

SECTOR ASSESSMENT (SUMMARY): WATER AND OTHER URBAN INFRASTRUCTURE AND SERVICES

Sector Road Map

1. Sector Performance, Problems, and Opportunities

1. The incidence of waterborne disease on Ebeye, an island within Kwajalein Atoll, is high by international standards: about one reported case per eight residents each year. Since 2001, Ebeye Hospital has recorded an average of 1,182 cases per year of waterborne disease, primarily gastroenteritis. The high incidence of waterborne disease is due to (i) limited access to safe water; (ii) ineffective hygiene, particularly among children; and (iii) a dilapidated sanitation system. Crammed living conditions exacerbate the incidence of waterborne disease on Ebeye, which has a population density of 31,013 per square kilometer. The average household on Ebeye has 7.8 members. However, many households are larger, some with as many as 20 members and in extreme cases up to 40 members.

2. **Limited sources of freshwater.** The primary sources of potable water for households on Ebeye are the public freshwater supply (78%), household rainwater tanks (21%), and bottled water (1%). The Kwajalein Joint Utility Resource, Inc. (KAJUR). operates the public freshwater supply system. Local sources of potable water are limited to rainwater capture from roof runoff and water produced by saltwater reverse osmosis (SWRO) desalination. Ebeye has minimal groundwater reserves, known as freshwater lens, and no freshwater streams. Other sources of potable water include imported bottled water and potable water shipped to Ebeye from the United States Army Base Kwajalein Atoll (an island about 4 kilometers south of Ebeye). The Marshall Islands is projected to have more hot days and warm nights in the future. While rainfall projections are uncertain, the wet season generally is expected to increase as will the frequency and severity of droughts.

3. **Limited public freshwater supply.** KAJUR produces water for the public freshwater supply by reverse osmosis. The Ebeye SWRO plant has four units with the following rated freshwater production capacities: 387,500 liters per day (units 1 and 2), 581,250 liters per day (unit 3), and 116,250 liters per day (Unit 4). The first two units were installed in 2000, but unit 1 has not operated since 2005 and unit 2 has not worked since 2011 because essential spare parts are no longer available. Unit 3, commissioned in 2001, produces an average of 474,000 liters per day, but it requires about 20% more energy than modern SWRO plants to produce the equivalent volume of potable water. Unit 4 was commissioned in 2014 and is operating at about 67% of its rated capacity.¹ In total, the SWRO plant produces about 590,100 liters of freshwater daily, potentially providing 61.5 liters per day to each Ebeye resident.

4. However, less than half of the freshwater supply is available as potable water because of leaks in the freshwater supply network. Freshwater production capacity is also constrained by the limited capacity of the saltwater water supply system. Freshwater is delivered to households through the water supply network for about 1 hour per week. Although KAJUR provides a water carting service, most households cannot afford the delivery charge and are forced to obtain water from a water filling station operated by KAJUR when household supplies are depleted.

5. Households are increasingly harvesting rainwater to increase access to potable water, but this source is not secure because of seasonal rainfall patterns and more frequent droughts. In

¹ The United States provided unit 4 as part of its response to the Marshall Islands' drought disaster in 2013.

drought years, water stored in rainwater tanks is rapidly consumed and tanks may not be replenished for long periods. Maintenance of rainwater harvesting facilities is also an issue because most households do not have the money for repairs or replacement parts. Limited maintenance of rainwater tanks, particularly cleaning and disinfection of storage tanks, reduces the effectiveness of rainwater harvesting and can be a source of waterborne illnesses. The government's Environmental Protection Authority (EPA) is responsible for monitoring the quality of public and private water supplies, focusing primarily on bacterial contamination. In 2011, the EPA found that most rainwater tanks in the country tested positive for pathogens. The main causes of contamination were (i) infrequent cleaning of rainwater harvesting systems; (ii) lack of covers on top of tanks; (iii) use of bails (tin cans) to obtain water because some tanks do not have outlets; (iv) belief by some households that water in rainwater tanks is free of contamination, and therefore does not need to be disinfected; and (v) limited access and affordability of household bleach on some remote outer islands. The EPA reports that most schools on Ebeye discontinued the supply of rainwater for drinking in 2009 and encourage students to provide their own water.

6. **Dilapidated sewer system.** The Ebeye saltwater sewerage system was commissioned in 1967 to service the southern half of the island. Until the construction of a sewage treatment plant (oxidation ditch) in the mid-1970s, raw sewage was discharged directly into Kwajalein Lagoon via a 120-meter outfall. The sewerage network was expanded during the construction of the sewage treatment plant to service the northern side of Ebeye. The sewerage collection system now comprises 2.9 kilometers of gravity sewers and force mains, 53 manholes, and 4 pump stations. Saltwater for the operation for the sewer system is sourced from two deep wells and is pumped through a dedicated saltwater reticulation network to all parts of Ebeye with the exception of the northwest corner of the island. The saltwater reticulation mains also serve as firefighting mains.

7. The sewerage system has progressively failed because of a lack of maintenance. The sewage treatment plant has not operated since 2000 because of the failure of the brush aerators, and untreated sewage is discharged directly into the lagoon. All four pump stations have only one pump, which frequently breaks down and results in uncontrolled sewage overflows from the pump stations. A 1978 report prepared by the United States Army Corps of Engineers estimated that infiltration of groundwater into the sewers on the northern side of Ebeye accounted for 50% of the flow within the sewers. The American Samoa Power Authority, which operated Ebeye's power, water, and sewerage systems from the late 1990s to about 2004, reported that emptying the wet well of one pump station during high tide was impossible, indicating significant sea water infiltration. In 2003, the New Zealand consulting firm Beca International reported that the high infiltration levels undermine the performance of pumping equipment and overload the hydraulics of Ebeye's sewer system. The reticulated saltwater system suffers from saltwater infiltration during high tides, which can cause raw sewage to overflow from manholes and pump stations into the streets. Pressure in the saltwater reticulation mains is insufficient to operate fire hydrants and only capable of supplying water to ground floor sanitary systems in multistory buildings.

8. Overflows from the sewerage network and discharge of raw sewage to the lagoon present a serious health hazard. Water quality testing by the EPA from August 2011 to April 2014 indicated significant fecal coliform counts (enterococci)—well above the country's standard for marine water quality—at a number of locations on Ebeye's lagoon foreshore.² The impact of raw

² The standard for marine water quality is articulated in the country's Marine Water Quality Regulations (1992). The regulations classify the coastal waters on the lagoon side of Ebeye as class B. For Class B waters, the fecal coliform content shall not exceed an arithmetic average of 200 most probable number (MPN)/100 milliliters (ml) for any consecutive samples. Nor shall any single sample exceed 400 MPN/100 ml. The regulations further stipulate that the enterococci count shall not exceed an arithmetic average of 7 MPN/100 ml in not less than 5 samples equally spaced over a 30-day period.

sewage discharges on the aquatic ecosystems and marine life within the lagoon, including the fish and shellfish that are a source of food for people on Ebeye, is unknown. However, high levels of algal overgrowth and nutrient loading is visible, although quantitative data is not available.

9. **Financially unsustainable water and sewerage services.** Since 2008, KAJUR has recorded operating losses of \$2 million or more and operating revenue less than 65% of expenditure for most fiscal years. The gap between expenditure and operating revenue has narrowed since FY2009, and the operational loss in FY2013 was \$1.6 million. Electricity services accounted for about 94% of KAJUR's operating revenue for FY2013. KAJUR has financed the gap between expenditure and operating revenues from grants provided by the United States under the Compact of Free association. KAJUR understands that the services it delivers are financially unsustainable. KAJUR has developed a comprehensive reform strategy to improve its financial sustainability through better operational efficiency and higher revenues.

10. KAJUR provides water supply and sewerage services for free with the exception of bulk sales from Ebeye's filling station. Freshwater and saltwater consumer connections are unmetered. The KAJUR reform strategy includes plans to introduce charges for water supply and sewerage services starting in mid-2016. A block tariff structure for residential water customers is proposed with a lifeline tariff of \$5.00 per 3,785 liters applying to the first 7,571 liters consumed within a month. A charge of \$6.00 per 3,785 liters is proposed for residential consumption exceeding 7,571 liters per month and increased 15% per year to 2021. The lifeline tariff rate will remain fixed at \$5.00 per 13,785 liters until 2021. A flat rate sewer charge of \$10 per month for residential customers is also proposed and is not expected to change before 2017.

11. A water sales experiment was conducted in one of the poorest *wetos* (village) on Ebeye to assess the willingness to pay for water produced and delivered to households by KAJUR. The threshold at which demand increased in the wider population is \$0.005 per liter (or \$20 per 3,785 liters). This suggests that \$0.005 per liter is approaching the market value and is substantially higher than the water charges proposed by KAJUR.

12. **Reliance on electricity supply.** Because of the topography and the scarcity of freshwater, the water supply and sewerage systems on Ebeye rely on the electricity distribution system to (i) pump saltwater from wells to the SWRO plant and to the saltwater sewerage system, (ii) operate the SWRO plant for production of freshwater, (iii) distribute freshwater through the freshwater supply network, and (iv) operate the sewage pump stations. Without electricity, Ebeye's water supply and sewerage system cannot operate. Overall, Ebeye's electricity system is reliable and in good condition, and continuously meets the island's demand for electricity. However, several components of the electricity distribution system have outlived their design lives or require replacement, which could threaten the security of Ebeye's water supply and sewerage systems. The high-voltage busbars and protection systems and high-voltage switchgear at the Ebeye power station are more than 40 years old and rapidly deteriorating. In addition, most wooden power poles are in poor condition because of termite attacks. The power station monitoring system requires replacement as it is obsolete and does not capture the data required to efficiently operate the station.

13. **Awareness on hygiene and water-related issues.** Public awareness and education on hygiene and water-related issues is low, and awareness and education activities and outreach are limited. A long-duration hygiene and water awareness campaign is needed to foster the sustained behavioral change required to improve hygiene and reduce the incidence of waterborne diseases. Campaigns need to focus on women and children (children constitute 45% of Ebeye's population) through programs delivered to womens' groups and in schools. Upgrading school

sanitation facilities on Ebeye, where the ratio of students to functioning toilets exceeds 150 to 1 in some cases, is necessary to foster improved hygiene behaviors among Ebeye's students.

2. Government's Sector Strategy

14. The project is consistent with the Marshall Islands' national development theme, as articulated in National Strategic Plan, 2015–2017,³ to build “a sound infrastructure that provides energy, environmental, infrastructure, and transportation security for all atolls.” The project is well aligned with the government's National Water and Sanitation Policy goals to (i) reduce the occurrence of waterborne illness, (ii) ensure water resource sustainability, (iii) ensure water and sanitation utilities are financially solvent, (iv) target service improvements at the disadvantaged, and (v) build resilience to climate variability and extreme events.

3. ADB Sector Experience and Assistance Program

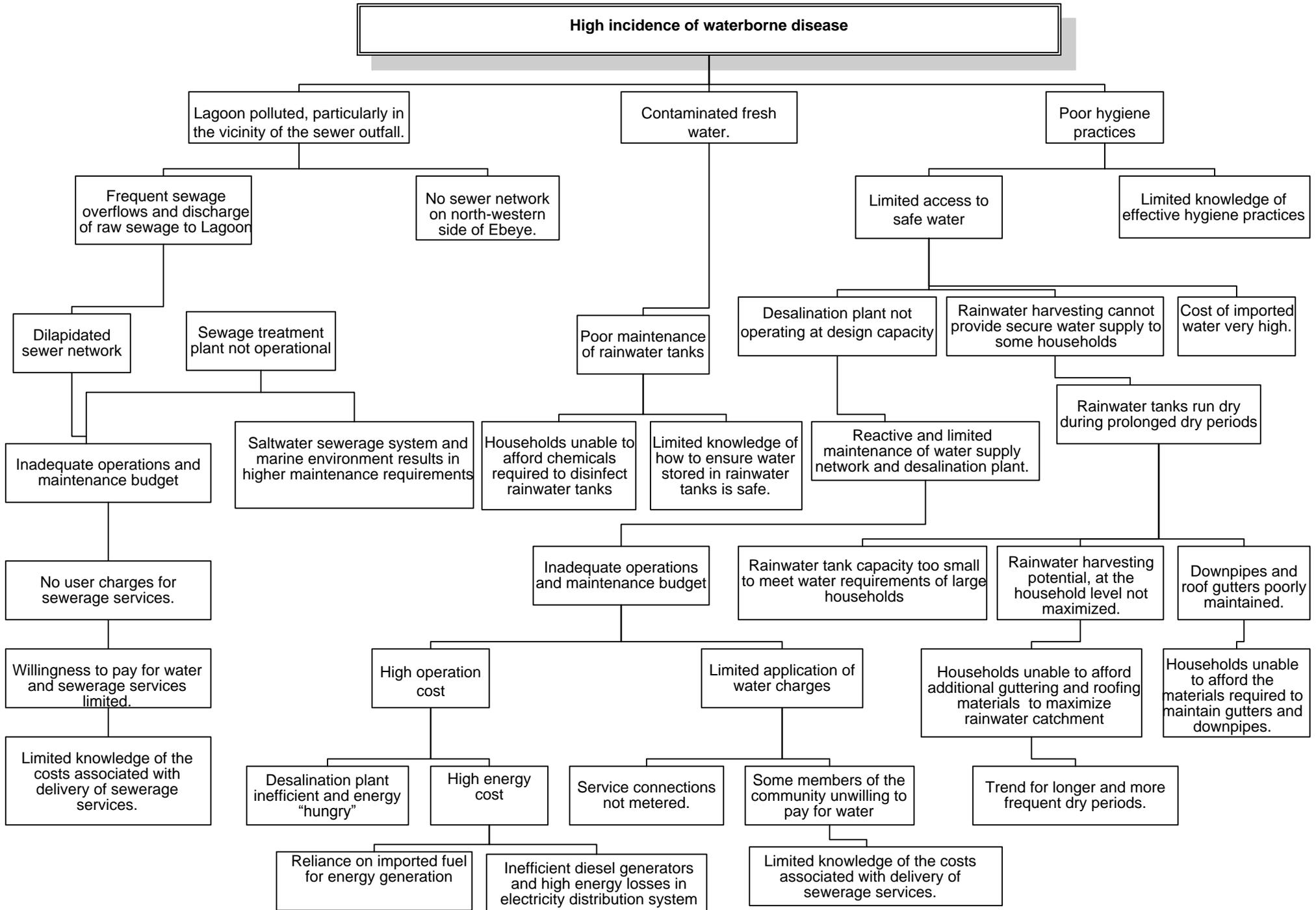
15. ADB's most recent assistance to the sector was the Majuro Water Supply and Sanitation Project, which was approved in September 1995 and closed in April 2002. It was evaluated as *partly successful*. Key lessons from the project include the following: (i) lack of adequate consultation at the project preparatory stage and at the design stage with the end user and other stakeholders can reduce the impact of a project; (ii) a thorough understanding of local conditions, the operational setup of the utilities concerned, and the cultural environment in which the project will operate are vital to proper design and implementation; and (iii) assumptions on revenue growth and tariff increases must be based on social indicators that are not unrealistically high.

16. ADB's most recent project on Ebeye was the Ebeye Health and Infrastructure Project, which was approved in August 1999 and closed in December 2003. The project included components to upgrade Ebeye's water supply and sewerage systems. It was evaluated as *highly successful*. Key lessons of the Ebeye Health and Infrastructure Project include the following: (i) minimal implementation problems were encountered because (a) adequate consultations were undertaken with all stakeholders during project preparation; (b) a domestic project manager headed the project management unit; (c) the government, particularly the Office of the President, provided full support; and (d) ADB provided some flexibility in implementation to address the special circumstances of the project; and (ii) given the isolation and remoteness of the location, an implementation period longer than 30 months should have been provided.

17. The project will provide (i) secure and safe freshwater supplies, (ii) effective and efficient sewerage services, (iii) enhanced hygiene awareness and improved hygiene behaviors, (iv) secure electricity supply for water supply and sewerage operations, and (v) effective project management. It will also ensure KAJUR is financially and technically sustainable.

³ The Government of the Marshall Islands. 2014. *National Strategic Plan, 2015–2017*. Majuro.

Problem Tree for Water and Other Urban Infrastructure and Services



Sector Results Framework (Water and Other Urban Infrastructure and Services, 2015–2021)

Country Sector Outcomes		Country Sector Outputs		ADB Sector Operations	
Outcomes with ADB Contribution	Indicators with Targets and Baselines	Outputs with ADB Contribution	Indicators with Incremental Targets	Planned and Ongoing ADB Interventions	Main Outputs Expected from ADB Interventions
More people have access to improved clean drinking water and sanitation services.	By the end of 2015, 95% of households have access to improved water and sanitation.	More people have access to improved clean drinking water and sanitation services.	<p>The proportion of the urban population with access to safe water increased to 95% by 2021 (2010 baseline: 92%)</p> <p>The proportion of the urban population with access to improved sanitation increased to 90% by 2021 (2010 baseline: 83%)</p>	<p>Planned target subsectors</p> <p>Secure and safe freshwater supplies (64% of funds)</p> <p>Effective and efficient sewerage services (34% of funds)</p> <p>Enhanced hygiene awareness and improved hygiene behaviors (2% of funds)</p> <p>Pipeline projects with estimated amounts</p> <p>Ebeye Water Supply and Sanitation Project (\$5 million)</p> <p>Ongoing projects with approved amounts</p> <p>None</p>	<p>Planned target subsectors</p> <p>About 1,250 households with new or improved water supply by 2021.</p> <p>100% of households connected to sewerage collection and treatment system by 2021.</p> <p>Incidence of waterborne diseases is reduced by 20% by 2023.</p> <p>Pipeline projects</p> <p>About 1,250 households with new or improved water supply by 2021.</p> <p>100% of households connected to sewerage collection and treatment system by 2021.</p> <p>Incidence of waterborne diseases is reduced by 20% by 2023.</p> <p>Ongoing projects</p> <p>None.</p>

ADB = Asian Development Bank.
Source: ADB.