

Al Wathbah-2 wastewater treatment plant and Abu Dhabi irrigation scheme

Country of implemented the study	United Arab Emirates
Location of the study	Abu Dhabi
Implementing Institution/ Organization	ADSSC/ ADDC/ ADAFSA
Funded by	ADSSC/ ADDC/ ADAFSA
Time period of the study	2011-2021
Goals	- Understanding the role that tertiary treated water from the Al Wathbah-2 WWTP can play in an arid region with very limited renewable freshwater resources, as part of integrated water resource management plans and sustainability measures. In addition to being an additional water source, it can also relieve pressure on deteriorated groundwater aquifers and costly desalinated water, reduce energy use and associated carbon dioxide emissions from desalination plants and minimize the environmental impacts of desalination. - supplying and installation of environmentally friendly bio trickling filters in the wastewater pumping stations have provided an environmentally friendly upgrade to the existing chemical scrubbers for the removal of odorous gas compounds in the recycled water. - using recycled water for irrigation in wetlands such as Al Wathbah Wetlands has environmental and ecological positive impacts.
Methodology (approach to implement)	To collect and review all the required data on the Al Wathbah-2 WWTP Plant, a data collection form designed by Mohamed Dawoud was sent to the Abu Dhabi Sewerage Services Company (ADSSC). In addition, two interviews were conducted including one with the Abu Dhabi Municipality team and one with the Al Wathbah-2 WWTP operation team. Other methods used during data collection and analysis included the design of data and output forms regarding the status of Al Wathbah-2 WWTP including capacity, production, reused quantities and quality in alignment with Department of Energy guidelines.
Key findings	Water reuse for irrigation, especially for food production, is central to the Emirate of Abu Dhabi's strategy to increase food security and food self-sufficiency. It is also central to its integrated water resource management plans, which include an ambitious target to reach zero discharge of recycled water into the environment by 2020. To this end, in 2016, the Abu Dhabi government approved two mega projects to reuse 55% of treated water, which was being discharged into the environment. These projects, which include the completion of the required transmission and distribution networks and pumping stations for the recycled water to reach end-users, started in

2020 with an expected completion date of August 2022 and an investment cost of almost USD 0.3 billion. The works had originally been scheduled to be completed by 2020 but were delayed due to the COVID-19 pandemic.

In addition to the 105,000 m³ /day of recycled water from Al Wathbah-2 WWTP currently used for irrigating landscaped areas and green spaces around local amenities, there is significant potential for its use in agricultural irrigation that could contribute to both food and environmental strategies. In 2014, 185 farms were supplied with 27,000 m³ /day of recycled water from the plant. By August 2022, it was anticipated that an additional 390,000 m³ /day of recycled water from Al Wathbah-1 and -2 WWTPs will be used to irrigate 4,200 farms, with half of this recycled water coming from Al Wathbah-2 WWTP (Dawoud 2017) (Figure 8.4).

In environmental terms, a preliminary assessment by the Department of Energy (DOE) found that aquifer recharge using recycled water from the plant could also be used as a means to enhance the quality of brackish groundwater and that excess irrigation wastewater during non-peak seasons could be recharged to the aquifer system to be used later. A big advantage of aquifer recharge using recycled water from wastewater treatment plants is that it breaks the pipe-to-pipe connection of direct reuse. This reuse project will make a significant contribution toward replacing the use of desalinated water by 125,000 m³ /day and the costs of maintaining and operating more than 1,000 groundwater wells.

The Emirate of Abu Dhabi is witnessing one of the fastest-growing populations and economies in the world, with a projected population of almost 7 million by 2030. The government needed to take action to ensure its wastewater infrastructure needs are met now and in the future.

Although the old Al Mafraq WWTP had been continuously upgraded over its history, including an upgrade in capacity to 260,625 m³ /day in 1997 and new systems for odor control and biosolids management, it became overloaded, leading to raw wastewater discharge into the environment and inefficient treatment of the collected volumes of wastewater. The construction of Al Wathbah-2 WWTP was part of planned activities carried out in the Emirate of Abu Dhabi between 2010 and 2013 to serve the wastewater needs of 3 million inhabitants.

Al Wathbah-2 WWTP is already providing socio-economic, health and environmental benefits including reduced discharge of raw sewage water to the environment, fewer odors and improved biosolids management. Raw sewage discharge has negative health and environmental impacts. The quality of the treated wastewater has improved increasing its reuse potential as irrigation water for both green and landscaped areas and for agricultural areas to replace the present use of desalinated water. This is saving USD 2.77 (AED 10.2)/m³ of desalinated water and reduces energy consumption, which is also minimizing carbon emissions from the desalination plants. It is also more cost-efficient. Recycled water costs USD 0.051 (AED 1.9)/m³ compared with expensive desalinated water.

Using recycled water from Al Wathbah-2 WWTP is also helping to improve and enhance deteriorated groundwater quality and increase reserves for future uses. By April 2022, it is expected that 4,200 farms will be irrigated with reused water, which

	will replace about 250,000 m ³ /day of brackish groundwater farms. In addition, the total dry mass of biosolids produced at the plant will be recycled for producing compost. In 2020 this amounted to 13,859 t.
Conclusions	• <u>STRENGTHS:</u> Enabling legislative framework Training on operation and management. Construction of collection tunnels to minimize the seepage of seawater into the collection network Wastewater tariffs will be enforced by 1 January 2023 as part of cost recovery • <u>WEAKNESSES:</u> Discharge of stormwater to the wastewater collection network Only 45% of produced water from the Al Wathbah-2 WWTP is reused Discharge of 55% of recycled water produced is discharged into shallow and closed Al Musaffah marine channels causing negative environmental impacts Lack of wastewater transmission and distribution infrastructures. Seepage of seawater to the collection network is increasing the salinity of raw wastewater to 3,000-4,000 ppm that is not removed by Al Wathbah-2 during the treatment process Discharge of 13,859 tons of biosolids to the environment Wastewater tariffs could be a threat to reuse • <u>OPPORTUNITIES:</u> Raising awareness of the environmental aspects of wastewater treatment plants Construction of transmission and distribution infrastructures to reach 100% utilization of produced treated wastewater Increasing and empowering women's employment in operational roles at the Al Wathbah-2 WWTP, which are currently low Development of legislation related to recycled water use in farming Recycling of 13,859 tons of biosolids for producing compost Establishing agricultural measures to monitor agricultural land that uses recycled water for irrigational purposes Stakeholder involvement and engagement in water reuse for irrigation Enhance cost recovery for reuse in farming • <u>THREATS :</u> CAPEX needed to implement and maintain proper treatment or mitigation measures to solve the salinity level of treated wastewater from Al Wathbah-2
Recommendations	It has been found that this project is one of the most effective and sufficient projects in the middle east and it is recommended for it to be applied and adapted in more countries with similar environmental conditions.
Lessons learned	• Reuse of tertiary treated wastewater in irrigation can save using costly desalinated water and safe groundwater. • Emerging and state-of-the-art technologies can help to reduce both CAPEX and OPEX. • There are many treatment options for the direct reuse of reclaimed water in developing countries. • Direct reuse of recycled water from wastewater treatment plants in the Emirate of Abu Dhabi is the most technical and economically feasible solution when compared to other options such as aquifer recharge of district cooling.
References (resources) Found in the case study	• ADSSC (Abu Dhabi Sewerage Services Company). 2020. Abu Dhabi annual wastewater production and reuse statistical report. Abu Dhabi, United Arab Emirates (UAE): ADSSC. • Dawoud, M. 2017. Feasibility of using treated wastewater in groundwater aquifer recharge in Abu Dhabi. The Gulf Water Science and Technology Association (WSTA). 12th WSTA Gulf Water Conference, March 28-30, 2017, Bahrain. WSTA.

	https://www.researchgate.net/publication/323476712_Feasibility_of_Using_Treated_Wastewater_in_Groundwater_Aquifer_Recharge_in_Abu_Dhabi • DOE (Department of Energy). 2019. Recycled water first regulatory control. Abu Dhabi, United Arab Emirates (UAE): DOE. 43p. • FCSC (Federal Competitiveness and Statistics Center). 2021. Annual statistics report. Abu Dhabi, United Arab Emirates (UAE): United Arab Emirates Ministry of Cabinet Affairs. • QCC (Abu Dhabi Quality and Conformity Council). 2010. Trade effluent control regulations 2010. Abu Dhabi, United Arab Emirates (UAE). The Regulation and Supervision Bureau for the Water, Wastewater and Electricity Sector in the Emirate of Abu Dhabi. 30p. https://jawdah.qcc.abudhabi.ae/en/Registration/QCCServices/Services/STD/ISGL/ISGL-LIST/WA-721.pdf • SCAD (Statistics Centre Abu Dhabi). 2021. Statistical yearbook of Abu Dhabi 2020. Abu Dhabi, United Arab Emirates (UAE): SCAD. 272p. https://www.scad.gov.ae/Release%20Documents/Statistical%20Yearbook%20of%20Abu%20Dhabi_2020_Annual_Yearly_en.pdf
Publications from the study	Source book
study adapted/developed by	AWC

Acronyms

AADC: Al Ain Distribution Company

ADDC: Abu Dhabi Distribution Company

ADSSC: Abu Dhabi Sewerage Services Company

DOE: Department of Energy

RSB: Regulation and Supervision Bureau

SCAD: Statistical Center – Abu Dhabi

UAE: United Arab Emirates

WWTP: Wastewater Treatment Plant

Images:

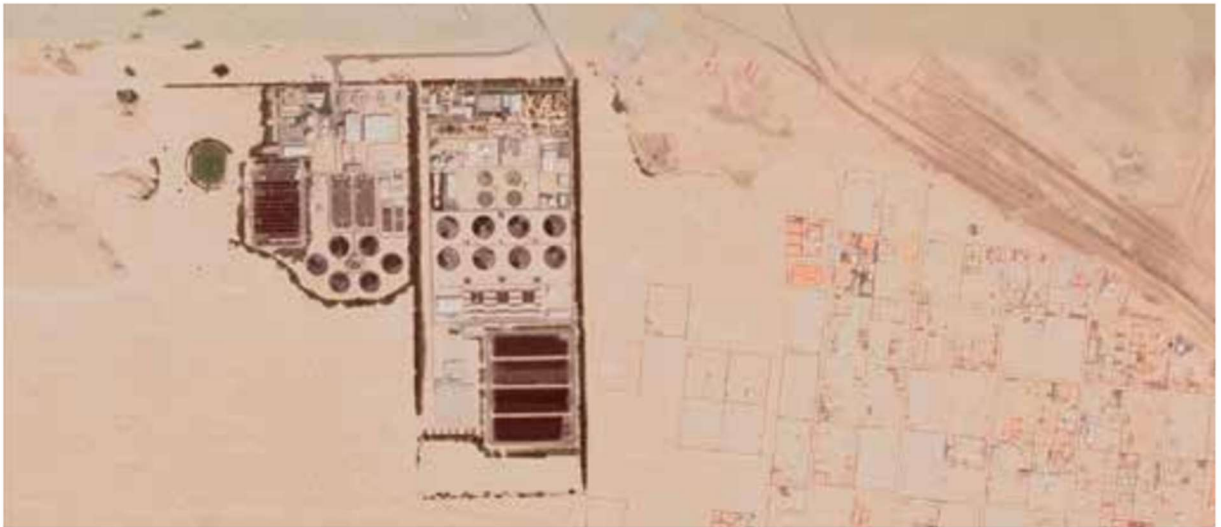


FIGURE 8.2 Al Wathbah-2 WWTP: location map and layout.
SOURCE: Google Earth.



IMAGE 8.1 Al Wathbah-2 WWTP.
SOURCE: ADSSC.

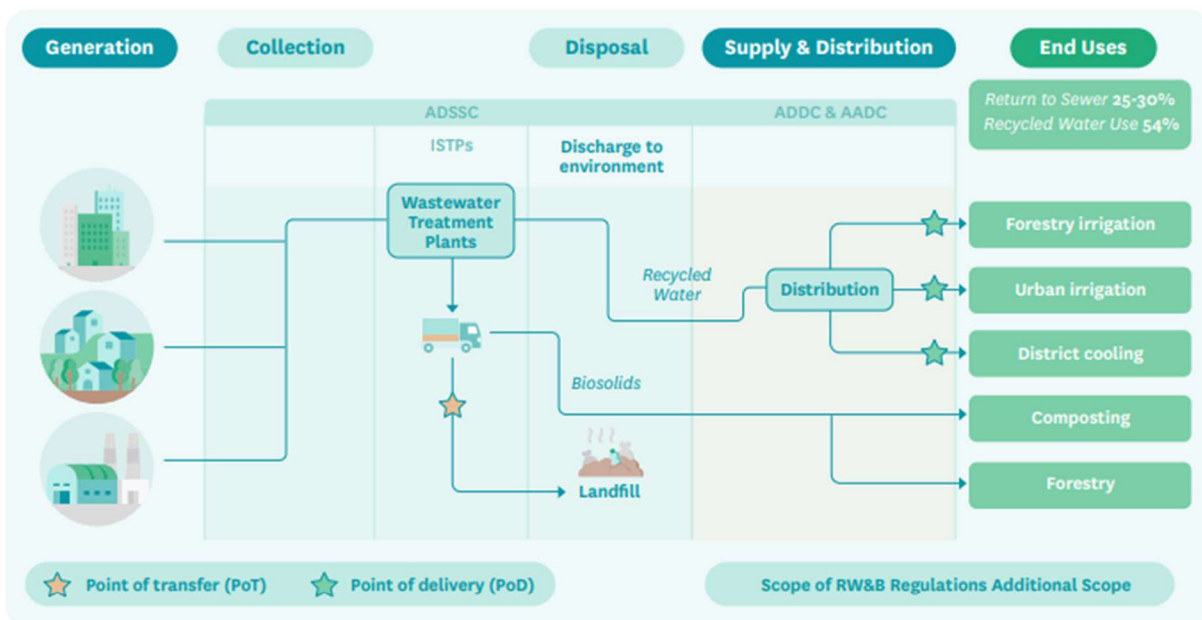


FIGURE 8.4 Al Wathbah-2 WWTP and reuse project: Schematic diagram and management model.
SOURCE: DOE 2019.

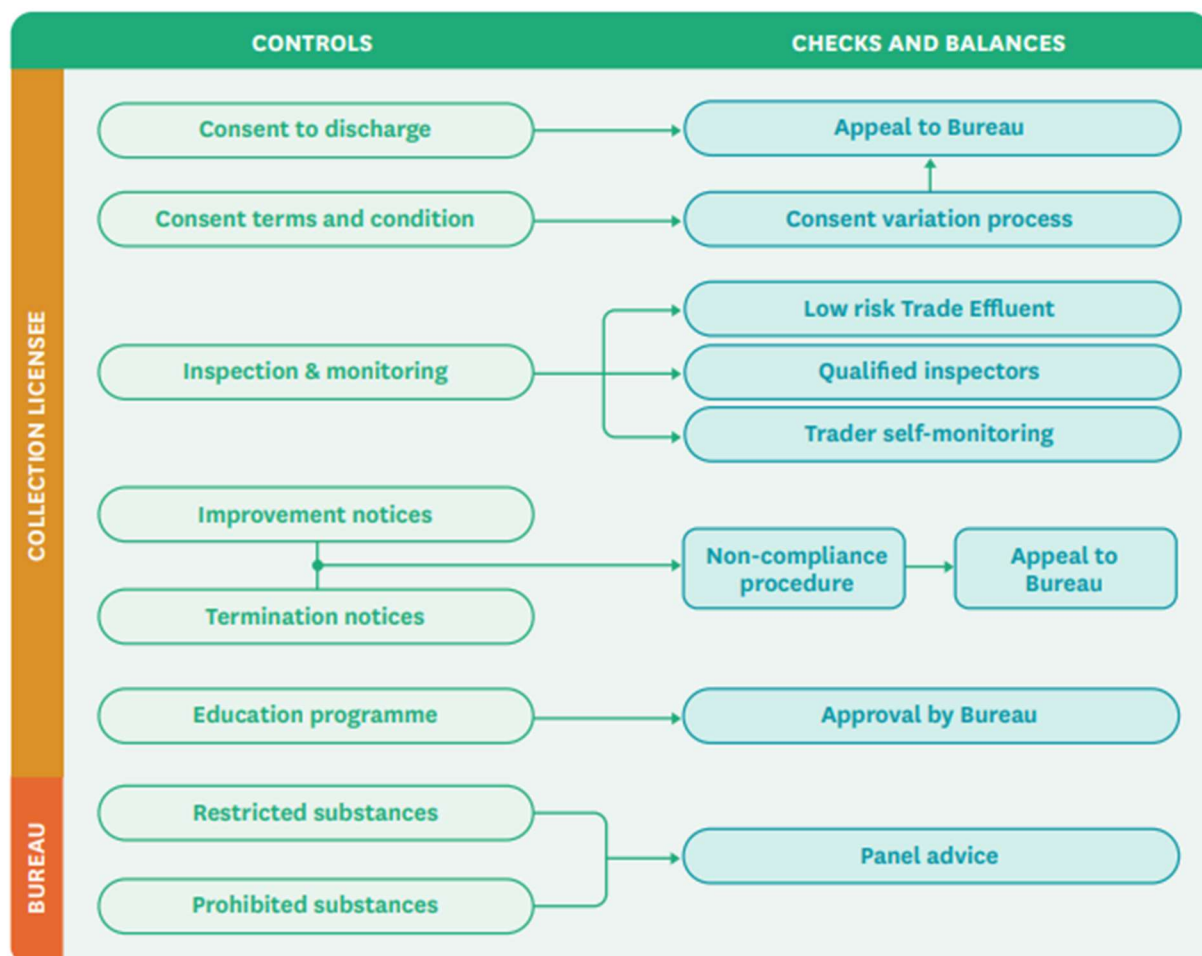


FIGURE 8.5 Emirate of Abu Dhabi Trade Effluent Control Regulations 2010 Framework.
SOURCE: QCC 2010.

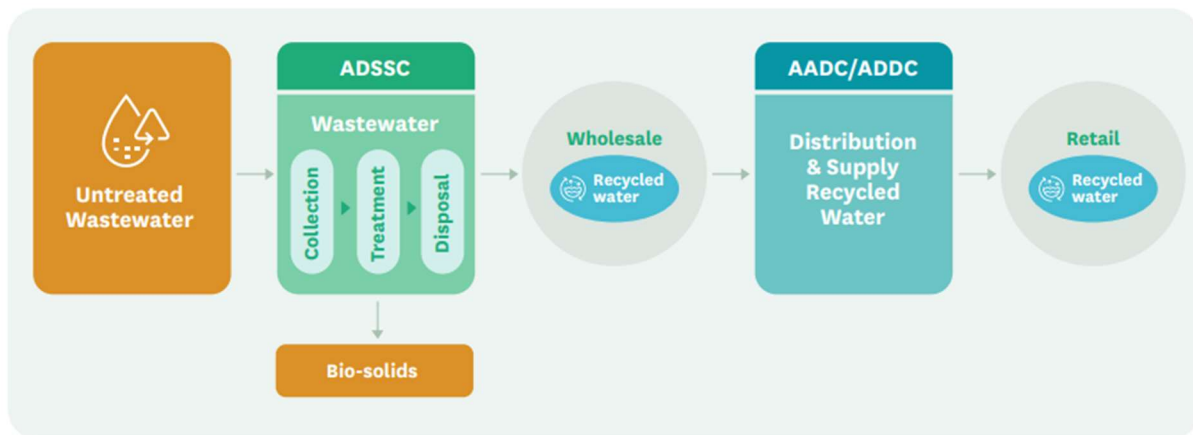


FIGURE 8.7 Structure of the recycled wastewater collection, treatment and reuse for Al Wathbah-2.
 SOURCE: DEO 2019. NOTES: Al Ain Distribution Company (AADC), Abu Dhabi Distribution Company (ADDC), Abu Dhabi Sewerage Services Company (ADSSC).

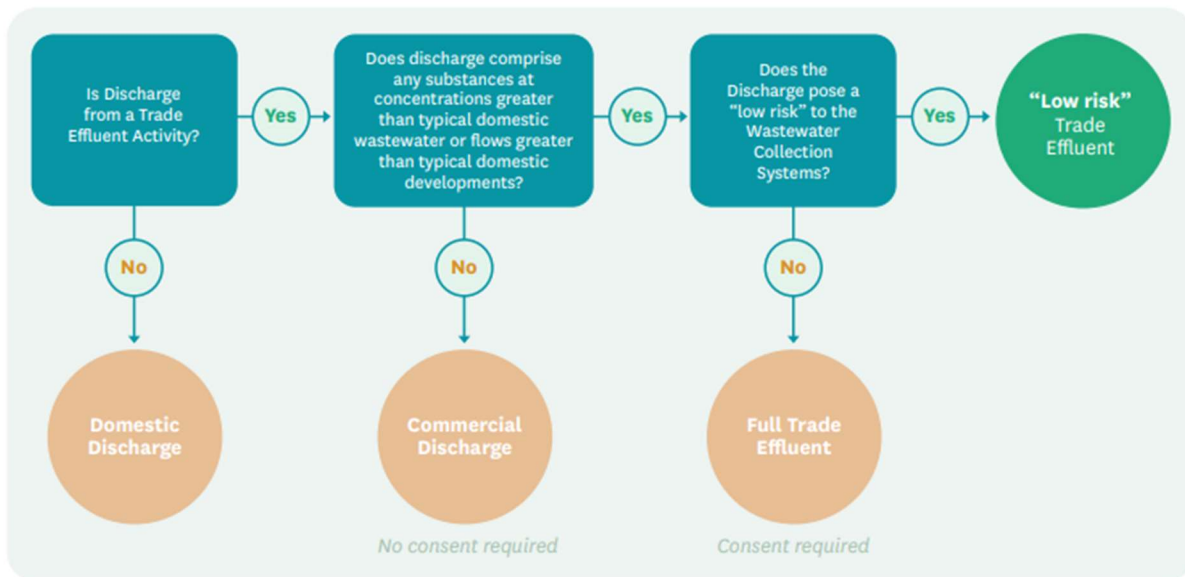


FIGURE 8.6 Trade effluent discharge characterization chart in the Emirate of Abu Dhabi.
 SOURCE: QCC 2010.