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IMPLEMENTATION COMPLETION AND RESULTS REPORT

(IBRD 7917-TN, IBRD 8644-TN and GEF TF096891)

ON A LOAN

IN THE AMOUNT OF US\$39.4 MILLION

AN ADDITIONAL LOAN

IN THE AMOUNT OF EUR 16.2 MILLION

WITH THE GUARANTEE OF THE

REPUBLIC OF TUNISIA

AND ON A

GRANT FROM THE GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF US\$8.03 MILLION

TO THE

OFFICE NATIONAL DE L'ASSAINISSEMENT (ONAS)
(NATIONAL SANITATION UTILITY)

FOR THE

TUNISIA NORTHERN TUNIS WASTEWATER PROJECT

December 23, 2021

CURRENCY EQUIVALENTS

(Exchange Rate Effective June 30, 2021)

Currency Unit = TND Tunisian Dinars

TND 2.77 = US\$1

US\$ 0.36 = TND 1

FISCAL YEAR

July 1 - June 30

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ABBREVIATIONS AND ACRONYMS

BOD5	Biological Oxygen Demand
CAPEX	Capital Expenditure
CO2	Carbon Dioxide
COD	Chemical Oxygen Demand
COVID-19	Coronavirus disease
CPF	Country Partnership Framework
CRDA	Regional Commission for Rural Development
EIB	European Investment Bank
ERR	Economic Rate of Return
ESIA	Environmental and Social Impact Assessment
ESMPs	Environmental and Social Management Plans
FC	Fecal coliforms
FM	Financial management
FY	Fiscal Year
GDA	<i>Groupement de Développement Agricole</i> - Agricultural Development Group
GEF	Global Environment Facility
GEO	Global Environmental Objective
GIS	Global Information System
GoT	Government of Tunisia
IBRD	International Bank for Reconstruction and Development
ICR	Implementation Completion Report
IFI	International Finance Institutions
IFRs	Interim Financial Reports
IPF	Investment Project Financing
ISMs	Implementation Support Missions
ISR	Implementation Status and Results
LAP	Land Acquisition Plan
M&E	Monitoring and Evaluation
MARHP	<i>Ministre de l'Agriculture, des Ressources Hydrauliques et de la Peche</i> - Ministry of Agriculture, Water Resources and Fisheries
MTR	Mid-Term Review
NPV	Net Present Value
NT106.02	Tunisian standard for effluent quality
NT106.03	Tunisian standard for quality of water for reuse
O&M	Operation and Maintenance
ONAS	<i>Office National de l'assainissement</i> - National Sanitation Utility
PAD	Project Appraisal Document
PDO	Project Development Objective
PISEAU II	Second Water Investment Project
RF	Results Framework

SCADA	Supervisory control and data acquisition
SCD	Systematic Country Diagnostic
SONEDE	<i>Société Nationale d'Exploitation et de Distribution des Eaux</i> - National Water Supply Utility in Tunisia
SS	Suspended Solids
TOC	Theory of Change
TND	Tunisian Dinar
TWW	Treated Wastewater
US\$	United States Dollar
WWTP	Wastewater Treatment Plant

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**DATA SHEET****BASIC INFORMATION****Product Information**

Project ID	Project Name
P117082	Tunisia Northern Tunis Wastewater Project
Country	Financing Instrument
Tunisia	Investment Project Financing
Original EA Category	Revised EA Category
Full Assessment (A)	Full Assessment (A)

Related Projects

Relationship	Project	Approval	Product Line
Supplement	P118131-TN-GEF Northern Tunis Wastewater Project	17-Jun-2010	Global Environment Project
Additional Financing	P154713-Tunisia - Northern Tunis Wastewater Project Additional Financing	31-Aug-2016	IBRD/IDA

Organizations

Borrower	Implementing Agency
Office National de l'Assainissement (ONAS)	Office National de l'Assainissement (ONAS)

Project Development Objective (PDO)

Original PDO

The project development objectives of the Project are to: (a) provide an environmentally safe disposal system for the treated wastewater which will not be reused in agriculture in the North of Tunis; and (b) increase the quantity and quality of treated wastewater made available to farmers to encourage its reuse in agriculture in the Borj Touil area.



Revised PDO

The project development objective is to provide an environmentally safe disposal system for the treated wastewater in the North of Tunis, and increase availability for its reuse in the Project Area.

FINANCING

	Original Amount (US\$)	Revised Amount (US\$)	Actual Disbursed (US\$)
World Bank Financing			
P117082 IBRD-79170	52,000,000	39,400,000	39,400,000
P117082 IBRD-86440	18,000,000	18,000,000	18,808,996
P118131 TF-96891	8,030,000	8,030,000	8,030,000
Total	78,030,000	65,430,000	66,238,996
Non-World Bank Financing			
Borrower/Recipient	8,600,000	7,570,000	10,780,000
Total	8,600,000	7,570,000	10,780,000
Total Project Cost	86,630,000	73,000,000	77,018,996

KEY DATES

Project	Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
P117082	17-Jun-2010	14-Apr-2011	06-Feb-2014	31-Dec-2015	30-Jun-2021

**RESTRUCTURING AND/OR ADDITIONAL FINANCING**

Date(s)	Amount Disbursed (US\$M)	Key Revisions
02-May-2014	3.18	Change in Implementing Agency Change in Results Framework Change in Components and Cost Change in Loan Closing Date(s) Cancellation of Financing Change in Financing Plan Reallocation between Disbursement Categories Change in Procurement
23-Dec-2015	7.47	Change in Components and Cost Change in Loan Closing Date(s)
20-May-2016	7.66	Change in Components and Cost Reallocation between Disbursement Categories
10-Aug-2016	8.45	Additional Financing Change in Project Development Objectives Change in Results Framework Change in Components and Cost Change in Loan Closing Date(s) Reallocation between Disbursement Categories Change in Legal Covenants Change in Procurement Change in Implementation Schedule Other Change(s)
11-Dec-2019	42.99	Change in Results Framework Change in Components and Cost Change in Loan Closing Date(s) Reallocation between Disbursement Categories Change in Disbursements Arrangements Change in Implementation Schedule

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Moderately Satisfactory	Satisfactory	Substantial

**RATINGS OF PROJECT PERFORMANCE IN ISRs**

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US\$M)
01	30-Jul-2010	Satisfactory	Satisfactory	0
02	11-May-2011	Satisfactory	Moderately Satisfactory	0
03	03-Jan-2012	Satisfactory	Moderately Satisfactory	0
04	22-Aug-2012	Satisfactory	Moderately Satisfactory	0
05	14-Apr-2013	Moderately Satisfactory	Moderately Unsatisfactory	.14
06	09-Aug-2013	Moderately Satisfactory	Moderately Unsatisfactory	1.64
07	16-Oct-2013	Moderately Unsatisfactory	Moderately Unsatisfactory	3.18
08	15-Apr-2014	Moderately Unsatisfactory	Moderately Satisfactory	3.18
09	08-Jun-2014	Moderately Satisfactory	Moderately Satisfactory	3.18
10	08-Dec-2014	Moderately Satisfactory	Moderately Satisfactory	3.21
11	18-May-2015	Moderately Satisfactory	Moderately Satisfactory	4.15
12	18-Nov-2015	Unsatisfactory	Moderately Unsatisfactory	7.47
13	15-Apr-2016	Moderately Satisfactory	Moderately Satisfactory	7.47
14	13-Oct-2016	Moderately Satisfactory	Moderately Satisfactory	11.48
15	20-Apr-2017	Moderately Satisfactory	Moderately Satisfactory	19.35
16	09-Nov-2017	Moderately Satisfactory	Moderately Satisfactory	22.82
17	18-May-2018	Satisfactory	Moderately Satisfactory	33.10
18	18-Dec-2018	Satisfactory	Moderately Satisfactory	38.73
19	12-Jun-2019	Satisfactory	Moderately Satisfactory	40.96
20	19-Feb-2020	Satisfactory	Satisfactory	44.63
21	17-Aug-2020	Satisfactory	Satisfactory	48.52
22	23-Feb-2021	Satisfactory	Satisfactory	52.59
23	22-Jun-2021	Satisfactory	Satisfactory	53.67



SECTORS AND THEMES

Sectors

Major Sector/Sector (%)

Water, Sanitation and Waste Management 100

Sanitation 95

Public Administration - Water, Sanitation and Waste Management 5

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3) (%)

Environment and Natural Resource Management 99

Environmental Health and Pollution Management 99

Air quality management 33

Water Pollution 33

Soil Pollution 33

ADM STAFF

Role	At Approval	At ICR
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I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Context

1. At the time of appraisal, Tunisia's macroeconomic performance was one of the best in the Maghreb region. The focus of its development strategy was an early commitment to structural reforms, steady investments in human capital and infrastructure, pro-active macroeconomic management and a focus on global trade integration. This model allowed Tunisia to sustain an average 5 percent growth rate between 1990 to 2010, with a corresponding increase in the welfare of its population underscored by poverty levels that were the lowest in the region (3.8 percent in 2005).
2. Tunisia's development achievements were also translated into strong progress in its water sector. By the time of the Project appraisal, all the urban population and 90 percent of the rural population had access to improved potable water, and 87 percent of the population had access to improved sanitation services as defined at the time by the millennium development goals.¹ In terms of the institutional set-up, its two national utilities, SONEDE for water supply services and ONAS for sewerage services, had established themselves as models for well-run public utilities in the region, providing high standard of services to the population.
3. Water scarcity was one of the most serious challenges facing the country, exacerbated by climate change and increased water resource demands. In 2010, the water resources availability in Tunisia was only 4.2 billion m³ or 407 m³ per capita,² compared to a regional average of 1,100 m³ and a global average of 6,600 m³. Climate change projections anticipated a 5 to 20 percent reduction in rainfall and a reduction in run-off due to increases in average temperatures by 2 to 3 degrees Celsius by 2100.³ These challenges were compounded by an agricultural sector that utilized 80 percent of the country's water resources⁴ and employed almost 20 percent of the workforce,⁵ with 90 percent of arable lands located in arid and semi-arid zones. Groundwater provided more than two thirds of the water supply but represented only 44 percent of the resource, resulting in one third of the country's aquifers being severely over-exploited.⁶
4. In addition to growing water scarcity, the coastal and marine ecosystems in Tunisia were threatened by diffuse pollution from agricultural drainage and from both untreated and treated wastewater discharges. The Gulf of Tunis was identified as the biggest pollution "hot spot" in the country with significant adverse economic and environmental impacts. About 2.4 million people lived in the Greater Tunis area at the time,⁷ which was also a major tourist destination. Although 86 percent of the volume of wastewater collected was treated annually in the existing wastewater treatment plants (WWTPs) of the Greater Tunis area,⁸ the existing infrastructure did not allow for the proper treatment and disposal

¹ WHO/UNICEF Joint Monitoring Programme (JMP) water and sanitation access estimates for 2010. <https://washdata.org/data/household#!//tun> Accessed 21 September 2021.

² FAO. 2007. AQUASTAT Database. AQUASTAT Website accessed on 21 September 2021.

³ Tunisia's Third National Communication as part of the United Nations Framework Convention on Climate Change <https://unfccc.int/sites/default/files/resource/Synthese%20Ang%20Finalise%20Tunisia.pdf>

⁴ IWMI -USAID. 2016. La Gouvernance des Eaux Souterraines en Tunisie. http://gw-mena.iwmi.org/wp-content/uploads/sites/3/2017/04/Rep.7-Groundwater-governance-in-Tunisia_final_cover.pdf

⁵ 2014. World Bank. The unfinished revolution - Bringing Opportunity, Good Jobs And Greater Wealth To All Tunisians. https://www.banquemondiale.org/content/dam/Worldbank/document/MNA/tunisia_report/the_unfinished_revolution_fre_chap9.pdf

⁶ IWMI -USAID. 2016. La Gouvernance des Eaux Souterraines en Tunisie. http://gw-mena.iwmi.org/wp-content/uploads/sites/3/2017/04/Rep.7-Groundwater-governance-in-Tunisia_final_cover.pdf

⁷ Tunisian National Institute of Statistics. 2010 Population projections for the governorates of Tunis, Ariana, Ben Arous and Manouba, which form part of the so called Greater Tunis metropolitan area.

<http://dataportal.ins.tn/en/DataAnalysis?2DmNVjQN0GuZ5XQfODStA> Accessed on 21 September 2021.

⁸ Data as presented in the Project Appraisal Document



of the effluents due to: (i) WWTPs operating at overcapacity, (ii) absence of nitrogen and phosphorus removal in the treatment processes, and (iii) lack of submarine outfalls for efficient disposal.

5. To address these issues, the Government of Tunisia (GoT) developed its 2007-2011 National Development Plan, where it made a national priority to protect sensitive ecosystems, reduce nutrient discharges in the Gulf of Tunis, and develop the use of treated wastewater (TWW) as a non-conventional source of water for agriculture. Based on this plan, the Ministry of Environment and Sustainable Development together with the National Sanitation Utility (Office National de l'Assainissement - ONAS) developed a National Program for Wastewater Reuse aiming at minimizing TWW discharge in the Mediterranean Sea by transferring it to irrigation perimeters across the country.

6. The World Bank had been a major partner to ONAS since its creation in 1974, continuously accompanying its development and implementing together seven major lending projects by 2010. Through these projects, ONAS gradually grew into a competent utility of about 5000 employees providing services to 88 percent of the urban population and operating 106 WWTPs across the country. As ONAS faced a new challenge in the implementation of the ambitious strategy to improve its wastewater treatment and discharge infrastructure and promote the use of TWW, further support from the Bank was sought. The TWW reuse strategy was well aligned with the objectives of the GoT's and Bank's Country Partnership Strategy for the period FY10-13 (Report No. 50223-TUN), particularly on Pillar II, "Sustainable development and climate change" which had as a specific objective "Strengthening infrastructure for wastewater re-use in Tunis".

7. In addition, the Bank was already financing two ongoing projects at the time which complemented the GoT's strategy: the Second Water Investment Project (PISEAU II) (IBRD-77260/P095847) which promoted the modernization of water resources management in Tunisia; and the Tunis West Sewerage Project (IBRD-73970/P099811) which sought to improve the quality of sanitation services in the Western portion of Tunis. Therefore, involvement of the World Bank in a new project supporting the new reuse strategy was well justified.

Project specific context

8. The Northern Tunis area suffered from aging and inadequate wastewater treatment, transfer and disposal infrastructure. At appraisal, the TWW transfer infrastructure had been in operation for almost 30 years, since 1983. It consisted in large part of an open-air channel carrying low quality TWW from the collection point at the Choutrana wastewater treatment center,⁹ to the Khelij river which ultimately discharged at the sea. Along the transfer infrastructure, the Regional Commission for Rural Development (CRDA), ascribed to the Ministry of Agriculture, Water Resources and Fisheries (MARHP), managed a pumping station that distributed the TWW for reuse at the Borj Touil irrigation perimeter. In addition, a section of the open-air channel had been recently rehabilitated by ONAS.

9. The low quality TWW conveyed through the outdated transfer and disposal infrastructure created environmental and health risks and hindered its utilization in the area. The TWW produced at two¹⁰ of the four WWTPs discharging in the transfer infrastructure exceeded the acceptable limits for Tunisian TWW effluent quality standards for Biological Oxygen Demand (BOD₅), Chemical Oxygen Demand (COD) and Suspended Solids (SS) under the norm NT106.02.¹¹ A water quality campaign conducted by ONAS in 2007 showed that the quality parameters of the TWW deteriorated further along the transfer infrastructure. The concentration of fecal coliforms (FC) also increased from a concentration of 2,500 FC/100ml to 1,500,000 FC/100ml from the discharge at the Khelij river into the sea (the Tunisian standard limit for this parameter in TWW is 2,000 FC/100ml).¹² This deterioration was caused by illegal discharges of domestic and industrial untreated wastewater into the open channel, solid waste contamination worsened by

⁹ Includes the wastewater from four WWTPs serving the North of Tunis: Choutrana I, Choutrana II, Côtîère Nord and Chagria

¹⁰ Choutrana I and Côtîère Nord WWTPs

¹¹ NT106.02 establishes the following limits for TWW discharge: BOD₅ <30 O₂mg/l; COD <90 mgO₂/l and SS <30 mg/l.

¹² ONAS. 2007. Campaign measurement and analysis in the canal El Khelij - ONAS/PPE-August 2007



stormwater flows and diffuse pollution from agricultural areas.¹³ The local population living in the vicinity of the open channels and Raoued beach (estimated by ONAS to be about 50,000 people at the time) complained from bad odors and suffered a higher risk of public health hazards, especially skin and respiratory diseases.¹⁴ In addition, contamination at the Raoued beach did not allow for bathing activities and limited its potential for tourism and economic development. Further, although the Borj Touil irrigation perimeter represented the main agricultural area in Northern Tunis habilitated for the reutilization of TWW, less than a third of the 3145ha were irrigated with the TWW. This was mostly due to (i) farmers reluctance to utilize TWW of varying quality coming from the Choutrana wastewater treatment center, and (ii) aging irrigation infrastructure.¹⁵ The majority relied instead on rainfed agriculture, with rainfall variability posing risks to their crop productivity.

10. To respond to the above challenges, the National Program for Wastewater Reuse contemplated investments for the safe transfer, disposal and storage for reuse of TWW in Northern Tunis. These were to be funded by different financing sources and to be implemented in three segments. At Project appraisal, ONAS had secured funding from the European Investment Bank (EIB) to rehabilitate the upstream section of the TWW transfer infrastructure (*Segment 1*).¹⁶ The middle section (*Segment 2*) had already been rehabilitated by ONAS.¹⁷ The implementation of the downstream portion (*Segment 3*) was the focus of this Project. It included the transformation of this third segment into a double TWW effluent transmission pipeline, and the construction of TWW transfer, pumping, storage (basin) and disposal (submarine outfall) facilities. Besides ensuring appropriate and safe disposal of excess TWW effluents, this new infrastructure would enable increased TWW reuse in the area. Activities related to the reuse portion of the Project were to be co-financed with a grant from the Global Environment Facility (GEF). Since the World Bank Project was the downstream portion of the transfer infrastructure, it depended on the satisfactory completion of the EIB-funded project (which was implemented in parallel to this Project) to fully achieve its development objective.

11. The National Program also foresaw investments for the rehabilitation and extension of the irrigation systems at Borj Touil to enable the effective reuse of TWW generated in the North of Tunis. These investments were meant to be implemented by the MARHP under a parallel project also to be financed by the World Bank, though as discussed under *Significant changes during implementation*, this project was not realized limiting the actual consumption of TWW.

Theory of Change (Results Chain)

12. The Project Appraisal Document (PAD) did not explicitly include a graphical representation of its Theory of Change (TOC) or Results Chain and therefore a TOC was constructed ex-post for the preparation of this Implementation Completion Report (ICR) and presented in Figure 1. Since the Project was co-financed by a GEF grant, the Project also incorporated a Global Environmental Objective (GEO) and associated GEF outcome indicators that were also included as part of the Project's results framework (RF).

13. Under its first objective, the Project sought to provide an environmentally safe disposal system of TWW (mostly through Component 2). This was to be achieved through the construction of the terrestrial and maritime portions of a submarine outfall which discharged the TWW to the sea, 6 km from the Raoued beach, ensuring adequate dilution and dispersion of the TWW at the discharge point. This would reduce environmental and health risks at the beach, and indirectly improve tourism opportunities in the area.

¹³ World Bank Commissioned Study. 2016. Pollution sources other than treated wastewater in the "river basin" Hissiène-Khalij.

¹⁴ 2010. Project's Environmental Impact Assessment.

¹⁵ Tunisian Institute for Strategic Studies. 2014. Systeme Hydraulique de la Tunisie a l'horizon 2030.

¹⁶ The scope included the transformation of the first segment of the open-air channel into a double pressurized TWW pipeline.

¹⁷ Financed using remaining funds under the Bank-funded Greater Tunis Wastewater project. The rehabilitation consisted in the transformation of this section of the open-air channel into a double covered culvert.

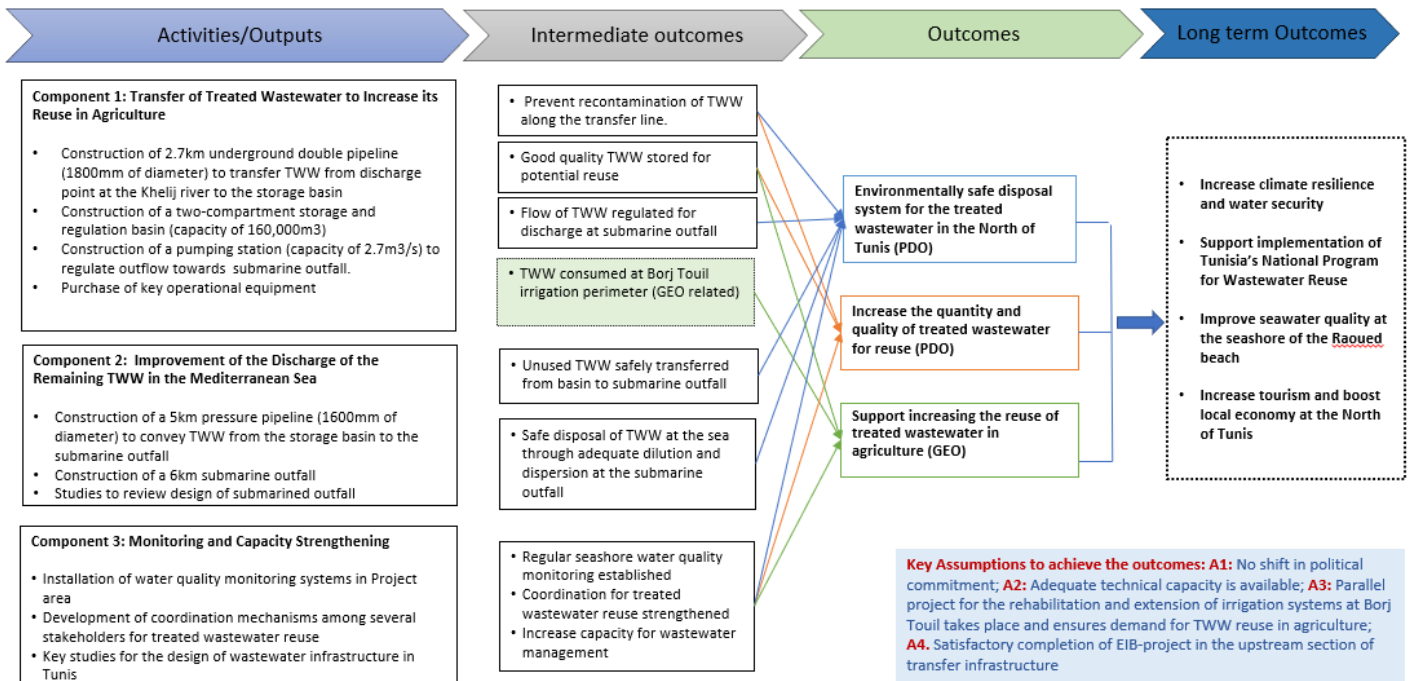


14. Under its second objective, the Project sought to increase the quantity and quality of TWW for reuse in Northern Tunis (mostly through Component 1). For this, the Project would finance double underground pipelines for the safe transfer of TWW to a two-compartment storage and regulation basin, also financed by the Project. The purpose of the infrastructure was to: (i) separate the TWW according to its quality, allowing the better quality TWW to be utilized for irrigation; and (ii) allow the lower quality TWW to be discharged through the submarine outfall. The underground pipelines were also meant to prevent recontamination of the TWW along the transfer infrastructure and reduce environmental and health risks in the surrounding areas.

15. Under the GEO, the Project sought to increase the actual reuse of TWW in agriculture at the Borj Touil perimeter. Infrastructure constructed under Component 1 partially supported this objective by making TWW available for reuse, however, the achievement of this objective depended on the realization of the parallel project for the rehabilitation and extension of irrigation systems at Borj Touil to be implemented by MARHP.

16. Technical assistance activities under Component 3 sought to increase the institutional capacity to support these three Project objectives. Ultimately, the Project would support Tunisia’s longer-term objectives of increasing water security and resilience to climate change, increasing wastewater reuse, improving seawater quality at the seashore of Raoued beach and therefore supporting the local economy and tourism. The overall achievement of the objectives depended on several assumptions outlined on Figure 1.

Figure 1 Project’s Original Theory of Change



Project Development Objectives (PDOs)

17. The original objectives of the Project as per the Loan Agreement dated October 7, 2010 (LN 7917-TN) and the PAD were to: (a) provide an environmentally safe disposal system for the treated wastewater which will not be reused in agriculture in the North of Tunis; and (b) increase the quantity and quality of treated wastewater made available to farmers to encourage its reuse in agriculture in the Borj Touil area.



18. The GEO was not stated in the Loan Agreement nor in the Grant Agreement. The GEO in the PAD was to: *support increasing the reuse of treated wastewater in agriculture, thereby reducing treated wastewater discharge from Greater Tunis into the Gulf of Tunis, an environmentally sensitive area of the Mediterranean Sea.*

Key Expected Outcomes and Outcome Indicators

19. The Project was structured around three objectives: (i) Providing an environmentally safe disposal system for the treated wastewater in the North of Tunis; (ii) increasing the quantity and quality of treated wastewater made available to farmers to encourage its reuse in agriculture in the Borj Touil area, and (iii) support increasing the reuse of treated wastewater in agriculture (GEO). As defined in the PAD, the achievement of these outcomes was to be measured through the following outcome indicators:

- Percentage of TWW from Northern Tunis WWTP discharged at the Raoued beach per annum;
- Adequate dilution and dispersion of TWW in the Mediterranean Sea at the sampling points of the submarine outfall as defined in the Environmental Management Plan (Percentage of seawater samples meeting the norm NT106.02 in terms of fecal coliforms in the surrounding of the outfall);
- Volume (m³) of TWW available for potential reuse in agriculture, measured at the storage basin;
- Percentage of samples of TWW made available for irrigation complying with the Tunisian norm NT106.03 (BOD₅, COD, Suspended Solids) at the outflow of the storage basin;
- Volume (m³) of TWW consumed in the Borj Touil irrigation perimeter, as measured by ONAS and CRDA of Ariana. (GEO related indicator).

Original components

20. **The original Project scope (as in the PAD) included three components with the following activities:**¹⁸

- *Component 1: Transfer of TWW to Increase its Reuse in Agriculture* (IBRD US\$13.16 million and GEF grant US\$7.58 million at approval). It included the construction of a 1800 mm double pipeline to transfer the TWW from its existing discharge point close to the El Khelij river up to a two-compartment 160,000 m³ storage and regulation basin, a pumping station and the purchase of key operational equipment.
- *Component 2: Improvement of the Discharge of the Remaining TWW in the Mediterranean Sea* (IBRD US\$36.48 million). It included the construction of one pressure pipeline to convey the TWW for about 5 km from the storage basin to the Raoued beach following the North side of the El Hissienne river; the construction of a 6 km submarine outfall discharging at a depth of 20 m, and the financing of studies to review in detail the design of the submarine outfall and the supervision during critical phases of its construction.
- *Component 3: Monitoring and Capacity Strengthening* (IBRD US\$2.23 million and GEF grant US\$0.45 million). It included financing for consulting services to strengthen: (i) water quality monitoring systems in the Project area; and (ii) coordination mechanisms among agencies involved in wastewater reuse, in particular ONAS and the MARHP. This component also financed key studies related to the detailed design for improved TWW disposal through a submarine outfall in the South of Tunis and the detailed design of a new WWTP in the North of Tunis; and dissemination of Tunisia TWW reuse experience through knowledge exchange events.

¹⁸ Financing amounts presented in this section include contingencies and exclude taxes which were to be financed by counterpart funds.



B. SIGNIFICANT CHANGES DURING IMPLEMENTATION (IF APPLICABLE)

Revised PDOs and Outcome Targets

21. On August 10, 2016, as part of the Project’s additional financing (AF), the PDO statement was simplified to better capture expected outcomes under the second objective.¹⁹ The new PDO read as “to provide an environmentally safe disposal system for the treated wastewater in the North of Tunis and increase availability for its reuse in the Project Area.” The definition given to the term “availability” still included the quantity and quality aspects of the original PDO as the RF still monitored these two aspects and all original activities as foreseen in the PAD were maintained.

22. Through this change, the PDO was no longer limited to ONAS making TWW available for reuse in agriculture at the Borj Touil irrigation perimeter, but also beyond and for other uses, including developers or municipalities that would be willing to connect to the regulation and storage basin constructed under Component 1. This responded to the dropping of the parallel project that was to be implemented by the MARHP and whose objective was to expand and rehabilitate the existing irrigation infrastructure within the Borj Touil perimeter and use the TWW made available at the storage basin to feed the system. Since the project was never realized due to several uncertainties in the design of the perimeter and future land use, the farmers did not have the adequate infrastructure to significantly increase the volume of TWW effectively used for irrigation. Growing urbanization, particularly with the new developments at the Tunis financial port and Bay City, also made it apparent that agriculture may no longer be the main TWW user in the area and highlighted the need to expand the PDO to other uses. Due to the unrealized demand for reuse in agriculture, the GEO related indicator was downscaled from focusing on actual consumption of TWW in agriculture to TWW made available from the storage and regulation basin for future reuse through an established agreement with farmers, developers or municipalities in the vicinity of the Project. Specifically, it was replaced from “Volume (m³) of TWW consumed in the Borj Touil irrigation perimeter, as measured by ONAS and CRDA of Ariana” with a target of 11 million m³,²⁰ to the indicator “Average annual volume of TWW made available to farmers, developers or municipalities in the vicinity of the Project” with a target of 3 million m³. Despite this change in the GEO indicator, the actual GEO statement was not amended as the AF was processed after the grant closing on June 30, 2016.

Revised PDO Indicators

23. In May 2014 and August 2016, the Project’s PDO indicators were revised to: (i) include adjusted indicator definitions for better PDO measurement, (ii) include core (corporate) indicators, (iii) revise indicator and targets in alignment with the downscaled PDO related to reuse and (iv) include detailed information on data sources, methodology, and monitoring and evaluation criteria. Specific changes made to the PDO indicators are reflected in Table 1 below.

Table 1 Revised PDO and GEO Indicators

Original	Restructuring – 05/01/2014	Restructuring – 08/10/2016	Comments
PDO outcome indicators			
Percentage of TWW from Northern Tunis WWTP discharged at the Raoued beach per annum	Percentage of TWW (not reused in the irrigation) from Northern Tunis WWTP discharged at the submarine outfall	Became an intermediate indicator	The original indicator was lowered to intermediate level as it provided information at the output level – amount of TWW conveyed in the transfer and submarine outfall system.

¹⁹ This was also reflected in the Additional Financing Loan Agreement, dated November 30, 2016 (LN 8644-TN).

²⁰ Target was lowered to 9 million m³ in the 2014 restructuring.



<p>Adequate dilution and dispersion of TWW in the Mediterranean Sea at the sampling points of the submarine outfall as defined in the Environmental Management Plan (Percentage of seawater samples meeting the norm NT106.02 in terms of fecal coliforms in the surrounding of the outfall).</p>	<p>Percentage of seawater samples meeting the norm NT106.02 in terms of fecal coliforms in the surrounding of the outfall</p>	<p>Percentage of seawater samples at Raoued Beach complying with imperative norms in total coliforms and fecal coliforms (respectively 10,000 TC/100ml and 2,000 FC/100ml). Average annual count of fecal coliforms in seawater samples in the surrounding of the outfall (actual measurement)</p>	<p>The changes to the original indicator streamlined its wording and provided better definitions for measurement. Rather than focusing on discharge standards (NT106.02) it focused on international bathing quality standards as established in the European Directive on bathing water quality (EC/160/CEE). This change was to align the indicator with the MedPol Programme for the Protection of the Mediterranean Sea of which Tunisia was a signatory. The established imperative norms implied sufficient sea water quality for bathing, which represented a better measurement of the impact of the submarine outfall. The changes also allowed to monitor total coliforms, not included before, and actual annual average values of fecal coliforms in the surrounding of the outfall.</p>
<p>Volume (m³) of TWW available for potential reuse in agriculture, measured at the storage basin</p>	<p><i>Deleted</i></p>		<p>This indicator was deleted because it provided output level information on the amount of water available at the basin. Although at the output level, the indicator provides information on the quantity of TWW available for reuse and it kept being monitored as part of the Project.</p>
<p>Percentage of samples of TWW made available for irrigation complying with the Tunisian norm NT106.03 (BOD5, COD, Suspended Solids) at the outflow of the storage basin.</p>	<p>Average annual concentration of suspended solids in TWW made available at the El Hissiène basin</p>	<p>Average annual concentration of suspended solids in TWW made available at the El Hissiène basin</p>	<p>This indicator was changed to focus on the concentration for suspended solids at the storage basin (El Hissiène basin), as high SS concentrations clog and damage irrigation systems, rendering them ineffective and being a main limiting factor for reuse in agriculture. The other two quality aspects of the original indicator, BOD and COD kept being monitored under the Project outside of RF.</p>
		<p>Direct project beneficiaries (% female)</p>	<p>Indicator added to align the RF to required World Bank corporate indicators.</p>
GEO outcome indicators			
<p>Volume (m³) of TWW consumed in the Borj Touil irrigation perimeter, as measured by ONAS and CRDA of Ariana (Project and GEO related indicator).</p>	<p>Volume (in m³ per annum) of TWW reused in the Borj Touil irrigation perimeter</p>	<p>Average annual volume of TWW made available to farmers, developers or municipalities in the vicinity of the Project</p>	<p>The change in the original indicator represented a downscale from actual reuse to just availability formalized through an agreement. The scope of the indicator was limited to the TWW made available at the Hissiène basin (excluding that made available at the CRDA pumping station). Target values were reduced from 11 million m³ to 3 million m³ to account for the dropping of the MARHP project.</p>
<p>Volume (m³) of TWW available for potential reuse in agriculture, measured at the storage basin (GEO related indicator)</p>	<p><i>Deleted</i></p>		<p>Same explanation as corresponding PDO indicator above.</p>



Revised Components

24. The main changes in relation to project components compared to the PAD description, were as follows: (i) the activity for strengthening reuse coordination mechanisms was switched from Component 3 to Component 1 and it included the design and development of a reuse pilot in the Project Area (Sidi Amor) with related dissemination activities, training, and technical assistance for the supervision of said pilot; (ii) the construction of the pumping station was switched from Component 1 to Component 2, as it was not directly oriented towards reuse; (iii) capacity-building activities previously financed under the Tunis West Sewerage Project, including a joint SONEDE-ONAS customer and billing system, were included under Component 3 as they would increase ONAS's capacity for wastewater management and enhance the sustainability of the Project financed infrastructure; (iv) implementation support was moved from Component 3 to under each activity; and (v) new activities were added to Component 1 during the 2019 restructuring (see paragraph 31).

Other Changes

25. The Project and GEF grant underwent five restructurings, including an AF. In three of those restructurings the closing date was postponed, ultimately resulting into an aggregated extension from the original closing date of December 31, 2015 to the final closing date of June 30, 2021.

26. The Project financing plan underwent substantive changes throughout implementation. These were due to an initial cancellation of US\$12.6 million in 2014, an Additional Financing of EUR 16.2 million (US\$18.8 equivalent) in 2016, and the incorporation of new activities in the Project scope in 2019 due to a US\$13 million balance resulting from the depreciation of the Tunisian Dinar. The detailed rationale for these changes is explained in the following section *Rationale for Changes and Their Implication on the Original Theory of Change*.

Rationale for Changes and Their Implication on the Original Theory of Change

27. **First restructuring (level 2): May 1, 2014.** The 2011 Arab Spring and the ensuing institutional stalemate in the country,²¹ had a dramatic impact on progress during the first years of implementation. By 2013, progress had stalled on multiple fronts and by March 31, 2014 disbursements stood at 4 percent of total Project financing. In view of these issues, the Bank team carried out a detailed Project Mid-Term Review (MTR) between February 6 to 14, 2014. The review showed that an extension of the closing date (from December 31, 2015 to June 30, 2017) was needed if main Project infrastructure was to be constructed and Project objectives were to be reached. In addition, by the MTR, most of the activities of the ground portion of the Project had been contracted or bid. The received bids were lower than expected due to changes in market conditions and competition between local firms after the 2011 Arab Spring. This left US\$12.6 million in unallocated funds that were agreed to be cancelled (this did not imply any cancellation of activities). Other changes sought to ensure that all GEF grant funds were allocated and utilized and that Project focus stayed on core activities to achieve the PDO. The RF was adjusted to streamline indicators and include better definitions and measurement of the PDO achievement. There were no substantial implications to the Project's original TOC, but the GEO reuse indicator target value was lowered from 11 million m³ to 9 million m³.

28. **Second restructuring (level 2): December 18, 2015.** This restructuring extended the closing date of the GEF grant from December 31, 2015 to June 30, 2016. No change was made to the overall Project's closing date. The extension allowed ONAS to complete all GEF-financed activities under Component 1, including partial testing of infrastructure and technical assistance to sustain the Sidi Amor reuse pilot's institutional achievements. There were no changes in the RF or implications to the Project's original TOC.

²¹ Beginning in December 2010, anti-government protests were rampant in Tunisia in response to corruption and economic stagnation. Uprisings and armed rebellions followed and spread across much of the Arab world by early 2011, to what is now known internationally as the Arab Spring.



29. **Third restructuring (level 2): May 11, 2016.** This restructuring consolidated the disbursement categories of the GEF Grant under a single category for all Grant-financed works, goods and consultant services. There were no changes in the original Loan Agreement nor in the original TOC.

30. **Fourth restructuring and Additional Financing (AF): August 10, 2016.** This restructuring included an additional financing of EUR 16.2 million (US\$18 million equivalent in 2016, US\$18.8 million equivalent at closing). At Project appraisal in 2010, ONAS initial estimates for the cost of the submarine outfall was TND 36 million inclusive of taxes. Once ONAS conducted the evaluation of the bids in 2014, it became apparent that the actual cost would be around TND 67 million exclusive of taxes. The underestimation was due to a combination of factors, including: (i) for its initial estimate, ONAS used cost ratios based on average costs of domestic production of pipes observed during construction of recent, yet much smaller outfalls built in Tunisia, (ii) extensive consultations during the review of the submarine outfall modeling and design, led to more stringent environmental and technical constraints than expected, and (iii) market variability during the period of time between the Project appraisal (2010) and the bidding for the submarine outfall (2014). The Bank mobilized international expertise to review the cost analysis provided by ONAS and confirmed that the higher cost estimate was in line with international benchmarks at the time, leading to the AF in May 2016 to cover the higher contract cost. In addition to the AF, the PDO statement was simplified, and the GEO indicator was downscaled as explained in paragraphs 21 and 22. The restructuring also added the joint SONEDE-ONAS billing system and other capacity building activities to the Project scope. The closing date of the original Loan was postponed to December 31, 2019 to allow for enough time to reach the Project's PDOs.

31. **Fifth restructuring (level 2): December 10, 2019.** Due to the depreciation of the Tunisian dinar between 2016 and 2019 (including by 21 percent and 11 percent, against the Euro and US\$, respectively, since the approval of the AF), the Project accumulated a balance of about US\$13 million. At the same time, the deteriorating fiscal situation of ONAS and of the country in general, led to ONAS' inability to maintain its commitment to co-finance the upstream portion (*Segment 1*) of the transfer infrastructure with the EIB (refer to Context section). Since the EIB was unable to commit additional financing for the completion of these works, and the remaining balance under this Project was enough to cover the associated costs, this infrastructure was added to the Project's scope. The additional works substituted the existing open-air channel from Choutrana to the CRDA pumping station by a double transfer pipeline. These were essential to prevent pollution along the transfer infrastructure and ensure the quality of the TWW during conveyance, both for reuse and for discharge at the submarine outfall. The remaining balance also allowed for the inclusion of urgent repairs and rehabilitation works on the WWTPs and wastewater pumping stations of the Northern Tunis Wastewater Treatment system, which though not essential to achieve the Project's PDO, were important to improve treatment performance and maintain effluent pollutant concentrations below applicable thresholds in the long-term. To account for the inclusion of the new activities the Project restructuring (i) extended the Project's closing date from December 31, 2019 to June 30, 2021; (ii) updated the intermediate indicators in the RF to account for the expanded Project scope; (iii) revised the project description of activities and costs; (iv) revised the disbursement estimates and implementation schedule; (v) updated the economic, financial, technical, social and environmental analysis to incorporate aspects related to the new activities added to the scope of the Project; and (vi) partially reallocated IBRD loan proceeds from disbursement category 1 to a newly created category 3 earmarked for the co-financing of the new activities.

32. The revised TOC is shown in Annex 1C which followed upon restructurings of the Project. Annex 7, Map A7.3 illustrates the final scope and main infrastructure constructed under the Project.



II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating

33. The Project's objective remains highly consistent with the country's current development priorities and with current Bank country and sectoral assistance strategies. The PDO is fully aligned with the Bank's 2015 Systematic Country Diagnostic (SCD), the current Country Partnership Framework (CPF) for the period FY16-FY21 (Report No. 104123-TN) and its subsequent 2018 Performance and Learning Review (Report No. 123957-TN). The Project's PDO is particularly aligned with Pillars four and five of the SCD which focused on improving services and promoting green growth for sustainable development, respectively. The Project is explicitly included as part of CPF Objective 2.1 *Improved access to services in lagging regions*, which for the wastewater sector was understood to be supported through *improvements in municipal infrastructure (transport and water and sanitation)* and *improvement in satisfaction with water and sanitation services*. The Project directly contributes to these to aspects by its focus on a safe disposal of TWW which provides better sanitation services to Northern Tunis citizens and environmental benefits at the Golf of Tunis. The Project also contributes to the CPF's Objective 2.2 *Enhanced economic opportunities in lagging regions* and Objective 3.1 of the CPF *Increased opportunities for young men and women*, as the Project's environmental benefits are expected to lead to new economic opportunities and job creation, particularly in tourism and increasing the productivity of scarce water resources by making TWW available for reuse in agriculture or for other recreational uses. Although Northern Tunis is not considered a *lagging region* as such, the governorates directly benefitting from the Project have higher poverty rates than the average for the Greater Tunis area (6.9 percent for Raoued, and 12.5 percent at Kalaat Andalous, compared to 6.1 percent of the Greater Tunis area).²² The Project also indirectly contributes to Objective 1.1 *Strengthened macro-economic and fiscal management* which has the modernization of state owned enterprises as one of its focus areas. The Project has supported the successful implementation of the SONEDE-ONAS IT billing system which has allowed ONAS to modernize its financial systems and enhance its performance efficiency (more under *Institutional Strengthening* section).

34. The Project is aligned with the *GEF 2020 strategic priority of Enhancing Resilience and Adaptation* to climate change,²³ and the CPF's crosscutting priority of supporting Tunisia's climate change adaptation and mitigation efforts established in their National Determined Contributions for 2015-2030, which explicitly mention the transfer and reuse of TWW as one of its key adaptation actions.²⁴ The Project also fully contributes to the World Bank's Middle East and North Africa 2021 Regional Strategy Update, particularly on the focus area of *Enabling green growth* through the promotion of resource recovery in key services and natural resource management. The Project is well aligned to *Pillar 5: Promoting green growth for sustainable development*, of the 2015-2020 GoT's "*Note d'Orientation Strategique*" which aims to ensure the sound utilization of natural resources with an emphasis on rationalizing the use of water while promoting modern agricultural systems that guarantee food security. Reducing treated wastewater effluents' pollutant loads, preserving marine ecosystems and increasing water reuse rates are listed as key objectives of the 2020 National Environmental Protection Strategy ("*Stratégie Nationale de Protection de l'Environnement Poste 2020*").

35. **Rating:** Based on the above, relevance is rated **High**.

²² http://ins.tn/sites/default/files/publication/pdf/Carde%20de%20la%20pauvrete%C3%A9%20en%20Tunisie_final_0.pdf

²³ https://www.thegef.org/sites/default/files/publications/GEF-2020Strategies-March2015_CRA_WEB_2.pdf

²⁴ <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Tunisia%20First/INDC-Tunisia-English%20Version.pdf>



B. ACHIEVEMENT OF PDOs (EFFICACY)

36. The Project has met its intended direct beneficiaries target, which now stands at 60,000 people (49 percent female) when adjusted for the rapid population growth in the area (50,000 at appraisal).²⁵ These include people from the municipalities of Raoued and Kalaat el Andalous, benefitting from improved environmental conditions along the TWW transfer line and at Raoued beach. This number also includes about 500 farmers and their families from the Borj Touil irrigation perimeter who are benefitting from improved TWW reliability and quality at the CDRA pumping station. Indirectly, the Project is benefitting the overall population of the Greater Tunis area (estimated at 2.6 million inhabitants).

37. The PDO has been grouped around three objectives for the efficacy analysis: (i) to provide an environmentally safe disposal system for the TWW in the North of Tunis; (ii) to increase the quality and quantity of TWW made available for its reuse, and (iii) to support increasing reuse of TWW in agriculture (GEO). Given significant changes to the original PDO and PDO indicators in May 2014 and August 2016, a split evaluation has been carried out.

Assessment of Achievement of Each Objective/Outcome

PDO 1: Provide an environmentally safe disposal system for the TWW in the North of Tunis

Table 2 PDO 1: Outcome of Key Indicators Pre and Post Restructuring

Pre-restructuring (May 2010 to May 2014) – Rating: High		Post- 2014 Restructuring 1 (May 2014 to August 2016) – Rating: High		Post 2016 AF (August 2016 to Closure) – Rating: High	
INDICATOR	ACHIEVEMENT LEVEL	INDICATOR	ACHIEVEMENT LEVEL	INDICATOR	ACHIEVEMENT LEVEL
Percentage of TWW from Northern Tunis WWTP discharged at the Raoued beach per annum	Target of 0 % achieved. No TWW is discharged at Raoued beach.	Percentage of TWW (not reused in the irrigation) from Northern Tunis WWTP discharged at the submarine outfall.	Target of 95% surpassed. 100% of TWW not reused is being discharged at the submarine outfall.	Dropped to intermediate indicator.	Target of 95 % surpassed. 100% of TWW not reused is being discharged at the submarine outfall.
Adequate dilution and dispersion of TWW in the Mediterranean Sea at the sampling points of the submarine outfall as defined in the EMP (Percentage of seawater samples meeting the norm NT106.02 in terms of fecal coliforms in the surrounding of the outfall)	Target surpassed. 99% of seawater samples in the surrounding of the outfall meet NT106.02 of 2000/100ml for fecal coliforms. (Target 95%)	Same.	Same.	Percentage of seawater samples at Raoued Beach complying with imperative norms in total coliforms and fecal coliforms (respectively 10,000 TC/100ml and 2,000 FC/100ml).	Target of 90% surpassed. 96% of seawater samples at Raoued Beach are compliant with the established imperative norms (respectively 10,000 TC/100ml and 2,000 FC/100ml).
				Average annual count of fecal coliforms in seawater samples in the surrounding of the outfall.	Target <2000/100ml) achieved. Average annual count is 106 fecal coliforms/100ml at the surrounding of the outfall which is under the standard of 2000/100ml set by NT 106.02.

Source: Sea water quality campaigns performed by ONAS



38. **Pre-restructuring and Post-2014 restructuring ratings: High.** As shown in Table 2, the construction of the submarine outfall and the transfer infrastructure is ensuring that 0 percent of the TWW generated in the four WWTPs serving the North of Tunis is discharged at the Raoued beach. Instead, 100 percent of the TWW not reused in agriculture is being discharged at the submarine outfall, 6 km from the coast at a depth of 20m. Adequate dilution and dispersion is observed in the surrounding of the outfall, as 99 percent of the seawater samples within a radius of 2km of the outfall meet the standard limits established in norm NT106.02 for effluent discharge into the sea: <2000 fecal coliforms/100ml.

39. **Post-2016 AF rating: High.** As shown in Table 2, the Project surpassed its post-2016 AF PDO indicator targets. After commissioning of the submarine outfall, 96 percent²⁶ of seawater samples at Raoued Beach are complying with the imperative norms in total coliforms and fecal coliforms for bathing waters as established by the European Directive on bathing water quality (EC/160/CEE),²⁷ compared to a baseline of 92 percent.²⁸ In addition, the average annual count of fecal coliforms in the surrounding of the outfall (106FC/100ml) is below the standard limits established in norm NT106.02 for effluent discharge into the sea. The intermediate results indicator measuring FC at the beach was achieved at 68 percent (reduction by 85 points *versus* a target of 126 point decrease) with an actual average count of 141FC/100ml. This also represents a significant reduction in FC at the beach itself and is well below the bathing water quality limits and effluent discharge standards presented before (<2000FC/100ml). Transparency of seawater along the coastline also presents significant improvements, from 69 percent of water samples complying with the imperative standard of 1 m transparency to 77 percent, before and after construction of the outfall, respectively. The improvement was particularly marked along the coast with important implications for the visual and touristic appeal of the beach. Finally, there was a marked reduction in the presence of detergents in the water samples before and after commissioning of the outfall.

40. The result of these improvements means that the beach at Raoued is now suitable for bathing with important implications for future tourism and economic development of the area. In fact, in 2020 and 2021, the Ministry of Health authorized swimming activities at Raoued beach for the first time in years given marked improvements in the water quality of the area and which were corroborated by their own water quality campaigns.²⁹ In addition, the average number of days spent by foreign tourists in the area was on the rise from a low of 2.7 days in 2015 to 3.5 days in 2020.³⁰ During technical visits to the Raoued beach, fishermen expressed their support to the Project and mentioned their satisfaction with the overall environmental improvement of the area, particularly of the clarity of the water and the better sand quality.³¹ Majors from the Kalaat Andalous and Raoued municipalities interviewed for this ICR, also

²⁵ This number is based on estimates provided by ONAS during the ICR mission. The target was estimated based on census data for the Raoued and Kalaat el Andalous delegations which in 2014 had a total population of 133,210. ONAS carried out consultations with the local authorities and determined that approximately 50,000 of the total would directly benefit from the infrastructure constructed under the Project. The current number reported by ONAS of 60,000 is higher as it accounts for the rapid population growth experienced in recent years in the area.

²⁶ After commissioning, all the instances where samples exceeded the norm happened in the month of September 2019. This month had higher-than-average rainfall which brought contaminated run-off from the city into the beach.

²⁷ The indicator follows the European Directive standards to align the Project with the international MedPol Programme for the Protection of the Mediterranean Sea of which Tunisia was a signatory.

²⁸ The baseline value presented here has been calculated by the ICR team based on the results of the 2015 sea water quality campaign performed before the commissioning of the outfall. The baseline value presented in the 2016 restructuring and which was monitored by the Project until closing was 80 percent based on an estimate provided by the Ministry of Health's water quality campaigns as informed by the ONAS during the ICR mission. This explains the target set at 90 percent. The Bank team should have revised the baseline targets once data from the seawater monitoring campaigns became available, but this was not done. In either case, the results show an improvement in sea water quality against both baseline values.

²⁹ Data presented by the Directorate of Environmental Health and Environmental Protection of the Tunisian Ministry of Health.

³⁰ Office National du Tourisme Tunisien, Le Tourisme Tunisien en Chiffres 2020

³¹ Interviews carried out as part of the environmental and social supervision of the Project with three fishermen of the area in August 2019 and documented in the respective Aide Memoire.



expressed their satisfaction with the Project’s results. See Annex 8, pictures A8.1 and A8.2 for the visual change of the sea at the coast before and after the Project.

41. The construction of TWW transfer infrastructure that runs fully underground is preventing further contamination of the TWW and reducing environmental and health risks to the nearby population. Before the Project, the open-air channel was a source of deterioration of the TWW quality as people disposed of their solid waste directly there, or raw wastewater was directly discharged along the line and it created a physical barrier dividing the city in two. It represented a source of environmental and health risks: breaches along the channel were observed which resulted in contaminated wetlands in the vicinity of the surrounding inhabitants, there was a proliferation of rodents and insects, clandestine pumping of contaminated TWW for unknown uses and livestock was observed to be drinking from the contaminated water.³² The replacement of the open-air channel with underground pipelines have eliminated these sources of concern. The result is that the population living or carrying economic activities along the transfer pipelines are no longer exposed to the environmental and health risks described before, as well as the visual and offensive odors nuisance that used to be caused by the uncovered TWW before the Project. Since the TWW is now running fully underground on impermeabilized pipelines, infiltration of polluted TWW into the groundwater is no longer a problem. Annex 8, Pictures A8.5, A8.6 and A8.7 showcase these impacts.

42. The Project has also included measures to enhance the sustainability of the Project in the long-term. On one hand, the submarine outfall is designed to provide a safe disposal of the TWW even if there are fluctuations in its quality caused by potential underperformance of the WWTPs upstream. Further, in the 2019 restructuring, the Project included the rehabilitation of electromechanical equipment in six wastewater pumping stations in the Northern Tunis wastewater system. These works support wastewater treatment performance in the long-term to maintain pollutant concentrations in the effluent below applicable thresholds. At closing, one of those was fully operational, while the construction of other two was almost finalized in December 2021 (95 percent) and were highly likely to be operational by January 2022. The remaining three wastewater pumping stations were removed from the scope of this Project and transferred to the Tunisia Sanitation PPP Support Project (P162957) which is under preparation. This decision was taken to ensure consistency in the procurement packages that were bid under the PPP project, and reduce risks in implementation as these three pumping stations were part of the infrastructure to be operated by the private operator. Capacity strengthening activities are further discussed under the *Institutional strengthening section*.

43. **Rating:** Since the Project achieved or surpassed its intended PDO and targets pre-and-post restructurings, with important benefits already seen as a result, the rating for PDO 1 is **High**.

PDO 2: Increase the quality and quantity of TWW made available for its reuse

Table 3 PDO 2: Outcome of Key Indicators Pre and Post Restructuring

Pre-restructuring (May 2010 to May 2014) – Rating: High		Post- 2014 Restructuring 1 (May 2014 to August 2016) – Rating: High		Post 2016 AF (August 2016 to Closure) – Rating: High	
INDICATOR	ACHIEVEMENT LEVEL	INDICATOR	ACHIEVEMENT LEVEL	INDICATOR	ACHIEVEMENT LEVEL
Volume (in million m ³ per annum) of TWW available for potential reuse in agriculture, measured at the storage basin	Target of 58 million m ³ / yr surpassed. 59.8 million m ³ /yr are available for potential reuse at the Hissiene basin.	Dropped	N/A	Dropped.	N/A

³² As reported in the 2019 Environmental and Social Impact Assessment.



Percentage of samples of TWW made available for irrigation complying with the Tunisian norm NT106.03 (BOD ₅ , COD, SS) at the outflow of the storage basin	Target of 95% surpassed. 100% of samples for the quality campaign of August 2021 are compliant with BOD ₅ , COD and SS standards.	Percentage of samples of TWW made available for irrigation complying with the Tunisian norm NT106.03 for BOD ₅	Target of 75% surpassed. 100% of samples for the quality campaign of August 2021 are compliant with BOD ₅	Average annual concentration of suspended solids in TWW made available at the El Hissienne basin	Target of <30mg/L in standard NT106.03 achieved. The average concentration of SS at the exit of the reservoir is 19 mg/L.
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Source: TWW quality campaign performed by ONAS in August 2021, after all infrastructure was finalized and ONAS evaluation report.

44. **Pre-restructuring and Post-2014 restructuring rating: High.** An annual average of 59.8 million m³ of TWW meeting Tunisian reuse standards are being made available for potential reuse at the El Hissiene basin, surpassing the PDO target of increased quantity of TWW to 58 million m³ (Table 3). The reservoir (total capacity of 160,000 m³) serves the double function of storing the TWW for potential reuse while also regulating its flow for discharge into the submarine outfall. The constructed infrastructure includes a pumping station that can be coupled to future infrastructure to pump the TWW for reuse. The Project also surpassed its pre-and post-2014 restructuring targets related to the quality of TWW made available at the basin. Based on ONAS water quality monitoring data of August 2021, 100 percent of the samples are compliant with relevant parameters of the Tunisian norm for reuse NT106.03: BOD₅ <30 mgO₂/L, COD <90 mgO₂/L and SS <30 mgO₂/L.

45. **Post-2016 AF rating: High.** The Project has achieved its post-restructuring indicator *Average annual concentration of suspended solids in TWW made available at the El Hissiene basin*³³ with a value of 11mg/L for SS, well under the SS NT106.03 standard of <30 mg/L. It represents a seven-fold reduction in SS in TWW for reuse from the baseline of 120mg/L. Although not part of the RF, Table 4 presents the average values for the other TWW quality parameters, which are all under the established limits in NT106.03 thus ensuring adequate quality of TWW for potential reuse. The available quantity for potential reuse (although not formally monitored in the RF post-2016 AF) is the same as presented in the pre-restructuring evaluation: 59.8 million m³/yr which represents about 22 percent of the total TWW produced in the WWTPs managed by ONAS.³⁴

46. The Project also financed the study for the design of a new WWTP in the North of the Greater Tunis area (El Hissiene WWTP), with a capacity of 60,000 m³/day. This new WWTP is part of ONAS Sanitation Master Plan and will replace three WWTPs in the Ariana and Tunis governorates that are deteriorated and underperforming. The TWW generated at the El Hissiene WWTP will be transferred to the El Hissiene storage and regulation basin and will further increase the amount of TWW potentially available for reuse. The designs are ready and by October 2021, ONAS was in the process of identifying financing sources for its implementation.

Table 4 Average values for TWW at the entrance and exit of the El Hissiene basin (August 2021)

Water Quality Parameter	Tunisian standard NT 106.03	At the entrance of the reservoir	At the exit of the reservoir ^a	Target achievement
Biological Oxygen Demand (BOD ₅ mgO ₂ /L)	<30	24	17	Achieved
Chemical Oxygen Demand (COD mgO ₂ /L)	<90	106	79	Achieved
Suspended Solids (SS mg/L)	<30	36	19	Achieved

^a Data from ONAS' water quality campaign of August 2021.

47. **Rating:** Since the Project achieved or surpassed its intended PDO and targets pre-and-post restructurings the rating for PDO 2 is **High**.

³³ This indicator focused only on the concentration for suspended solids as this is an important factor in the availability of TWW for reuse. High SS concentrations lead to damage in irrigation systems by clogging them and making them ineffective.

³⁴ MARHP 2019. Presentation of the Study for the preparation of the National Master Plan for Reuse 2050.

PDO 3: Support increasing reuse of TWW in agriculture (GEO)

48. This PDO will be evaluated against the PDO quantity targets established pre-and-post restructurings, improvements in TWW quality achieved, and institutional activities that sought to improve the coordination of TWW for reuse and promote its uptake.

Table 5 PDO3: Outcome of Key Indicators Pre and Post Restructuring

Pre-restructuring (May 2010 to May 2014) – Rating: Negligible		Post- 2014 Restructuring 1 (May 2014 to August 2016) – Rating: Modest		Post 2016 AF (August 2016 to Closure) – Rating: Modest	
INDICATOR	ACHIEVEMENT LEVEL	INDICATOR	ACHIEVEMENT LEVEL	INDICATOR	LEVEL OF ACHIEVEMENT
Volume (in million m ³) of TWW consumed in the Borj Touil irrigation perimeter, as measured by ONAS and CRDA of Ariana	43 percent target achievement. 4.8 million m ³ /yr are currently reused at the Borj Touil irrigation perimeter. (Target 11 million m ³ /yr). Water quality has significantly improved.	Same. Though target revised to 9 million m ³ .	53 percent target achievement. 4.8 million m ³ /yr are currently reused at the Borj Touil irrigation perimeter. (Target 9 million m ³ /yr) Water quality has significantly improved.	Average annual volume of TWW made available to farmers, developers or municipalities in the vicinity of the Project	49 percent target achievement. 1.46 million m ³ /yr are to be reused from the basin at the Tunis Financial Harbor formalized through an agreement with ONAS. (Target 3 million m ³ /yr)

Source: TWW consumption records kept by the CRDA as provided during the ICR mission in September 2021; Agreement between ONAS and Tunis Bay Company.

49. **Pre-restructuring and Post-2014 restructuring rating: Negligible and Modest respectively.** In terms of *quantity*, The Project is enabling the reutilization of an annual average of 4.6 million m³ of TWW at the existing Borj Touil irrigation perimeter fed from the CRDA pumping station (Table 5)³⁵. This is below the original targets of 11 million m³/yr and 9 million m³/yr pre-restructuring and post-2014 restructuring, respectively, and a small increase from the baseline of 3 million m³. The targeted TWW reuse quantities did not materialize because the parallel project to be implemented by the MARHP for the rehabilitation and extension of the Borj Touil irrigation perimeter did not take place due to reasons outlined in paragraph 22. Despite this, the Project has significantly improved the *quality* of TWW pumped at the CRDA station, with average values for BOD₅, COD and SS meeting the reuse standards established in NT106.03 (see Table 6). This will benefit more than 500 farmers and their families in the irrigation perimeter.³⁶ During the ICR mission, the CRDA noted the improvement in the TWW quality in the last months since the infrastructure became fully operational (July 2021). In addition, they confirmed the renewed interest by farmers to utilize TWW now that its quality has been improved. In October 2021, the CRDA, in coordination with the MARHP, have launched a call for tenders for a study to update the plans to expand and rehabilitate the Borj Touil irrigation perimeter which will take as a key consideration the infrastructure constructed under the Project, which if realized would significantly increase the amount of TWW reused in the area. The study is expected to be finalized by mid-2022.

Table 6 Average values for TWW at the exit of the Ariana CRDA pumping station for reuse (August 2021)

Water Quality Parameter	Baseline (2009) ^a	Target - Tunisian Standard NT 106.03	At exit of CRDA pumping station ^b	Target achievement
Biological Oxygen Demand (BOD ₅ mgO ₂ /L)	46	<30	25	Achieved
Chemical Oxygen Demand (COD mgO ₂ /L)	102	<90	89	Achieved
Suspended Solids (SS mg/L)	75	<30	29	Achieved

^a From data presented in the 2015 update to the Environmental and Social Impact Assessment of the Project. The data corresponds to the 2009 quality of TWW at the entrance of the Khelij river. ^b Data from ONAS' water quality campaign of August 2021.

³⁵ Based on TWW consumption records kept by the CRDA as provided during the ICR mission in September 2021.

³⁶ This represents about 10 percent of the total area (3200 Ha) at the Borj Touil irrigation perimeter.



50. **Post-2016 Additional Financing rating: Modest.** In terms of *quantity* targets, the Project has supported the signing of an agreement between the ONAS and the Tunis Bay Project Company for the future reuse of 1.46 million m³ per year from the Hissiene basin to irrigate the green areas of the new Tunis Bay City at the Tunis Financial Harbor, which represents a modest achievement of its PDO related target (Table 5).³⁷ The agreement was signed on January 29th, 2020 which sets the guidelines for the reuse of an average of 4000 m³/day from the basin. The TWW will be actually fully consumed once the tertiary treatment and transfer infrastructure to the Tunis Bay area is constructed, which is expected in the next 5 years.³⁸ The Tunis Bay City will be a residential city covering an area of 523 hectares, which when fully constructed will benefit 160,000 people. The new city includes large green spaces for leisure areas and outdoor sports activities, including a golf course and gardens for residential complexes and office buildings. The current agreement for 4000 m³/day will cover the immediate irrigation needs of the golf courses and green areas covering 40 ha of the development. In the future, as the construction of the new city advances, the Tunis Bay Project Company expects that an additional 4000 m³/day will be needed.³⁹ In terms of *quality*, TWW at the basin meet the quality standards for reuse as presented in Table 4.

51. Regarding *institutional activities*, the Project has had an important impact in advancing the discussion and coordination on reuse between stakeholders through the successful implementation of the Sidi Amor reuse pilot.⁴⁰ The Sidi Amor pilot included the construction of an innovative treatment facility (vegetated filter and maturation tank) to ensure constant good quality in the TWW for reuse, a pumping station, an irrigation system, a laboratory to analyze the TWW quality and a demonstration center where sensitization activities are carried out to showcase the benefits of TWW reuse.⁴¹ Today, the TWW at the pilot site is of high quality (see Table 7) fully meeting its related intermediate indicator for SS. In addition, it is allowing the irrigation of a total of 7.5 hectares of demonstration plots in the Sidi Amor Agricultural Development Group (GDA) domain and the plots of 3 farmers from Borj Touil, for a total of 520 m³/day.⁴² During the ICR mission, the Sidi Amor GDA mentioned that the experience has inspired a similar project in a neighboring area 30 km from the pilot. The Sidi Amor GDA is also exploring opportunities for reuse of the TWW in forest fires and for the irrigation of green areas in partnership with the Raoued municipality.

52. The pilot is testing coordination mechanisms among stakeholders involved in TWW reuse value chain. In May 2018, the ONAS, the Ariana CRDA and the GDA of Sidi Amor (which is located within the Borj Touil irrigation perimeter), signed an agreement establishing a framework for cooperation and clear roles and responsibilities in the management of TWW for reuse and its related infrastructure. Under this framework, ONAS has committed to ensure that the TWW upstream of the storage basin is of good quality, the CRDA draws up a contract with the GDA for its supply of TWW, and the GDA, manages the tertiary treatment structures and establishes a subscription contract with the three partner farmers of the pilot. This is currently taking place at the pilot level. In addition, the National Agronomic Institute of Tunisia is invited to operate the water quality control laboratory built on the pilot site, thus allowing collaboration with master's students interested in advancing the subject of reuse in Tunisia. This was an important milestone as coordination among these stakeholders had been historically difficult, hindering an effective approach to TWW reuse and it represents a model to inform other reuse initiatives. In addition, the pilot has served as a springboard to develop the terms of reference and initiate the discussion for Tunisia's future Water Reuse 2050 Master Plan which is currently under preparation.

³⁷ In contrast with the pre and post-2014 restructuring indicators, the 2016 indicator measured TWW made available through an agreement for future reuse specifically from the Hissiene basin. It did not include the TWW pumped at the CRDA station.

³⁸ Funding has been secured by the Tunis Bay Project Company but the construction has been delayed until a legal land issue for the location of the tertiary treatment plant is solved. There is commitment on both parties to solve this issue as soon as possible.

³⁹ Information provided by the Tunis Bay Executive Director during the ICR mission.

⁴⁰ <http://lasaisonbleue.com/actualites/pour-une-mer-plus-propre-dans-le-golfe-de-tunis/>

⁴¹ <https://www.sidiamor.org/documentation/>

⁴² Data provided by ONAS on their qualitative and quantitative evaluation report from August 2021.

Table 7 Average values for TWW at the exit of the treatment station at the Sidi Amor pilot (August 2021)

Water Quality Parameter	Tunisian standard NT 106.03	At exit of treatment station Sidi Amor ^a	Target achievement
Biological Oxygen Demand (BOD ₅ mgO ₂ /L)	<30	9	Achieved
Chemical Oxygen Demand (COD mgO ₂ /L)	<90	50	Achieved
Suspended Solids (SS mg/L)	<30	11	Achieved

^a Data from ONAS' water quality campaign of August 2021.

53. **Rating:** The Project has had an important impact in advancing institutional dialogue and coordination for TWW reuse and in improving the overall quality of TWW for reuse however, based on the negligible achievement of pre-restructuring quantity targets, modest achievement of post-2014 restructuring quantity targets and modest achievement of post 2016 AF quantity targets, the rating for PDO 3 is **Modest**.

Justification of Overall Efficacy Rating

54. Given that the PDO and associated indicators and targets were adjusted over the course of implementation, a split evaluation for each PDO was carried out (see Table 10 below). Based on the Project's overall substantial achievement of the PDO pre- and post- restructurings, the ICR Team rates overall efficacy as **Substantial**.

C. EFFICIENCY

55. **Economic analysis.** The economic analysis shows that the Project remains economically justified as it yields a net present value (NPV) of about TND 172 million (2021 TND) over 25 years with an 8 percent discount rate, and an economic rate of return (ERR) of 15.2 percent, which is consistent with ERR at appraisal (15.8 percent in the base case scenario). This ERR is a satisfactory value for an environmental project which also generates many positive externalities which have not been accounted for in the calculations. Annex 4 includes the detailed economic and financial analysis carried out for this ICR. Six types of benefits have been quantified as shown in Table 8:

Table 8 Project benefits

Type of benefit
Benefits from reuse of TWW in agriculture. At appraisal, farmers at Borj Touil received low-quality TWW for irrigated crop production, with the majority relying instead on rainfed agriculture. Rainfall variability affects soil water availability to crops, and thus poses production risks to agriculture. At completion, the improved availability of TWW, as presented in the <i>Efficacy section</i> , are expected to lead to direct improvements in agricultural production at Borj Touil due to the higher consumption of better-quality TWW and hence, a reduced dependence on rainfall (considering that the crop pattern, level of intensification and soil fertility remain the same, i.e. without rehabilitation of the irrigation systems). At completion, there are over 500 farmers, growing a mix of corn, sorghum, millet, alfalfa, and olive trees, who stand to benefit from the increased reliability and quality of the TWW.
Benefits to local tourism. At appraisal Raoued beach was labeled as contaminated with local tourists preferring to travel to other distant beach areas for bathing. This resulted in additional transportation costs for local residents and added energy consumption and emissions of CO ₂ in the atmosphere. At completion, sea water quality at Raoued has significantly improved as shown in <i>Efficacy section</i> and in 2020 and 2021, Tunisian health authorities authorized swimming activities in the Raoued beach for the first time in years. This is expected to result in the local population benefitting from less costs associated with the traveling to distant areas in Tunisia to enjoy bathing activities, as well as less costs to the environment associated with avoided CO ₂ emissions.
Benefits to international tourism. At appraisal, the touristic North Tunis area at Gammarth, in the vicinity of the Raoued beach, catered mainly to foreign tourists visiting Tunis for business or sightseeing, but many of these spend only a few days in Northern Tunis. As a result of the sea water quality improvements at Raoued, the area is expected to experience an increase in the average number of days spent by foreign tourists. At completion, COVID-19 has caused a significant downturn in international tourism, however during implementation the average number of days spent by foreign tourists in the area was on the rise.
Benefits for fisheries. At appraisal, marine pollution was affecting fisheries production in Tunisia, with the volume and values of



catches gradually decreasing in the most polluted areas, while it was going up in the rest of the coast. In 2016, the loss of production at Raoued due to marine pollution was evaluated by looking at the difference between the production in the Raoued area and the Kalaat El Andalous area which is similar in size and type of fishing, but was not polluted by the TWW discharge. The difference in production and sales between the two areas was approximately 40 percent less on average in Raoued. With the improvements in sea water quality presented in the *Efficacy section*, fisheries at Raoued are expected to reach a similar production level as fisheries at Kalaat El Andalous, with important positive effects on their income and livelihoods.

Benefits for public health. Benefits derived from a reduction in public health hazards are difficult to estimate in the absence of epidemiological data and given the multiplicity of diseases (diarrhea, skin and respiratory diseases) potentially affecting the population who previously lived in the vicinity of the open-channel transporting contaminated TWW and nearby the polluted Raoued beach. The Project stands to decrease public health hazards in this localized setting through the achieved improvements in seawater quality and the replacement of the open-air channel with an underground TWW transmission pipeline. These benefits are important given the size of the population concerned (60,000 people), a large proportion of them being low-income families.

Benefits for real estate values. Although difficult to estimate since real estate values are driven by many factors, at appraisal the Raoued area was affected by contaminated TWW nuisances (odors and contamination risks) which made the area less attractive to live in, lowering property values and making it less attractive for further developments. At the time, real estate value in the Raoued beach stood at 100-150 TND per m², compared to 400-550 TND per m² in other nearby beach areas (e.g. La Marsa). At completion, with COVID-19 affecting various aspects of the economy in Tunisia, the full impact on real estate values cannot yet be measured. However, since the environmental nuisances described before have been eliminated, this is expected to drive an increased willingness-to-pay for real state in the area.

56. **Financial analysis.** The sustainability of the Project benefits relies on the continued improvement of ONAS's broader financial performance. ONAS has a long operational track record and adequate financial management arrangements. A financial assessment of ONAS based on audited financial accounts for the period 2012-2020 was developed which considered key operational and financial indicators. The review of audited financial statements of ONAS show that ONAS has covered an average of 70 percent of its operating expenses through tariffs in the last 10 years, which is a similar rate to other comparable utilities in the region. Full cost recovery is reached through the Government's commitment to cover the remaining operating deficit through an annual transfer of funds. There is no reason to expect a change in government support to ONAS in years to come, given the high priority set to sanitation and wastewater reuse. In addition, tariff increases were approved in 2018, aimed at ensuring that ONAS can cover 100 percent of its O&M by 2029. Annual increases of 11 percent from 2022 to 2025 and 6.3 percent annually from 2025 to 2029 are currently under review by the government. In addition, the Project has financed a joint ONAS-SONEDE customer and billing system which is modernizing the revenue collection system for both the water supply and wastewater supply and has improved the billing efficiency of ONAS (see more in *Institutional strengthening* section). Based on these factors, ONAS is expected to continue having the ability to manage and operate a project of this size and scale in the future. However, consistent application of the tariff increases will be needed to ensure full cost recovery in the future.

Administrative efficiency

57. **Project costs.** The Project's original scope of activities and some additional technical assistance activities were implemented at a cost of US\$6.79 million less than expected at appraisal. The total Project cost at appraisal was estimated at US\$60.8 million (excluding taxes). At closing, the total cost of the original activities (including some studies and technical assistance added in the restructurings of 2014 and 2016), stand at US\$53.24 million. The activities added as part of the 2019 restructuring amount to a cost of additional US\$13 million (excluding taxes). The added activities, importantly included the upstream portion (*Segment 1*) of the TWW transfer infrastructure which ONAS could no longer commit to co-finance with the EIB, as originally envisioned, and which was instrumental for achieving the PDOs. Other key activities added to the scope included urgent repairs and rehabilitation works on the WWTPs and wastewater pumping stations of the Northern Tunis Wastewater Treatment system. At closing, the total cost of original and additional activities added to the Project scope stands at US\$66.24 million. Summary presented in Table 9.



Table 9 Summary of US\$ Costs at Appraisal and ICR

Estimated cost at appraisal	Actual cost of original Project scope	Actual cost of activities added to Project scope in 2019	Total actual Project cost
US\$60.8 million	US\$53.24 million	US\$13 million	US\$66.24 million

Note: The costs presented in this table exclude taxes which are paid with counterpart funds.

58. **Implementation timeline.** The Project’s closing date was extended three times, leading to an overall implementation timeline of 11 years. This includes the 1.5-year closing date extension needed for the additional infrastructure added to the Project scope in 2019. Hence the original Project scope was implemented in about 9 years as all original activities had been completed in August 2019. As mentioned in the *Key Factors That Affected Implementation Section*, several factors were cause for delays in Project implementation. In particular, the Arab Spring of 2011 had a dramatic effect in the initial years of implementation, causing political and institutional instability which paralyzed implementation for the first 2 years. The Arab Spring also had trickle-down repercussions in the tightening of national procurement systems in the country leading to the duplication of procurement reviews as explained in paragraph 74 which, in part, were cause of delays in the bidding of the submarine outfall. Procurement processes related to the inclusion of activities in the 2019 restructuring were lengthy as explained in paragraph 80 which delayed the processing of the restructuring paper. An analysis of contract implementation lengths (from signature to work completion) at implementation versus original estimates show that some contracts experienced delays during implementation. At closing, 100 percent of the loan and grant had been disbursed.

Rating

59. As presented above, the Project has managed to substantially achieve its intended outcomes with important benefits as a result. Benefits are expected to be maintained as ONAS has the capacity to operate and manage infrastructure of this scale. Approved tariff increases and the utilization of the joint ONAS-SONEDE commercial system are expected to increase ONAS future efficiency in the sector, but these are pending full implementation. The original scope of activities at appraisal were implemented at a lower US\$ cost than expected. The accumulated balance in US\$ due to the deterioration of the Tunisian Dinar was used to add infrastructure which was key for PDO achievement, and all Project funds have been fully disbursed. However, the Project’s implementation timeline was lengthy, even discounting the 1.5-year extension needed for the realization of the additional activities included in 2019. Although, part of the delays can be explained by the political and economic instability that the country went through after the Arab Spring, various delays, particularly for the contract of the submarine outfall, warrant an efficiency rating of **Modest**.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

Table 10. Split evaluation

	<i>Pre-restructuring (May 2010 to May 2014)</i>	<i>Post- 2014 Restructuring 1 (May 2014 to August 2016)</i>	<i>Post 2016 AF (August 2016 to Closure)</i>
Relevance	High	High	High
Efficacy (rounded PDOs average)	Substantial (3)	Substantial (3.3)	Substantial (3.3)
PDO 1	High (4)	High (4)	High (4)
PDO 2	High (4)	High (4)	High (4)
PDO 3	Negligible (1)	Modest (2)	Modest (2)
Efficiency	Modest	Modest	Modest
Overall Rating (6-scale)*	4	4	4



Weight (% disbursed before/after PDO change)	5.2% (US\$3.41 million disbursed)	17.2% (US\$11.44 million disbursed)	77.6% (US\$51.39 million disbursed)
Weighted value	0.208	0.688	3.104
Rounded score	4		
Final rating (rounded)	Moderately Satisfactory		

60. Based on the above split evaluation and weighted ratings for achievement of the Project Objectives, Relevance and Efficiency, the overall outcome is considered **Moderately Satisfactory**.

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

Institutional Strengthening

61. The Project has financed a joint SONEDE-ONAS IT billing system which is playing a critical role in modernizing the outdated revenue collection system (dating from the 1980s) of both the water supply and wastewater sectors, and thus helping strengthen their financial sustainability to maintain service provision and sustain the achievements under the PDOs. Before the installation of this new commercial system, ONAS depended on SONEDE to provide the figures and balances related to sanitation fees, which represent the main component of ONAS’ income statement and which were often received with significant delays and thus constrained its cashflow. In the past, this delay represented a cost to ONAS of TND 600,000 per year.⁴³ Now, ONAS receives its billing data instantly and is able to make changes directly to its customer data base. The project has also financed the modernization of ONAS’s IT systems, including its Geographical Information Systems (GIS), SCADA,⁴⁴ data center⁴⁵ and internal messaging systems. The modernization of these systems is enabling ONAS a better and more secure remote management of wastewater treatment and collection processes. This is allowing ONAS to capture and understand operational information rapidly in order to make swift and informed decisions to enhance their operational efficiency.

62. Further, the design and construction of the submarine outfall was innovative and the first of its kind at the time in Tunisia which directly increased ONAS experience in the management of this type of complex infrastructure, while following best practice, like the inclusion of hydrodynamic modelling to improve its design and the set-up of a comprehensive water quality monitoring system. Following this experience, the Project has financed the design of a similar submarine outfall to safely discharge the TWW generated in the South of Tunis, whose implementation is expected to benefit from ONAS improved capacity for the management of this type of infrastructure.

63. As detailed in paragraph 52, the Sidi Amor pilot is also playing a key role in strengthening coordination mechanisms among stakeholders along the reuse value chain.

Gender

64. The Project was not gender tagged, however the indirect effects of the increased tourism in the area are expected to provide future opportunities for entrepreneurship, for which the youth and women are particularly suited. Women account for 35 percent of the hotel workforce in Tunisia’s north governorates, which is higher than the national employment rate for women (26 percent).⁴⁶ Although there is no information on the breakdown of how many of the

⁴³ As informed by ONAS during the ICR mission.

⁴⁴ Supervisory Control and Data Acquisition. SCADA is a computer-based system for gathering and analyzing real-time data to monitor and control equipment that deals with critical and time-sensitive materials or events.

⁴⁵ The Data Center contains an integrated system that will allow ONAS to store its computer data in good security conditions in accordance with the standards in force.

⁴⁶ https://www.etf.europa.eu/sites/default/files/m/300DD6D021DB90FC125797C0040FD1C_Women%20%26%20work_Tunisia_EN.pdf



farmers at Borj Touil are women, there are no identified constraints to their participation in the benefits of the Project. Under the reuse pilot, a workshop specifically directed at women from the rural areas of Sidi Thabet was organized in July 2018 to showcase the preparation and commercialization of artisanal products that could be developed from crops irrigated with TWW at Sidi Amor (See picture A8.10 in Annex 8).⁴⁷ The Sidi Amor Pilot has generated interest among university and high school students. Several master's and engineering school students have done internships and end-of-study research projects either on the plots or on the pilot WWTP. Many middle and high school students visited and participated in workshops related to the WWTP. According to the GDA Sidi Amor, the majority of the visiting academics and schools are women (70 percent).

Mobilizing Private Sector Financing

65. The Project provided a platform to discuss with ONAS options for the future mobilization of private capital through public-private partnerships options to achieve its sanitation objectives and indirectly supported the preparation of the Tunisia Sanitation PPP Support Project (P162957). In addition, it financed the study for the design of the El Hissiene WWTP which will be developed under a Build-Operate-Transfer model, in which a private sector partner will be responsible for the design, building and operation of the WWTP (during the contracted period) and then transfer back the infrastructure to ONAS. The improved environmental conditions at the Raoued beach are expected to result in improved economic opportunities for local private sector development, including the opening of restaurants, hotels, water recreational activities, etc. resulting from an increased incidence of local and international tourism in the area. In addition, ONAS' efforts to modernize its financial system through the ONAS-SONEDE billing system, complemented by the approved tariff increases, are expected to contribute to their future sustainability and credit-worthiness, making them better suited to attract private capital.

Poverty Reduction and Shared Prosperity

66. The Project is enabling better economic opportunities and touristic development at the Raoued beach due to the improvements of sea water quality. Benefits for local tourism are important, allowing lower-income households save on transportation costs to enjoy recreational activities nearby rather than in more distant beaches. In addition, benefits from international tourism are expected to boost local economies. The project is also expected to increase revenues from fisheries due to the overall improvement in marine biotopes. In addition, it is having a positive impact on the livelihoods of farmers at the Borj Touil irrigation perimeter through the provision of good quality TWW for reuse.

Climate change adaptation

67. The Project is increasing the availability of non-conventional water resources to meet Tunisia's water demands in the future, thereby increasing its water security and resilience to climate change effects. The infrastructure constructed under the Project and the technical assistance activities geared towards encouraging TWW reuse is an important aspect to foster efficient management and conservation of water in a scarcity context, and is a key component of Tunisia's climate adaptation strategy. The Project is also contributing to reduced CO2 emissions by allowing shorter travel distances and less transportation costs from the local population to the nearby Raoued beach, as opposed to further beaches.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

68. The Project responded to the strategic needs identified in the Government's National Program for Wastewater Reuse as well as the FY10-13 Country Partnership Strategy. It also complemented on-going Bank financed activities including the PISEAU II and the Tunis West Sewerage Project. Given the swiftness with which the Government wanted to

⁴⁷ <https://www.sidiamor.org/workshop-vers-le-developpement-integre-du-paysage-de-sidi-amor/>



move forward and to not lose the window of opportunity, the Project was prepared in a total of seven months from Concept Note to approval by the Executive Board of Directors. For this short-preparation time, the team requested, and was granted, a waiver to perform a Quality Enhancement Review meeting before the Decision meeting,⁴⁸ but an informal review was carried out instead to maintain the technical quality of the operation. Preliminary designs for underground infrastructure and the submarine outfall had already been prepared by ONAS in 2009, and the land for the regulation basin had already been identified though not secured, which meant that final designs still needed to be prepared for bidding processes. Hence, the Project had a moderate level of readiness before the start of implementation.

69. The preparation team correctly identified ONAS's limited capacity in the implementation of a submarine outfall of this scale, hence, the Project included international consulting services to perform a detailed review of the existing preliminary design. The review showcased that the complexity of the submarine outfall had been underestimated and it required additional hydrodynamic modelling expertise. The Bank team proactively worked with ONAS to ensure that the hydrodynamic modelling took place at the highest standard. Although this led to delays in the preparation of the bidding documents for the submarine outfall during implementation, it ultimately paid off as it improved the quality of the technical design and ensured adequate dispersion and dilution of the TWW at the outfall's discharge point.

70. Investments for the rehabilitation and extension of the Borj Touil irrigation perimeter had been originally included in the Project at PCN stage under Component 2. However, following the Government of Tunisia's request for such investments to be implemented separately through another project with the MARHP, these were removed from the Project at the Decision Meeting before appraisal. The decision simplified the Project design as it reduced the number of implementing agencies to only one – ONAS - and removed several design and potential safeguards issues related to the expansion of the irrigation perimeter. It also modified the scope of the reuse component of the Project as the focus was shifted to the bulk supply portion of the reuse infrastructure. The final PAD PDO correctly reflected this new level of ambition and committed to only increasing the availability of TWW for reuse, rather than ensuring its actual consumption. Although Project indicators were revised from Project Concept Note to Appraisal stage to reflect these changes, one of the GEO related outcome indicators still measured actual consumption in response to GEF financing requirements, even though this was outside of what was achievable under the new Project design.

71. The PAD identified several critical technical risks to achieving the PDO, including potential delays in the construction of the first segment of the TWW double pipeline from the Choutrana Wastewater treatment center to the Ariana CRDA pumping station, originally to be financed by the EIB and counterpart funds; potential delays in the investments for the upstream reuse infrastructure and the rehabilitation and expansion of the Borj Touil irrigation perimeter; potential insufficient quality of the TWW, lower than expected farmers demand for TWW and financial sustainability of ONAS to maintain the infrastructure. The risks were rated between low and moderate after mitigation measures, which heavily relied on the pressure the government had to deliver on the Presidential program for Wastewater Treatment and Reuse, and on ONAS's capacity to coordinate the timely implementation of different activities. The team could not have foreseen the historical events of early 2011 leading to the Arab Spring, which ultimately affected the government's political stability with direct impacts on Project implementation.

B. KEY FACTORS DURING IMPLEMENTATION

(i) Factors Outside the Control of the Government/Implementing Entities

72. The Project was approved a few months before the historical events of the 2011 Arab Spring. The revolution brought about significant shifts in the country's political economy, governance, socio-economic development priorities, and worsening security situation. A direct result was a delay in the Project's declaration of effectiveness (10 months after

⁴⁸ Due to the tight preparation timeline and relative simplicity of the Project.



Board approval) and an implementation standstill in the early stages. The earliest contract for the terrestrial portion of the works was signed about two years after initially planned, delaying the installation of the transfer pipelines.⁴⁹

73. The 2011 historical events also caused delays in the expropriation declaration of the plot of land where the regulation basin was constructed. Following Bank safeguard procedures, ONAS requested the expropriation in 2011 but the expropriation decree was only signed in October 2012.⁵⁰ In May 2013, ONAS requested the land possession to the judicial authority. Despite ONAS' follow-up efforts and following a recess of the judicial staff, the authorization to take possession of the land only took place in May 2014, delaying the works for the construction of the basin.

74. Following the 2011 Arab Spring, public institutions showcased an increased risk awareness to corruption in Tunisia which slowed down decision making. Some of the significant delays in project implementation were partly related to the duplication of procurement procedures and the multiplication of procurement review committees. In fact, in the course of 2013, each procurement package for the ground portion of the investments was examined by the ONAS Procurement Commission Permanent Secretariat,⁵¹ the Departmental Commission of the Ministry of Equipment and Environment⁵² and the High Commission for Public Contracts⁵³ (HCPC). These procedures were superimposed on the a priori reviews carried out by the World Bank. In 2015, a major disagreement emerged between the HCPC and the Bank's award recommendation on the evaluation of the two bids received for the submarine outfall. ONAS had asked the Bank for clarification on the interpretation of a procurement rule during their evaluation of the bids, but Bank procurement management did not intervene until the submission of the final bid report. Because ONAS' own interpretation on the rule was different to the Bank's guidance, their award recommendation had to be reversed. This caused various delays in the process as a consensus had to be sought between ONAS, the HCPC and the Bank procurement management. After a lengthy process, the Borrower reversed its position and recommended the award consistent with Bank's policy. This significantly delayed the signature of the contract to May 2016.

75. The COVID-19 pandemic did not have a strong effect on the implementation of works as the only on-going, and well-advanced works contract was the installation of the double pipeline for *Segment 1*. However, the pandemic did affect ongoing procurement processes for the rehabilitation of the pumping stations, acquisition of vehicles, IT equipment, etc., because the evaluation committee and the ONAS Board of Directors were unable to meet for a length of time. It also delayed the engineering design of the southern submarine outfall.

76. Other factors delaying project implementation included the one-month strike of judges in November 2020, that deferred the audience with the judicial authority for the resettlement compensation issue (see paragraph 88), and the two-month strike of engineers in April 2021, that delayed the review of output produced by engineering consultants and the processing of payments for ongoing works and engineering services.

(ii) Factors Subject to the Control of the Government/Implementing Entities

77. Following the Project's MTR in 2014, ONAS intensified its efforts and initiated recovery actions on all fronts to make up for start-up delays. In particular, ONAS substantially reinforced its implementation team, and strived to finalize the bidding of all contracts for works and technical assistance for the ground portion of the Project on one hand, and quickly finalized the bidding documents for works and technical assistance for the marine portion of the Project on the other hand.

⁴⁹ Some of the delay was also caused by plans to widen the roads where the pipes were to be laid down (double the road from Raoued to Kalaat El Andalous, to make it an expressway). This required an update to the pipe transfer design and approval by the Ministry of Equipment which further delayed project implementation.

⁵⁰ Despite the delay, this was a major achievement as it was part of the first decrees to signed by the new administration, more than a year and a half after the events of 2011.

⁵¹ Secrétariat Permanent de la Commission des Marchés de l'ONAS

⁵² Commission Départementale du Ministère de l'Équipement et de l'Environnement

⁵³ Commission Supérieure des Marchés



This was an important achievement, given the complexity of the infrastructure and the country context at the time. The Bank team proved to be a reliable partner through-out the process, showing proactive action through the Project restructurings and mobilizing technical assistance when needed.

78. Though ONAS' mandate only focuses on the bulk supply of TWW for reuse (the upstream portion of the reuse chain), the reuse component could have benefitted from a better coordination with the MARHP for a stronger impact. Although the pilot at Sidi Amor is a successful example of what can be achieved through a coordinated effort for TWW reuse, ONAS showed weak ownership of the reuse component and struggled in advancing these efforts during Project implementation. The Bank team mobilized various grant resources to increase cooperation, for instance through the organization of a national conference on reuse of TWW, two study tours to Spain and Jordan in 2017 with representatives of 8 different government agencies, and site visits to GDAs, which contributed to the success of the reuse pilot.

79. Other key aspects that influenced the different Project's restructurings and AF were explained in *Rationale for Changes and Their Implication on the Original Theory of Change*.

(iii) Factors Subject to the Control of the World Bank

80. Bank's supervision efforts and Bank Management involvement were adequate though some procurement related aspects could have been handled better. The procurement process for the submarine outfall was lengthy as mentioned in paragraph 74. Further, the 2019 restructuring added the financing of the upstream segment of the transfer infrastructure that was originally meant to be funded with ONAS' and EIB resources. The process was slow on the Bank's side as it required the inclusion of two EIB-procured contracts that did not follow standard World Bank procurement guidelines, nor had they used standard bidding documents. The process required extensive ex-post due diligence, EIB approval and ONAS' providers acceptance of required amendments to the contracts to align them with World Bank regulations, amendments to the E&S safeguards documents, RSA approval and consultations.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

81. The Project's implied TOC had mostly clear linkages between the activities, outputs, intermediate outcomes and the PDO, except for the GEO indicator related to the consumption of TWW for reuse whose achievement depended on the realization of the parallel MARHP project. However, this indicator was a pre-requisite to maintain the GEF financing, and thus it was kept as part of the RF. Though one PDO indicator was too output-focused, it was later downgraded to an intermediate indicator. As per the project's M&E system design, ONAS had the responsibility for collecting all Project indicator related data. The RF further elaborated the data sources; the data collection methodology and responsibilities, including some definitions of the Project indicators. In addition to the RF, as part of the Environmental and Social Management Plan (ESMP), the Project also established a well-functioning and comprehensive M&E system to monitor dispersion and dilution through water quality monitoring in the Bay of Tunis at the surrounding of the outfall, which was a first in Tunisia (previous measurements were only made on the shore by the Health Ministry). The ESMP included detailed provisions for the monitoring of additional parameters to measure TWW quality, sea water quality and ecology, as well as the quality of operation of the infrastructure.



M&E Implementation

82. The Project team and ONAS reviewed the status of all indicators for the Project Implementation Status and Results (ISRs) reports, however, most of the chosen indicators could only be monitored once all infrastructure had been constructed, which is typical for this type of infrastructure projects. This limited the utilization of the project's M&E during the first half of project implementation. However, as part of the ESMP, ONAS, through the contracting of a specialized firm, performed extensive sea water quality monitoring campaigns lasting between 7 to 9 months, across 18 sampling points before the construction (2015), during the construction (2017-2018) and after (2019-2020) the commissioning of the submarine outfall (see Annex 7, Map A7.2). ONAS implemented the provisions of the ESMP in a satisfactory manner, and the sea water quality campaigns were thorough and timely and have been adequate to measure the Project achievements related to the submarine outfall. ONAS also collected the data related to the quality of TWW at different points of the transfer infrastructure which were a useful monitoring tool once the infrastructure was fully operational (June 2021). Monitoring of the reuse indicators required an additional coordination effort with the CRDA and GDA which were carried out once the reuse pilot was running and for Project closing. ONAS regularly reported on Project implementation through their semi-annual progress report.

83. Project restructurings sought to improve the quality of the RF by simplifying the number of indicators, including better definitions more directly aligned with the PDO, detailed information on data sources and methodology, and monitoring and evaluation criteria. Once the MARHP project was dropped, the PDO was adjusted and the reuse indicator was restructured to account for the reduction in the Project's scope. There were some shortcomings related to the baseline data for the sea water quality indicators, which were not updated in the RF once the results of the quality campaigns had been realized, and the intermediate indicator introduced in the 2019 restructuring was not revised to reflect the actual scope of the envisioned works.

M&E Utilization

84. ONAS utilized a number of tools to monitor implementation progress and guide decision making, namely direct contract follow-up and management, the provisions of the ESMP for the sea water quality campaigns and their own procedures for TWW quality campaigns in the infrastructure they managed. This was done to counter the limitation of the RF, which was a useful monitoring tool once the infrastructure was fully operational. Because the sea water quality campaigns are expensive and require extensive effort, it is unlikely that ONAS will be able to continue this arrangement on their own, and instead will rely on the Ministry of Health's quality control campaigns. ONAS will continue monitoring TWW quality at different points of the transfer infrastructure as part of their normal operational procedures.

Justification of Overall Rating of Quality of M&E

85. The Project's M&E system design has been sufficient to adequately evaluate the outcomes of the Project. Thorough and complex sea water quality campaigns were carried out and TWW quality campaigns were performed by ONAS as established in the provisions established in the PAD. Limitations in the RF due to some indicators could only be measured after all infrastructure was constructed were compensated by ONAS direct contract monitoring and follow-up. Though some baseline data and targets were not updated in the later stages of implementation, the RF was proactively adjusted to respond to changes during implementation (adjustments to the PDO and PDO indicators, inclusion of better indicators and definitions). ONAS has a plan to continue monitoring the Project results (rely on sea water quality monitoring from the Ministry of Health and their own operational procedures for TWW quality). Due to these factors, the assigned M&E quality rating is **Substantial**.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

86. **Environmental and social safeguards compliance.** The Project was designated as **Category A** due to the potential negative impacts related to the nature and size of proposed works, the complexity of their implementation, the nature



and quantity of treated wastewater (70 million m³/year) involved, and the project influence area that goes beyond the location of the outfall into the Gulf of Tunis. The safeguard policies triggered at Project design were Environmental Assessment (OP/BP 4.01), and Involuntary Resettlement (OP/BP 4.12). Subsequent restructurings did not trigger new safeguard policies or change safeguard categories.

87. In compliance with **OP 4.01**, ONAS prepared an Environmental and Social Impact Assessment that was regularly updated and publicly disclosed to reflect changes related to the relevant project restructurings, the dispersion modeling studies for the submarine outfall and the inclusion of a grievance redress mechanism. Environmental and Social Management Plans were prepared for the various Project investments, and their provisions were in the most part adequately implemented throughout the Project's lifetime.⁵⁴

88. In compliance with **OP 4.12**, ONAS prepared a Land Acquisition Plan (LAP) which foresaw the acquisition of a total of about 9 ha of private land for the construction of the storage and regulation basin and the associated pumping station. The private land belonged to 158 co-owners,⁵⁵ had no productive uses and it was not divided into individual or identifiable plots. The Project did not require any resettlement of persons or production sites and was not considered to carry any risks in terms of income or livelihood losses for affected farmers or anyone else. The expropriation process followed the LAP provisions and there were no compliance issues. However, as mentioned under "*Key factors during implementation*", the expropriation process was significantly delayed until May 2014 due to reasons beyond ONAS's control. The Project closed with an unresolved issue related to the compensation of two plot owners of the land where the basin was constructed. As of October 2021, the two land-owners had not been compensated yet as the resolution of an ongoing title dispute is following due process, which has been slow due to the postponing of the court hearing a number of times. The full compensation amount is in escrow waiting for the final resolution of the case. The Bank safeguards team will continue monitoring this issue until its resolution.

89. **Financial Management (FM).** During preparation, the main FM risk identified was that the ONAS accounting system did not allow for the automatic generation of Interim Unaudited Financial Reports. After mitigation measures the residual risk was assessed as low. During implementation, the Project showed adequate FM arrangements since they allowed for the recording of all project's transactions and balances, supported the preparation of regular and reliable financial statements, and were subject to external auditing reviews which, in the most part, were found acceptable to the Bank after incorporation of comments. FM was mostly rated moderately satisfactory during Project implementation due to shortcomings in the timeliness of the submission of project financial and audit reports. However, the Project closed with no overdue audit nor interim financial reports.

90. **Procurement.** Main Project procurement issues are explained in paragraphs 74 and 80. Despite these issues, bidding processes and contract implementation were for the most part smooth and in compliance with Bank norms. The Project finished with a Moderately Satisfactory procurement rating due to a few on-going contracts beyond the Project's closing date. During the ICR mission, ONAS confirmed that the remaining payments will be performed using ONAS's own financial resources. The Bank will continue monitoring the final payment of ongoing contracts.

C. BANK PERFORMANCE

⁵⁴ Two issues that required particular follow-up from the Bank's safeguards team were related to ensuring workers safety for the terrestrial part of the works (laying of the pipes) and implementation of safety measures around the tertiary treatment plant at the Sidi Amor pilot.

⁵⁵ Expropriation Decree N° 2012-2453 dated October 10, 2012.



Quality at Entry

91. The project was relevant to the country and Bank priorities both at preparation and at closing. In terms of technical aspects, the removal of the rehabilitation of the irrigation system at Borj Touil simplified the Project design, while still allowing for the double objective of a safe disposal of TWW and increasing the availability of TWW for reuse. Although all investments were identified and preliminary designs had been prepared, Project readiness was moderate due to the short 7-month preparation timeline. Delivery within this short timeline, however, allowed the Bank to respond to the short window of opportunity for the realization of this Project. In addition, during this short period, the Bank team prioritized efforts to convince the client to include detailed hydrodynamic modelling, which ensured the design of the submarine outfall would be consistent with international best practices. It also ensured that a detailed plan for sea water quality monitoring would be established. These two activities were important for assessing and finally achieving the intended outcomes for the submarine outfall.

92. Economically, the Project made sense, with an Internal Rate of Return of 15.8 percent. On the Environmental and Social systems, and Fiduciary aspects, the project had been designed with suitable policy application, compliance procedures and risk mitigation measures as stated in Section IV B. With respect to project implementation arrangements, deciding to implement the Project directly through ONAS' own technical, financial, legal and administrative departments rather than through a Project Implementing Unit, allowed for the continued strengthening of ONAS's capacity for better wastewater management in the country. On *M&E* system design's adequacy, refer Section IV A. On *Risks* consideration and mitigation measures, see paragraph 71.

Quality of Supervision

93. The World Bank team provided good supervision throughout Project implementation, regularly providing guidance on implementation constraints and helping to design appropriate solutions. A total of 23 Implementation Support missions (ISMs) were conducted by the World Bank during implementation, as well as frequent technical and field visits. ISMs included relevant team members with different skills. The supervision team intensified its supervision efforts during the critical years of 2013 and 2014, averaging four ISMs per year, including a comprehensive MTR, which were critical for the Project's turn-around.⁵⁶ Bank teams sought proactively to bring about corrective measures through multiple restructurings to allow for a more effective implementation and maximize results particularly when viewed in the extremely challenging post-revolutionary context. For example, once the parallel irrigation project was dropped, the team focused on working with ONAS and MARHP counterparts to set up the Sidi Amor pilot even when there was little buy-in for the activity in the beginning. An AF was processed to finance the higher than estimated cost for the submarine outfall, which was the most important infrastructure for meeting the sea water quality objectives of the Project. The Bank team also accompanied the long process to set up the SONEDE-ONAS commercial system, a key institutional strengthening activity which was transferred from another project. The Bank team also proactively engaged with procurement management to find a suitable solution for the procurement issues of the submarine outfall and to include the EIB procured contract under the Project scope in 2019 which were essential for meeting the PDO.

94. The Aide Mémoires prepared at the end of each mission were informative, clear, and timely, and identified the issues that needed to be addressed before the next mission. Critical problems were identified as early as possible, adequately reflected in Project ratings and solutions were sought in close collaboration with the ONAS and World Bank management. There were four TTLs from preparation to completion and transitional arrangements were adequate. The Bank team facilitated knowledge exchange activities and mobilized expert technical support when needed. Fiduciary and safeguards support was provided from the Country Office, offering the opportunity for frequent interactions.

⁵⁶ Under normal circumstances, ISMs occur twice per year.



Justification of Overall Rating of Bank Performance

95. During preparation, the Bank team utilized the tight preparation timeline to prioritize key activities needed for the success of the Project, even if readiness of investments were moderate. During implementation, the Bank team proactively supported ONAS and sought solutions to implementation bottlenecks. The different restructurings were essential to substantially achieve the Project objectives. Because of this, and the other reasons outlined before, overall Bank performance is rated **Satisfactory**.

D. RISK TO DEVELOPMENT OUTCOME

96. As mentioned in paragraph 56, the sustainability of the Project relies on the continued improvement of ONAS's broader financial performance. ONAS has a long operational track record and adequate financial management arrangements. It has implemented a wide range of sanitation infrastructure projects funded by a variety of donors and financial partners. The overall revenue collection and financial performance of ONAS is expected to improve in the short to medium-term as a result of the roll out of the new ONAS-SONEDE joint commercial information system and measures to improve SOE performance envisaged under the Tunisia First Resilience budget support program. Full cost recovery is reached thanks to the Government's commitment to cover ONAS' operating deficit through an annual transfer of funds. This arrangement is expected to continue in the near future allowing ONAS to adequately manage and operate the infrastructure constructed under the Project. Further, tariff increases were approved in 2018, and additional tariff increases are being negotiated for 2022-2025 and 2025-2029. However, consistent application of the tariff increases will be needed to ensure full cost recovery.

97. The sustainability of the reuse component depends on wider reuse endeavors in the country. Currently, the MARHP is leading the preparation of Tunisia's future Water Reuse 2050 Master Plan.⁵⁷ The plan is being prepared through a participatory process which includes several relevant stakeholders, including ONAS. The plan will include a detailed diagnostic of the different uses for reuse, a market study, possible development scenarios and action plans for the short (2020-2025), medium (2026-2030) and long (2031-2050) term, including an investment plan. The infrastructure constructed under the Project is a key part considered in the preparation of the Master Plan.

V. LESSONS AND RECOMMENDATIONS

98. **Fostering coordination and cooperation, before focusing on institutional change, is key to achieve engagement and initial results for TWW reuse objectives.** TWW reuse is at the end point of a vertical value chain that spans various jurisdictions from ministries of environment, health and agriculture. It encompasses issues ranging from upstream industrial and solid waste pollution affecting the quality of the wastewater, the efficacy of the wastewater treatment system, the potential tense interface between the TWW provider (ONAS) and end users (CRDA and GDAs), the behavior and willingness of farmers to use TWW, regulatory and pricing issues and competition with other resources. The reuse pilot at Sidi Amor created a platform to bring the different stakeholders to the same table, initiate dialogue that would not naturally happen otherwise and foster formal cooperation mechanisms. At the national level, the pilot has served as a jumping board to start the discussions on the preparation of the National Water Reuse Plan 2050, led by the MARHP and which is engaging several stakeholders through a participatory process. Bank teams working in follow-up projects of a similar nature should consider the establishment of formal intersectoral committees for cooperation as key aspect of their design.

⁵⁷ The terms of reference for the preparation of the Master Plan were prepared through a Water Partnership Program grant, that was mobilized by the Bank team during the Project's implementation.



99. **Tackling marine pollution requires a holistic environmental remediation approach.** The submarine outfall addressed the main source of contamination at Raoued beach. However, coastal waters are the recipients of various sources of pollution whose control falls under different jurisdictions. In this case, achieving good environmental outcomes depend on each institution doing their intended function well (i.e. municipalities improving their stormwater and solid waste management, industries controlling their effluents, agriculture controlling fertilizer usage, etc.), and where cooperation may not be as necessary. Teams working on similar projects should consider multi-sectoral approaches for achieving these type of objectives.

100. **It pays off for Bank teams to focus on key activities needed for development impact.** This Project showcased how prioritizing a number of key activities in addition to the main infrastructure investments (hydrodynamic modelling, sea water quality monitoring system, Sidi Amor pilot, the SONEDE-ONAS commercial system, the inclusion of upstream infrastructure in the Project scope, etc), was key for the Project's success. Teams are encouraged to prioritize client and internal dialogue that allow the inclusion of activities with a clear development impact in the long-run.

101. **Preparation teams and Bank management need to balance Project readiness and pressure to deliver with extended implementation timelines.** The Project was prepared under a tight timeline to be able to respond to the Government's request. In retrospective, the decision to move quickly seems to have been the right one as the changing political condition could have resulted in the Project not being realized. However, this meant that Project readiness was only moderate which ultimately affected implementation timelines. Bank management and teams that ultimately choose for shorter preparation times need to account for extended implementation timelines to finalize designs and ensure their quality, particularly if experience with those types of investments is limited in the implementing agency.

102. **Implementing projects in rapidly deteriorating conflict and fragile environments requires proactive action, time and flexibility.** In situations of sudden conflict and fragility of governance, it pays off for project teams to intensify supervision efforts, assess implementation bottlenecks regularly and act early and as frequently as necessary to course correct implementation. When deciding whether or not to extend a Project (or how long to extend a project for), it is critical to take a holistic view of implementation issues. Without the different Project restructurings, closing date extensions and Bank procurement flexibility, PDO achievement would not have been possible and opportunities for additional benefits incorporated in the Project would have been lost.



ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: Provide an environmentally safe disposal system for the treated wastewater in the North of Tunis

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Direct project beneficiaries	Number	0.00	50000.00		60,000.00
		31-Dec-2010	16-Mar-2015		05-Feb-2021
Female beneficiaries	Percentage	0.00	50.00		49.00

Comments (achievements against targets):

The Project has met its intended direct beneficiaries target, which now stands at 60,000 people (49 percent female) when adjusted for the rapid population growth in the area (50,000 at appraisal). These include people from the municipalities of Raoued and Kalaat el Andalous, benefitting from improved environmental conditions along the TWW transfer line and at Raoued beach. This number also includes about 500 farmers and their families from the Borj Touil irrigation perimeter who are benefitting from improved TWW reliability and quality at the CDRA pumping station.

The reported number is based on estimates provided by ONAS during the ICR mission. The target was estimated based on census data for the Raoued and Kalaat el Andalous delegations which in 2014 had a total population of 133,210. ONAS carried out consultations with the local authorities and determined



that approximately 50,000 of the total would directly benefit from the infrastructure constructed under the Project. The current number reported by ONAS of 60,000 is higher as it accounts for the rapid population growth experienced in recent years in the area.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Percentage of seawater samples at Raoued Beach complying with imperative norms in total coliforms and fecal coliforms (respectively 10,000 TC/100ml and 2,000 FC/100ml).	Percentage	92.00 31-Dec-2015	90.00 10-Aug-2016		96.00 03-Aug-2020

Comments (achievements against targets):

The target for this indicator has been surpassed.

The baseline value presented here has been calculated by the ICR team based on the results of the 2015 sea water quality campaign performed before the commissioning of the outfall. The baseline value presented in the 2016 restructuring and which was monitored by the Project's RF until closing was 80 percent based on an estimate provided by the Ministry of Health's water quality campaigns as informed by the ONAS during the ICR mission. This explains the target set at 90 percent. During implementation, the baseline targets should have been revised once data from the seawater monitoring campaigns became available, but this was not done. In either case, the results show an important improvement in sea water quality against both baseline values and indicate that it is suitable for swimming.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
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Average annual count of fecal coliforms in seawater samples in the surrounding of the outfall	Number	164.00	2000.00		106.00
		31-Dec-2015	10-Aug-2016		03-Aug-2020

Comments (achievements against targets):

The target for this indicator has been met. The presented target value for this indicator is actually the upper limit of the imperative standard for the count of fecal coliforms per 100ml of sea water, not a value to be reached. Counts lower than this in the surrounding of the outfall indicate that submarine outfall is providing adequate dilution and dispersion of the TWW, therefore providing a safe disposal.

The baseline value presented in the 2016 restructuring and which was monitored by the RF, was 200 counts/100ml based on an estimate provided by the Ministry of Health’s water quality campaigns as informed by the ONAS during the ICR mission. The baseline presented here is calculated by the ICR team based on the results of the 2015 sea water quality campaign. The Bank team should have revised the baseline targets once data from the seawater monitoring campaigns became available, but this was not done. In any case, the achieved target presents a reduction in annual counts of fecal coliforms against both baselines.

Objective/Outcome: Increase availability of wastewater for its reuse

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Average annual volume of TWW made available to farmers, developers or municipalities in the vicinity of the Project	Cubic Meter(m3)	0.00	3000000.00		1,460,000.00
		31-Dec-2010	10-Aug-2016		13-Sep-2021

Comments (achievements against targets):



This indicator has been moderately achieved. The achieved value corresponds to the TWW to be made available for reuse at the green areas of the Tunis Bay City, as reflected into an agreement between the Tunis Bay Project Company and the ONAS to allow the reuse of an average of 4000m³/day from the El Hissiene reservoir.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Average annual concentration of suspended solids in TWW made available at the El Hissiene basin	Percentage	120.00 31-Dec-2015	30.00 10-Aug-2016		19.00 13-Sep-2021

Comments (achievements against targets):

The Project has fully met this target and represents a seven-fold reduction in SS in TWW for reuse from the baseline of 120mg/L.

A.2 Intermediate Results Indicators

Component: Part A: transfer of treated wastewater (TWW) to increase availability for its reuse

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Length of pipe installed	Meter(m)	0.00 31-Dec-2010	12000.00 19-Mar-2014	16,300.00 10-Dec-2019	16,300.00 13-Sep-2021



Comments (achievements against targets):

This indicator's target has been fully achieved against the 2019 restructuring target (16,300m) and exceeded the original target established in the PAD (12,000m). The target was revised to account for the additional works introduced in the 2019 restructuring. All of the terrestrial transfer pipeline have been installed and are operating as expected.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Average annual count of fecal coliforms in seawater samples at Raoued beach	Number	226.00 31-Dec-2015	100.00 10-Aug-2016		141.00 08-Feb-2021

Comments (achievements against targets):

This intermediate results indicator was achieved at 68 percent (reduction by 85 points *versus* a target of 126 point decrease) with an actual average count of 141FC/100ml vs 100FC/100ml target. This represents a significant reduction in FC at the beach itself and is well below the bathing water quality limits and effluent discharge standards of (<2000FC/100ml).

The baseline value presented in the 2016 restructuring and which was monitored by the Project's RF was higher at 450 counts/100ml based on an estimate provided by the Ministry of Health's water quality campaigns as informed by the ONAS during the ICR mission. The baseline presented here is calculated by the ICR team based on the results of the 2015 sea water quality campaign. The Bank team should have revised the baseline targets once data from the seawater monitoring campaigns became available, but this was not done. In any case, the achieved target presents an important reduction in annual counts of fecal coliforms against both baselines.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
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Number of WWTPs and pumping stations in the Northern Tunis system benefiting from equipment rehabilitation and maintenance	Number	0.00	6.00		1.00
		30-Oct-2019	10-Dec-2019		27-Sep-2021

Comments (achievements against targets):

The target for this indicator has been partially met. By October 2021, the Chatt Ghaba rehabilitation works had been completed and the station was under a testing period. The contract for the other two pumping stations at Montplaisir and Tunis Nord were advanced at 95 percent in December 2021 and are expected to be fully functional by January 2022. Remaining payments under the contract are being financed by ONAS’s own budget.

The target for this indicator (set in December 2019) include three WWTPs and pumping stations that were removed from the scope of this Project and transferred to the Tunisia Sanitation PPP Support Project (P162957), which is under preparation. This decision was taken to ensure consistency in the procurement packages that were bid under the PPP project, and reduce risks in implementation as these three pumping stations were part of the infrastructure to be operated by the private operator. The RF should have been revised to reflect this change but it was not formally processed.

These works will improve wastewater treatment performance and maintain pollutant concentrations in the effluent below applicable thresholds in the future, but are not essential for the achievement of the PDO 1 as the submarine outfall and transfer infrastructure are already ensuring a safe disposal of the TWW.

Component: Part B: improvement of the discharge of the remaining TWW in the Mediterranean Sea

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Average annual concentration of suspended solids in TWW	Microgram/m ³	120.00	30.00		11.00



made available at the Sidi Amor reuse pilot		31-Dec-2010	10-Aug-2016		13-Sep-2021
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Comments (achievements against targets):

This indicator has been fully achieved. The achieved quality values are well below the Tunisian norm NT106.03 for reuse thanks to the construction of the tertiary treatment plant constructed under the pilot (vegetated filter and maturation tank).

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Average annual concentration of suspended solids in TWW at the entry point of the transfer system	Microgram/m ³	120.00	30.00		26.00
		31-Dec-2010	10-Aug-2016		13-Sep-2021

Comments (achievements against targets):

This intermediate indicator has been fully achieved.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Percentage of TWW (not reused) from Northern Tunis WWTP discharged at the submarine outfall	Percentage	0.00	95.00		100.00
		31-Dec-2010	10-Aug-2016		10-Sep-2021



Comments (achievements against targets):

This indicator has been fully achieved.

Component: Part C: monitoring and capacity strengthening

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Grievances registered related to delivery of project benefits addressed (%)	Percentage	0.00 31-Dec-2010	75.00 10-Aug-2016		100.00 13-Sep-2021

Comments (achievements against targets):

This indicator has been fully achieved.



B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1 Provide an environmentally safe disposal system for the treated wastewater in the North of Tunis	
Outcome Indicators	<ol style="list-style-type: none"> 1. Direct project beneficiaries 2. Percentage of seawater samples at Raoued Beach complying with imperative norms in total coliforms and fecal coliforms (respectively 10,000 TC/100ml and 2,000 FC/100ml) 3. Average annual count of fecal coliforms in seawater samples in the surrounding of the outfall
Intermediate Results Indicators	<ol style="list-style-type: none"> 1. Length of pipe installed 2. Average annual count of fecal coliforms in seawater samples at Raoued beach 3. Number of WWTPs and pumping stations in the Northern Tunis system benefiting from equipment rehabilitation and maintenance 4. Percentage of TWW (not reused) from Northern Tunis WWTP discharged at the submarine outfall 5. Grievances registered related to delivery of project benefits addressed (%)
Key Outputs by Component (linked to the achievement of the Objective/Outcome 1)	<ol style="list-style-type: none"> 1. Construction of one 4.2 km pressure pipeline (1600mm of diameter) to convey TWW from the storage basin to the submarine outfall 2. Construction of a 6km submarine outfall (1600mm of diameter) 3. Construction of pumping station (civil engineering and equipment) at Choutrana WWTP, flow rate of $2 \times 3\text{m}^3/\text{s} = 6\text{m}^3/\text{s}$ 4. Rehabilitation of three pumping stations Chatt Ghaba, Montplaisir and Tunis Nord 5. Studies to review design of submarined outfall 6. Key studies for the design of wastewater infrastructure in Tunis



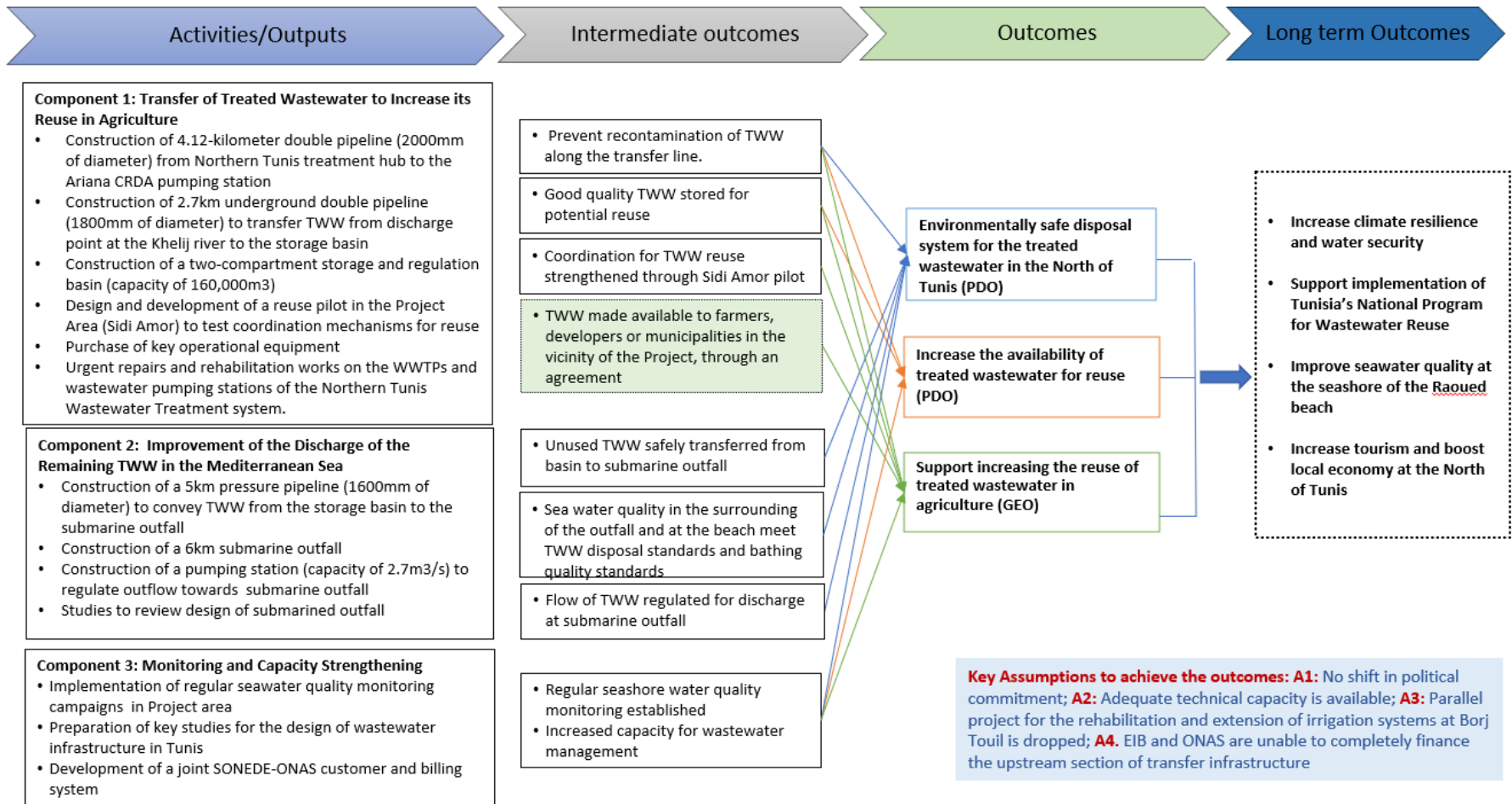
	7. Three sea water quality monitoring campaigns carried out at the beach and vicinity of submarine outfall
Objective/Outcome 2 Increase availability of treated wastewater for its reuse in the Project Area support	
Outcome Indicators	<ol style="list-style-type: none">1. Volume (m³) of TWW available for potential reuse in agriculture, measured at the storage basin2. Average annual concentration of suspended solids in TWW made available at the El Hissiene basin
Intermediate Results Indicators	<ol style="list-style-type: none">1. Average annual concentration of suspended solids in TWW at the entry point of the transfer system
Key Outputs by Component (linked to the achievement of the Objective/Outcome 2)	<ol style="list-style-type: none">1. Construction of 2.2 km double pipeline (1800mm of diameter) from discharge point to storage basin2. Construction of 4.12-kilometer double pipeline (2000mm of diameter) from Northern Tunis treatment hub to the Ariana CRDA pumping station3. Construction of a two-compartment storage and regulation basin (capacity of 160,000m³) covered with a geotextile - geomembrane complex, built over an area of 9.2 hectares4. Construction of a pumping station (capacity of 3 m³/s) to feed the outflow towards reuse infrastructure and to submarine outfall.5. Construction of vegetated filter and maturation tank at Sidi Amor reuse pilot.



Objective/Outcome 3 Support increasing actual reuse of TWW	
Outcome Indicators	<ol style="list-style-type: none">1. Average annual volume of TWW made available to farmers, developers or municipalities in the vicinity of the Project2. Volume (m³) of TWW consumed in the Borj Touil irrigation perimeter, as measured by ONAS and CRDA of Ariana
Intermediate Results Indicators	<ol style="list-style-type: none">1. Average annual concentration of suspended solids in TWW made available at the Sidi Amor reuse pilot
Key Outputs by Component (linked to the achievement of the Objective/Outcome 3)	<ol style="list-style-type: none">1. Construction of a vegetated filter and maturation tank, a pumping station, an irrigation system, a laboratory to analyze the TWW quality and a demonstration center at Sidi Amor reuse pilot.2. Signing of TWW reuse agreement between ONAS and Tunis Bay Project company for 4000m³/day



C. Revised Theory of Change (following restructurings)





ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Xavier Chauvot de Beauchene	Task Team Leader
Mohamed Benouahi	Team Member
Philippe Marin	Team Member
Jaafar Friaa	Team Member
Lene Lind	Social Specialist
Salim Benouniche	Procurement Specialist
Renée Desclaux	Finance Officer
Colin Scott	Social Specialist
Jean-Charles de Daruvar	Senior Counsel
Mohammed Bekhechi	Lead Counsel, Environment
Anas Abou El Mikias	Financial Management Specialist
Mohammed Larbi Khrouf	Consultant, Water Supply and Sanitation
Georges Khoury-Addad	Consultant, Implementation Specialist
Moez Makhoulf	Consultant, Financial Management
Slaheddine Ben-Halima	Consultant, Procurement Specialist
Mohamed Ghourabi	Consultant, Environmental Specialist/Safeguards
Supervision/ICR	
Zael Sanz Uriarte, Jean-Martin Brault, Richard Abdounour, Xavier Chauvot de Beauchene	Task Team Leader(s)
Abdoulaye Keita, Blandine Marie Wu Chebili, Jean-Jacques Verdeaux, Moustapha Ould el Bechir, Walid Dhoubi,	Procurement Specialist(s)
Mehdi El Batti, Ahmed Zouari, Shirley Foronda,	Financial Management Specialist
Claudine Kader	Team Assistant
Mohamed Larbi Khrouf	Consultant, Water and Sanitation Specialist
Antoine V. Lema	Social Specialist



Rahmoune Essalhi	Procurement Team
Andrianirina Michel Eric Ranjeva	Team Member
Elena Segura Labadia	Counsel
Mohamed Adnene Bezzaouia, Taoufiq Bennouna	Environmental Specialist(s)
Mehrez Chakchouk, Khalid Anouar	Consultant(s), Environmental Specialist
Moez Makhoulouf	Consultant, Financial Management
Elvira Broeks Motta	ICR Author
Derek Ensing	ICR Contributor, Efficiency Analysis

B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US\$ (including travel and consultant costs)
Preparation		
FY09	2.200	18,398.80
FY10	24.641	233,915.62
FY11	0	2,340.46
FY12	0	- 74.18
FY13	0	0.00
Total	26.84	254,580.70
Supervision/ICR		
FY11	7.260	41,533.81
FY12	5.225	38,154.16
FY13	7.190	58,481.54
FY14	13.488	143,563.95
FY15	14.275	140,267.07
FY16	35.475	305,282.74
FY17	17.844	333,994.74
FY18	20.391	463,261.11



FY19	14.844	96,117.17
FY20	23.167	163,010.89
Total	159.16	1,783,667.18



ANNEX 3. PROJECT COST BY COMPONENT

Components	Amount at Approval (US\$M)				Actual at Project closing (US\$ M)				Percentage of approval			
	IBRD	GEF	GoT	Total	IBRD	GEF	GoT	Total	IBRD	GEF	GoT	Total
Comp. 1 Transfer of treated wastewater (TWW) to increase availability for its reuse	13.16	7.58	2.39	23.13	20.81	8.03	4.86	33.69	158%	106%	203%	146%
Comp. 2 Improvement of the Discharge of the Remaining TWW in the Mediterranean	36.48	0	5.46	41.94	33.48		5.51	39.00	92%		101%	93%
Comp. 3 Monitoring and Capacity Strengthening	2.23	0.45	0.75	3.24	3.92		0.41	4.33	176%	0%	55%	134%
<i>Front-end fee</i>	<i>0.13</i>											
Total	52.00	8.03	8.60	68.63	58.21	8.03	10.78	77.02	112%	100%	125%	113%

As per the PAD and Project restructuring papers, the Government of Tunisia's financing contribution is estimated based on the value added taxes associated to the Project's contracts and paid with counterpart resources. These are 18 percent for Works contracts, 12 percent for consultancy contracts and 1 percent for goods contracts. The denomination of components costs in US\$ relies on pro-rated estimates between amounts disbursed in US\$ and total expenditures incurred in TND over the Project's implementation timeline. For purposes of this calculation, contingencies have been attributed to each component. Overall Project costs in US\$ have remained stable. The 12 percent increase in IBRD financing between approval and closing corresponds to the difference in amounts cancelled in 2014 (US\$12.6 million) and the 2016 Additional Financing (EUR 16.2 million, US\$18.8 million equivalent).



ANNEX 4. EFFICIENCY ANALYSIS

NPV: TND 172 million (8 percent discount rate); **ERR:** 15.2 percent

1. The economic analysis of the Project has been prepared following the usual cost-benefit approach, consistent with the approach followed at appraisal. The analysis compares the situation at time of appraisal “without Project” to the situation upon completion of the project “with Project”, taking into account various expected benefit streams that will materialize over the life of the project. The evaluation for this ICR was based on the actual benefits and actual costs of the components and are compared with what was expected at the time of appraisal. The analysis was done using a discount rate of 8 percent to ensure consistency with the methodology at appraisal.

2. At the time of completion, the ERR of the project stands at 15.2 percent compared to 15.8 percent at appraisal. This is a very satisfactory value for a project especially one that generates many positive externalities which cannot be accounted for in the calculations due to data or methodological limitations.

Economic Costs of the Project

3. Tunisia has faced significant currency fluctuations with the value of the Tunisian Dinar having lost approximately half its value against the United States Dollar since the beginning of the Project. From 2010 to 2020, domestic prices increased by 64 percent while the value of the Tunisian Dinar against the United States Dollar depreciated by 90 percent. The result is that while domestic prices increased, they did not completely offset the exchange rate fluctuations leading to US\$1 being able to purchase more in 2020 than was possible in 2010. By 2019, the Project accumulated a balance of US\$13 million as the fluctuation in exchange rates were larger than price fluctuations faced by ONAS in TND.

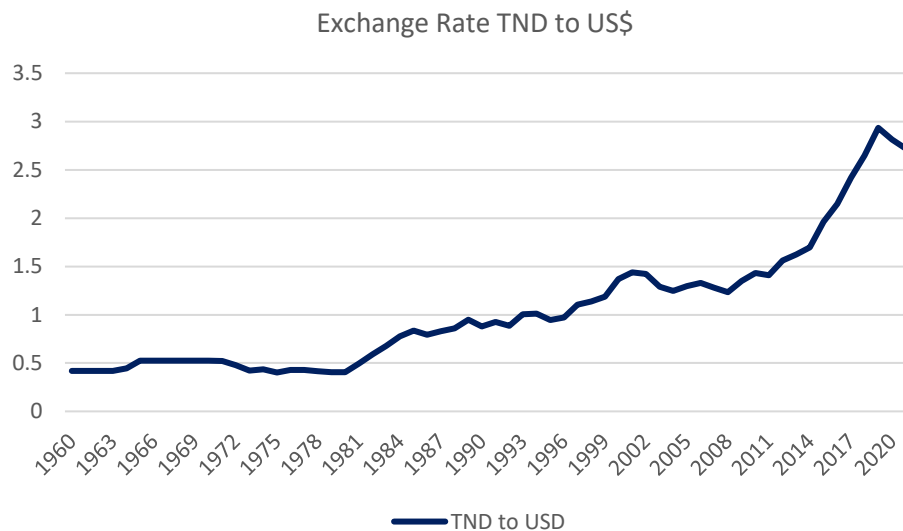


Figure A4.1 Exchange rate of the TND against the US\$ through the years

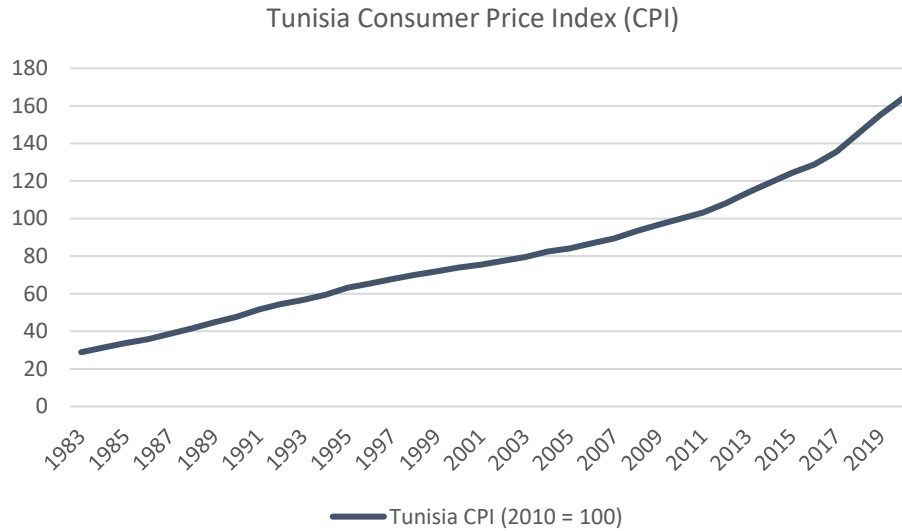


Figure A4.2 Tunisia consumer price index through the years

4. Economic costs shown in table A4.1 are derived from the Capital Expenditure (CAPEX) associated with component 1 and 2 at completion of the project and compared to the expected costs at the time of appraisal. As shown in table A4.1, total CAPEX costs in US\$, when adjusted for inflation, have decreased since appraisal. While economic costs in US\$ decreased, significant works were added to the Project through the restructuring in 2019. The task team used the accumulated balance of US\$13 million to add new activities to the Project scope. This importantly included the upstream portion (*Segment 1*) of the TWW transfer infrastructure which ONAS could no longer commit to co-finance with the EIB as originally envisioned, and which was instrumental for achieving the PDOs. Other activities added to the scope included urgent repairs and rehabilitation works on the WWTPs and wastewater pumping stations of the Northern Tunis Wastewater Treatment system.

5. Economic costs in TND underwent substantive changes through the different restructurings during implementation. As shown in Table A4.1, the CAPEX cost of the investment in nominal TND now stands at about TND 124.1 million (compared with TND 83.2 million at appraisal, TND 104.2 at the 2016 additional financing and TND 112.3 million at restructuring in 2019). The reasons for the increase in economic costs in nominal TND since appraisal are due to the following key factors: (i) implementation delays resulting from the 2011 Arab Spring, leading to unexpected variability in market conditions; (ii) under-estimation of costs associated with the submarine outfall, (iii) inclusion of the additional works in the 2019 restructuring; and (iv) drastic decrease in the value of TND. The full rationale for these factors are explained in the section *Rationale for Changes and Their Implication on the Original Theory of Change*.

Table A4.1 Summary of Economic Costs at Appraisal and ICR

	Economic Cost (Nominal ⁵⁸ Million TND)	Economic Cost (2021 Million TND)	Economic Cost (2021 Million US\$) ⁵⁹
At Appraisal	83.2	136.5	50.2

⁵⁸ Nominal costs are not adjusted for inflation

⁵⁹ 2021 US\$ Costs represent economic costs under component 1 and 2 based on the contract value in TND which have been adjusted for inflation and converted to US\$ at the prevailing exchange rate of 2.77 TND to 1US\$.



At 2016 Additional Financing	104.2	132.7	48.8
At 2019 Restructuring	112.3	118.6	43.6
At ICR	124.1	124.1	45.6

6. The annual average operating cost of the wastewater infrastructure has been estimated at TND 0.71 million per year (compared with TND 0.5 million at appraisal). In addition to updated economic costs, capital expenditures were originally expected over the first 5 years of the project but were extended to 8 years to reflect the elements of the project added during the 2016 additional financing and 2019 restructuring.

Economic Benefits of the Project

7. Economic benefits generated by the project have remained consistent since appraisal. At appraisal, the project estimated an improvement in seawater quality and uptake in TWW reuse which would produce significant environmental and social benefits. At Project closing, infrastructure completed under components 1 and 2 of the Project have: (i) improved environmental conditions of seawater in the North Tunis area, and (ii) increased reuse of better quality treated wastewater in agriculture in the Borj Touil irrigated perimeter which is located nearby the new sewerage infrastructure.⁶⁰ This translates into a series of important benefits as outlined below, many of which have been quantified for the purpose of estimating the economic return of the Project: (i) benefits for local tourism (reduction in transport costs of local population to more distant beaches), (ii) benefits from international tourism (with foreign tourists spending more nights in the Raoued and, nearby Gammarth area), (iii) increased revenues from fisheries (due to the expected improvement in marine biotopes), (iv) reduction in public health hazards (due both to improvement in the quality of seawater in the North Tunis area, and reduced contamination exposure of the local population living nearby the previous TWW open-air channel), and (v) improvement of the quality of life and landscape surrounding the Raoued beach, where the wastewater is currently discharged (as measured by an increase in real estate rental costs in the area), (vi) increased reuse of treated wastewater in the Borj Touil area.

Table A4.2 Summary of Economic Benefits at Appraisal and ICR

Benefit Category	Nature of benefit	PAD (2021 TND per year) Median	Additional Financing 2016 (2021 TND per year)	Restructuring 2019 (2021 TND per year)	ICR (2021 TND per year)
National Tourism	Reduced transportation costs	4.6	9	11	8
International Tourism	Increased revenues from tourism	3.6	23	26	27
Fisheries	Increased revenues for fishermen	6.6	0.6	0.7	0.7
Public Health	Reduction in public health hazards	3.1	2.4	2.7	1.9
Real estate	Increased real estate value in the Raoued	6.2	2.8	3.1	2.2

⁶⁰ While the full increase estimated at appraisal of reuse of treated wastewater in agriculture in the Borj Touil irrigated perimeter did not materialize there was an increase from the baseline of 3 million m³ TWW to 4.6 million m³.



	beach area				
Increased TWW reuse	Increased revenues for farmers in Borj Touil perimeter	1.5	0.4	1.4	2.2
Total		25.6	38.1	44.5	41.5

8. The updated economic analysis shows that the Project remains economically justified as it yields a net present value (NPV) of about TND 172 million (2021 TND) over 25 years with an 8 percent discount rate, and an economic rate of return (ERR) of 15.2 percent, which is consistent with the ERR at appraisal (15.8 percent in the base case scenario).

Table A4.3 Summary of Economic Analysis at Appraisal and ICR

	Economic Rate of Return	Economic NPV (Nominal Million TND)	Economic NPV (2021 Million TND)	Economic NPV (2021 Million US\$)
At Appraisal (8%) Discount Rate	15.8%	65	107	39
At 2016 Additional Financing (8%) Discount Rate	17.5%	101	129	47
At 2019 Restructuring (8%) Discount Rate	13.7%	116	123	45
At ICR (8%) Discount Rate	15.2%	172	172	63

9. **Benefits to national tourism.** At appraisal, Raoued beach was labeled as contaminated with local tourists preferring to travel to other beach areas, namely Hammamet and Bizerte. This resulted in additional transportation costs for the economy, as well as added energy consumption and emissions of CO2 in the atmosphere. At completion, through the intervention of the Project, there has been a demonstrated improvement in seawater quality. Before the commissioning of the outfall, 92 percent of sea water samples complied with imperative norms in total coliforms and fecal coliforms for bathing, which has improved to 96 percent at completion. In addition, sea water transparency has increased, with 77 percent of the samples complying with 1m transparency standards, compared to 69 percent before commissioning. In 2020 and 2021, Tunisian health authorities authorized swimming activities in the Raoued beach for the first time in years given marked improvements in the water quality of the area. Benefits from local tourism were estimated using an avoided-cost method,⁶¹ valuing the additional transport cost, as well as added energy consumption and CO2 emissions. At appraisal benefits from reduced transportation costs were estimated to be 4.6 million 2021 TND per year. At completion the benefit is 8 million 2021 TND per year. The increase in benefits is driven by greater improvements to seawater quality than estimated at appraisal and a slight uptake in tourism.

10. **Benefits to international tourism.** The benefits from international tourism at appraisal were estimated using the willingness-to-pay methodology. At appraisal, it was estimated that the willingness-to-pay of foreign tourists visiting Tunisia for improvements to seawater quality stood at 4.5 million TND per year for North Tunis. This value was then adjusted using a conversion factor to account for secondary contamination leading to a benefit of 3.6 million 2021 TND per year. In the 2016 restructuring, the methodology was adjusted to instead evaluate the additional earnings of

⁶¹ For the purpose of calculating the avoided cost, assumptions are: (i) transportation cost by car at 0.5 TND per km for 4 people, (ii) hotel cost per night and person at 26 TND, (iii) length of stay of 2.7 nights per person, (iv) estimate of 115,000 inhabitants travelling farther due to low seawater quality (12 percent of Northern Tunis population)



the tourism industry in the area, as a result in an increase in the average number of days spent by foreign tourists brought about by the improved environmental conditions in the North of Tunis. At the time, occupancy rates in Northern Tunis were estimated on average from 45 percent in June or September to 30 percent in July or August, whereas in the Nabeul-Hammamet area it varies from 65 percent to 85 percent, which showed that the latter area drained a significant amount of potential tourists from the Northern Tunis area in the peak summer period. With the realized improvements in sea water quality in Northern Tunis, is expected to close half the gap in occupancy rates between these two areas. At completion COVID-19 has caused a significant downturn in international tourism, however during implementation the average number of days spent by foreign tourism was rising, with the average length of hotel stays in Carthage rising since appraisal.⁶² Tourism is expected to return eventually post COVID-19, allowing for a benefit of 27 million TND per year, in line with estimates at restructuring in 2016 and 2019.

11. **Benefits to fisheries.** At appraisal, a 2004 Bank study showcased how marine pollution was affecting fisheries production in Tunisia, with the volume and values of catches gradually decreasing in the most polluted areas, while it was going up in the rest of the coast. The loss in revenues from fisheries due to marine pollution in Tunisia was estimated to be between 13.3 to 20.2 million TND per year. In the 2016 restructuring, the loss of production at Raoued due to marine pollution was evaluated by looking at the difference between the production in the Raoued area and the Kalaat El Andalous area which is similar in size and type of fishing, but was not polluted by the TWW discharge. The difference in production and sales between the two areas was approximately 40 percent less on average in Raoued. At completion, the significant improvements in seawater quality are expected to encourage fishermen to return to Raoued beach due to expected improvement in marine biotopes. The benefits at completion are calculated based on revenues from the fishermen and nearby Kalaat El Andalous and are conservatively expected to reach similar levels leading to a benefit of 0.7 million TND per year. This is considerably less than the benefit of 6.6 million TND per year estimated at the time of appraisal with the difference resulting from the change in methodology. The methodology used at completion is consistent with the restructurings in 2016 and 2019 and leverages localized and updated figures.

12. **Benefits to public health.** The benefits derived from a reduction in public health hazards are difficult to estimate, in the absence of epidemiological data and given the multiplicity of diseases (diarrhea, skin and respiratory diseases) potentially affecting the population living in the vicinity of the open sewer canal and Raoued beach. The project stands to decrease public health hazards in this highly localized setting through improving the TWW quality that is discharged at Raoued beach and replacing the open-air canal between the treatment hub and the existing pumping station operated by the Ariana CRDA by a double TWW transmission pipeline. These benefits are nonetheless significant given the size of the population concerned (about 60,000 people), a large proportion of them being low-income families. A Bank study (2004) estimated the costs induced by diarrhea alone in Tunisia stood between 11 and 56 million TND per year. Overall, the benefits derived from the Project through improvement in public health have been estimated conservatively to be approximately TND 1.9 million per year which is consistent in methodology with appraisal.

13. **Benefits to real state values.** Although difficult to estimate since real estate values are driven by many factors, at appraisal the Raoued area was affected by contaminated TWW nuisances (odors and contamination risks) which made the area less attractive to live in, lowering properties values and making it less attractive for further developments. At the time, real estate value in the Raoued beach stood at 100-150 TND per m², compared to 400-550 TND per m² in other nearby beach areas (e.g. La Marsa). At appraisal it was estimated that the project would lead to

⁶² Office National du Tourisme Tunisien, Le Tourisme Tunisien en Chiffres 2020



an increase in property value of 2 to 5 TND per m² mostly due to reduced contaminated TWW nuisances making the properties more attractive. At completion water quality improvements have been realized, the open-channel has been closed and the Raoued beach is expected to attract local and international visitors making the area more attractive to investment. With COVID-19 disrupting various aspects of the economy in Tunisia, the full impact on real estate values cannot yet be measured. As a result, benefits at completion were estimated based on a willingness to pay methodology. Willingness to pay for better environmental quality is estimated at TND 50 per month leading to an increase in real estate values of 2.2 million TND per year.

14. **Benefits to farmers.** At the time of appraisal, 3 million m³ of low quality TWW were being reused at the Borj Touil irrigation perimeter with an increase to an estimated 11 million m³ expected by the end of the project. At closing, the current uptake of 4.6 million m³ of good quality TWW is above the high scenario for wastewater reuse developed at restructuring but well below the expected scenario at appraisal of 11 million m³. Although a modest increase in quantity, during the ICR mission, the CDRA noted the improvement in the TWW quality in the last months since the infrastructure became fully operational (July 2021). In addition, they confirmed the renewed interest by farmers to utilize TWW now that its quality has been improved. The consumed TWW corresponds to that made available at the Ariana CRDA pumping station. In addition to the TWW made available at the Ariana CRDA pumping station, 4,000m³ per day will be made available to the Port Financier golf course. This additional TWW for reuse has not been valued as part of the benefit as uptake has not yet begun at the time of completion.

15. There are over 500 farmers covering 330ha in the irrigated perimeter of Borj Touil growing a mix of corn, sorghum, millet, alfalfa, and olive trees. These farmers stand to benefit from expected improvements in agricultural production due to higher consumption of better quality TWW and less dependency on rainfalls - considering that the crop pattern, level of intensification and soil fertility will remain the same (i.e. without rehabilitation and drainage works). In order to quantify the benefits to farmers, the economic value of the TWW is compared to the cost borne by the farmers. A study completed for the Ministry of Agriculture (MARHP) in 2017 has estimated that the economic value of treated wastewater for farmers, given prevailing conditions in Borj Touil, was TND 0.389 per m³ while there is currently no fee to farmers. At appraisal the benefit of TWW reused in agriculture was expected to rise from TND 2 million per year in year 5 to TND 5 million per year in year 15. At completion the uptake in reuse of TWW is in-line with year 5 estimates at appraisal (TND 2.2 million).

Financial Analysis

16. The sustainability of the project relies on the continued improvement of ONAS's broader financial performance. ONAS has a long operational track record and adequate financial management arrangements. It has implemented a wide range of sanitation infrastructure projects funded by a variety of donors and financial partners. The overall revenue collection and financial performance of ONAS is expected to improve significantly in the short to medium-term as a result of the roll out of the new ONAS-SONEDE joint commercial information system and measures to improve SOE performance envisaged under the Tunisia First Resilience budget support program.

17. A financial assessment of ONAS was carried out to analyze its operational efficiency, financial capacity, and long-term viability following the methodology at the time of appraisal. The analysis was based on audited financial accounts for the period 2012-2020. Key operational and financial indicators developed at appraisal that were designed to monitor ONAS financial performance during Project implementation including the ratio of total operating revenues to total operating expenses (Working Ratio, excluding depreciation) and the ratio of current assets to current liabilities (Current ratio) were analyzed. These two indicators were designed to monitor the financial health of ONAS as an



institution. The level of cost recovery of the operation and maintenance (O&M) costs of ONAS, which draws its revenues mainly from the sanitation tariff collected through water bills, has remained relatively steady in the past 10 years (see table A4.4). ONAS has consistently covered about 70 percent of its operating expenses through tariffs which is in line to comparable rates in utilities of a similar size and countries of similar income in the region. Full cost recovery is reached thanks to the Government’s commitment to cover the remaining operating deficit through an annual transfer of funds to compensate for these losses. This Government intervention, which began prior to the Project, has continued throughout implementation and is expected to continue in the future. There is no reason to expect a change in government support to ONAS in years to come, given the high priority set to sanitation and wastewater reuse. In addition, tariff increases were approved in 2018, aimed at ensuring that ONAS can cover 100 percent of its O&M by 2029. Annual increases of 11 percent from 2022 to 2025 (i.e. 3 percent more than what had already been approved back in 2017) and 6.3 percent annually from 2025 to 2029 are being negotiated for approval by the government. Consistent application of the tariff increases will be needed to ensure full cost recovery.

Table A4.4 . ONAS key operational and financial indicators

	2008	2012	2013	2014	2015	2016	2017	2018	2019	2020
Operating Revenue	119,255	138,105	143,258	158,711	162,869	171,868	192,750	210,397	211,225	210,699
Total Expenses	185,575	220,497	220,272	226,612	237,394	264,247	269,357	283,437	315,835	333,933
	(66,320)	(82,392)	(77,014)	(67,901)	(74,525)	(92,379)	(76,607)	(73,040)	(104,610)	(123,234)
Operating Loss										
Depreciation and Provisions	63,134	71,565	70,962	68,812	72,621	77,461	80,116	90,420	100,685	106,903
Total Expenses (excluding depreciation)	122,442	148,932	149,310	157,800	164,773	186,786	189,241	193,017	215,150	227,030
Operating Income-Loss (excluding depreciation)	(3,186)	(10,827)	(6,052)	911	(1,904)	(14,918)	3,509	17,380	(3,925)	(16,331)
Net interest paid	3,642	12,794	9,597	7,720	8,436	6,422	5,087	7,124	7,298	6,921
Total expenses (excluding depreciation & interest)	118,799	136,138	139,713	150,080	156,337	180,364	184,154	185,893	207,852	220,109
Operating Income-Loss (excluding depreciation & interest)	(6,829)	(1,967)	(3,545)	(8,631)	(6,532)	8,496	(8,596)	(24,504)	(3,373)	9,410
Working ratio (excluding depreciation & interest)	1.00	0.99	0.98	0.95	0.96	1.05	0.96	0.88	0.98	1.04
Working ratio (excluding depreciation)	1.03	1.08	1.04	0.99	1.01	1.09	0.98	0.92	1.02	1.04
Operational ratio (including depreciation and interest)	0.64	0.63	0.65	0.70	0.69	0.65	0.72	0.74	0.67	0.63
Current Ratio	1.03	1.10	1.09	1.01	1.05	0.77	0.57	0.73	0.74	0.91



ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS

1. The ICR team shared with the borrower a draft of the ICR for their comments on November 23, 2021. Minor comments were received by ONAS on December 9, 2021, which included some factual corrections and clarifications. These have been incorporated in the final ICR.
2. The ICR team received the borrower's ICR report on November 16, 2021. The below includes a summary of the main sections of the borrower's report. Full version of the Borrower's ICR is in project files.

Reuse

3. Tunisia is already well advanced in terms of reuse in the region. TWW is reused for irrigation. However, recurring problems related to the quality and availability of TWW supplied by ONAS to farmers have resulted in significant reluctance on the part of farmers to increase their consumption.
4. The integration between the projects of wastewater treatment plants and irrigation schemes has often been insufficient, as has coordination between ONAS and the departments of the Ministry of Agriculture in charge of irrigation. This project was able to remedy this situation by ensuring that the transport infrastructure for TWW in the Tunis North area is designed by ONAS in coordination with the CRDA, with the objective of promoting reuse by farmers. This was achieved through a transport and storage infrastructure to separate the TWW according to its quality.
5. The Project has also served as a very important pilot for the implementation of the ambitious national program of reuse. The Government's efforts to promote reuse in agriculture were hampered by the fact that the sanitation infrastructure developed and operated by ONAS did not really take into account the distribution of water to farmers and due to the poor quality and unreliability of the water supply offered to farmers, who were therefore strongly opposed to reuse. Within the framework of this Project, the sanitation transport infrastructure that has been constructed has been designed with reuse in mind. The Project made it possible, if necessary, to separate the TWW from the different treatment plants according to their quality, the outfall at sea made it possible to justify the Project from an economic point of view.
6. The project was designed on the basis of regular and efficient cooperation between ONAS and the Ministry of Agriculture.

Submarine Outfall

7. The Project directly benefits the inhabitants of the Raoued and Ghar el Melah areas as well as tourists (national or international), who use the beach and the coast for recreation. The Project will also benefit the fishermen and the investors of the Port Financier - employees, inhabitants and visitors -, who would otherwise suffer the negative impacts linked to the degradation of the environment.

Institutional Strengthening

8. "SIC" - commercial information system. The SIC is a business software package for the commercial management of SONEDE and ONAS, it has made it possible to carry out computerized management of the basic functions of the two organizations centered on the concept of the customer, to have the necessary and useful information from the common base and make timely changes through webservices. Thus, it will allow process-based management and above all optimized and real-time monitoring of the revenue from the sanitation fee and its collection, which for ONAS is very useful information, especially since it only had it with a month or more of delay. These processes include: (i) monitoring and control of tariff codes; (ii) individual connection; (ii) connection within the framework of the projects; (iii) management of industrial discharges and polluting activities; (iv)



management of water charges other than those coming from the public drinking water network; (v) management of domestic wastewater discharge agreements in treatment plants; (vi) management of industrial wastewater discharge agreements in the grouped station; (vii) ONAS-SONEDE relationship... etc.

9. The SIC allows ONAS to have information on their customers and their receipts in real time and also allowed ONAS to intervene on the data of its customers directly and in real time, a task that was carried out with a certain delay by SONEDE on the basis of the information communicated to it by ONAS.

10. ONAS was able to take advantage of this new management tool for the implementation of a real customer-oriented commercial policy. Optimal use of the SIC is underway in order to be able to effect a qualitative change in commercial policy and to improve its revenue from fees and new connections.

11. This tool was able to open up a new horizon in the relationship between ONAS and SONEDE for everything relating to customers. The ONAS-SONEDE relationship governed by a service contract by which SONEDE establishes the invoicing of the sanitation fee and ensures its recovery without ONAS having a look at the meter management policy which can have a significant impact on the amount. the royalty or the means of collecting the royalty which may have an impact on ONAS' cash flow.

12. Also, through the SIC, updating the pricing code could be done directly by the regional services of ONAS without going through SONEDE.

World Bank Performance

13. The project benefited from constant support from the Bank, from the preparation of the project, the effectiveness, during the supervision missions, during the restructuring missions and the completion mission.

14. Two successful restructurings of the basic project made it possible to move towards the effective achievement of the objectives. The project experienced some difficulties during its implementation, but close monitoring and support from the Bank in general and the project manager made it possible to remove all reservations and achieve the project objectives. It emerges from this experience that beyond supervision, assistance from project teams in the implementation of the project was received until its closure.

Lessons learned

15. Overall, with the implementation of the project, ONAS became particularly familiar with the Bank's procedures in terms of environmental and social safeguards. Thus, the anticipation of the management of environmental and social issues is a guarantee of the success of the project activities.

16. The participatory approach of public consultation with authorities, civil society, organizations and NGOs will allow the project to be successful. Also, the strong involvement of the municipalities in awareness-raising and information gathering activities and in resettlement committees has facilitated the implementation of environmental and social safeguard activities.

17. With regard to the level of project preparation, it is recommended to improve the maturity of designs and bidding documents in order to minimize the delay in the effective start of project activities.

18. A better involvement of the operator in the design stages of the project to take into account certain realities experienced in the operation must be carried out.



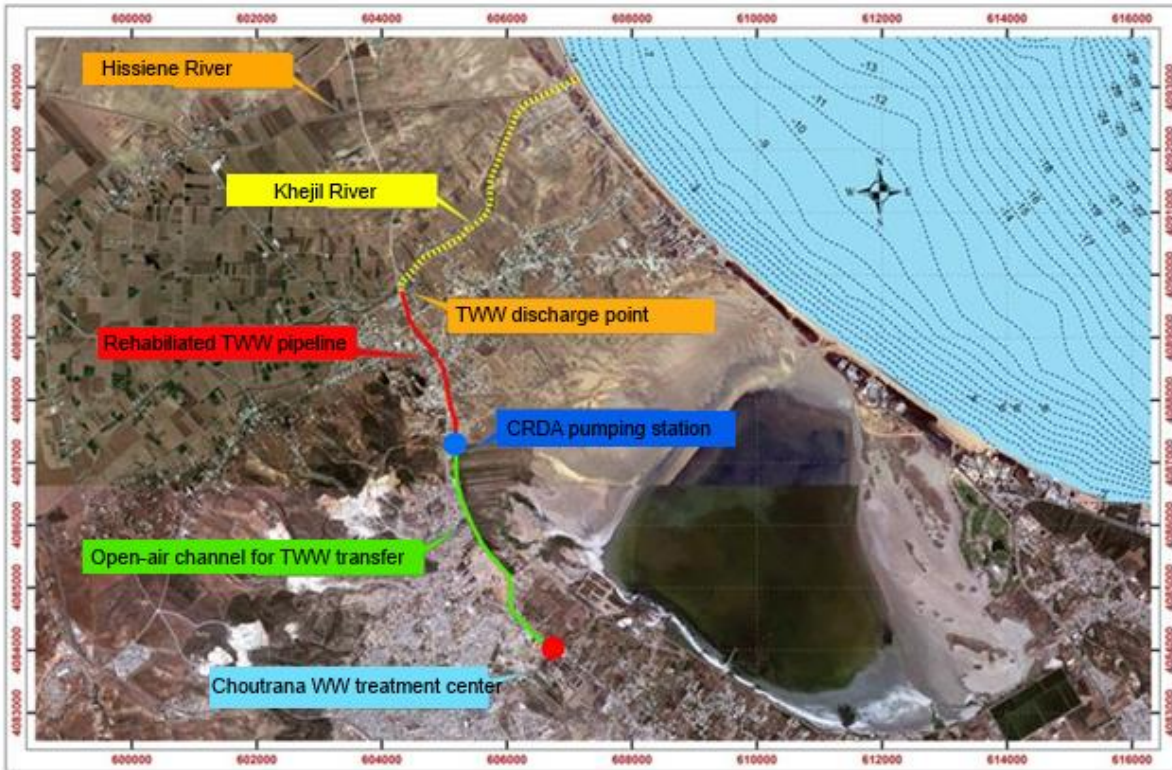
ANNEX 6. SUPPORTING DOCUMENTS (IF ANY)

Project Specific Documents

- Project Appraisal Document (PAD), dated May 20, 2010 (Report No: 53547-TN)
- Legal Agreement, dated October 7, 2010
- Amendment to the Legal Agreement, dated November 30, 2016
- Implementation Status and Results Reports (From Sequence 01, July 2010, to Sequence 23, June 2021)
- World Bank Supervision Aide Memoires
- May 2014 Restructuring Paper (Report No: RES14356)
- December 2015 Restructuring Paper (GEF) (Report No: RES21818)
- May 2016 Restructuring Paper (GEF) (Report No: RES23364)
- August 2016 Restructuring Paper and Additional Financing (Report No: PAD1425)
- December 2019 Restructuring Paper (Report No: RES35587)
- Environmental and Social Impact Assessments
- Environmental and Social Management Plans and reports
- Borrower Completion report
- Ministry of Health lists of beaches prohibited for swimming
- Terms of Reference to update the study for the rehabilitation of the Borj Touil Irrigation perimeter. Launched in October 2021.



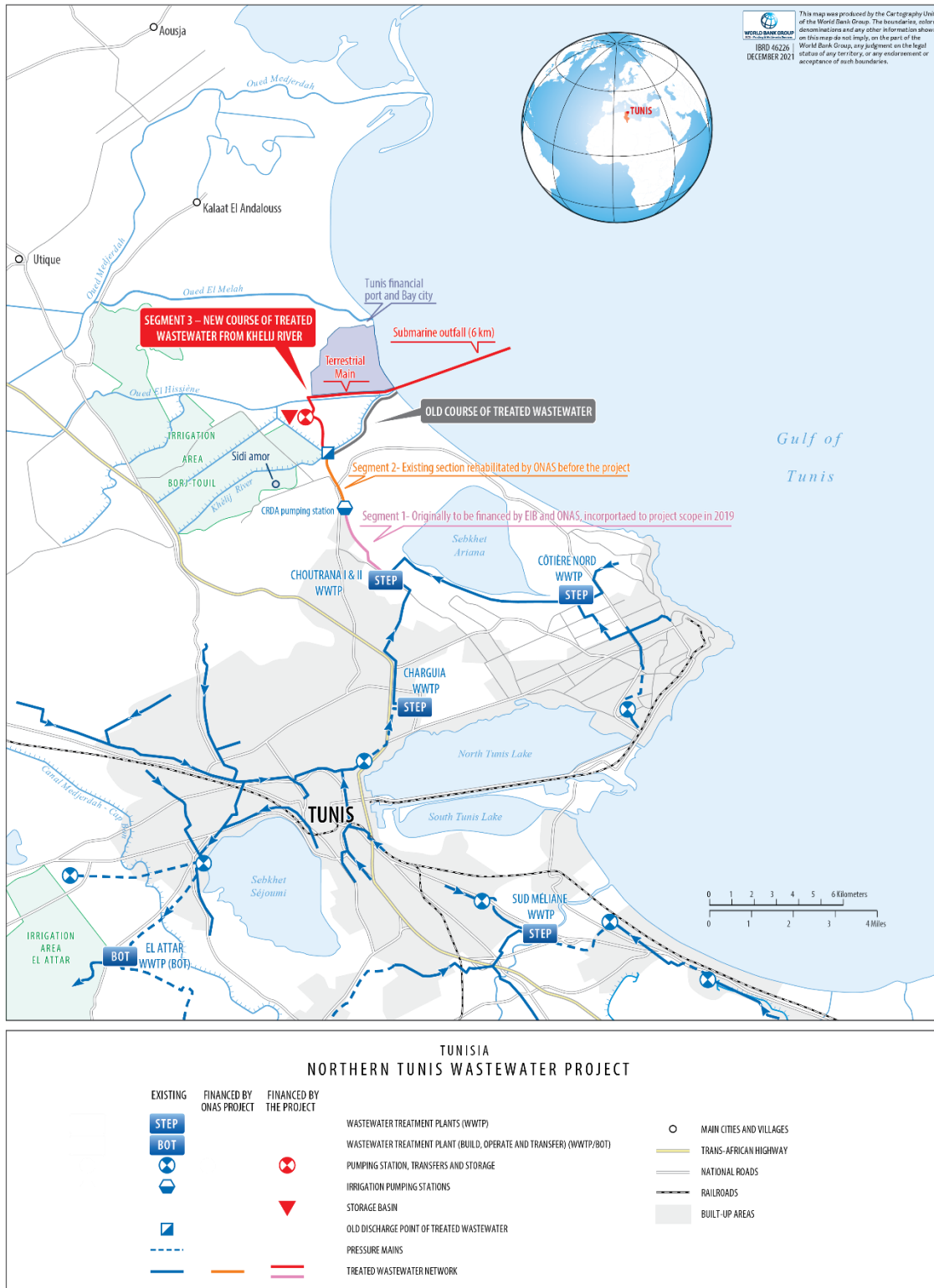
ANNEX 7. MAPS



Map A7.1 Before Project TWW transfer infrastructure



Map A7.2 Sea water quality monitoring and sampling points. Left picture shows sampling points near the coast at Raoued beach. Right picture shows sampling points further in the sea and close to the submarine outfall discharge point (red circle).



Map A7.3 Infrastructure financed under the Project.



ANNEX 8. Project pictures

Sub-marine outfall:



Picture A8.1 Contamination shown at discharge point of TWW at Raoued beach before the construction of the submarine outfall in 2015. Source: ONAS



Picture A8.2 Clear sea water at Raoued beach and Khelij river after the construction of the submarine outfall. Source: ONAS



Picture A8. 3 Installation of submarine outfall. Source: ONAS



Picture A8.4 Installation of terrestrial portion of pipeline connecting to the submarine outfall. Source: ONAS



TWW transfer system:



Picture A8.5 Low quality TWW conveyed through an open-air channel to the sea before the Project posing and environmental and health risks to the surrounding community. Source: ONAS



Picture A8.6 Open-air channel in the process of being decommissioned after the installation of the double underground pipeline. Source: ONAS



Picture A8.7 Fully underground TWW transfer system constructed under the Project, significantly reducing environmental and health risks to the community, and impeding recontamination along the line. Source: ONAS



El Hissiene storage and regulation basin:



Picture A8.8 El Hissiene basin constructed under the Project, enabling TWW flow regulation for discharge to the submarine outfall and TWW storage for future reuse. Source: ONAS

Reuse of TWW:



Picture A8.9 Left: Maturation tank of TWW at Sidi Amor. Center: Farmer irrigating his agricultural plot with TWW at Sidi Amor. Right: Rose garden irrigated with TWW at the reuse pilot of Sidi Amor. Source: GDA Sidi Amor.



Picture A8.10 Women from the rural areas of Sidi Thabet attending a workshop on the preparation and commercialization of artisanal products resulting from crops irrigated with TWW at Sidi Amor. Source: GDA Sidi Amor.