.</li> <li>- Laval Tijuana, S.A. de C.V.</li> <li>- Ke Corporación, S.A. de C.V.</li> <li>- WesTech Engineering, Inc.</li> </ul>

Source: National public tender no. 53112001-001-09.

The companies presented offers of monthly payments in Mexican pesos<sup>17</sup> to the CEA-SLP for four different line items for a total of 276 months (of the 300 that the project lasted, 24 months were construction [EPC], which did not involve payments to the concessionaire and 276 were operation [O&M]).

The contract fee comprised the following:

T1C = monthly fixed cost of loan amortization

T1R = monthly cost of amortization of capital (contributed by the partners of AQUOS El Realito)

T2 = monthly fixed cost of operation and management

T3\*Q = monthly variable operating cost (Q = water volume)

To get the total price of the offer, these four items were added throughout the payment months and discounted at a rate defined in the tender documentation to get a present value that would be used to compare the proposals of different bidders.

The proposals from the leading firms in each consortium were evaluated as shown in the following table.

<sup>17</sup> At prices from April 30, 2009.



**Table 3. Pre-qualified offers (in pesos)**

Consortium / Main companies in the consortia	Present value of the sum of monthly payments <sup>18</sup>	Total monthly payment	Total investment cost of the project (project cost + additional costs) <sup>19</sup>
AQUOS El Realito / Conoisa consortium	2,713,098,021	24,946,255	2,382,463,909
Abengoa México, S.A. de C.V.	5,582,495,870	51,887,448	2,973,015,175
PDAL	4,442,000,000	40,884,677	3,248,847,960
Constructora Makro, S.A. de C.V.	2,163,480,843	19,870,300	2,189,544,967

Source: Prepared by the authors.

First, the technical proposal was evaluated to determine if it was solvent or not, without specific scores. However, the offer from Constructora Makro, S.A. de C.V. (the lowest price of all, at 2,163,480,843 pesos) was not accepted (considered not solvent) due to the lack of documentation and requirements<sup>20</sup>.

The proposal led by Abengoa México, S.A. de C.V. was not considered as it was not one of the lower-priced proposals (present value of the sum of monthly payments, which was 5,582,495,870 pesos).

Ultimately, consideration was given to the two proposals with the lowest present values:

- AQUOS El Realito consortium (present value: 2,713,098,021 pesos)
- PDAL (present value: 4,442,000,000 pesos)

In the case of the AQUOS offer, adding the 276 months of monthly payments amounted to 6,611,161,332 pesos. This total was discounted 0.64%, to get a present value of 2,713,098,021 pesos, the amount of the winning tender. The offer from the other competitor, PDAL, resulted in a present value of 4,442,000,000 pesos.

The major economic difference between the two offers could derive from the substantial freedom that was offered in the design of the project to solve the same problem. Consequently, each company offered different solutions with different costs for the required needs.

On June 18, 2009, the project of the consortium AQUOS El Realito, S.A. de C.V. won the contract for the design, financing, building and operation of the project.

The two elements that tipped the scales in favor of AQUOS El Realito were:

- The technical proposal met all the technical and economic solvency requirements.
- The economic proposal was the best one presented.

### AQUOS

The detailed economic proposal of the two bidding companies was the one shown below.

<sup>18</sup> The total value for the entire period of the concession for each of these four prices was discounted to present value with an annual rate of 0.64% in order to compare offers. The discount rate was applied to all bidders.

<sup>19</sup> Not including interests.

<sup>20</sup> The consortium led by Constructora Makro, S.A. de C.V. took legal action against the ruling in the Office of Disputes and Sanctions in Public Procurement (case no. 205/2009). The judgment of the Federal Court of Fiscal and Administrative Justice No. 115.5, on November 15, 2013, stated that the company's non-acceptance of the decision was not justified.

**Table 4. Offers from qualified companies (pesos)**

AQUOS El Realito / Conoisa consortium		PDAL	
Present value of monthly fees	2,713,098,021	Present value of monthly fees	4,442,000,000
Monthly payment <sup>21</sup>	Monthly cost (pesos)	Monthly payment	Monthly cost (pesos)
T1C*	7,611,249	T1C*	13,241,812
T1R	4,167,606	T1R	8,505,073
T1 (T1C + T1R)	11,778,855	T1 (T1C + T1R)	21,746,885
T2	2,046,986	T2	10,324,450
T3*Q	11,120,413	T3*Q	8,813,342
Total	24,946,255	Total	40,884,677

Source: Decision on proposals. National public tender no. 53112001-001-09.

**Table 5. Comparison of offers**

Component	% of revenue for AQUOS	% de ingresos PDAL	Difference between proposals <sup>22</sup>
Fixed cost of loan amortization (T1C)	31%	32%	57%
Amortization of the capital cost (T1R)	17%	21%	49%
Fixed cost of O&M (T2)	8%	25%	20%
Variable cost (T3*Q)	45%	22%	126%
<b>Monthly payment</b>	<b>100%</b>	<b>100%</b>	<b>61%</b>

Source: Prepared by the authors.

Additionally, in the proposal from AQUOS El Realito the volume of monthly variable income over total income (45%) was greater than that of the competitor (22%), thus resulting for the contracting authority in the transfer of a greater risk of lawsuit to the operator.

Ultimately, the winning consortium had to make a single payment in the amount of 48,035,000 pesos within 30 days following the start of the SC to offset the cost of the previous studies and technical project of the infrastructure commissioned by the CEA-SLP prior to the tender.

<sup>21</sup> As of month 265, the T1C loan amortization fee was not paid. All fees were charged starting in month 25.

<sup>22</sup> AQUOS El Realito/PDAL.

## 5. Internal characteristics of the project

The key internal aspects of the project are described below, grouped by sections: consortium or special purpose vehicle (SPV), main members of the winning consortium, project structure, fee structure of the PPP, risk and mitigation, financing, trust structure, technical elements and governance.

### 5.1. Consortium or Special purpose vehicle (SPV)

AQUOS El Realito S.A. de C.V., was the consortium created on July 2, 2009 to carry out the project. The SPV comprised the following companies:

- a. Conoisa. Subsidiary of one of the largest construction companies in Mexico, ICA (50.999% of the capital).
- b. Aqualia Gestión Integral de Agua, S.A. (44%)
- c. Aqualia Infraestructuras, S.A. (5%)
- d. Servicios de Agua Trident, S.A. de C.V., (0.001%)

### 5.2. Main members of the winning consortium

#### FCC Aqualia

Aqualia is the FCC Group's water management company whose main lines of business are environment, water, and infrastructure.

It is present in 21 countries and serves more than 22.5 million people in over 1,100 municipalities. It currently has 7,764 employees.

It is a leader in the management of the complete water cycle in Spain, third in Europe and sixth in the world. In 2016, its total revenues were €1.01 billion.

Beyond offering services to city councils, it has extensive experience in EPC and O&M contracts. It has successfully executed more than 700 projects in these sectors in Europe, Latin America, the Middle East and North Africa.

<sup>23</sup> [www.ica.com.mx/en\\_US/web/ica/](http://www.ica.com.mx/en_US/web/ica/), last accessed February 2018.

<sup>24</sup> [www.ica.com.mx/es/agua-prieta-wastewater-treatment-plant](http://www.ica.com.mx/es/agua-prieta-wastewater-treatment-plant), last accessed February 2018.

<sup>25</sup> [www.ica.com.mx/es/web/ica/atotonilco-wastewater-treatment-plant](http://www.ica.com.mx/es/web/ica/atotonilco-wastewater-treatment-plant), last accessed February 2018.

Some of the latest projects carried out by the FCC group in Mexico are:

- Aqualia and Aqualia Infraestructuras de México in conjunction with FCC Construcción participate in Aqueduct II of Querétaro.
- Aqualia Infraestructuras de México participates in El Caracol pumping plant and the expansion of the Cutzamala system.
- FCC Construcción participates in several infrastructure projects, most notably El Zapotillo dam, Coatzacoalcos tunnel, and Nuevo Necaxa-Ávila Camacho highway.

#### Aqualia Infraestructuras, S.A.

A 100% subsidiary of Aqualia specialized in engineering and construction of hydraulic infrastructures, particularly transport, pumping and storage, as well as desalination plants, water treatment plants and wastewater treatment.

#### Conoisa

Mexican engineering and construction services company. Operates and maintains infrastructures for the supply, distribution and treatment of drinking water. It is a subsidiary of Empresas ICA<sup>23</sup>, S.A. de C.V., one of the largest construction companies in Mexico specializing in infrastructures such as roads, ports, airports, water, energy, oil & gas, etc. It had revenues in 2016 of 20.401 billion pesos.

The latest projects carried out by this entity include:

- Agua Prieta wastewater treatment plant (Jalisco, 2011)<sup>24</sup>, whose objective was to improve the quality of drinking water, sewage, sanitation and reuse in Jalisco. The project included carrying out the executive plan and the engineering, construction and electromechanical equipment, along with functionality and capacity testing.
- Atotonilco wastewater treatment plant (Atotonilco de Tula, Hidalgo; 2010)<sup>25</sup>. The project included designing, building and operating for 22 years and transferring the plant to the federal government at the end of the contract. It is the largest wastewater treatment plant in Latin America and one of the largest in the world; this plant enables the use of treated water, which is currently used in agriculture.

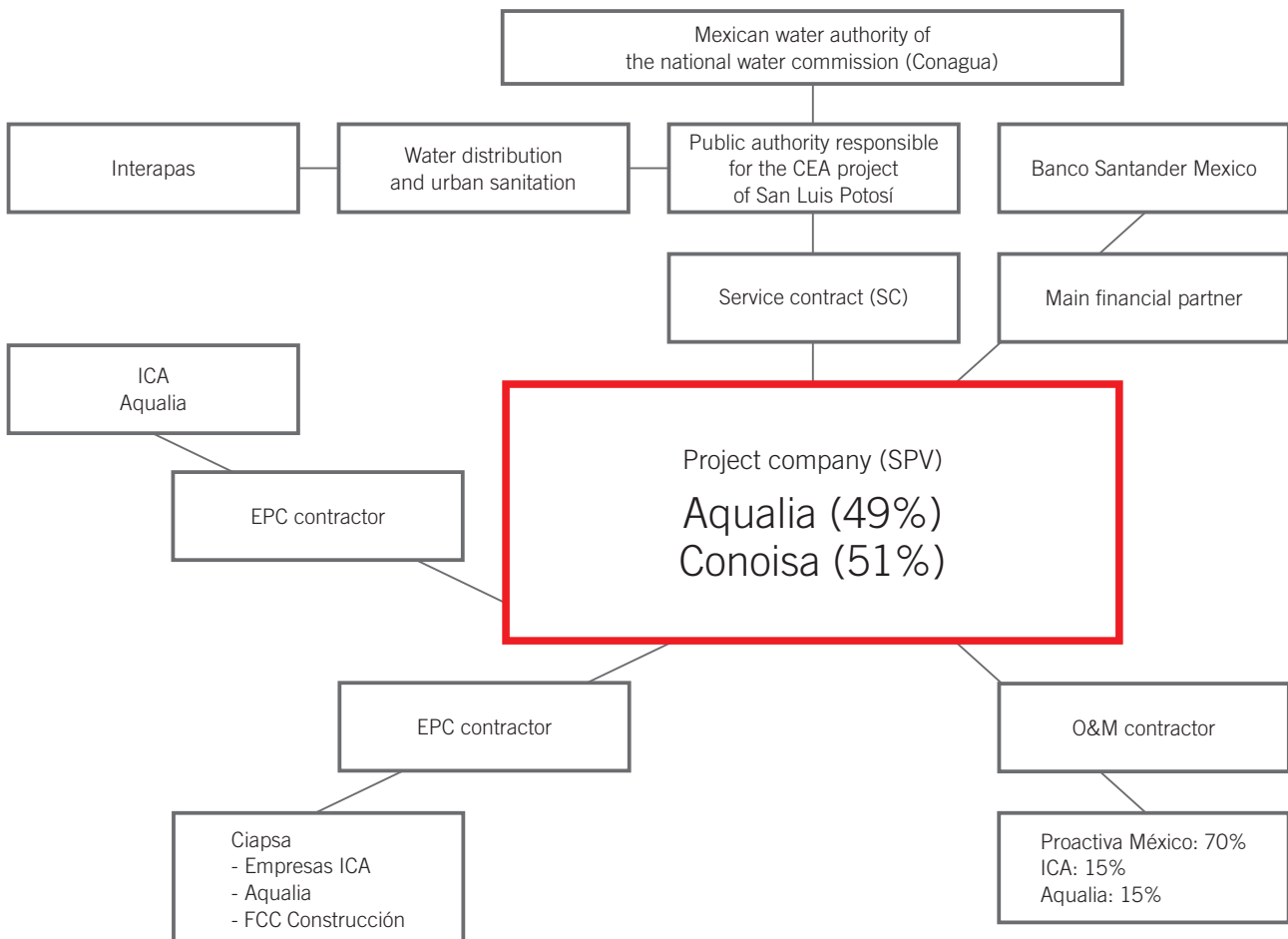
## Servicios de Agua Trident, S.A.

Subsidiary of the Japanese company Mitsui & Co., specialized in the water sector. Initially it was to participate in the AQUOS El Realito consortium, but ultimately withdrew. In order to stay eligible for the presenting the offer, it agreed to stay on with 0.001%.

## 5.3. Structure

Figure 9 summarizes the relationships between the different organizations, institutions and companies involved in the project.

**Figure 9. Organizations, institutions and companies**



Note: For reasons of simplicity in the project structure, companies with relevant participation are mentioned at the SPV level.

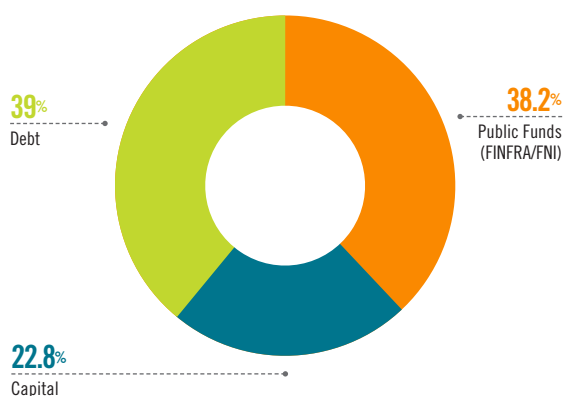
Source: Prepared by the authors.

## 5.4. Financing

The El Realito aqueduct project was structured as a PPP in which 61.8% of the value of the project investment (not the total cost including additional components such as finance fees, single consideration, administration trust fees, etc.) was financed by the private sector (the capital contributed by the SPV amounted to 22.8%, while

the debt contributed by financial institutions was 39%) with the remaining 38.2% financed by public funds by Apoyo Fonadín (authorized by Finfra/FNI). This support is only used to pay part of the project works up to an amount of 910.69 million pesos, and no other costs associated with the project.

**Figure 10. Origin of the funds of the El Realito aqueduct and the water treatment plant**



Source: Document provided by AQUOS El Realito.

The financing structure of the project's cost and payments was particularly innovative, since a trust system was used (contracts between the concessionaire, administration and financial institutions) to increase the payment guarantees to both the SPV and the lending institutions. This was to encourage the participation of companies and banks and foster competition, ultimately reducing project costs for the taxpayer.

Regarding financing to the concessionaire, AQUOS El Realito, the senior debt was facilitated by a group of banking entities with Banco Santander as the agent bank. This financing group comprises the following financial institutions:

- Banco Santander
- Banobras, a development bank in Mexico under the Ministry of Finance and Public Credit.
- Banorte

The total investment costs were financed at the reference rates<sup>26</sup> plus an incremental margin over time. The initial differential (from 2011 to 2013) was 2.75%. A remarkable fact is that, when the financial closeout happened, the financing of the AQUOS El Realito project was set at a slightly lower rate than the one existing in the 10-year public debt bond.

<sup>26</sup> The benchmark rate is the 28-day interbank equilibrium interest rate (TIIE) calculated by the Bank of Mexico.

It is also important to highlight the role played by the Banobras development bank in PPP projects in Mexico. In the case of AQUOS El Realito, Banobras participated in the project debt, particularly having two benefits on:

- The public sector, since Banobras —and by extension the public administration— in this case earns a financial return on its investment above what it normally gets from the various low-risk financial products it usually invests in.
- The private sector, since it is an additional guarantee for collection, since the administration is also on the lenders' side, and it allowed for the project to be financed at a low cost at closing time.

## 5.5. Trust structure

A trust system generally consists of the signing of a contract between three different parties to mitigate the financial risks of the project.

In this system, **trustors** sign in favor of the beneficiary (**trustee**) a **trust** (contract) that is managed by a **fiduciary**. The elements and parties in this system are:

- Trustors: those required to contribute economic resources to the project for its execution
- Trust: "fund" to which the trustors contribute certain financial resources to meet the contractual obligations
- Fiduciary: manages the resources of the "fund," to ensure compliance with certain economic obligations of the contracting body (CEA-SLP, in this case), Interapas and the State of San Luis Potosí in favor of the trustee. The fiduciary is normally a financial institution that meets strict legal requirements, is authorized by the federal financial regulator and receives in trusteeship the property provided by the trustors, managing it and complying at all times with the latter.
- Trustee: the beneficiary to receive the resources of the fund if the conditions of the contract are met. In this case, AQUOS El Realito and the institutions that finance the project.

**Table 6. Institutions and companies**

Trust (contract)		
Trustor: contributes resources and/or rights	Fiduciary: administers resources and/or assets according to conditions	Trustee: beneficiary

Source: Prepared by the authors.

This structure results in a reduction of the financial cost of the project, since the guarantees provided by the trust system (contracts) mitigate the project risk, and for the concessionaire (AQUOS EI Realito).

The three trusts created in the project were:

- **Main trust or administration trust EI Realito.**

AQUOS EI Realito assumed the “obligation to obtain and contribute to the trust all the resources for the design, building, operation, conservation and maintenance of the aqueduct” and the “contribution

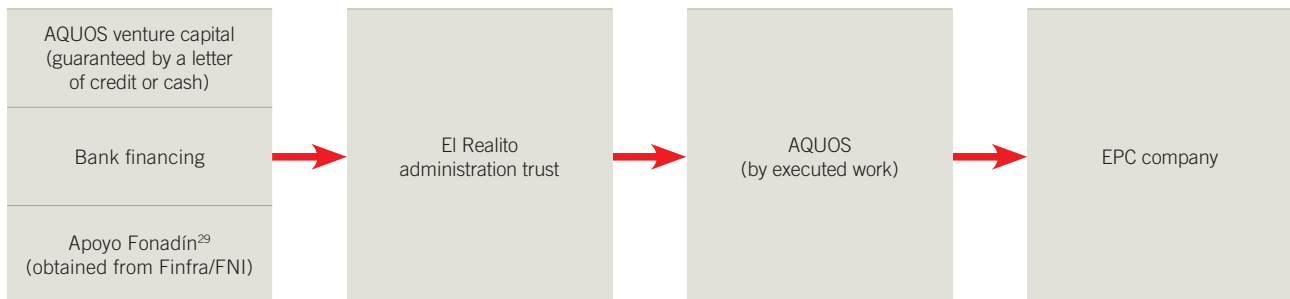
of the additional resources that the trust may require to cover the necessary expenses to keep the EI Realito aqueduct operational.”

- In the investment phase, the EI Realito administration trust manages the resources associated with the construction of the infrastructure and the resources contributed by AQUOS EI Realito (capital), banks (debt) and Finfra/FNI<sup>27</sup>. These resources are used to pay for the building of the aqueduct.

- In the operation and management phase, the administration trust EI Realito manages the resources associated with the operation and management of the infrastructure and contributed by:

- The state government trust.** The “vested rights of the CEA in the trust of the state government,” i.e., the resources committed by the state government with the CEA (up to 50% of payroll taxes) and contributed to said trust of the state government so that the CEA-SLP complies with its payment obligation to the concessionaire (AQUOS EI Realito) of the fee components T1C and T1R under the SC signed with AQUOS EI Realito and the financing agreement signed with the banks<sup>28</sup>.

**Figure 11. Contribution of resources to EI Realito administration trust and payments to AQUOS and EPC company in the investment phase**



Source: Prepared by the authors.

<sup>27</sup> Created February 2008.

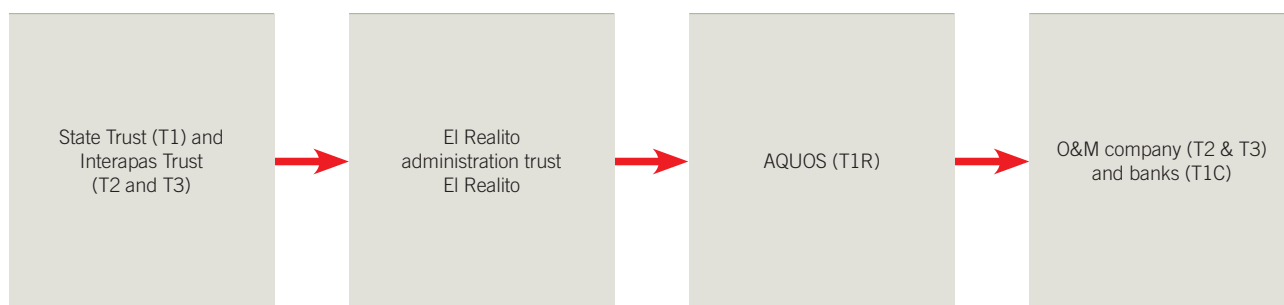
<sup>28</sup> The trust of the state government (not the CEA-SLP) shall pay the concessionaire directly. The CEA-SLP validates the invoice presented by AQUOS EI Realito to the administration trust (for the entirety, in case there are no eventualities due to causes attributable to AQUOS EI Realito). The latter automatically makes the payment to the concessionaire (T1R) and banks (T1C).

<sup>29</sup> The amount will only be delivered to the administration trust once AQUOS EI Realito has delivered the guarantee of contribution and obtained the loan.

b. **The Interapas trust.** The “vested rights of the CEA-SLP in the Interapas Trust,” i.e., the resources committed from Interapas to the CEA-SLP (up to 100% of the charges derived from the provision of the integrated water cycle service to citizens) so that the latter complies with its payment obligation to the concessionaire (AQUOS El Realito) of components T2 and T3 (fixed and variable

fee of operation and management of the project) of the fee per the SC signed with said party. If the Interapas trust failed to make the agreed contributions in the administration trust for payment of the services rendered, the fiduciary (manager) of the administration trust would obtain them from the letter of credit signed by Interapas (mentioned later in the Interapas trust).

**Figure 12. Contribution of resources to El Realito administration trust and payments to AQUOS, banks and O&M company in the investment phase**



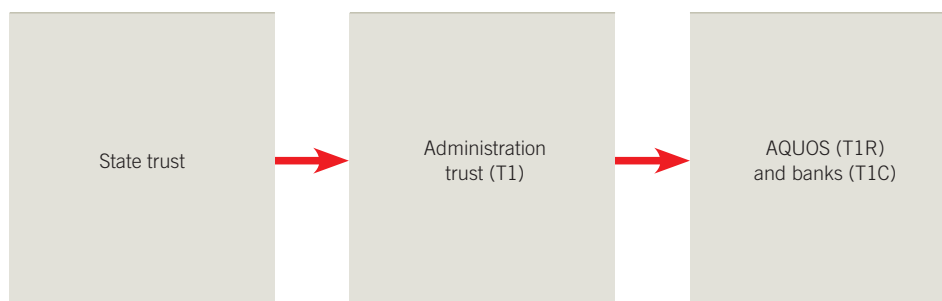
Source: Prepared by the authors.

- **The state government trust**

On December 20, 2008, the SLP state government was authorized to set up a trust for an amount equivalent to 50% of the collection obtained from payroll tax for the purpose of securing resources to ultimately guarantee the payment of component T1 of the fee

to AQUOS and the banks through the administration trust. Through this trust, the state government provides financial support to the CEA-SLP (which, through the assignment of its collection rights, allows payments under component T1 of AQUOS’ compensation to be made directly from the trust of the state government to that of the administration).

**Figure 13. State trust guarantee system**



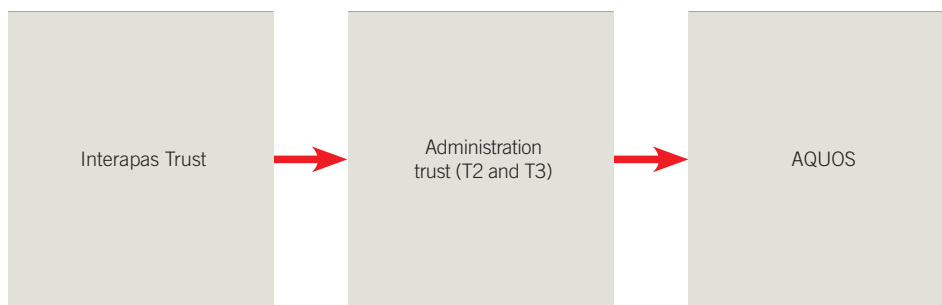
Source: Prepared by the authors.

- **Interapas Trust**

Interapas constitutes the Interapas trust, which manages the collection rights assigned by the CEA-SLP under the water supply contract between the latter and Interapas. These resources are associated with the payments of components T2 and T3 to AQUOS under the water procurement contract signed between the latter and the CEA-SLP.

To ensure timely payment of the Interapas trust to the CEA-SLP to the El Realito Administration Trust, which would correspond to the services provided for the delivery and purification of water, it also signed a letter of credit with Banorte for up to three times the amount of the monthly consideration—47.46 million pesos—and with joint-and-several guarantee of the Municipalities of San Luis Potosí and Soledad de Graciano Sánchez.

**Figure 14. Trust system of the Interapas trust**



Source: Prepared by the authors.

To summarize, Figure 15 shows the activity of each of the trusts, while Figure 16 shows the central role of the administration trust in the operation of the guarantee system.<sup>30</sup>

**Figure 15. Trust structure**

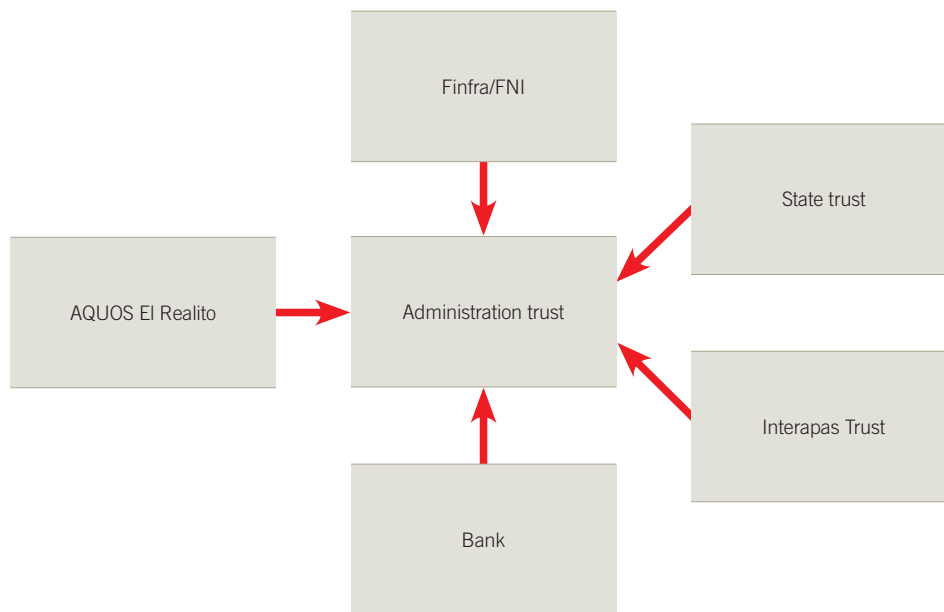
TRUSTS		
<p><b>The state government trust</b></p> <p>Provides administration trust with necessary resources to the fee component T1 to AQUOS.</p>	<p><b>Administration trust</b></p> <p>Manages the resources contributed by the trustors in the investment and operation phases and makes the payments to AQUOS for fees T1, T2 and T3.</p>	<p><b>Interapas Trusts</b></p> <p>Provides the administration trust with the necessary resources to pay fee components T2 and T3 to AQUOS.</p>

Source: Prepared by the authors.

<sup>30</sup> Exhibit 2 presents more detailed data on the information shown in Figure 16.



**Figure 16. Central structure of the administration trust (contribution of resources)**



Source: Prepared by the authors.

As shown in Figure 16, the administration trust centralizes payments through the different agents participating in the project.

## 5.6. Fee structure of the PPP

Payment of water for the delivery and purification service included two sections:

- Availability
- Variable based on the variable operating costs

Once the operation begins with the signing of the corresponding paperwork, the El Realito administration trust makes monthly payments to AQUOS El Realito on behalf of the CEA-SLP, according to the three fee terms defined contractually ( $T1_n, T2_n, T3_n$ ):

$$C_n = T1_n + T2_n + T3_n$$

Where:

- $C_n$  is the net total payment in the month “n” made to AQUOS El Realito for the delivery and purification service in Mexican pesos. The monthly payment includes an update due to the inflation variations of each of its three components.

- $T1_n = T1C_n + T1R_n$ , fee to pay the amortization costs of the investment made by AQUOS El Realito and financed with both the bank loan ( $T1C$ ) and venture capital ( $T1R$ ).
- Fee  $T1$  is paid by the El Realito administration trust on behalf of the CEA-SLP (with 50% guarantee of the state payroll amounts structured through the state government trust).

The term  $T1R_n$  includes a penalty in case the volume of water supplied by AQUOS El Realito was lower than 84,400 m<sup>3</sup>/day for causes attributable to the latter. No compensation is due, however, to AQUOS El Realito from the CEA-SLP in the event that the latter reduces its water demand.

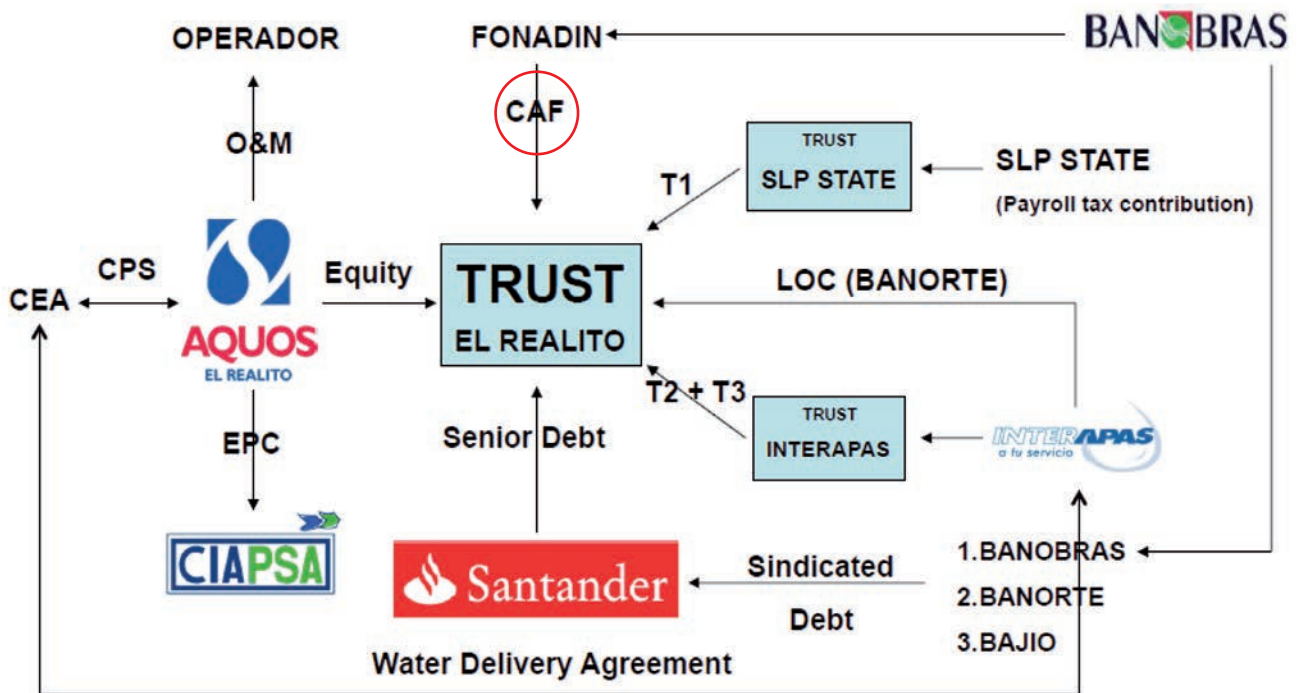
Fee  $T1C$  is paid for 240 months, from month 25 to 265 ( $T1R$ , however, prolongs its payment until month 300, the end of the project).

- $T2_n$ , monthly payment of the fixed costs of operation, conservation and maintenance of the project in accordance with that presented in the economic offer starting the first month as of the signing of the operation agreement. Paid by the El Realito administration trust on behalf of the CEA-SLP (with 100% guarantee of the amounts collected by Interapas for the provision of the service to citizens structured through the Interapas trust).

- $T_{3n}$ , monthly payment for the variable operating cost ( $m^3$ ) according to the economic proposal of the offer.  $T_{3n}$  is paid by the El Realito administration trust on behalf of the CEA-SLP from the first month of operation (once the operation agreement is signed) until the end of the contract.

Figure 17 summarizes the contributions of resources and the trust system of the contract with the respective fees:

**Figure 17. Contributions of resources and structure of trusts and guarantees**



Note: CAF here stands for financial support agreement.

Source: Document provided by AQUOS El Realito.

## 5.7. Risk: management and mitigation

The theory of PPPs states that an adequate distribution of risk is one of the crucial elements to ensure project success and provision of the service when this type of contract is used. Traditionally, academic literature<sup>31</sup> has argued that the risk should be transferred to the party that can manage it best and at the lowest cost. Therefore, it should not be assigned to an agent that does not have the capacity to reduce or manage it.

<sup>31</sup> Contract theory, which studies how economic agents handle contractual arrangements—normally with asymmetries in the available information—states that the risk must be allocated to the party best able to control its origin or to whomever can best manage the risk in case of high aversion (Engel, Fischer and Galetovic, 2014).

**Table 7. Assignment of risk**

Risk category	Assignment
Lands and space	CEA-SLP
Environmental	CEA-SLP / AQUOS
Design and construction	AQUOS
Financing	AQUOS / CEA-SLP / FNI
Inflation	CEA-SLP
Interest rates	AQUOS
FX risk	AQUOS
Operation and management	AQUOS
Demand	CEA-SLP / AQUOS
Political	AQUOS

Source: Prepared by the authors.

However, the optimal transfer of risk in PPP contracts requires a prior evaluation of each party's incentives—often monetary—to carry out the tasks assigned in the contract.

**Risk related to land and space:** The CEA-SLP is responsible for providing AQUOS El Realito with the temporary and free use of the land where the infrastructure was built, as well as obtaining the rights of way and making them available to the company cost-free. The obtaining of the latter was delayed, and thus the responsibility fell upon the contracting public authority to compensate AQUOS El Realito for the consequences derived from said delays.

**Environmental risk:** AQUOS El Realito is responsible for carrying out the process of updating and monitoring the approval of the Environmental Impact Statement and the mitigation programs. Obtaining the original document is the responsibility of the CEA-SLP.

**Design and construction risk:** The executive project was to be completed by AQUOS El Realito according to the requirements of the tender. The latter afforded a high degree of freedom to the concessionaire, although it had a prerequisite that the CEA-SLP could not raise any objections. The construction risk fell upon AQUOS El Realito, although in the case of any delays due to causes not attributable to the company, it would be the CEA-SLP that would provide compensation according to the prices established in the corresponding agreement.

**Financial risk:** This was shared between AQUOS El Realito, which contributed capital and had to obtain financing, and CEA-SLP, which was responsible for securing Apoyo Fonadín. The innovative trust system largely mitigated the risks of non-payment by the administration and, consequently, reduced the cost of financing the project.

**Inflation risk:** The contract called for updating the three fee components (T1, T2 and T3) due to inflation by the CEA-SLP. That said, it is important to consider that an increase in prices is tied to a depreciation of the local currency (the Mexican peso)<sup>32</sup>, which is used to remunerate the capital of the concessionaire.

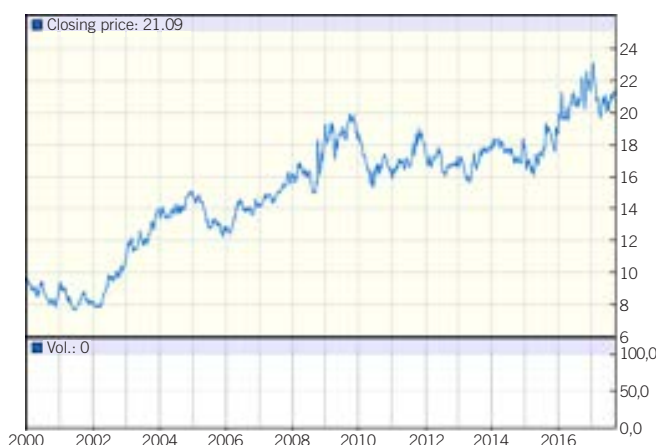
<sup>32</sup> According to economic theory, an increase in inflation must lead to a reduction in the demand for local products (since they are more expensive), which reduces the demand for local currency (Mexican pesos, in this case) in the currency markets, and that foreign consumers reduce their purchases of goods and services in the country. The consequence is a devaluation of the currency in which the concessionaire is paid.

**Interest rate risk:** This was taken over by AQUOS El Realito, which secured funding for the project. The interest rates, referenced to the 28-day interbank equilibrium interest rate (TIIE) calculated by the Bank of Mexico (variable), included a growing margin over time.

**Exchange rate risk:** This risk, which was in fact considerable, was taken on by the members of the AQUOS El Realito consortium. There could have been a depreciation of the Mexican peso due to economic factors (evolution of the economy and/or change in interest rates) or political instability. The contract does not include any fee adjustment mechanism linked to the exchange rate.

On that note, it is important to remember that, in 1994, Mexico experienced what is known as the “tequila crisis,” which led the local currency to lose more than 60% of its value over the next two years.

Figure 18. 1 EUR/MXP



Source: Data from Google Finance, last accessed November 2017.

**Operational risk:** AQUOS El Realito has primary responsibility for the operation and management throughout the life of the contract, as established in the SC for El Realito aqueduct. The company will be penalized if the aqueduct operates at a volume below 75% of the agreed capacity for reasons attributable to the company. In such a case, it will only receive the TIC fee to repay the loan. However, AQUOS El Realito entrusts a company with the O&M of the project, thereby transferring part of the risk to the subcontracted company Proactiva Medio Ambiente de México, S.A. de C.V., which has 70% of the capital of the contracting entity and which was 50% owned by Aqualia at the time.

**Demand risk:** This risk is shared between:

- The CEA-SLP, which must buy the water purified by AQUOS El Realito and pay fees T1C, T1R and T2 regardless of the volume delivered.
- AQUOS El Realito, which depending on the demand may be forced to deliver a lower volume than envisaged in the offer (reducing its profitability). According to this offer, 45% of the concessionaire's income was from T3. In the event that Interapas decided to increase the volume of water supplied from the wells (alternative source), this would not only cause economic damage to the concessionaire company, but would also represent a significant damage to the environment and the health of the population at large.

**Political risk:** Anything that can affect the private party due to the actions of the public sector, either changes in regulation (prices, quality standards or environmental restrictions) or alternative investments that affect the project's profitability. AQUOS El Realito is the one that takes on the risk of any action by the CEA-SLP, Interapas, the municipalities or the state government that could affect its interests.

## 5.8. Technical elements

The water delivery infrastructure spans 132.33 kilometers and is divided into three sections:

- 1<sup>st</sup> section. This is the discharge area, which stretches from the dam to the three pumping stations and extends to the head water chamber (14.5 km). The steel pipe is 36 inches in diameter.
- 2<sup>nd</sup> section. It runs from the head water chamber to the water treatment plant (19.83 km by gravity), with diameters of 48 inches in the sections of steel pipe and 1.434 mm in the sections of concrete pipe.
- 3<sup>rd</sup> section. It goes from the water treatment plant to the receiving tanks in ZMSLP, with a capacity of 16,000 m<sup>3</sup> (98 km by gravity). It has 48-inch diameter steel sections, 938-1636 mm-diameter concrete sections and various branches in high-density polyethylene (HDPE), 12-30 inches in diameter.

Its components:

- Three pumping stations: three sections.
- One head water chamber.
- One water treatment plant.
- Six receiving tanks.

## 5.9. Governance

In this contract, as in any other long-term contract involving different actors with potentially different priorities, governance is one of the keys to the project's success. Throughout the life of the project, unexpected situations may arise that force the parties to reach agreements on matters that were not initially considered. For this reason, contracts are considered incomplete, especially the longer the duration (Grossman and Hart, 1986)<sup>33</sup>. Having good governance mechanisms will ensure that the project progresses adequately over time.

The contract we are focusing on has two different phases where discrepancies may occur:

- Construction period.
- Operating period.

During the construction phase, the administration trust, with the approval of CEA-SLP and Apoyo Fonadín, hired supervision (which accounted for 2% of the total construction cost and was paid for by AQUOS El Realito) to monitor the project throughout this period<sup>34</sup>. The supervision assignment was primarily to:

- Verify partial and total deliveries.
- Monitor project execution and transmission of orders from the CEA-SLP to the company through the on-site project manager.
- Help on-site project manager check the quality of the materials.
- Supervise the payment of the estimates charged to the administration trust fund.

<sup>33</sup> S. J. Grossman, and O. D. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94: 691-719; O. D. Hart, and J. Moore (1990), "Property Rights and the Nature of the Firm," *Journal of Political Economy*, 98: 1119-1158.

<sup>34</sup> Section 14 of the contract.

- Prepare and deliver reports to the CEA-SLP through the on-site project manager and the administration trust.
- Verify project completion.

Additionally, the CEA-SLP appointed a public servant as an on-site project manager with the following functions<sup>35</sup>:

- Supervise, monitor, oversee and review the project on behalf of the CEA-SLP.
- Answer contract-related inquiries made by the supervision or the company.
- Authorize, if applicable, changes to the executive project.
- Analyze the solution alternatives offered by the supervision and AQUOS El Realito and determine which actions should be carried out.
- Review the reports submitted by the supervision and issue an opinion on the compliance of AQUOS El Realito.

Clause 53 of the contract refers to: the application of the Law on Acquisitions, Leases and Services of the Public Sector (LAASSP); the laws, regulations and administrative provisions of the State of San Luis Potosí; and the follow-up of an arbitration process for the resolution of disputes between the contracting authority and the concessionaire. If necessary, that procedure would be followed by litigation.

- Arbitration process: First, a solution is sought through the designated representatives, in no more than 10 days. Following that, the proposals of an arbitrator appointed by mutual agreement by both parties must be complied with.
- Litigation: if an agreement is not reached on all disputes arising from the interpretation, compliance or execution of the contract, they are resolved by the federal courts.

Aside from the arbitrator (in reactive mode), the contract does not provide for any independent body or periodic meetings to actively resolve any setbacks that may arise.

The project ran up against situations such as:

- Delay in the construction of infrastructure due to problems involving right of way (outside the company).

- Divergent positions in particular moments involving various aspects of water delivery.

Regarding this last point, it should be noted that documents prepared by the Autonomous University of San Luis Potosí (UASLP) and Coepris certified that the delivery of water by AQUOS El Realito was carried out according to the quality conditions established in the contract.

## 6. External characteristics of the project

The key external aspects of the project are described below, grouped by sections: economic/financial conditions; legislative context, regulations and technical support; and political conditions.

### 6.1. Economic / financial conditions

The Mexican economic situation in 2009, when the contract was signed, was not impervious to the international financial crisis.

In August 2007, the freezing of interbank lending markets (in which banks offer short-term loans to each other) due to the loss of confidence in the global banking system gave way, by December of that same year, to the start of what would be known as the Great Recession. The central banks of the developed economies responded by providing liquidity to the banking entities under advantageous conditions to avoid economic collapse.

In October 2008, given the scarce liquidity in the international financial system,

“The Bank of Mexico and the Federal Reserve of the United States agreed on the implementation of a reciprocal and temporary mechanism for the exchange of currencies (known as “swaps”) for a value of up to \$30 billion. This mechanism allowed such resources to be arranged for the purpose of providing liquidity in US dollars to financial institutions in Mexico”<sup>36</sup>.

<sup>35</sup> Section 15 of the contract.

<sup>36</sup> Bank of Mexico (2009), «2009», “Bank of Mexico announces an extension of the term of the swap line with the Federal Reserve of the United States” ([www.banxico.org.mx/informacion-para-la-prensa/comunicados/miscelaneos/boletines/%7b15390b4a-4c28-3468-42c8-dbe06934f6be%7d.pdf](http://www.banxico.org.mx/informacion-para-la-prensa/comunicados/miscelaneos/boletines/%7b15390b4a-4c28-3468-42c8-dbe06934f6be%7d.pdf)), last accessed February 2018. Minor edits were made to this quote for easier reading.

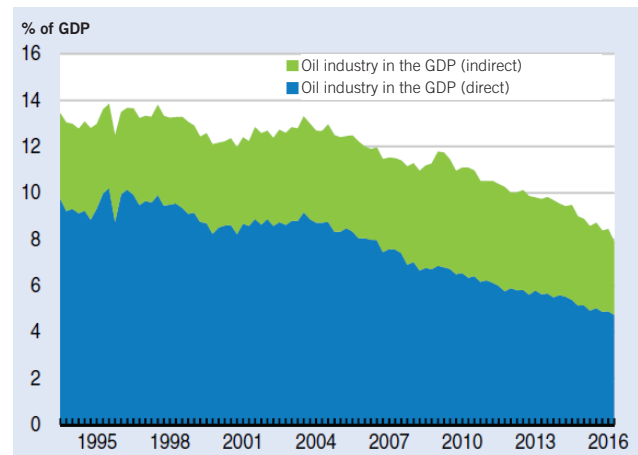
The government's additional measures included providing 30 billion pesos to Banobras and others 125 billion through Finfra/FNI for three years to promote investment. The El Realito aqueduct project, approved in June 2008, was able to benefit from these financial aids.

The measures adopted by the government probably helped reduce the impact of the state of the financial system on the real economy. Nevertheless, in the last quarter of 2008, it reduced the GDP growth forecasts in 2009 from 3% to 1.8%.

However, the Mexican economy had an ally in this delicate moment for the financial system: a sharp rise in oil prices in 2010 and 2011. In Mexico, until the mid-2000s, oil-related activities (including petrochemicals and petroleum products) accounted for about 13% of GDP (OECD, 2017).

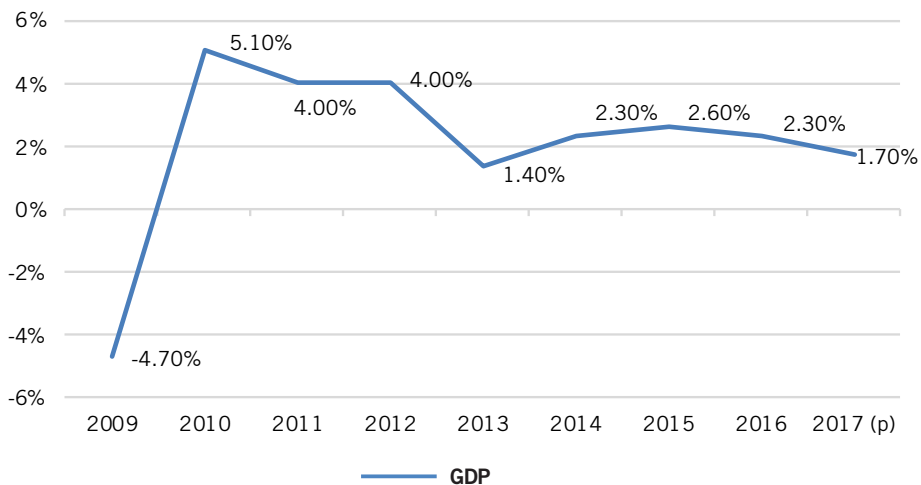
México, exportador neto de petróleo, se benefició de unos precios relativamente elevados entre 2010 y 2014, lo que permitió incrementar los ingresos del país, compensando el difícil escenario económico y financiero internacional.

**Figure 19. Mexico's dependence on oil**



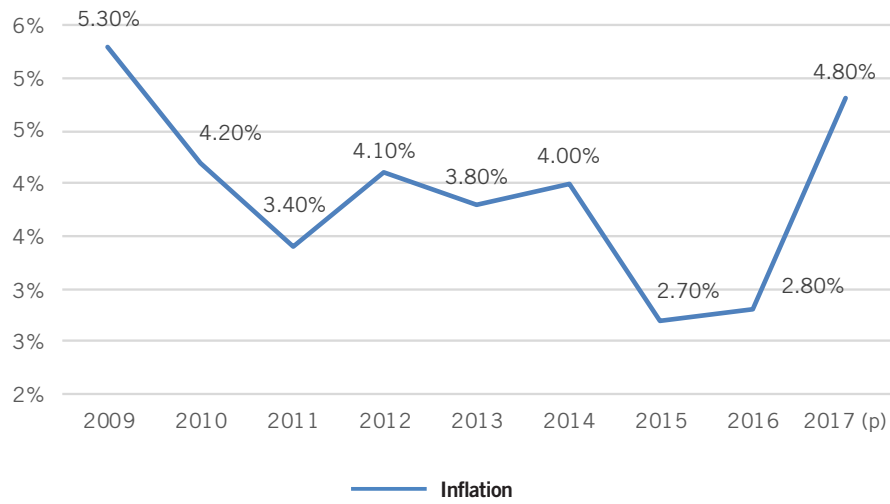
Source: OECD, 2017).

**Figure 20. GDP**



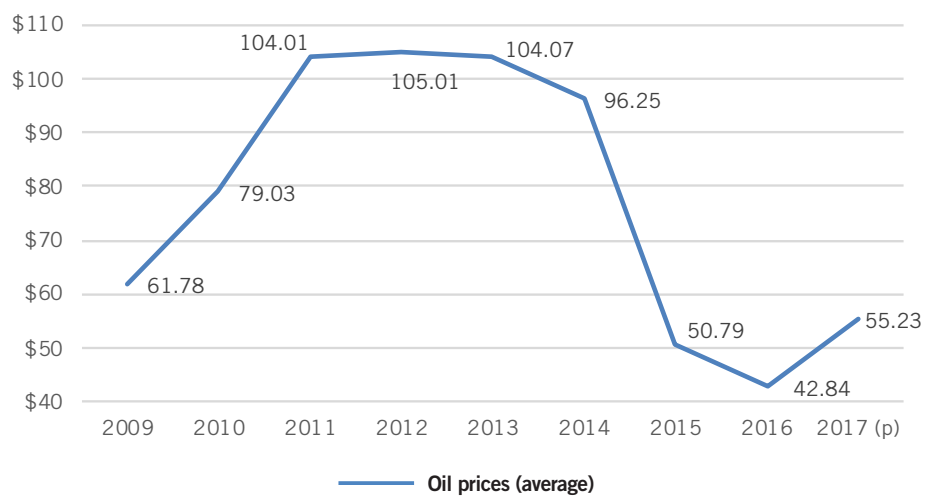
Source: IMF, Economic Outlook 2017, Banco de México.

**Figure 21. Inflation**



Source: IMF, *Economic Outlook 2017*, Banco de México.

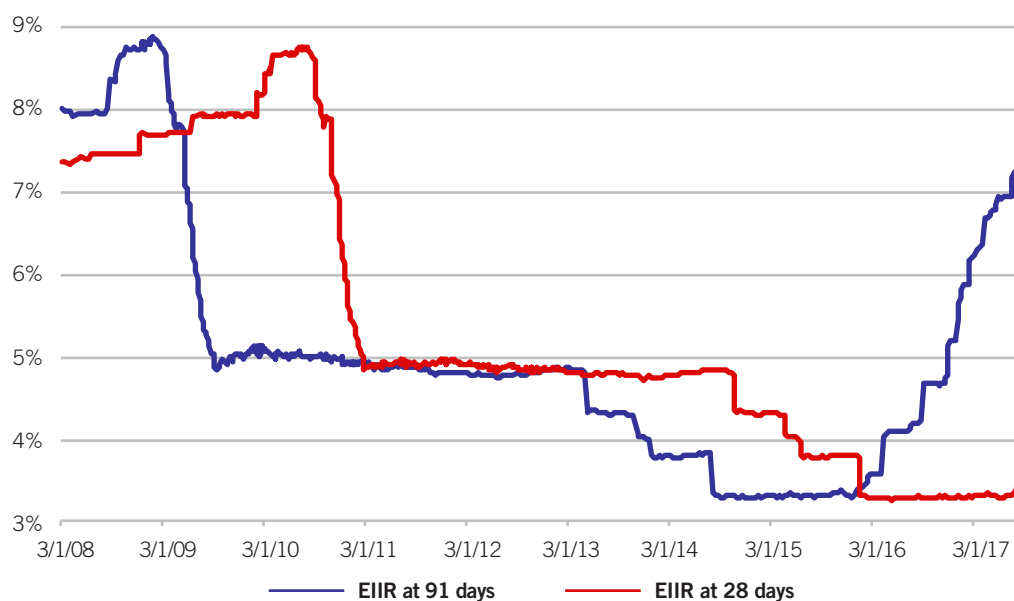
**Figure 22. Price of oil**



Source: IMF, *Economic Outlook 2017*, Banco de México.



**Figure 23. Interest rates**



Source: IMF, *Economic Outlook 2017*, Banco de México.

In 2008, in the temporary context in which the project was designed, oil revenues represented 44.3% of budget revenues<sup>37</sup>. This figure was reduced in 2016 to 13.3% of said revenues, the lowest level since 1990.

This volatility of oil in the national budget brings about the need to seek alternative funds to ensure the level of income required to implement public policies.

## 6.2. Legislative context, regulations and technical support

The project is primarily framed within the following legislative aspects:

- The contract was defined and signed according to the LAASSP and its regulations.
- The CEA is the administrative water authority according to article 7 of the water act of San Luis Potosí (LASLP).

In the 2000s, the Multilateral Investment Fund (MIF) and the Inter-American Development Bank (IDB) started the Program for the Promotion of Public-Private Partnerships in Mexican States (PIAPPEM)<sup>38</sup> with the purpose of

providing these states with technical and financial support in the development of PPP projects.

In June 2009, the IDB signed an agreement with the State of Guanajuato to provide technical cooperation (“ME- M1047: State of Guanajuato: Promotion of Public-Private Partnerships,” in conjunction with PIAPPEM) with the main objective of promoting the expansion and improvement of public services and infrastructure in Guanajuato through PPPs. The goal was “to strengthen the legal and institutional capacity of the government of Guanajuato to use coordinated PPP structures that would foster private participation in the expansion and operation of public services and infrastructure”<sup>39</sup>.

Subsequent to the project tender, on January 16, 2012, the *Official Journal of the Federation* published the Public-Private Partnerships act (LAPP), where “various provisions of the Public Works and Related Services Act are amended, added and repealed; the Law on Acquisitions, Leases and Services of the Public Sector; the Expropriation Law; the National Assets Law; and the Federal Code of Civil Procedures”<sup>40</sup>.

<sup>37</sup> Secretariat of Finance and Public Credit (SHCP).

<sup>38</sup> [www.piappem.org/](http://www.piappem.org/), last accessed February 2018.

<sup>39</sup> IDB, and Fomin, *State of Guanajuato: Promoting Public-Private Partnerships (ME-M1047)*. Donors Memorandum ([idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=1645722](http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=1645722)), last accessed February 2018.

<sup>40</sup> 2012), Ernst & Young Transaction Advisory Services, Public-Private Partnerships Act.



## 6.3. Political conditions

On December 1, 2006, Felipe Calderón of the National Action Party (PAN) became president of Mexico, replacing Vicente Fox, a member of the same political organization. Calderón took over the presidency with three priorities:

- Create productive jobs and economic growth.
- Achieve social justice and overcome poverty.
- Public security.

His mandate was shaped by the start of the war against drug trafficking in the country and also included initiatives such as the partial reform of hydrocarbons, universal healthcare coverage through Seguro Popular, the “Oportunidades” Human Development Program and the Food Support Program (PAL)<sup>41</sup>.

## 7. Impacts of the project

The project has had an impact predominantly on three areas: Administration, residents and environment.

### 7.1. Administration

The public administration must provide the population with effective access to water services, as the cornerstone of social welfare and development.

Hence, at the national level, public agencies should promote investment programs that look to ensure continuous, quality operation and adequate pressure from the supply networks, as well as reducing water losses to safeguard this scarce resource.

Data provided by the Secretariat of Finance and Public Credit (SHCP) and Banobras<sup>42</sup> show the overall efficiency of the operating agencies is below 50%. According to the

same sources, the local nature of the sector (municipal) presents problems for the rational and efficient use of the resource, so it is necessary to increase financial resources to increase technical development. As such, efficient management of existing resources will be vital.

Given this reality, Apoyo Fonadín and Conagua promoted PROMAGUA<sup>43</sup>, a program to foster the development of PPP projects that enable the transition from tandem systems to continuous operation of the network.

The El Realito PPP project allowed the administration to acquire new infrastructure to efficiently manage the resource; transfer to the concessionaire part of the risks associated with the infrastructure; and avoid the complexities derived from financing and operating the project, which are handled by a company with international experience that specializes in water management and related technologies.

Both the continuous operation and the increased quantity and quality of water bring added legitimacy to the Administration in the eyes of citizens, who benefit from more efficient public services.<sup>44</sup> This results in a strengthening of the institution as a guarantor of improvement in people’s quality of life.

The SHCP and Banobras maintain that in Mexico PPPs and performance contracts have paved the way for improving services and optimizing the resources needed to develop and operate projects. According to the same sources, long-term private management leads to better coverage, quality and physical and commercial efficiency, and ensures the maintenance, conservation and replacement of assets.

Finally, the use of trusts allowed for a strengthening of the financial experience of the local administration of ZMSLP, and thus the use of this instrument is valued for other public services provided through PPPs.

<sup>41</sup> Fundación CIDOB, “Felipe Calderón Hinojosa,” [www.cidob.org/biografias/lideres\\_politicos/america\\_del\\_norte/mexico/felipe\\_calderon\\_hinojosa](http://www.cidob.org/biografias/lideres_politicos/america_del_norte/mexico/felipe_calderon_hinojosa), last accessed February 2018.

<sup>42</sup> SHCP, and Banobras (2017), *Contratos Basados en Resultados para la Mejora de la Eficiencia y Calidad de los Servicios de Agua Potable: Una Alternativa de APP para asegurar la Sostenibilidad de los Organismos Operadores*, [www.cmic.org.mx/hidraulica17/ponencias/Lic\\_Fco\\_Antonio\\_Gzlez\\_Ortiz\\_Mena\\_BANOBRAS-CMIC-RNIH-2017.pdf](http://www.cmic.org.mx/hidraulica17/ponencias/Lic_Fco_Antonio_Gzlez_Ortiz_Mena_BANOBRAS-CMIC-RNIH-2017.pdf), last accessed February 2018.

<sup>43</sup> Promagua’s objective is to enable operators to carry out hydraulic infrastructure projects, and encourage the participation of the private sector.

<sup>44</sup> Subject to proper operation by Interapas.

## 7.2. Residents

With the new infrastructure, residents have greater availability of better quality drinking water, as well as more control over the water consumed. This constitutes an improvement in public health, especially in terms of reducing the intake of water with fluoride.

Management by a company with international experience translates into better service for citizens, while also increasing the safety of residents by minimizing the effects of subsidence derived from the exploitation of wells.

In the construction phase, the AQUOS EL Realito project employed approximately 814 workers<sup>45</sup>. Along with labor was the technical administrative staff of the EPC company, approximately 50 professionals in all during the 42-month construction period, which equates to an average of 864 workers.

While the number of direct SPV employees is between 3-5 people, the company's activity generates a significant volume of contracting of different services. With regard to O&M, the staff totals 65 people, including Management, Operation and management, Quality, Safety and Hygiene, and Administration.

## 7.3. Environment

The environment and ecosystems have also been major beneficiaries of the project (without forgetting the existing costs), by reducing the overexploitation of wells to foster the renewal of the ecosystem. This has led not only to greater sustainability of a natural resource as essential as water, but also improved safety conditions for the population.

## 8. Evaluation

As for the structuring of the EI Realito aqueduct as a PPP, this section looks at its most advantageous characteristics (namely, the packaging of tasks and innovative financial management) and those in which there are possible areas (cross subsidies, governance and risk allocation). We also analyze the impact of the project on the United Nations Sustainable Development Goals (SDG).

### 8.1. PPP methodology

The EI Realito aqueduct project presents a series of complexities and solutions that make it a truly useful case study regarding the use of PPP. In addition to two Mexican states, the aqueduct crosses three water management regions, so there is an interesting overlap between jurisdictions with different functions and objectives.

Although four consortia bid for the project, the final decision was between two of them, one being the international water operator Aqualia pairing up with a large Mexican construction company, and another involving the large diversified Mexican group Carso. The former came out the winner, meeting the technical requirements and presenting a better economic proposal.

For a project of this complexity, having four consortia in the bidding phase seems satisfactory, and the fact that the winner was the one with the most international presence surely removes any potential suspicions of favoritism or lack of objectivity that can arise at times in such processes.

The project features all the key characteristics of a PPP. First, the consortium that wins the contract takes on a wide variety of complementary tasks. Thus, the construction, operation and management are packaged. Meanwhile, risks are carefully allocated between the public and private sectors, although there could be room for improvement in this respect, as indicated below. Lastly, having a large multinational water operator and a major multinational bank participate in the consortium constitutes one of the major advantages of PPPs compared to the traditional service provision: being able to draw on the talents of agents with experience in global markets and access the technological advances in complex sectors.

---

<sup>45</sup> The construction process consisted of different cycles and, therefore, the number of full-time workers varied. Taking the average number of hours worked gives us the figure of 814 full-time employees. In the peak working months, that figure could climb to 1,200-1,800 employees.

The investments needed to execute the project are mainly carried out by the private sector, although a significant amount of public money is also invested in building the infrastructure. Although these are very specific investments, the fact that they are not too technology intensive and the quality of the service is verifiable allows for control by the public sector and the participating financial entities.

This project illustrates the importance of financial aspects in the more complex PPPs. The participation of these entities and the financial risk undertaken by the operator were possible thanks to the creation of a complex system of trusts that allowed for a coherent and coordinated management of financial flows, which led to reduced financial risk and, therefore, also of the risk premium demanded by private investors.

If the strong points are the packaging of tasks and the financial structure previously mentioned, some potential areas for improvement could be the water fee components, project governance and risk allocation.

Regarding fees, the fact that final consumption is subsidized equally for almost all consumers regardless of their income level (with the exception of the higher consumer segments) suggests that the fee system is regressive. This could eventually generate social unrest among residents that could cast doubt upon the compensation system. This situation is only a theoretical reflection as there is no evidence of any complaints in this regard in the case of El Realito...

The public authority must decide between developing a more equitable system with a higher price and subsidies aimed specifically at low-income sectors (which should include efforts to provide public explanation), and maintaining a system of low prices but with a subsidies system that is clearly regressive and hardly transparent.

Regarding governance, while there is a plan for conciliation mechanisms and supervision of works and maintenance, there is not a specific governing body for the project that includes all of the involved parties. Having such a body would help resolve coordination problems both upstream and downstream. In fact, it seems that initially there was a delay because there was a delay in completing the construction of the dam upstream, which corresponded to another project; it also seems there have been frictions downstream with the water distribution company in San Luis Potosí.

One alternative is to provide the project with an independent regulatory agency or create one for all PPP projects related to water distribution or in conjunction with other infrastructures. However, while this would allow for greater simplicity, it would not eliminate the problem of involving all affected sectors in an institutionalized way. A hybrid solution would be a body with the participation of all affected levels, as well as independent experts.

Finally, risk allocation could improve, since in a sector such as water, it seems hard to justify having the private operator take responsibility (to a large extent, anyway) for the demand, political and the exchange rate risks in long-term contracts, given the operator's influence on them. Conversely, risks associated with the management or operation of the service could be transferred more specifically to the private operator.

It is too early to do an assessment of the project, since it spans a period of 25 years and only six and a half years have transpired since construction began and just three since the operation began. Still, it is clearly a great project that nicely illustrates the major challenges faced by PPPs as well as their enormous potential.

**Table 8. Description of El Realito PPP aqueduct project**

EL REALITO AQUEDUCT		
EXISTING PPP METHODOLOGY	EXISTING	DETAILS
<b>1. Bidding methodology</b>		
1.1. Cost-benefit analysis	No	
1.2. Value for money	No	
1.3. Real competition for the contract	Yes	2 prequalified
1.4. Proposal evaluation committee	Yes	Internal
<b>2. Contract terms and incentives</b>		
2.1. Bundling	Yes	DBFOT
2.2. Verifiable quality of service	Yes	Quality and quantity
2.3. Externalities	Yes	Positive
2.4. Duration		25 years
<b>3. Risk, financing and payments</b>		
3.1. Building and operational risk	Transferred	AQUOS El Realito
3.2. Demand risk	Partially transferred (T3)	
3.3. Political and macroeconomic risk	Transferred	Exchange rate risk
3.4. Payment mechanism		Availability (T1 and T2) and variable (T3)
3.5. Special purpose vehicle (SPV)	Yes	AQUOS Realito
<b>4. Governance</b>		
4.1. Transparency	Yes	Particularly during building process
4.2. Participatory decision-making process	Not observed	
4.3. Internal/external monitoring	Yes	
4.4. Specific legal framework for PPPs	At start-up, no. Eventually, yes (2012)	
4.5. Distribution of tasks	Contracting authority	CEA-SLP
	Monitoring	CEA-SLP
	Renegotiation	CEA-SLP
	Regulation	Conagua
	Operation and quality	CEA-SLP
<b>5. Construction process</b>		
5.1. Cost overruns	Yes	Assumed by AQUOS until process decision under way
5.2. Extending the building period	Yes	Right of way
<b>6. Potential benefits</b>		
6.1. Price certainty	Yes	
6.2. Transfer of responsibility to the private sector	Yes	
6.3. Incentives for innovation	Yes	
6.4. Savings on public spending		Not quantified
6.5. Total infrastructure life cycle	Yes	
6.6. Incentives with respect to timing	Yes	Penalties for delays

Source: Prepared by the authors.

## 8.2. United Nations Sustainable Development Goals

The UN SDGs, in force at the time the project began, included an objective for the year 2015 of halving the proportion of people without access to:

- Sources of safe drinking water.
- Basic sanitation services.

The first objective was achieved worldwide, but the second was not.

In any case, looking at the SDGs (Table 9), we could venture that the El Realito aqueduct has a high impact on numbers 3 (Good health and well-being), 6 (Clean water and sanitation), 10 (Reduced inequalities), 11 (Sustainable cities and communities), 15 (Life on land) and 17 (Partnerships for the goals).

It is clear why the last objective has been reached (17), since the infrastructure is built on a PPP. Specifically, this PPP has made it possible to improve the water supply system; without its own financing model, the Government may not have been able to provide the necessary resources.

Surely, goal #15 is the one that sees the greatest impact, since the El Realito aqueduct allows for reduced use of well water thus preserving aquifers and maintaining the stability of the land. This stability also affects communities (SDG 11), since it reduces the risk of land sinking and ensures safer environments.

Finally, the effect on the quality of drinking water and sanitation clearly reflects compliance with goal #6, while, indirectly but intensely, positively influences #3, since it represents an improvement in public health. Being a public infrastructure, with a regulated price, these improvements benefit the entire population, and, therefore, the El Realito aqueduct helps reduce inequalities (SDG 10).

**Table 9. United Nations SDGs**

SUSTAINABLE DEVELOPMENT GOALS	EL REALITO AQUEDUCT	
	HIGH IMPACT	MODERATE IMPACT
1. No poverty		
2. Zero hunger		
3. Good health & well-being	✓	
4. Quality education		
5. Gender equality		
6. Clean water and sanitation	✓	
7. Affordable and clean energy		
8. Decent work and economic growth		✓
9. Industry, innovation, infrastructure		✓
10. Reduced inequalities	✓	
11. Sustainable cities and communities	✓	
12. Responsible consumption, production		
13. Climate action		✓
14. Life below water		
15. Life on land	✓	
16. Peace, justice and strong institutions		
17. Partnerships for the goals	✓	

Source: Prepared by the authors.

Beyond the more direct impacts, the El Realito aqueduct also has a secondary effect on goals 8 (Decent work and economic growth), 9 (Industry, innovation, infrastructure) and 13 (Climate action). The influence on the latter is due to improvements in ecosystems (SDG 15) and clean water (SDG 6), while the impact on the first two is caused by the infrastructure, which has represented an increase in economic activity, sustained by the activity that represents the exploitation of the drinking water service.

### 8.3. City strategy

To consider the impact of the project on the city's development, we use the 10 dimensions of the **Cities in Motion**<sup>46</sup>. The impact of the infrastructure on the different dimensions has been as follows:

**Table 10: Cities in Motion**

SMART CITY EVALUATION	EL REALITO AQUEDUCT	
	HIGH IMPACT	MODERATE IMPACT
1. Human capital	✓	
2. Social cohesion		✓
3. Economy	✓	
4. Public administration		✓
5. Governance		✓
6. Transportation		
7. Environment	✓	
8. Urban planning	✓	
9. International outreach		
10. Technology		✓

Source: Prepared by the authors.

Among these dimensions, the one that saw the biggest positive impact was undoubtedly the environment. The El Realito aqueduct allowed for a more sustainable use of water and ended the overexploitation of the wells that had been occurring. This also had direct positive effects on the urban population, which now had much better-quality water that complied with the existing regulations.

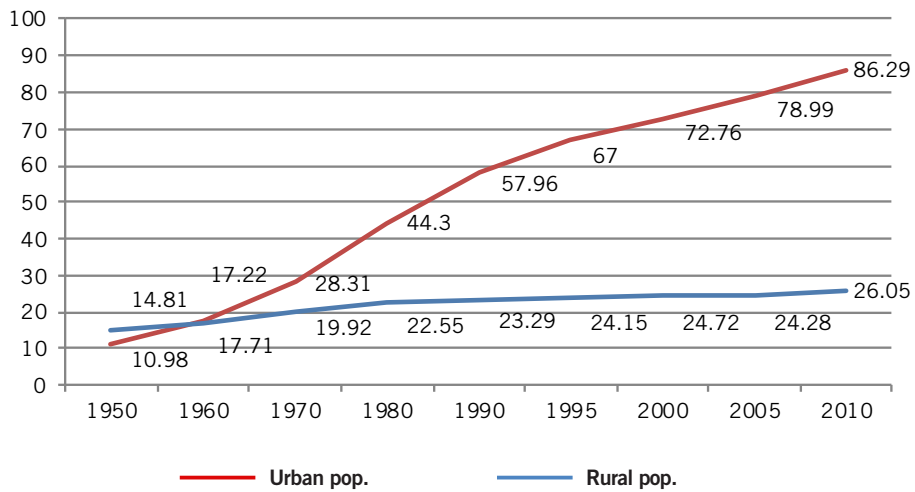
Infrastructure also constituted a great advancement in terms of urban planning since the city was equipped with the construction of an infrastructure adjusted to both the size and needs of the population in an area of such vital importance for the public health as water.

In Mexico, according to data provided by the National Institute of Statistics and Geography (INEGI), a rural population is one that lives in nuclei of less than 2,500 inhabitants, while it is considered urban if it consists of more than 2,500 inhabitants.

In 1950, less than 43% of the population in Mexico lived in urban areas, while in 2010 this percentage was 77%.

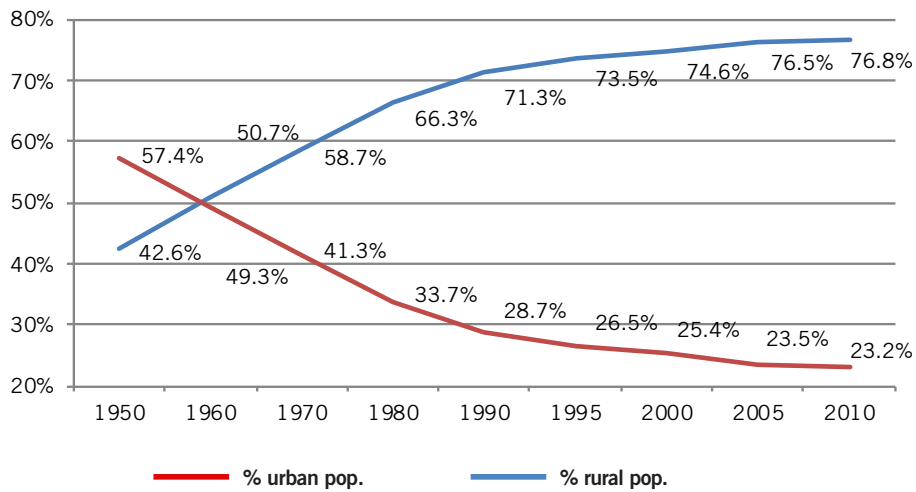
<sup>46</sup> <http://citiesinmotion.iese.edu/indicecim/>, last accessed February 2018.

**Figure 24. Urban and rural population**



Source: INEGI (2015), "Censos y conteos generales de población y vivienda." Figures based on millions of inhabitants.

**Figure 25. Percentage of urban and rural population**



Source: INEGI (2015), "Censos y conteos generales de población y vivienda."

This urbanization process has had an important impact on the consumption patterns of citizens of resources like water. Cities, in the process of expansion, consume more ecosystem services worldwide than they produce. Although they only generate 0.2% of the freshwater supply, urban ecosystems serve between four and five billion people (Vörösmarty, et al., 2005)<sup>47</sup>.

In the particular case of Mexico, according to the 2010 population census, 90.9% of the national population had access to drinking water (95.6% of urban population and 75.7% of rural)<sup>48</sup>. With data from 2013, it was estimated that the national coverage was 92.3% (95.4% of urban population, and 81.6% of rural).

Current population projections estimate an increase of 19 million inhabitants between 2013 and 2030, when it is expected that 80% of the population of Mexico will live in urban areas. This population growth will continue to reduce the amount of renewable water available per capita in the country.

Therefore, cities must define clear growth strategies based on sustainability and respect for the environment. Only in this way can the benefits derived from population concentration and the exchange of ideas be obtained, while also avoiding the dangers deriving from uncontrolled urbanization with known negative effects.

In this line of action, it would be important for urban areas to take all measures at their disposal to limit activities with negative environmental impacts, such as overexploitation of water wells by the municipal operator, which would have negative consequences for the population.

The construction of the infrastructure represented a good opportunity for the application of advanced technologies in water management at the municipal level, with the aim of achieving a more sustainable use of this precious resource. However, while the aqueduct and the plant incorporate technical elements that make it possible to manage it as efficiently as possible, there are no known advances by the city in this area, which could improve these and other public services.

## 9. Conclusions

The PPP to build the El Realito aqueduct between the states of Guanajuato and San Luis Potosí in Mexico is an important case study of the design, construction, financing and operation of a large water infrastructure in a complex institutional environment. This complexity is inevitable due to the problems associated with water consumption, given that this resource is unequally distributed in the territories (especially in large countries with diverse climates, such as Mexico) and the population is not distributed evenly in relation to the resource.

As mentioned above, the project lasts 25 years and consists of design, construction of a set of new infrastructures (greenfield), financing, as well as the operation and management of the associated aqueduct, which takes water from a dam upstream in the state of Guanajuato to the metropolitan area of San Luis Potosí, downstream.

The El Realito aqueduct project offers multiple reasons and arguments to show that PPPs are not only useful instruments, but in fact necessary for the development of first-class infrastructures at the service of citizens, who in this case will have access to a basic asset such as drinking water in the quantities and qualities that legal standards demand.

One item of special interest is the financing system through different trusts, which allow for mitigating the risks of non-payment and, therefore, the costs for taxpayers associated with the project. These trusts are possible only through a strong commitment on the part of all the agencies and institutions that participate in the project. The learning in the use of trusts by the Administration can be useful for application in other public services that require private investment and in which the Administration is reluctant to invest due—as observed in previous sections—to the volatility of Mexican public budgets, which are closely tied to the evolution of oil prices.

<sup>47</sup> C. J. Vörösmarty, et al. (2005), «Geospatial Indicators of Emerging Water Stress: an Application to Africa», *Ambio*, 34(3), 230-236.

<sup>48</sup> Gobierno de la República, Semarnat, y Conagua (2014), *Numeragua*, México.



The project has a significant positive impact in multiple areas, both economic, social and environmental. The reduction of well water use not only diminishes the negative effect on the ecosystems and favors the recovery of the same, but also improves the security of the citizens by avoiding land subsidence and the consumption of water with excessive levels of fluoride, which ties in with the UN SDGs.

In short, it can be considered that, , the El Realito aqueduct is a good project from the perspective of learning for other administrations, since it is an example of:

- Construction of a complex infrastructure with multiple agents from different administrative levels, some having little experience with PPPs.
- Use of innovative mechanisms for guaranteeing payment to the private sector, which reduces the risk and financial cost associated with an administration with unstable revenues. Ways to improve governance and the role of the public sector in the project (which is linked to the delays that prevented the start of works as planned).
- Methods to achieve solutions for the benefit of citizens and the environment through PPPs.
- Ways to make the payment of PPPs involved with the supply of water.

Lastly, according to the simulator of the National Institute of Statistics and Geography (INEGI) of Mexico, the construction project of the El Realito aqueduct entailed an increase of the Mexican GDP of 0.02% in the short term.

# References

- Aqualia (2012), *Acueductos y PPP de Agua en México 2012*.
- Aqualia (2017), *Annual Accounts*.
- AQUOS (2009), *Acueducto El Realito. Descripción del proyecto*.
- Conagua (2008), *National Water Program 2007-2012*.
- Conagua (2015), Atlas del Agua en México, <http://www.conagua.gob.mx/CONAGUA07/Publicaciones/Publicaciones/ATLAS2015.pdf>, last accessed February 2018.
- Conagua (2016), *Atlas del Agua en México*, [http://201.116.60.25/publicaciones/AAM\\_2016.pdf](http://201.116.60.25/publicaciones/AAM_2016.pdf), last accessed February 2018.
- Comisión Nacional del Agua Insurgentes Sur (2012), *Programa Hídrico Regional Visión 2030. Región Hidrológico-Administrativa IX Golfo Norte*.
- Gobierno de la República, Semarnat, and Conagua (2015), *Estadísticas del Agua en México, 2015*.
- Gobierno de la República, Semarnat, and Conagua (2016), *Atlas del Agua en México 2016*.
- Gobierno de la República, Semarnat, and Conagua (2017), Presas y acueductos para abastecimiento de agua potable. *Presa El Realito. Acueducto El Realito–San Luis Potosí, SLP. Programa Nacional de Infraestructura 2014-2018*.
- Engel, E., Fischer, R. D., and A. Galetovic (2014), *The Economics of Public-Private Partnerships: A Basic Guide*, Cambridge University Press, Cambridge (United Kingdom).
- FCC Aqualia (International Division KWPPP), “Water PPP Structure evolution,” document provided by the company.
- FCC Servicios Ciudadanos (July 2017), presentation by Carlos M. Jarque, CEO.
- FCC Servicios Ciudadanos (April 2017), corporate presentation. Marketing corporativo y Marca.
- Grossman, S. J., and O. D. Hart (1986), “The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration,” *Journal of Political Economy*, 94: 691-719.
- Hart, O. D., and J. Moore (1990), “Property Rights and the Nature of the Firm,” *Journal of Political Economy*, 98: 1119–1158.
- Meléndez-Salazar, L. (2008), “La construcción de la presa El Realito, una alternativa viable para lograr la recuperación del acuífero del Valle de San Luis Potosí,” *Boletín del Archivo Histórico del Agua*, 40: 78-82.
- OECD (2010), *Financing Water Resources Management in Mexico*. <http://www.oecd.org/env/resources/44863726.pdf>, last accessed February 2018.
- OECD (2015), *Water Resources Allocation*. <https://www.oecd.org/environment/resources/Water-Resources-Allocation-Policy-Highlights-web.pdf>, last accessed February 2018.
- Pérez-Feito, R. (2017), “The Challenges of Water Supply. Case Study: El Realito Aqueduct. San Luis Potosí (México),” *III International Conference PPP for Cities*, Barcelona.
- Pérez-Feito, R., International director of operations in Aqualia. interviews with Salvador, J, Barcelona, March 2017. (2017), Ernst & Young Transaction Advisory Services, *Public-Private Partnerships Act*, Madrid.
- SHCP, and Banobras (2017), *Contratos Basados en Resultados para la Mejora de la Eficiencia y Calidad de los Servicios de Agua Potable: Una Alternativa de APP para asegurar la Sostenibilidad de los Organismos Operadores*, [www. cmhc.org.mx/hidraulica17/ponencias/Lic\\_Fco\\_Antonio\\_Gzlez\\_Ortiz\\_Mena\\_BANOBRAS-CMIC-RNIH-2017.pdf](http://www.cmhc.org.mx/hidraulica17/ponencias/Lic_Fco_Antonio_Gzlez_Ortiz_Mena_BANOBRAS-CMIC-RNIH-2017.pdf), last accessed February 2018.
- Sidaoui, J., et al., “The Global Financial Crisis and Policy Response in Mexico,” *BIS Papers*, 54.
- *The Economist* (2004), “Tequila slammer. The peso crisis, ten years on.”

# Appendix A. Assessment of the Broad Economic Impact of El Realito Aqueduct PPP Project on Mexican GDP

This subsection presents the macroeconomic impact created by the investment in the construction of the El Realito aqueduct. This analysis emphasizes the creation of short-term economic activity, particularly in the infrastructure construction phase, as mentioned earlier in this paper. Meanwhile, the long-term effects include increased productivity associated with the improvements deriving from the new infrastructure, and increased productivity due to enhanced quality of life of the citizens of the state of San Luis Potosí.

In this project a total of 2,169,451,491 pesos are invested in the construction of new infrastructure. That amount represents 0.011% of the country's gross domestic product (GDP), and 2% of the national GDP in the area of construction of works for the supply of water, oil, gas, electric power and telecommunications. At the state level, this project constitutes 0.53% of the GDP of the state of San Luis Potosí, a region that accounts for 2.1% of the national GDP and will primarily see the concentration of the economic effects of the project. Below is a table summarizing the economic figures for the project.

The calculation of the macroeconomic impact derived from the project will be estimated based on the application of the input-output matrix model<sup>49</sup> by Wassily W. Leontief, using the simulator published by INEGI.

**Table 1. Summary of key economic information**

GDP (Mexico)	18.841 billion MXP	1.326 billion USD
GDP of the state of San Luis Potosí	403.449 billion MXP	28.241 billion USD
Investment of the El Realito aqueduct project	2.169 billion MXP	152.73 billion USD
Estimation of the project's impact on the national economy	3.297 billion MXP	232.13 billion USD <sup>50</sup>
GDP generated	0.02% of the national GDP	
Direct jobs in construction	934 jobs, 864 of which were offered during the 42 months of the EPCM phase <sup>51</sup>	

Source: Input-product matrix simulator, INEGI.

<sup>49</sup> Input-output.

<sup>50</sup> EPCM: engineering, procurement & construction management. Nomenclature used in LatAm.

<sup>51</sup> Exchange rate for 2009, year of the project concession.

## Simulation of short-term macroeconomic impact

This simulator uses a methodology based on a matrix of inter-sector multipliers that help predict the total impact of the change in the demand of a specific industry on all other industries and, therefore, on country's overall economy.

Therefore, this methodology presents three different classes of short-term identifiable economic impacts, namely, direct, indirect and induced impact:

- Direct impact represents the added value in the construction sector. This effect is generated by the increased demand and mobilization of its production factors.
- Indirect impact concentrates the effect of investment in construction on other related economic sectors.
- Induced impact is a consequence of the increased consumption generated by the indirect impact.

For this purpose, the official and public application of INEGI allows for a reliable estimate of the total impact of a project on the country's economy according to the increased demand, both intermediate and final, of the actors belonging to the economic sectors most closely tied to the particular project. Despite this, the methodology does not enable the extrapolation of these results in the medium-long term, nor does it capture the social or environmental dimension of the project.

The results indicate that the investment of nearly 2.2 billion pesos has generated a total impact of 3.3 million pesos on the national economy.

57% of the economic activity generated relates to the project's direct impact (1.9 billion pesos). This is the project's effect concentrated in the construction sector, more specifically in the construction branch of works for the supply of water, oil, gas, electric power and telecommunications.

Meanwhile, 9% of the total economic impact (297 million pesos) would be from the indirect effect, in other words, the increase in intermediate demand generated in the three economic sectors closest to construction: manufacture of machinery and equipment for sales and services, other specialized works for the construction and manufacture of metal structures and blacksmith products.

As for the remaining 30% or so of economic impact (some 990 million pesos) in the short term, it would be driven by increased demand, mainly due to the high number of jobs created as a result of the project.

In short, the El Realito aqueduct construction project would represent an increase of 0.02% of Mexico's GDP. It is an economic impact that, due to the nature of the project, will tend to be concentrated in the short term and in the state of San Luis Potosí.

## Long-term macroeconomic impact: utilization

The specialized literature in the field proposes different methodologies for calculating the macroeconomic impact of a long-term project. The most common corresponds to the estimated increase in productivity derived from the Cobb-Douglas production function. However, the complexity of the El Realito aqueduct project does not allow us to establish a direct causal link with increased productivity, since this would also depend on the social and environmental impact it had on citizens.

This impact would involve the quality of the water received by the resident population of San Luis Potosí (information that can be obtained through an analysis of the amount of fluoride), as well as the effect of these facilities on citizens' access to water, industry and trade (focusing on the consumer price index and the evolution of the water market). Both dimensions could be synthesized in a satisfaction survey and assessment of the infrastructure and its effects on the population and economy of the municipalities of Cerro de San Pedro, San Luis Potosí and Soledad de Graciano Sánchez.

This methodology implies a deployment of resources and means that are not currently available, which limits the possibility of drawing conclusions from the results. However, it can be deduced that the project has a positive macroeconomic impact in the long term, although this statement should be confirmed through an analysis of the quality and impact of the infrastructure on society and the local economy. The fact that the plant has been in operation for three years is important for being able to develop this methodology when it is considered appropriate.

## References

INEGI (2012), *Simulador de Impactos de Insumo Producto 2012* ([www.inegi.org.mx/est/contenidos/proyectos/cn/mip12/simulador.aspx](http://www.inegi.org.mx/est/contenidos/proyectos/cn/mip12/simulador.aspx)), last accessed January 23, 2018.

## Appendix B. Trust system

Figure 16 contains the following elements:

- 1. The state government trust:** associated with the contributions to the administration trust for component T1 of the fee (T1R [remuneration of risk capital] and T1C [repayment of bank loan]).
  - a. Trustor (contributor): Government of the State of San Luis Potosí, which guarantees the contributions with 50% of the payroll tax collected.
  - b. Trustee (beneficiary): El Realito administration trust.
  - c. Fiduciary (resource manager): Banco del Bajío.
  - d. Resources: from the State Government and guaranteed with 50% of the payroll tax revenue.
- 2. Interapas Trust:** associated with the contributions to the administration trust that were required for the T2 and T3 components of the fee (monthly fixed cost of O&M and variable cost of operation).
  - a. Trustors (contributor): Interapas, municipalities of San Luis Potosí and Soledad de Graciano Sánchez.
  - b. Trustee (beneficiary): El Realito administration trust.
  - c. Fiduciary (resource manager): Banco de Bajío.
  - d. Resources: collection for the provision of water and sanitation services to citizens. Guaranteed (for an amount equivalent to three months) with a line of credit through Banorte.
- 3. Main trust (El Realito administration trust):** divides the activities of each agent into two periods: investment and operation.
  - a. Trustors (contributors):**
    - i. Investment period (24 months of EPC and start-up):
      1. Banco Santander: contributes credit funds to the project.
      2. AQUOS El Realito: contributes the capital coming from the partners.
      3. Finfra/FNI: contributes public subsidy funds to the project.
    - ii. Period of operation (23 years):
      1. State Government: contributes funds through the trust of the same name.
      2. Interapas: contributes funds through the Interapas administration trust.
      3. AQUOS El Realito: contributes capital for the reserve fund (as long as there are debt repayment obligations) and any corresponding insurance compensation.
  - b. Trustees (beneficiaries):**
    - i. Investment period (24 months of EPC and start-up):
      1. Fiduciary (resource manager): administration trust. Receives money for its supervisory activity.
      2. AQUOS El Realito: receives money based on the work progress, VAT, the sole consideration for the bidding of the CEA-SLP, the interest payable during the investment phase for the project loan and eventual compensation.
      3. Finfra/FNI: receives interest generated by its non-disbursed contributions.

- ii. Operating period: 23 years
  - 1. Fiduciary (resource manager): administration trust. Receives money for its supervisory activity (source: T2).
  - 2. AQUOS El Realito: receives the following money to make payments in the following order of priority:
    - a. Venture capital (source: T1R).
    - b. Operation and management and taxes, including VAT (source: T2 and T3).
    - c. VAT from construction (source: T1C and T1R).
  - 3. Banks: receives money related to the payment of interest and repayment of the principal of their loan (source: T1C).
  - 4. AQUOSCEA-SLP: receives money in the case of excess contributions (due to calculation errors) from the state government trust to the main trust.
- 4. Profitability of funds from the El Realito administration trust not disbursed and invested.
- 5. Insurance compensation.
- 6. VAT repaid to AQUOS El Realito.

- ii. Operating period: 23 years
  - 1. Funds from the state government trust.
  - 2. Funds from the Interapas administration trust.
  - 3. Profitability of funds from the administration trust El Realito not disbursed and invested.
  - 4. Reserve fund contributed by AQUOS El Realito for debt service.
  - 5. Insurance compensation to AQUOS El Realito.

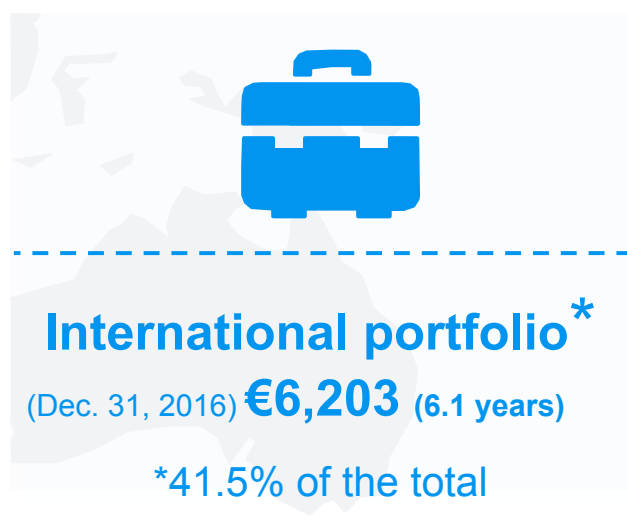
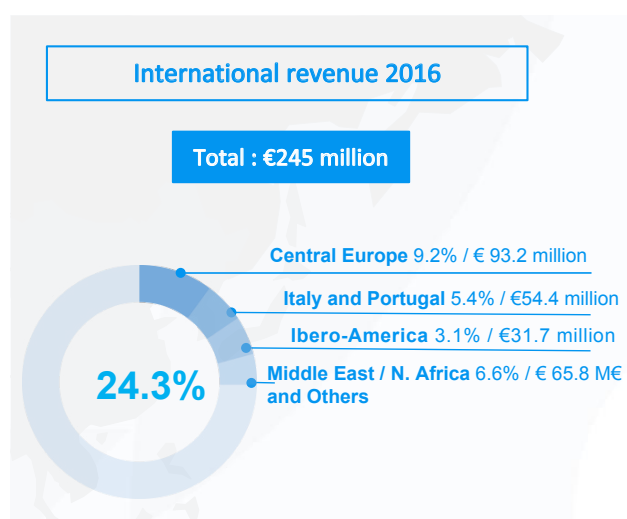
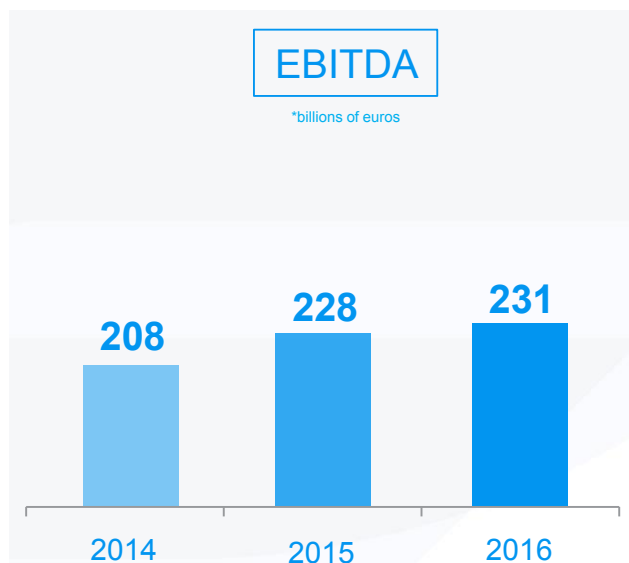
**c. Fiduciary (resource manager):** Banco del Bajío

**d. Resources:**

- i. Investment period: 24 months of EPC and start-up
  - 1. Venture Capital from the partners.
  - 2. Project financing loan.
  - 3. Funds from the support of Finfra/FNI.

# Exhibit C. Financial information

## Aqualia



Source: FCC Servicios Ciudadanos, corporate presentation, April 2017.

## **Timeline**

- Drafting of the contract begins: July 30, 2008
- Authorization for the start of the project to the CEA-SLP: December 20, 2008
- Publication of the bidding rules: February 5, 2009 (no. 53112001-001-09)
- Award decision: June 18, 2009
- Water service contract with CEA-SLP and Interapas: June 29, 2009
- Signing of contract: July 3, 2009
- Service contract (SC): July 3, 2009
- Official start of construction: June 24, 2011
- Dam construction completed: October 9, 2012
- Official completion of construction: September 25, 2014
- Official start of operation and management: January 9, 2015
- End of contract: July 2, 2034





A Way to Learn  
A Mark to Make  
A World to Change

**Follow us**

 [IESE Business School](#)

 [IESE Business School](#)

 [iesebs](#)

 [iese](#)

---

**Barcelona**

Av. Pearson, 21  
08034 Barcelona, Spain  
(+ 34) 93 253 42 00

**Madrid**

Camino del Cerro  
del Águila, 3  
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