

SUSTAINABILITY REPORT 2022



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ABOUT THIS REPORT

With the publication of this Sustainability Report, PUB acknowledges the role we play as Singapore's national water agency in managing our activities and impacts in a sustainable and responsible manner. This report covers PUB's sustainability approach, initiatives and performance for our key environmental, social and governance ("ESG") topics.

For a more comprehensive view of PUB's business and performance, we recommend that this report be read together with PUB's Annual Report 2021/2022.

For any questions or feedback on the report, please email TIN_Jing_Jie@pub.gov.sg

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REPORTING SCOPE AND PERIOD

The report covers our performance from 1 April 2021 to 31 March 2022 ("FY2021") unless otherwise stated. Where available, the prior year ("FY2020") data has been included for comparison. The reporting scope of the Sustainability Report is aligned with PUB's GreenGov.SG reporting submissions.

REPORTING STANDARDS

This report has been prepared in accordance with the GRI Sustainability Reporting Standards ("GRI Standards").

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ABOUT PUB: OUR VITAL ROLE

OUR MISSION

Supply Good Water. Reclaim Used Water. Tame Stormwater. Resist Rising Seas.

OUR VISION

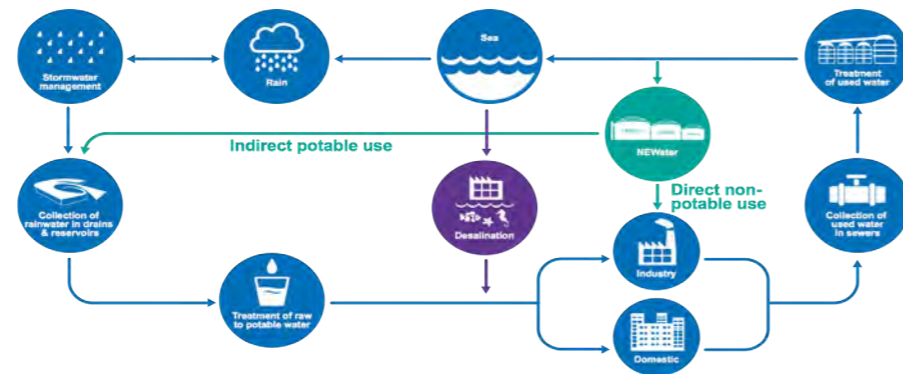
Water for Every One. Everyone for Water.

SINGAPORE'S NATIONAL WATER AGENCY

PUB is a statutory board under the Ministry of Sustainability and the Environment (MSE). As Singapore's National Water Agency, PUB is responsible for the collection, production, distribution and reclamation of water in an integrated manner. In April 2020, PUB was appointed the national Coastal Protection Agency to lead, coordinate and explore Whole-of-Government efforts to protect Singapore's coastline.

Water is vital to Singapore's survival. Through the Four National Taps strategy (water from local catchment, imported water, NEWater and desalinated water), PUB has ensured a diversified and sustainable supply of good-quality water for Singapore. PUB leads and coordinates Whole-of-Government efforts to protect Singapore from the threat of rising seas and manages inland and coastal flood risks in a holistic manner.

PUB calls on everyone to use water wisely, save water, keep our waterways clean and care for Singapore's precious water resources. Together, we can ensure that there will always be enough water for a vibrant, thriving Singapore.



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CHAIRMAN'S MESSAGE



CHIANG CHIE FOO

Chairman

PUB, Singapore's National Water Agency

Singaporeans today enjoy universal access to clean, safe drinking water with the simple turn of a tap anytime, anywhere. We sometimes forget that Singapore's quest to provide secure and sustainable water for the country did not come easy. The World Resources Institute has ranked Singapore as one of the most water-stressed countries in the world and the Singapore Water Story is one where we strive to secure a sustainable water system for all. Long-term planning, tackling long-term challenges using innovative and technological solutions, and investing ahead of our needs are ingredients that have made this story possible. The strive for a secure and sustainable water system continues as new challenges emerge. It is a never-ending story.

As an island nation with a total land area of about 730km², land and water are both scarce resources. Despite abundant rainfall, Singapore cannot achieve water security in a conventional way due to a lack of land to store and capture rainwater. From our humble beginnings in the 1960s where MacRitchie, Peirce and Seletar Reservoirs were the main domestic sources of water, Singapore has come a long way in our sustainable water journey. Since the development of Singapore's first Water Master Plan in the 1970s, PUB has built a robust, diversified and resilient water system with the introduction of NEWater and Desalinated Water. The development of these sources of water would not have been possible without forward planning, committed and sustained investments in research and development and, most importantly, good men and women at the heart of PUB who are dedicated to delivering PUB's mission.

Even as we expand Singapore's water infrastructure and strive to ensure the adequacy of our water resources, we recognise that climate change has now become the defining challenge for all of us. We are making strides in strengthening flood resilience by improving our drainage infrastructure to cope with extreme rainfall, and boosting flood response capabilities. Our enhanced rainfall nowcasting and monitoring help to give extremely valuable reaction time in the event of

extreme rainfall. We are also developing a Coastal Protection Master Plan to future-proof Singapore's coastlines. We have commenced two site-specific studies since 2021, along Singapore's City-East Coast and the north-west coast, where we aim to develop strategies that are flexible and adaptable as well as complementary to other land use needs.

Mitigating carbon emissions and adopting sustainable energy are critical components in PUB's sustainability journey in light of the challenges brought about by climate change. In October 2022, the Public Sector and Singapore have announced targets to achieve net zero emissions around 2045 and by 2050 respectively to secure a greener and more sustainable living environment for future generations. Under the GreenGov.SG sustainability movement launched in 2021 as part of the Singapore Green Plan 2030, the public sector aims to spearhead sustainability efforts at the national level and has committed to peak carbon emissions by 2025 and increase solar deployment to 1.5GWp by 2030. PUB will leverage renewable energy sources, energy-efficient technologies and innovative carbon capture solutions to deliver on these targets.

I am confident that, with the support of the general public, businesses, industries and stakeholders, PUB will achieve net zero emissions and a sustainable water system for all Singaporeans.

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CHIEF EXECUTIVE'S MESSAGE



GOH SI HOU

Chief Executive
PUB, Singapore's National Water Agency

SUSTAINABILITY AT OUR CORE

Climate change will significantly impact PUB's ability to achieve our mission. With more volatile weather conditions, the risk of extended dry spells threatens the sustainability of Singapore's Water System. More intense storms will lead to a higher risk of flooding, while sea-level rise threatens to inundate Singapore's low-lying coastlines.

At the same time, our core operations, from water treatment to used water reclamation, are energy dependent and contribute to carbon emissions. Our expanded national taps, including NEWater and desalination, will be more energy intensive than conventional water treatment. Transitioning to a low-carbon future will require a redesign of our operations and a concerted push towards technological innovation. We must also pursue sustainable development in meeting our goal of water security, by developing infrastructure in an environmentally sensitive approach.

Sustainability must therefore be at the core of PUB. It will define our mission success, as well as fundamentally shape the way we

operate going forward. For PUB, we must step up our efforts to make the long-term transition to a low-carbon future, even as we continue to develop new water infrastructure to strengthen the resiliency of our water system. This Sustainability Report lays out PUB's sustainability strategies, achievements and upcoming initiatives towards our goal of **a green and sustainable water system for Singapore**.

ENHANCING DROUGHT RESILIENCE

2022 marks a special milestone in PUB's Sustainability journey. This year, we celebrated the 20th Anniversary of NEWater, our third National Tap. Since its launch in 2002, NEWater has been indispensable in ensuring the sustainability of Singapore's water supply, allowing us to close the water loop while cushioning our water supply against the vagaries of weather. This year, we also commissioned the Jurong Island Desalination Plant (JIDP), Singapore's fifth desalination plant, as part of our fourth National Tap. JIDP is more energy efficient than conventional desalination plants due to its co-location with a power plant. As desalination remains the most energy-intensive source of water, such innovative approaches are key as we strive to reduce the energy required to produce the next drop of water.

COMMITMENT TOWARDS DECARBONISATION

In line with the public sector's target as announced in October 2022, PUB targets to achieve net zero emissions around 2045, contingent on the progress of technologies and international cooperation to enable mitigation measures. PUB's decarbonisation strategy is underpinned by 3Rs—Replace, Reduce and Remove.

First, we aim to replace carbon-based energy with renewable energy. Solar energy has the highest potential in Singapore. PUB's endeavour has already begun with the opening of the 60MWp solar farm at Tengeh Reservoir, Singapore's first large-scale inland floating solar farm, in 2021.

Second, we aim to reduce carbon emissions by improving the energy efficiency of our treatment processes. This involves

the development of new technologies through Research and Development. For instance, we are investing in the use of biomimetic membranes, to reduce the energy consumption of desalination from 3.5kWh/m³ to 2kWh/m³.

Third, we aim to explore technologies to capture and remove carbon. While these are yet to be proven at scale, this is a critical pathway for PUB and Singapore to achieve our net-zero targets, as we do not have ready access to alternative energy. We are leveraging our experience in water and wastewater treatment as well as our network of research partners, to source for solutions that can be integrated with PUB's operations. For instance, PUB is exploring the use of electrolysis technology to capture carbon dioxide in seawater, which could in turn reduce the energy consumption of desalination.

COASTAL PROTECTION AND FLOOD RESILIENCE

Singapore is vulnerable to sea level rise because 30% of our land is less than 5 metres above the mean sea level. As Singapore's national Coastal Protection Agency, PUB seeks to develop effective coastal protection measures against long-term sea level rise, while re-imagining our coastlines as multi-functional spaces to add value to our community. To manage inland flood risks due to climate change, PUB is masterplanning our drainage system to cater for higher rainfall intensity, and developing capabilities in rainfall nowcast and enhancing flood responses. We are also building an integrated Coastal Inland Flood Model to assess coastal and inland flood risk in a holistic manner.

SUSTAINABLE FINANCING

PUB has also developed a Green Financing Framework to meet our goals in sustainable development. To ensure good governance, our framework is based on the International Capital Market Association Green Bond Principles 2021 and ASEAN Green Bond Standards 2018. This year, we raised SGD 800 Million in our inaugural Green Bond issuance. Net proceeds from the Green Bonds will be used to fund sustainable projects in our pursuit towards a low-carbon future. For example, this could support the funding of our new Tuas Water Reclamation Plant (TWRP) which is co-located with the National Environment Agency (NEA)'s

Integrated Waste Management Facility to collectively form Tuas Nexus. It marks Singapore's first initiative to harness potential synergies of the water-energy-waste nexus by integrating used water and solid waste treatment processes to make TWRP energy self-sufficient, hence reducing our carbon emissions.

BUILDING CAPACITY

Our people are the main driving force of PUB's operations and transformation. With sustainability at our core, we aim to equip and upskill our workforce so that they can advance our sustainability agenda effectively. We are developing a Sustainability Competency Framework that will guide our workforce development, and provide our people with an appreciation of the evolving policy and technology landscape as well as the skillsets to drive sustainability efforts. This will enable PUB to unlock the potential and aspirations of our people to achieve a green and sustainable water system for Singapore.

BUILDING PARTNERSHIPS

The theme of sustainability and climate action has also become integral to our partnerships with industry and research partners. The Singapore International Water Week held in April 2022 marked a new focus on the implications of climate change on the resilience of our water resources, as well as coastal protection and flood resilience. The event was enriched by the exchange of best practices across government and industry to tackle climate change and harness opportunities. This year, PUB is also establishing a new Coastal Protection and Flood Management Research Programme, to work with our research institutes and industry to pioneer new approaches and solutions to protect Singapore from the long-term threat of sea level rise and more intense rainfall.

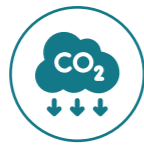
Climate change may be a defining challenge for us, but our Water Story has always been one of overcoming challenges and constraints through bold vision and purposeful action. PUB has set out ambitious sustainability goals and targets for the immediate and longer term. We cannot do this alone, and will continue to leverage the collective strengths and expertise of our partners. We look forward to working together to navigate this challenging but exciting journey ahead.

KEY PERFORMANCE SNAPSHOT FOR FY2021

WATER AND SUSTAINABLE MANAGEMENT



MAINTAINED 100%
of water-quality tests meeting **WHO drinking water guidelines**



6% REDUCTION
in CO₂-eq of emissions to **279kt**



40% INCREASE
in renewable energy deployment to **140.5 GWh**



4% REDUCTION
in waste generated to **193,393 tons**



9% REDUCTION
in potable water consumption to **199,773 m³**

CAPABLE AND ENGAGED WORKFORCE



15% INCREASE
in training hours per staff to **52 hours**

STRONG PARTNERSHIPS



0.5% INCREASE
in number of customer feedback resolved within 3 working days to **93.5%**¹

BUSINESS EXCELLENCE



\$7.4M
of cost savings expected from **192**¹ staff innovation projects



3% INCREASE
in total awarded value of R&D projects since 2002¹ to **\$837 mil**²

¹ Data reported is for CY2021 and benchmarked against CY2020 performance. All other data reported is for FY2021 and benchmarked against FY2021 performance.

² Projects have contributed to a 30% footprint reduction at Tuas Water Reclamation Plant compared to conventional treatment processes, and a reduction in specific energy consumption from 3.5kWh/m³ to 2.6 kWh/m³ for desalination and an improvement in used water treatment self-sufficiency to 85% in R&D pilot projects.

HIGHLIGHTS

PILLAR 1: WATER AND SUSTAINABLE MANAGEMENT

Jurong Island Desalination Plant—Singapore's Fifth Desalination Plant

The Jurong Island Desalination Plant, Singapore's fifth desalination plant, was officially opened on 17 April 2022. Given its co-location with an existing power plant, the Jurong Island Desalination Plant can save up to 5,000 MWh per year which can power nearly 1,000 HDB households annually. For more information, please refer to [page 19](#) of this report.



An aerial view of the Jurong Island Desalination Plant. (Photo: PUB)

CLEAN WATER
from
CLEAN ENERGY



Ambition to Achieve Net-Zero Emissions

In line with the public sector's target as announced in October 2022, PUB will target to achieve net-zero emissions³ around 2045, contingent on the progress of technologies and international cooperation to enable mitigation measures. PUB's emissions have already peaked in FY20 at about 298kt-CO₂eq. PUB's decarbonisation strategy involves 3Rs—replacing fossil fuel-based energy sources with renewable sources, reducing carbon emissions through energy efficiency and water conservation, as well as removing carbon through carbon capture, utilisation and removal technologies. For more information, please refer to [page 25](#) of this report.

PUB is investing in solar deployment to green our operations.

Digitalising Water Demand Management

Under the first phase of the Smart Water Meter Programme, PUB is rolling out some 300,000 smart water meters in residential, commercial and industrial premises across 7 locations (Tampines, Hougang, Bukit Batok, Jurong West, Tuas and new estates in Tengah and Tampines North). Installation of the first batch of Smart Water Meters commenced on January 2022 at Tampines Central. Besides delivering good customer experience, it could help to reduce domestic water consumption when customers have real-time information. For more information, please refer to [page 21](#) of this report.



The Smart Water Meter helps customers conserve water and stay on top of their water usage.

³ PUB's Net Zero 2045 target pertains to Scope 1 and 2 Emissions.

PILLAR 2: CAPABLE AND ENGAGED WORKFORCE



Sustainability Competency Framework

With growing emphasis on environmental sustainability and climate change, a Sustainability Competency Framework co-developed by PUB with agencies within the MSE family will equip our officers with broad knowledge and awareness of sustainability-related issues. The Competency Framework will also provide staff who hold sustainability-related portfolios with the necessary skill sets to perform their work, such as comprehensive environmental studies and stakeholder engagement. For more information, please refer to **page 39** of this report.

PILLAR 3: STRONG PARTNERSHIPS

Singapore World Water Day (SWWD) 2022

Annually, PUB launches the “Make Every Drop Count” campaign and celebrates SWWD in March, which coincides with the United Nation’s World Water Day (22 March 2022). Through various initiatives, we remind and rally the public to appreciate and be conscious about using water wisely and responsibly. In 2022, PUB partnered with some 460 organisations including grassroots, schools, retailers and corporate partners, who promoted the water cause through community events and retail promotions as part of the #Goblue4SG movement. For more information, please refer to **page 46**.



ArtScience Museum turns blue in support of Singapore World Water Day 2022.

PILLAR 4: BUSINESS EXCELLENCE



Ms Grace Fu, Minister for Sustainability and the Environment, Singapore delivered the opening address of the Singapore International Water Week and CleanEnviro Summit Singapore 2022.

Singapore International Water Week (SIWW)

SIWW 2022 returned as an in-person event from 17–21 April 2022 at the Sands Expo & Convention Centre. Held alongside the CleanEnviro Summit Singapore, both events hosted over 11,000 delegates and visitors from 65 countries and regions, and 300 participating exhibitors. At SIWW2022, emerging themes such as climate mitigation and adaptation, resource circularity, net zero, decarbonisation and coastal protection were discussed to spur innovation and share sustainable solutions and best practices. For more information, please refer to **page 53** of this report.

PUB’S SUSTAINABILITY JOURNEY

Sustainability is not new to PUB. Since our formation in the 1960s, PUB has strived to strengthen and diversify Singapore’s water resources for a sustainable water system.

1970s

PLANNING FOR A SUSTAINABLE WATER SYSTEM

The first water conservation campaign was launched in 1971, at a time when Singapore was facing the threat of water rationing after a prolonged dry spell. To ensure an adequate, diversified supply of water to meet Singapore’s needs, the seeds of our Four National Taps Strategy were sown into Singapore’s first Water Master Plan, which was drawn up in 1972.

1980s

CLEAN AND CLEAR WATERS

Launched in 1977, the Singapore River clean-up was a multi-agency effort that spanned over a decade. Besides the physical cleaning of the heavily polluted waters, proper sewerage infrastructure and anti-pollution measures were implemented to minimise pollution and protect our precious waterways.

1990s

EXPLORING UNCONVENTIONAL SOURCES

It was not until the late 1990s, through significant improvements in the cost and performance of membrane technology, that reclaimed water became a viable water source. In 1998, PUB laid the foundation for the launch of Singapore’s 3rd National Tap—NEWater—by testing the application of the latest proven membrane technology for water reuse, through a NEWater demonstration plant, supported by a comprehensive scientific review of the water quality as well as public outreach programmes.

2000s

DIVERSIFYING OUR WATER RESOURCES

NEWater was officially launched with the commissioning of PUB’s first NEWater Factories in Bedok and Kranji in February 2003. In September 2005, with the opening of the SingSpring Desalination Plant, Singapore further diversified its water sources and turned on its 4th National Tap.

2010s

STRENGTHENING WATER RESILIENCE

PUB commissioned several water infrastructure in the 2010s to build up our 3rd and 4th National Taps and strengthen Singapore’s water resilience, such as the Changi NEWater Factories 1 and 2 and the Tuas Desalination Plant. PUB also made significant R&D investments and constructed an Integrated Validation Plant (IVP) in 2017, which allowed PUB to assess and validate new and innovative used water treatment technologies for deployment at upcoming water infrastructure, such as the Tuas Water Reclamation Plant.

2020s

POSITIONING PUB FOR A NEW DECADE

As PUB transitions into a new decade, we are taking steps to address the perennial challenges of extreme weather and rising sea levels due to climate change, while tackling emerging challenges such as higher energy prices and the imperative to ensure water sustainability. Our priorities are as follows:

- **Resisting Rising Seas**
As Singapore’s national Coastal Protection Agency, PUB is working with agencies to develop a Coastal Protection Master Plan underpinned by holistic risk assessment, adaptive and flexible approach and integrated planning to protect Singapore from rising sea levels.
- **Decarbonising PUB’s Operations**
To do our part in mitigating the impact of climate change, PUB is committed to reducing our carbon footprint. PUB adopts a three-pronged approach to replace fossil fuel-based energy with renewable sources, reduce electricity consumption through developing and implementing energy-efficient technologies and water conservation, as well as remove carbon through carbon capture and utilisation solutions that can be integrated with our water treatment facilities.
- **Increasing Energy Efficiency and Resource Circularity**
The upcoming Tuas Nexus will harness potential synergies of the water-energy-waste nexus by integrating used water and solid waste treatment processes. This maximises energy efficiency, generation and resource recovery while maintaining a small footprint.
- **Transforming into a Smart Utility**
To address rising energy prices and meet future challenges such as manpower constraints, PUB must do more with less to ensure that PUB delivers our mission seamlessly. To improve our operational efficiency and resilience, PUB has launched a SMART PUB Roadmap to guide PUB in our transformation journey. For example, the Smart Water Meter Programme enables remote monitoring of water consumption at a more granular level, and together with a customer portal, enables PUB to alert our customers so that they can take action to manage their water consumption as well as address suspected leaks within their premises, thereby saving costs, reducing manpower required for manual meter reads and conserving water.

PUB'S SUSTAINABILITY APPROACH

As PUB charts our sustainability journey, one key lesson we have learnt is to turn our vulnerability into our strength. Despite Singapore being ranked as one of the most water-stressed countries in the world,⁴ PUB has, over the past decades, focused on ensuring the adequacy of our water supplies through diversification into the four National Taps—imported water, local catchment, NEWater and desalinated water.

NEWater and desalinated water are two National Taps that are weather-resilient and would be what Singapore could count on, in times of drought, to meet our daily needs. However, these two National Taps need more energy to produce, as compared to water that is treated from rivers or surface reservoirs. It is hence important for PUB to seek innovative technologies that are more energy-efficient so that the carbon footprint from NEWater and desalinated water are kept to the lowest possible while ensuring the resilience of our water supply system.

Besides the drive to decarbonise, the current energy crisis, with the global surge in energy prices, further brings home the need for PUB to maximise the amount of renewable energy it can generate. In addition to enhancing the energy recovery from biogas in used water treatment, PUB has also been actively seeking opportunities to deploy more floating solar PV systems on its surface reservoirs. This allows PUB to make use of the vast surface area offered by the surface reservoirs, a rare commodity in land-scarce Singapore. This, however, requires careful planning and balancing between the various functions of the reservoirs, namely as a water supply, supporting recreational needs as well as to support the biodiversity and ecosystem in the vicinity.

Being an island city-state, Singapore is faced with another existential threat brought about by climate change—sea level rise. By 2100, the mean sea level is projected to rise up to 1 metre and could be up to 4–5 metres due to daily tidal activity, storm surges and land subsidence. This is of concern to Singapore, with about 30% of Singapore less than 5 metres above mean sea level. PUB, as Singapore's national Coastal Protection Agency, has been carrying out site-specific studies for vulnerable coastlines and exploring possible measures to hold back the rising seas. In the face of this perennial concern lies an immense opportunity for us to reimagine our coastline, as one that is liveable, adaptable and sustainable.

Be it the past, present or future, it is clear that sustainability will continue to be at the centre stage of PUB's operations, both in the context of climate change adaptation and mitigation. Hence the first and foremost pillar of PUB's Sustainability Framework is termed Water and Sustainable Management.

The other three pillars comprise, then, the supporting force that enables PUB to propel forward in our core mission of safeguarding a resilient and sustainable water supply for Singapore. At the heart of the organisation is PUB's committed workforce. PUB relies on a competent and skilled workforce to tackle new and emerging challenges while ensuring that the entire water system operates in a resource-efficient and sustainable manner. PUB recognises the importance of a competent, engaged and healthy workforce through the second pillar of PUB's Sustainability Framework, a Capable and Engaged Workforce.

Beyond PUB, everyone has a part to play in water conservation for a sustainable water system. Every drop not used is a drop that does not have to be produced. PUB strives to forge strong partnerships with the community, businesses and industries through Strong Partnerships, the third pillar of our Sustainability Framework. PUB must also constantly evolve, build on robust management systems and processes, and adapt to Industry 4.0. Through Business Excellence, the fourth pillar of PUB's Sustainability Framework, PUB embraces digital technology, innovation, strong governance systems and financial sustainability to support our sustainability efforts.

Singapore and PUB support the United Nations Sustainable Development Goals (SDGs). PUB has highlighted specific goals that are most relevant to our Sustainability Framework and operations. Reference has been made to guidance documents including the SDG Compass Inventory of Business Indicators, linking the SDGs and the GRI Standards published by the GRI, Singapore Statistics by the Department of Statistics Singapore and peer reports.

⁴ <https://www.wri.org/insights/ranking-worlds-most-water-stressed-countries-2040>.

DELIVERING OUR MISSION RESPONSIBILITY

Pillar 1: Water and Sustainable Management

Addresses the **importance of resource sustainability** as a major ingredient for PUB's mission, and PUB's responsibility in managing its environmental impacts.

- Sustainable Water System
- Resource Efficiency and Circularity
- Climate Change Adaptation

Mapped SDG



Pillar 2: Capable and Engaged Workforce

Addresses the **importance of our people** as the main driving force and cornerstone of PUB's operations.

- Health and Safety
- Competent Workforce
- Inclusive and Fair Workplace

Mapped SDG



Pillar 3: Strong Partnerships

Addresses the **importance of the shared responsibility of all stakeholders in the community** to conserve and protect our water resources and environment.

- Customer-centric Water Service
- Partnership and Engagement

Mapped SDG



Pillar 4: Business Excellence

Addresses the **importance of business excellence** to ensure a PUB that is responsible and trusted by all our stakeholders in delivering our mission.

- Trust and Transparency
- Innovation
- Digitalisation and Cybersecurity
- Financial Sustainability

Mapped SDG



GRI [2-29]

OUR STAKEHOLDER ENGAGEMENT

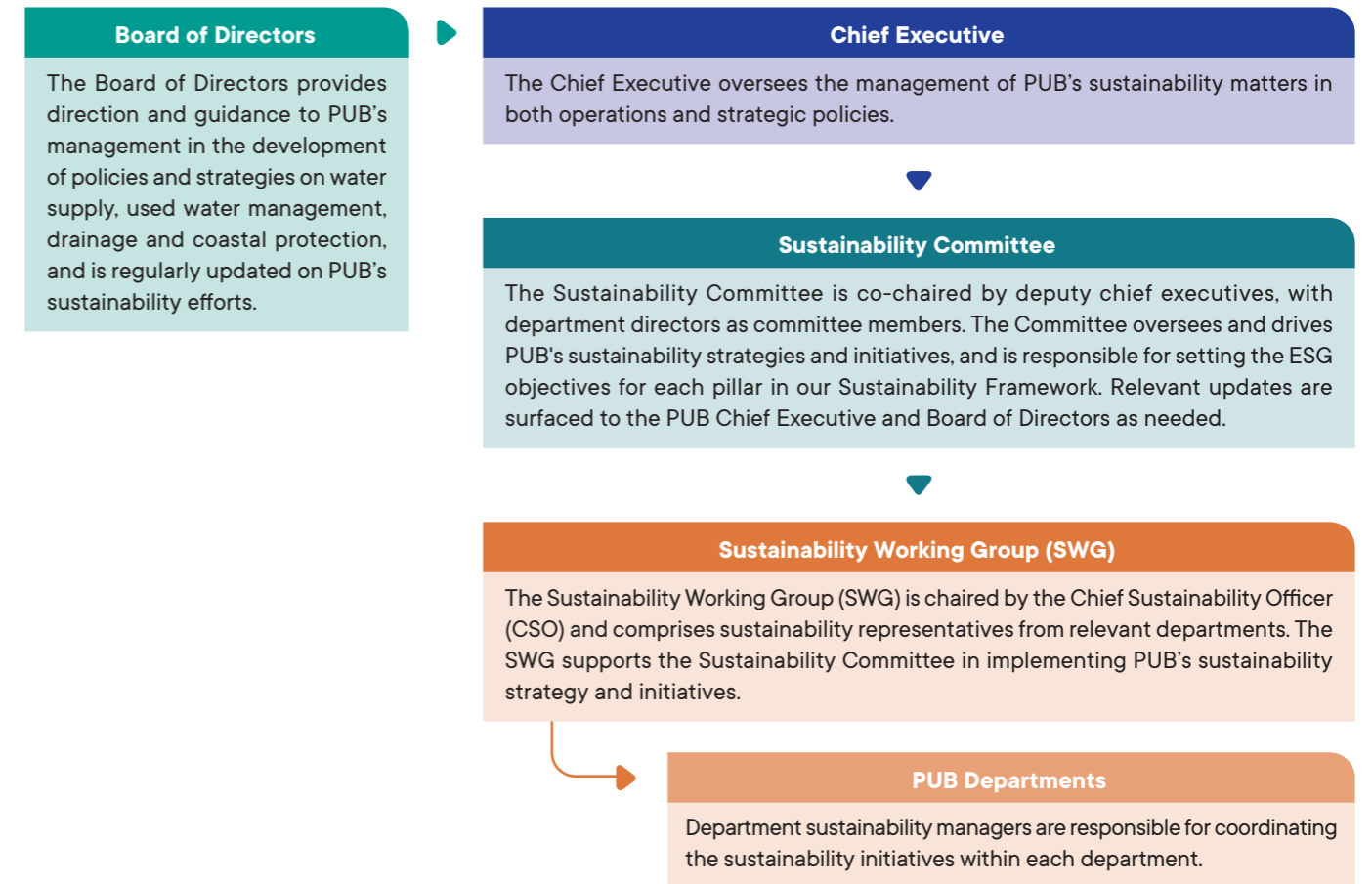
Stakeholder engagement and public outreach is important to PUB. We identify and select stakeholder groups based on the mutual impact of our activities on the group and vice versa. By doing so, we aim to identify actual and potential impact across our activities and business relationships in order to better understand the concerns of our stakeholders. This also enables us to share and educate them on PUB's work in fostering community stewardship and growing advocates for water sustainability.

KEY STAKEHOLDER GROUPS	ENGAGEMENT PLATFORMS AND DETAILS	FREQUENCY OF ENGAGEMENT
Public-sector agencies and ministries	• Inter-agency meetings and workgroups to facilitate and enable a Whole-of-Government approach in the public service.	• Workstream-dependent
	• Partner with agencies in events to celebrate and support Singapore World Water Day.	• Major event in March
Business community and research partners	• Organise dialogue sessions with various trade associations, e.g., Association of Consulting Engineers Singapore (ACES) and Singapore Institute of Architects (SIA) to facilitate sharing and feedback on industry practices and challenges.	• At least once a year
	• Organise site visits to industry premises and annual dialogue sessions with companies and trade associations to share best practices to manage the quality of trade effluent, and invite companies which have successfully carried out water recycling projects to share their experience at industry forums to encourage water conservation.	• Several times a year
	• Initiate grant calls, and organise information sessions and sharing sessions with industries on the Technology Roadmap and Focus Areas.	• Several times a year
	• Collaborate with corporates for events to promote the importance of water, e.g., Singapore World Water Day.	• Regularly with major event in March
Non-governmental organisations (NGOs)/nature groups	• Collaborate with NGOs for events to promote the importance of water, e.g., Singapore World Water Day.	• Regularly with major event in March
	• Conduct specific project engagements to solicit feedback on measures to mitigate the environmental impact of PUB's projects.	• Project-dependent
Public and the community	• Carry out specific project engagements to keep stakeholders informed about PUB's projects, solicit feedback and source for partnership opportunities.	• Project-dependent
	• Provide flash flood alerts, monsoon advisories and precautionary tips via various platforms such as Telegram and "myENV" mobile app.	• Throughout the year
	• Organise events/roll out initiatives to celebrate water and promote water conservation, e.g., Singapore World Water Day, and conduct surveys to understand the public's knowledge and behaviour on water management and water conservation.	• Annually in March
	• Collaborate with grassroots in events to promote the importance of water, e.g., Singapore World Water Day.	• Regularly with major event in March
Schools	• Collaborate with schools/student groups in events to promote the importance of water, e.g., Water Wednesdays as part of Singapore World Water Day celebrations.	• Regularly with major event in March
	• Facilitate learning journeys for students, e.g., self-guided Active, Beautiful, Clean Waters (ABC Waters) Learning Trails and visits to Marina Barrage and NEWater Visitor Centre.	• Throughout the year, subject to schools' availability
	• Work with Ministry of Education (MOE) curriculum planners to incorporate water topics in the curriculum for various subjects and age groups.	• MOE's curriculum planning cycle
	• Organise PUB Splash Lab, a collaboration with Institutes of Higher Learning (IHLs), to deepen youth engagement on water conservation and sustainability through ideation and participation.	• IHLs' academic cycles
Media	• Organise media lunch engagements, media briefings, site visits, background information and demonstration sessions to enable the media to gain deeper insights into specific topics, e.g., coastal protection, flood management, green efforts in water treatment and SMART PUB initiatives.	• Bi-monthly
Employees and workers	• Carry out surveys, dialogue sessions and fireside chats with management, roadshows, department townhalls, virtual and physical staff engagement sessions, and whistleblowing channel to keep employees and workers engaged and facilitate feedback.	• Varies from monthly to annually
	• Provide employees with equal opportunity to be considered for competency-based training, and various technical knowledge webinars through Intranet portal and mobile application to improve sharing and retention of knowledge.	• Varies from monthly to annually
	• Disseminate regular emails and updates via Intranet portal and Workplace by Facebook, and messages from senior management to keep employees informed of the latest initiatives across PUB and the public service.	• Several times a month

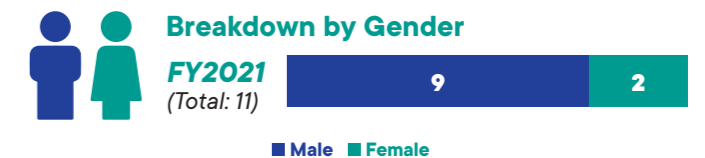
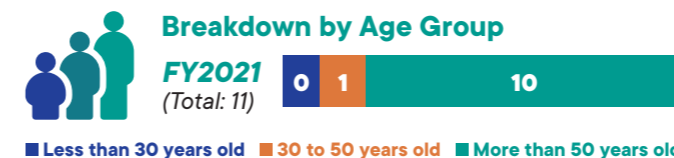
GRI [2-9] [2-12] [2-13] [2-14] [405-1]

SUSTAINABILITY GOVERNANCE

PUB's Board of Directors, headed by PUB Chairman who is an independent Board Member, comprises members who provide the appropriate balance and diversity in experience, knowledge and expertise in areas such as engineering, finance, audit and legal to assist in the governance of PUB. Approved by the Singapore Cabinet, the Board is guided by PUB's Code of Board Governance to provide good governance and clear decision-making that are critical in enabling PUB to deliver our mission. While the Board provides strategic guidance and direction to the management in the development of our Sustainability policies, the implementation of PUB's Sustainability Policy is driven by the Sustainability Committee and supported by the Sustainability Working Group.



BOARD MEMBERS:



GRI [3-1] [3-2]

PUB'S MATERIAL ISSUES

MATERIALITY ASSESSMENT

PUB's 2020–21 materiality assessment provided an inside-out and outside-in perspective on PUB's financial and ESG impacts on the stakeholders and business. A preliminary list of potential material topics and their impacts were identified with reference to megatrends, peer benchmarking and key sustainability risks to PUB under our Enterprise Risk Management (ERM) framework. In prioritising the impacts of the material topics, PUB surveyed a wide range of internal and external stakeholder groups, including employees, businesses and industries. PUB has assessed that the identified material topics remain relevant to PUB.

FINAL LIST OF MATERIAL TOPICS

SUSTAINABILITY PILLARS	MATERIAL TOPICS	WHY TOPIC IS MATERIAL
Water and Sustainable Management	Sustainable water system	It is PUB's core mission to ensure sustainable, high-quality water supply and sanitation for Singapore.
	Resource efficiency and circularity	Promoting resource efficiency and circularity contributes to a lower carbon and waste footprint, which is critical in resource- and land-scarce Singapore.
	Climate change adaptation	Singapore needs to be future-proofed against the risks and uncertainties brought about by climate change.
Capable and Engaged Workforce	Health and safety	All PUB employees and workers must feel safe at work and be able to carry out their work in a safe manner.
	Competent workforce	Our people are the main driving force and cornerstone of PUB's operations.
	Inclusive and fair workplace	An inclusive culture promotes a sense of well-being which increases engagement and supports strong performance.
Strong Partnership	Customer-centric water service	As an essential service provider, customer service is core to PUB's business.
	Partnership and engagement	With limited water resources, everyone in the community must come together and play a part to conserve our water resources.
Business Excellence	Trust and transparency	As a public agency, the sustainability of PUB's business hinges on the trust bestowed by our stakeholders that PUB is committed and competent in delivering our mission.
	Innovation	PUB must constantly improve and find innovative, efficient and improved ways to carry out our everyday work, produce superior outcomes and deliver finer service.
	Digitalisation and cybersecurity	As PUB embraces digitalisation and extensively adopts digital technologies to enhance operations, we need effective cybersecurity management to ensure secure operation of our systems and handling of data.
	Financial sustainability	PUB must make financially responsible and sustainable decisions to ensure that there are sufficient funds to meet developmental and operational needs.

1

WATER AND SUSTAINABLE MANAGEMENT

Water is essential to every household, business and organisation. Sustainable management of water is critical to PUB's success as Singapore's national water agency. The sustainable management of water is founded on three overarching strategies:

1-1 SUSTAINABLE WATER SYSTEM

- Diversifying Our Water Sources
- Water Demand Management
- Protecting Our Infrastructure

1-2 RESOURCE EFFICIENCY AND CIRCULARITY

- Reducing Our Energy and Carbon Footprint
- Maximising Resource Circularity

1-3 CLIMATE CHANGE ADAPTATION

- Coastal Protection
- Flood Risk Management

GRI [3-3]

1-1 SUSTAINABLE WATER SYSTEM

KEY FOCUS AREA 1
DIVERSIFYING OUR WATER SOURCES

COMMITMENT

Ensure that there will always be **enough water for all**

PERFORMANCE



100% of population served by tapped water supply and modern sanitation



Two-thirds of Singapore's land as local water catchment area in FY2021

LOOKING AHEAD

Changi NEWater Factory 3 and **Deep Tunnel Sewerage System Phase 2** projects slated to be completed in 2025 and 2026 respectively

Water is a fundamental natural resource and access to safe and clean drinking water and sanitation is a basic human need. PUB must ensure that there will always be a robust and sustainable water supply to meet the needs of our growing nation. Despite abundant rainfall, Singapore cannot achieve water security in a conventional way due to a lack of land to capture and store rainwater. PUB must continue to diversify our water sources by exploring and developing unconventional water sources for a sustainable water system through the following strategies.

MAKE EVERY DROP COUNT

Water from Local Catchment

In Singapore, rainwater and used water are collected and conveyed through separate systems, ensuring that our waterways are free of pollution. Rainwater collected in local catchment areas is stored in 17 reservoirs and treated at 7 local waterworks to produce potable water. With limited land to collect rainwater, one of PUB's strategies is to create estuarine reservoirs by damming up major rivers. To maximise rainwater collection yield and make every drop of rainfall count, PUB also collects rainwater from urbanised catchment areas. Since 2011, with the completion of the Marina, Punggol and Serangoon reservoirs, the water catchment area has increased from half to about two-thirds of Singapore's land surface.

RECLAIM USED WATER

NEWater

Water reclamation allows each drop of water to be reused more than once. PUB is a world leader in this. Used water is treated before undergoing microfiltration and reverse osmosis (RO) to remove contaminants, bacteria and viruses, and is finally disinfected with ultraviolet light as an additional barrier. The water reclamation process recycles Singapore's used water into ultra-clean, high-grade NEWater, a weather-resilient source of water that closes the water loop and moves Singapore and PUB a step closer towards a sustainable water system. While NEWater is mainly used for industrial and commercial purposes, it is also used to replenish and sustain local reservoirs during dry months. The blended raw water is further treated at local waterworks before it is supplied to consumers.

HARNESSING THE SEA

Desalinated Water

As Singapore is an island surrounded by sea, diversifying our water supply through desalination is a natural option, especially as advances in membrane technology have made desalination more economically viable. Being a weather-resilient source of water,

desalination cushions our water supply against the impact of climate change, such as prolonged drought. While desalination is an essential source of potable water and PUB continues to develop desalination infrastructure, it is the most energy-intensive and expensive method of producing water. Therefore, PUB continues to invest in research and technology to find better and less expensive ways of desalting seawater.

FEATURE STORIES



JURONG ISLAND DESALINATION PLANT
SINGAPORE'S FIFTH DESALINATION PLANT



An aerial view of the Jurong Island Desalination Plant. (Photo: PUB)

The Jurong Island Desalination Plant, Singapore's fifth desalination plant, was officially opened by Deputy Prime Minister Heng Swee Keat on 17 April 2022. The 3.7-hectare plant can produce the equivalent of 55 Olympic-sized swimming pools of water, which strengthens Singapore's water security. Constructed under the Design, Build, Own, Operate model, Jurong Island Desalination Plant is co-located with Tuas Power's Tembusu Multi-Utilities Complex (TMUC). This unique integration with TMUC makes Jurong Island Desalination Plant about 5% more energy-efficient than conventional desalination plants.

GRI [3-3]

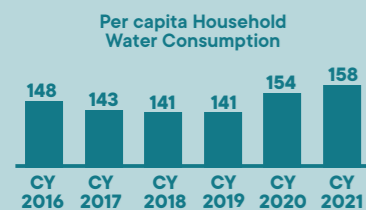
1-1 SUSTAINABLE WATER SYSTEM

KEY FOCUS AREA 2
WATER DEMAND MANAGEMENT

COMMITMENT

Achieve household water consumption of **130 litres per person per day** (also known as litres per capita per day or LPCD) by 2030*

PERFORMANCE



Note: The average household water consumption increased slightly to 158 LPCD in 2021 from 154 LPCD in 2020. This could be attributed to the COVID-19 pandemic situation in 2021, during which people were more likely to stay at home and engage in more frequent water usage activities such as showering, WC flushing, washing/cleaning and cooking. However, the rate of increase in water consumption decreased slightly with the progressive relaxation of COVID measures, though it had yet to go back to pre-COVID levels. The total volume of water sales remained relatively constant between 2020 and 2021.

Water Supply (Mil m ³)	CY2016	CY2017	CY2018	CY2019	CY2020	CY2021
Sale of potable water in Singapore						
Domestic	301.4	294.8	294.2	297.6	320.7	316.5
Non-domestic	215.6	204.5	201.3	202.6	180.5	184.9
Sale of NEWater	126.9	140.2	140.5	145.5	141.1	148.9
Sale of Industrial Water	21.0	19.9	20.6	17.9	13.0	11.4

LOOKING AHEAD

300,000 smart water meters installed in new and existing residential, commercial and industrial premises from 2022

Working towards a robust and sustainable water supply through infrastructure development and improvement is only part of the equation. As the population and economy continue to grow, it is crucial to ensure that the demand for water does not rise at an unsustainable rate. PUB adopts a multi-pronged approach to manage water demand, which is key to water sustainability.

PRICING WATER TO REFLECT ITS SCARCITY VALUE

In Singapore, water is priced to recover the full costs of supply and production, reflect its scarcity value and encourage consumers to use water wisely. The price considers the entire water system's costs, including those of reservoir management, NEWater production, desalination, used water collection and treatment, as well as the maintenance and expansion of the island-wide network of water pipelines and sewers. The potable water price reflects the higher costs of producing water from unconventional sources, specifically NEWater and desalination. Additionally, it includes a water conservation tax to reinforce the message that water is precious and everyone must play a part in conserving this scarce resource.

MANDATING WATER EFFICIENCY STANDARDS

The water efficiency of everyday appliances and fittings continues to improve with advances in technology. As a regulator, PUB mandates and regularly reviews standards to ensure that households, businesses and industries continue to use water efficiently.

Mandatory Water Efficiency Labelling Scheme (MWELS) and Minimum Water Efficiency Standards

Initially introduced as a voluntary scheme in 2006, water efficiency labelling helps consumers make informed purchasing decisions and encourages suppliers to introduce more water-efficient products into the market. Since July 2009, it has been mandatory for suppliers to label the water efficiency of their water fittings and appliances before advertising and displaying them for sale in Singapore under the MWELS. MWELS is a

*Hybrid work arrangements and an increased emphasis on hygiene are expected to persist post-Covid. PUB is reviewing the 2030 household water consumption target of 130 litres per capita per day (LPCD) and expects to complete the review by 1Q2023.

Water Efficiency Management Plan (WEMP)

grading system that denotes the water efficiency of a product with a "0/1/2/3/4" tick rating, with a higher tick rating corresponding to higher water efficiency. To encourage water conservation, the MWELS has been gradually extended to encompass a wider range of products (including washing machines and dishwashers for household use). PUB continued to push for the use of more efficient fittings and appliances, by mandating a minimum rating of 2 ticks for fittings sold and supplied in Singapore from April 2019. Since January 2022, MWELS has been extended to include water closet flush valves, to have a minimum rating of 2 ticks. Minimum water efficiency standards were implemented for commercial equipment (i.e. washer extractors, dishwashers and high-pressure washers), to facilitate water savings from the use of these equipment.

The WEMP was introduced in 2010 as a voluntary initiative for non-domestic users to improve the efficiency of their water use. Since January 2015, it is mandatory for all large water users who have met the water use threshold of 60,000 m³ in the preceding calendar year to submit annual WEMPs to PUB for at least three consecutive years. As part of preparing the WEMPs, companies are to establish water management systems which involve the installation of private water meters to monitor consumption at major water usage areas. This helps companies account for the breakdown of water consumption, thereby allowing for better management of water usage and development of water conservation measures.

Water Efficiency Manager Course

To better equip WEMP representatives with the relevant technical knowledge to implement water efficiency measures and submit WEMPs on behalf of the qualifying consumers, PUB requires that at least one WEMP representative of each qualifying consumer be certified as a water efficiency manager with effect from 2019. WEMP representatives must attend a two-and-a-half-day water efficiency manager course (jointly conducted by PUB and Singapore Polytechnic) and pass an assessment prior to being certified as a water efficiency manager.

ENCOURAGING WATER CONSERVATION

PUB works with various stakeholders such as schools and large water users to design targeted programmes to encourage water conservation. These are outlined under the section of Partnership and Engagement on page 44.

FEATURE STORIES

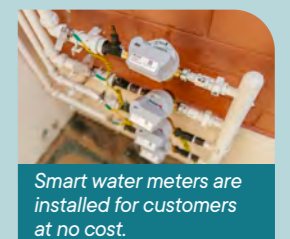


DIGITALISING WATER DEMAND MANAGEMENT

PUB is leveraging digital technologies via the Smart Water Meter Programme to encourage behavioural change towards water conservation, optimise water demand management and achieve greater operational efficiencies. Pilot studies in Punggol and Yuhua in 2016 and 2018, respectively, have met with success, with 800 households reporting an average of 5% in water savings, with early leak detection and adoption of water-saving habits.

With smart water meters, meter readings will be transmitted digitally and automatically daily to PUB. This removes the need for labour-intensive manual readings which are currently carried out once every 2 months. Paired with a customer portal, customers can easily view and track their daily water consumption—this empowers them to become smarter users of water, saving water and money in the process. Customers will also receive alerts of suspected leaks and high water usage within their households or premises. With these alerts, they will be able to detect and stop leaks quickly to reduce water loss.

Under the first phase of the Smart Water Meter Programme, PUB is rolling out some 300,000 smart water meters in residential and commercial/industrial premises across 7 locations (Tampines, Hougang, Bukit Batok, Jurong West, Tuas and new estates at Tengah and Tampines North). PUB will review this first phase rollout, build up its capabilities and expertise, and consider the advances in technology before implementing it nationwide.



Smart water meters are installed for customers at no cost.



With MySmartWaterMeter, customers can access water usage data anytime, anywhere.

GRI [3-3]

1-1 SUSTAINABLE WATER SYSTEM

KEY FOCUS AREA 3
PROTECTING OUR INFRASTRUCTURE

COMMITMENT

Ensure that our water is **not lost nor contaminated**

PERFORMANCE



Maintained **100%** water-quality tests meeting WHO Guidelines for drinking water quality

% Distribution Losses for **Potable Water**

CY2019	8.2%
CY2020	8.0%
CY2021	8.2%

Percentage Distribution Losses (DL) for potable water increased from 8% in 2020 to 8.2% in 2021. This increase was due to transitional accounting, driven by the exit of several Open Electricity Market (OEM) retailers in 4Q 2021, which necessitated a transfer of affected customer accounts from these retailers back to SP Services. This transition led to a delay in billing, wherein some customers were not issued utility bills in November–December 2021 and the accumulated water consumption was billed in January–February 2022. The lower sales for November–December 2021 resulted in an overall higher percentage distribution loss for 2021. Discounting the effect caused by the exit of OEM retailers, DL for 2021 would have been 7.9%.

LOOKING AHEAD

Development of smart technologies and expansion of the current sensor network to better protect and operate sewerage infrastructure

While ensuring a sustainable supply and demand of water, minimising the loss and contamination of this precious resource as it travels through the water loop is critical for a sustainable water system. This is carried out through holistic management and protection of water infrastructure at source and distribution via the following measures.

PROTECTING OUR RESERVOIRS

Whole-of-Government land-use planning is the first step towards reducing pollution in our reservoirs. PUB works with various government agencies at the planning stage to site developments with high pollution risk outside water catchment areas. Developers and owners of potentially pollutive developments, such as farms, that are located within water catchment areas, are required to implement best management practices to avoid pollution. These practices prevent the spillage of hazardous or toxic substances and the generation of contaminated run-off, thus minimising adverse impact to catchment and reservoir raw water quality.

PUB has put in place a comprehensive water-quality monitoring system which includes the monitoring of reservoir water. Samples are routinely collected from reservoirs and tested at PUB's Water Quality Laboratory. Our source water quality is safeguarded to ensure that it is fit for drinking water production and recreational use—the latter is currently permitted for eight reservoirs and two waterways.

WATER NETWORK MANAGEMENT

Besides protecting our reservoirs, it is important to protect our network infrastructure and ensure that potable water is not lost through the treatment and distribution processes before reaching customers. To reduce the number of leaks and achieve low distribution losses, PUB follows a rigorous leak management programme. This includes good design and construction, effective leak detection and surveillance, and enhanced network renewal and replacement.

USED WATER NETWORK MANAGEMENT

PUB has 1200 permanent leak detection monitoring sensors in our network, monitoring about 500 km (about 40%) of transmission pipelines. These sensors accurately identify and pinpoint the location of leaks (within ±3 metres) along the pipeline. By tapping into intelligent leak monitoring and detection technologies, PUB is taking a smarter approach towards network management and moving away from resource-intensive leak detection operations.

In order to ensure good drinking water quality, water samples are collected for testing at PUB's Water Quality Laboratory from various points in the distribution system. In addition, online sensors are strategically deployed to monitor water quality at service reservoirs and the downstream distribution system. Over 500,000 tests are conducted annually on various water quality parameters. The quality of Singapore's drinking water is governed by the Environment Public Health (EPH) (Water Suitable for Drinking) (No. 2) Regulations 2019.

Used water is also an important water source that needs to be managed and protected as more NEWater is produced. PUB has a rigorous regulatory framework that stipulates requirements for: (i) sewerage and sanitary system design and maintenance; (ii) protection of the sewerage infrastructure from damage and misuse; and (iii) control of the quality of trade effluent discharged to public sewers. PUB also has a comprehensive operations and maintenance regime, which includes routine inspection and cleaning programmes, and a 24/7 operations centre that monitors an island-wide network of sensors and coordinates responses to site issues.

Additionally, smart technologies are being tapped to better protect PUB's sewerage infrastructure and provide better sensing and predictive capabilities to enable faster response to anomalies in the network. These technologies include:

- Activity Monitoring AND Alerts (AMANDA) System, a one-stop platform to monitor construction activities near sewerage infrastructure
- Geo-fencing of Sewerage Network and GPS tagging of construction machinery to detect when construction machinery that poses a risk of damage to sewerage infrastructure enters the sewer setback zone and sends real-time alerts to PUB officers
- Sewer Analytics and Management System (SAMS), a smart system to reduce service disruptions and optimise sewer maintenance through data analytics and machine learning
- SMART LOCK System, a centralised system to monitor general waste collection tankers' collection and disposal points across Singapore. This system provides real-time alerts to PUB officers of unapproved collection and disposal activities, and the cleaning frequency of grease traps maintained by food shops

A Trade Effluent Plan is also in place to manage the discharge quality in the sewers to ensure that every drop collected is fit to recycle into NEWater. Developed in 2017, the Trade Effluent Plan lays out a proactive approach to meet the challenges of trade effluent control through a four-pronged approach consisting of Prevention and Deterrence, Enforcement and Penalty, Stakeholder Engagement and Education, and Capability Development. Under this plan, PUB carries out checks on more than 5,000 factories and 8,000 eating establishments to ensure that the trade premises discharge compliant trade effluent into the sewers. PUB has deployed 100 Volatile Organic Compound (VOC) monitoring units in the sewer network to monitor used water discharged from industrial clusters and 175 Microbial Electrochemical Sensor (MES) units at high-risk factories to control at source and deter these factories from illegal discharge. PUB has also tightened its requirements on general waste collection companies to collect only approved general waste and discharge the waste only at approved water reclamation plants. Since the implementation of the Trade Effluent Plan, there has been a significant drop in the number of illegal discharge incidents in Singapore. Nonetheless, these efforts need to be upkept as discharge quality management remains a critical undertaking with the growing importance of NEWater.



ACTIVE, BEAUTIFUL, CLEAN WATERS (ABC WATERS) PROGRAMME



Active Beautiful Clean Waters (ABC Waters) at Sungei Ulu Pandan

Over the years, Singapore has developed a pervasive network of waterways and 17 reservoirs for stormwater management and water supply. PUB launched the ABC Waters Programme in 2006 to transform our utilitarian drains, canals and reservoirs into multifunctional recreational spaces that integrate seamlessly and holistically into the urban environment. These transformed spaces at our waterways and water bodies go beyond their utilitarian function, improving the liveability of our urban city.

Being a largely urbanised catchment, the quantity and quality of Singapore’s rainwater run-off must be managed. Developers are encouraged to adopt ABC Waters design features such as rain gardens and bioretention swales, which are natural drainage features that aim to slow down and treat rainwater run-off before it is discharged into our waterways as well as enhance the greenery in the area. With more developments implementing such features, we can create a more holistic and sustainable system to manage our rainwater run-off.

PUB has developed the ABC Waters Design Guidelines to guide developers and professionals on how to include ABC Waters design features in their developments. This is available on PUB’s website and is periodically updated. The ABC Waters Professional Programme and ABC Waters Certification Scheme have also been implemented to enhance industry capability and recognise efforts in these aspects. As of June 2022, there are 69 registered ABC Waters Professionals and 102 ABC Waters Certified projects, out of which eight have achieved Gold certification. In March 2022, PUB completed a new ABC Waters Project at Sungei Ulu Pandan, which includes lookout decks for the public to enjoy the scenic waterfront, habitat cells and rain gardens that cleanse rainwater run-off to enhance the aesthetic and biodiversity of the surrounding landscape.

GRI [3-3] [302-1] [302-4] [305-1] [305-2] [305-3]

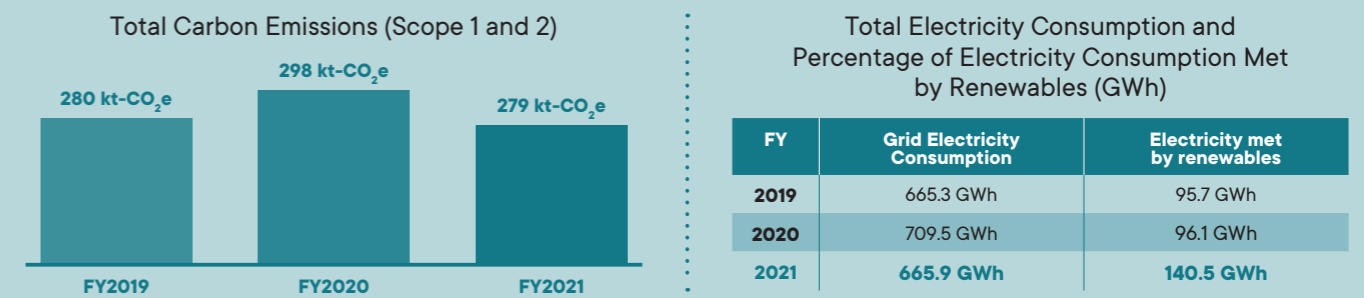
1-2 RESOURCE EFFICIENCY AND CIRCULARITY

KEY FOCUS AREA 1
REDUCING OUR ENERGY AND CARBON FOOTPRINT

COMMITMENT

- Peak **carbon emissions** by 2025
- Target to achieve **net-zero emissions** around 2045, contingent on the progress of technologies and international cooperation to enable mitigation measures

PERFORMANCE



The scope and sources of reported GHG emissions have been revised to align with PUB’s GreenGov.SG Reporting Submissions. N₂O emissions are calculated based on IPCC 2006 Guidelines for wastewater treatment at advanced wastewater treatment plants

PUB’s energy and electricity consumption is largely dependent on public demand for PUB’s services such as water and used water treatment, and operational conditions. Carbon emissions have decreased by about 6% from FY2020 to FY2021

LOOKING AHEAD

- Development of **floating solar PV systems** at Marina, Pandan and Lower Seletar reservoirs
- **Increasing solar deployment** on the rooftops of PUB installations
- **Procurement of EVs** to support PUB operations
- Proof-of-concept for **CO2Tech** and **Xylem carbon capture solutions** under the Carbon Zero Grand Challenge

With water demand projected to almost double by 2065 and increasing reliance on climate-resilient sources of water such as desalinated water and NEWater, PUB’s carbon footprint is projected to more than double from our current footprint of 279 kt CO₂-eq to about 1MT CO₂-eq, assuming business-as-usual (BAU). Ensuring resource efficiency is key to reducing excessive carbon emissions which would exacerbate climate change and global temperature rise, and mitigating the impact of higher energy prices wrought by a changing energy landscape. Aligning with the public sector’s net-zero emissions goal as announced in October 2022, PUB is committed to peak our emissions by 2025 and targets to achieve net-zero emissions around 2045, contingent on the progress of technologies and international cooperation to enable mitigation measures. PUB adopts a three-pronged approach to replace, reduce and remove our carbon emissions for a sustainable PUB and actively explores the following solutions to eventually reduce greenhouse gas emissions.

REPLACING CARBON-BASED ENERGY SOURCES WITH ALTERNATIVE SOURCES

Solar energy is clean, renewable and the most promising renewable energy source in Singapore. This, together with rising electricity prices, falling costs of solar modules and the need to reduce carbon emissions has spurred PUB to progressively deploy solar photovoltaic (PV) systems on the rooftops of our installations and on our reservoirs. In land-scarce Singapore, vast reservoir surfaces serve multifunctional purposes by allowing the capture of solar energy through floating solar PV systems while serving as both water catchment and storage. To date, PUB has awarded tenders for floating solar PV systems that can generate 64MWp of solar power. This includes Singapore’s

first large-scale inland floating solar farm at Tengeh Reservoir which was completed in July 2021 at a capacity of 60MWp, and Lower Seletar Reservoir and Pandan Reservoir have been identified as potential sites for 100MWp and 44MWp solar farms respectively. Currently, clean electricity generated from solar energy is sufficient to power PUB's local water treatment plants and the Marina Barrage, offsetting 10% of our annual electricity consumption and reducing carbon emissions by about 33 kt per year.

Used water sludge, a major by-product of used water treatment at our water reclamation plants (WRPs), also serves as a source of renewable energy. The sludge is treated in digesters to produce biogas, which is used as fuel to generate electricity that powers the plants. Together with the National Environment Agency (NEA), we have demonstrated that co-digesting food waste with used water sludge produces more biogas, compared to digesting the food waste and used water sludge separately. This idea will be implemented in the upcoming Tuas Nexus and Food Waste Treatment Facility at Changi WRP.

In 2020, Singapore announced its vision to phase out vehicles with internal combustion engines (ICE) and have all vehicles run on cleaner energy by 2040. In line with national goals, PUB is progressively replacing our diesel-powered vehicles with cleaner electric vehicles (EVs) to reduce carbon emissions. PUB has added our first 6 operational EVs to our fleet in 2021. By 2024, PUB will be replacing 70 more diesel-powered with suitable EV models running on cleaner energy. PUB is continuously seeking and testing new technologies and ideas to increase renewable energy generation and replace carbon-based energy sources with alternative sources to minimise our carbon footprint.

PUB's Solar Journey	
Period	Milestone
2008	Solar installation at Marina Barrage
2015	Solar panels installed on the rooftop of Choa Chu Kang Waterworks
2016	Launch of the 1MWp floating solar photovoltaic (PV) system testbed at Tengeh Reservoir
2018	Solar panels installed on the rooftops of Waterhub, Changi Water Reclamation Plant and Bedok Waterworks
2021	Completion of the 60MWp system at Tengeh Reservoir, and two 1.5 MWp systems at Bedok and Lower Seletar reservoirs
2022	Appointment of consultant for 100MWp and 44MWp floating solar farms at Lower Seletar and Pandan Reservoir

REDUCING CARBON EMISSIONS THROUGH ENERGY EFFICIENCY

PUB, together with our research partners, actively explores innovative and more energy-efficient technologies for adoption in new plants and infrastructure to reduce our energy and carbon footprint. On the research and development (R&D) front, technologies such as biomimicry and pressure-retarded osmosis are being explored to reduce the desalination energy requirement from the current 3.5 kWh/m³ to close to 2.0 kWh/m³ at the system level by 2025. This translates to carbon emission reductions equivalent to 0.6 kilograms of CO₂ for every cubic metre of desalinated water produced.

Besides the development of new technology, PUB also aims to improve and optimise the energy efficiency of its existing plants. To maintain the energy efficiency of its equipment over time, PUB adopts an equipment replacement regime where equipment is possibly retrofitted or replaced with one that is more efficient at the end of their useful economic life. PUB currently adopts the national Minimum Energy Performance Standards (MEPS) class of IE3 (Premium) for motors, and will consider procuring IE4 motors if they are assessed to be more energy efficient and cost effective on a life cycle basis. Our engineers regularly monitor the energy consumption of our equipment and buildings, and optimise its operations (e.g., operating hours, frequencies, patterns) so that the equipment can be operated at optimal condition.

REMOVING CARBON EMISSIONS

With our current efforts, we expect to abate approximately 90% of our carbon emissions around 2045 through replacing fossil fuel-based energy sources with renewable sources and reducing electricity consumption via energy-efficient technologies and water conservation. To remove the remaining 10% of carbon emissions and realise our target of net-zero emissions around 2045, PUB is working with our research partners to explore the application of carbon capture and removal solutions in our water treatment facilities.

While carbon removal is an emerging technology focus area, PUB has started two projects with A*STAR's Institute of Sustainability for Chemicals, Energy and Environment (ISCE²) and University of California, Los Angeles (UCLA) to explore carbon removal in PUB installations. With UCLA, we are exploring the use of electrolysis technology to capture carbon dioxide in seawater to form solid carbonates and hydrogen. We are also working with ISCE² to explore the feasibility of removing carbon dioxide from biogas and carbonising it with waste materials (e.g., incinerated ash) to produce aggregates or alternative sand. These products can potentially be used in the building construction industry or land reclamation applications.

To identify more game-changing carbon capture, utilisation and removal technologies, PUB launched the \$6.5 million Carbon Zero Grand Challenge on 19 October 2021 to source for solutions from companies and research institutions around the world that can be integrated with PUB's operations and deployed at a commercial scale within a decade. Through this open innovation challenge, two solutions from CO2Tech and Xylem were selected for proof-of-concept research.

FEATURE STORIES



Launched on 19 October 2021, the Carbon Zero Grand Challenge incentivises innovative carbon capture, utilisation and removal solutions at any technology readiness level that can help PUB achieve net-zero emissions around 2045 and scale to water facilities worldwide.

Through this open innovation challenge, 71 solutions from 21 countries were received. CO2Tech and Xylem were awarded up to \$250,000 each to develop a proof-of-concept, which involves the development of a desktop simulation and/or a lab-scale study and detailed design for a pilot project. CO2Tech's solution involves the use of combined solvent absorption and membrane separation to capture CO₂, while Xylem's solution uses a rotating algal biofilm growth system by Gross-Wen Technologies Inc. to treat the dewatering centrate of used water sludge and capture carbon at the same time.

The shortlisted proposals may be awarded a further \$2.5 million each to demonstrate a ~1 kilotonne-scale version of their solution at a PUB facility in Singapore.

GRI [3-3] [302-1] [302-4] [305-1] [305-2] [305-3]

1-2 RESOURCE EFFICIENCY AND CIRCULARITY

KEY FOCUS AREA 1

MAXIMISING RESOURCE CIRCULARITY

COMMITMENT

Minimise amount of waste generated and improve resource circularity

PERFORMANCE

Total Amount of Waste Generated from PUB-owned Operational Facilities



Reporting Year	Mass of Waste from Used Water and Water Treatment (Tons)
FY2019	225,283
FY2020	201,430
FY2021	193,393

Operational waste, such as water and used water sludge, comprises the bulk of PUB's overall waste. Sludge is a by-product of PUB's water and wastewater treatment processes, and the amount of waste that PUB generates is hence largely dependent on water demand and the quantity and quality of used water discharged by domestic and industrial sectors. The amount of waste generated from used water and water treatment has decreased by 4% from FY2020 to FY2021

PUB's operations generate large waste streams such as treatment sludge. With limited land for waste disposal and Singapore's target to reduce the waste sent to Semakau Landfill by 30% by 2030, PUB must strive to reduce and reuse operational waste at the system level. Maximising resource circularity preserves our scarce resources and allows PUB to do more with less for a more sustainable PUB.

IMPROVING NEWATER RECOVERY RATES

PUB aims to increase NEWater recovery rates at its NEWater factories to maximise resource circularity and increase our water supply. The Flow Reversal Reverse Osmosis (FR-RO) technology from Rotec was demonstrated at the Kranji NEWater Factory, where NEWater recovery was shown to increase from 75% to 85% with no increase in specific energy consumption. This technology is planned for implementation in the upcoming Changi NEWater Factory 3 and Tuas NEWater Factory.

MANAGING OUR WASTE STREAMS

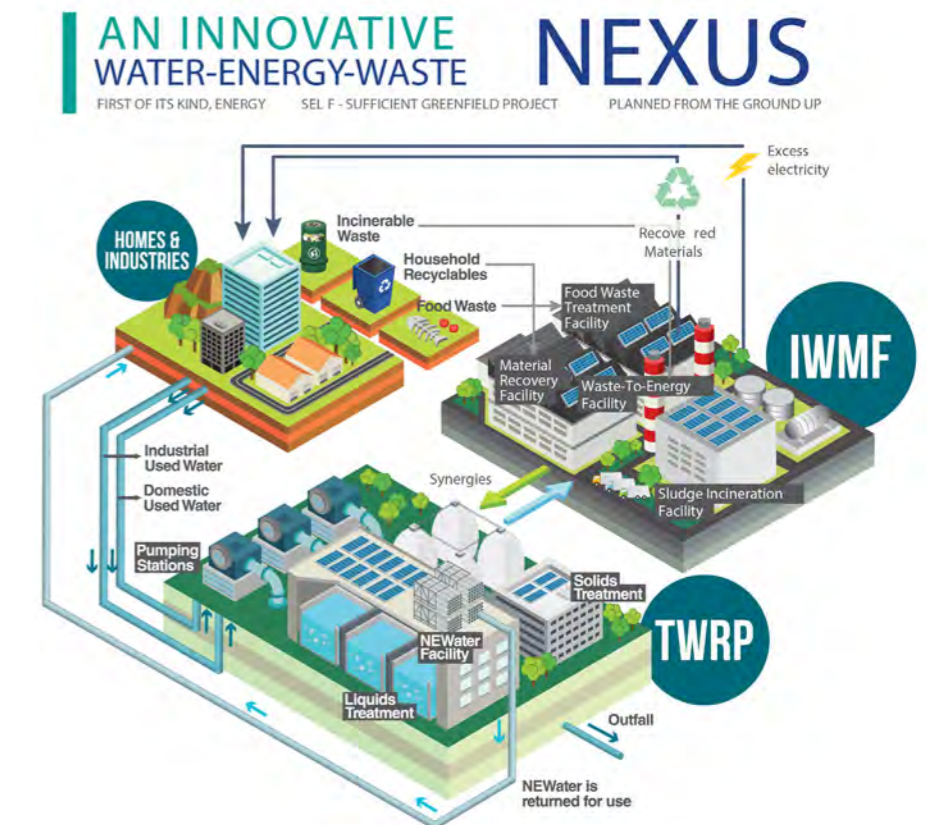
Within PUB, two major waste streams are sludge generated from our waterworks and WRPs. Singapore has limited space for waste disposal and PUB must reduce waste generation and increase resource reuse and recovery, where possible. In line with Singapore's aspiration to be a zero-waste nation, PUB aspires to reduce the amount of dewatered sludge sent to incineration through the following initiatives to achieve our waste reduction goals:

- i) The use of alternative coagulant for water treatment to reduce sludge generated from waterworks
- ii) Adopting proven technologies such as biosorption, membrane bioreactor, co-digestion and thermal hydrolysis process to reduce the amount of sludge produced from the WRPs.
- iii) Exploring alternative technologies to convert PUB's waste into higher value products. These technologies include: (a) high temperature slagging gasification to produce slag from sludge for structural and non-structural applications; (b) pyrolysis to produce biochar as adsorbent for odour control and fire retardant board; and (c) encapsulation of sludge ash in a graphene based construction material.

In terms of liquid waste streams, PUB carries out environmental studies and routine monitoring of seawater to ensure that the quality of surrounding seawaters would not be adversely affected by effluent discharges from desalination, NEWater and water reclamation plants. PUB also carries out routine monitoring to ensure effluent quality complies with regulations.

HARNESSING CO-LOCATION SYNERGIES

PUB's long-term infrastructure planning involves working with government agencies to look for co-location synergies to improve resource circularity. One of the key projects is the Tuas Nexus, which integrates the operations of PUB's Tuas WRP and NEA's Integrated Waste Management Facility (IWMF) to manage and treat used water and solid waste within a single facility. The project will harness potential synergies of the water-energy-waste nexus by integrating used water and solid waste treatment processes to maximise energy efficiency and generation, and resource recovery while maintaining a small footprint.



Tuas Nexus, Singapore's first Integrated Water and Solid Waste Treatment Facility.

SUPPORTING THE NATIONAL SUSTAINABILITY AGENDA

The Singapore Public Service is committed to leading sustainable development by example via the GreenGov.SG sustainability movement, launched in July 2021 under the Singapore Green Plan 2030. In line with the resource efficiency targets set for the public sector in resource efficiency, PUB is committed to improving our Energy Utilisation Index (EUI) and Water Efficiency Index (WEI) by 10% by 2030 from 2018-20 levels, and improve the Waste Disposal Index (WDI) by 30% from 2022 levels for PUB's Standard Buildings⁵.

PUB's potable water consumption has decreased by 9% from FY20 to FY21 and is largely dependent on public demand for PUB's services and operational conditions. PUB will conduct water audits on our non-Standard infrastructure to identify areas for improvement.

Potable Water Consumption	
Reporting Year	Potable Water Consumption from PUB facilities (m ³)
FY2019	240,005
FY2020	219,700
FY2021	199,773

⁵ PUB's Standard Buildings include Waterhub, Woodleigh Complex and PUB Recreational Club

GRI [3-3]

1-3 CLIMATE CHANGE ADAPTATION

KEY FOCUS AREA 1
COASTAL PROTECTION

COMMITMENT

Protect Singapore's coastlines from rising sea levels

LOOKING AHEAD

- Ongoing development of **Coastal-Inland Flood Model**
- Ongoing development of **new policies and regulatory framework** for coastal protection
- Ongoing **site-specific studies** for City-East Coast and north-west coast
- Formulation of **Coastal Protection Master Plan**
- Feasibility Study for **Coastal Barriers**

By 2100, the mean sea level around Singapore is projected to rise by up to 1 metre due to climate change. In an extreme event where high tides and storm surges coincide, sea levels could rise up to 4–5 metres above the current mean sea level. Singapore is vulnerable to sea level rise because about 30% of our land, equivalent to 30,000 football fields, is less than 5 metres above the mean sea level and we do not have abundant high grounds to retreat to, unlike other countries. Without timely action and adequate planning, low-lying coastal areas and landmarks could be flooded. To future-proof Singapore against the rising sea levels, PUB is working with agencies to develop a national Coastal Protection Master Plan underpinned by the following three approaches.

HOLISTIC RISK ASSESSMENT

To strengthen Singapore's overall resilience against climate change, there is a need to assess coastal and inland flood risk holistically. In 2021, PUB commenced the development of the Coastal Inland Flood Model with the National University of Singapore (NUS) and Hydroinformatics Institute (H2i). The model is capable of simulating flood events under the combined effects of extreme sea levels and intense rainfall. The purpose-built model allows for a continuous review of flood risks based on the latest available climate change data from the Intergovernmental Panel on Climate Change (IPCC) and Centre for Climate Research Singapore (CCRS).

ADAPTIVE AND FLEXIBLE APPROACH

With the current state of climate science, the exact rate and magnitude of sea level rise remain uncertain. Nonetheless, it is imperative to formulate plans now and implement them progressively as the development of coastal protection measures requires a long lead time and substantial investment. To cater to uncertainties in climate projections, coastal protection measures will have to be flexible and adaptive to allow for adjustments according to the latest climate science. Singapore needs to be adequately protected against the rising sea and yet, not overinvest in such infrastructure. Under the new Coastal Protection Master Plan, planning parameters will also be established to guide the implementation of coastal protection measures.

INTEGRATED PLANNING

Singapore's coastline is highly varied and there is no one-size-fits-all strategy. Coastal protection measures to be developed will need to complement the land use master plan and incorporate elements of multi-functionality and design with nature, where possible, to enhance the living environment. Site-specific studies will be progressively carried out for the various segments of our coastline to develop coastal protection measures that suit the local characteristics.

Following the first site-specific study along Singapore's City-East Coast in 2021, PUB is embarking on site-specific studies at the north-west coast in 2022 and 2023. The studies include a review of international and regional best practices, collecting site data and conducting a broad-level environmental study to support the formulation of adaptation options and pathways, as well as developing the conception design of coastal protection solutions. PUB will also work closely with other government agencies such as the National Parks Board (NParks) to explore the implementation of hybrid solutions that combine natural elements, such as mangroves, with hard engineering solutions. Stakeholder outreach and engagement will be carried out to seek input and feedback on potential coastal protection solutions.



Coastal Protection Studies and Jurong Island and North-West Coast to commence in 2022.

GRI [3-3]

1-3 CLIMATE CHANGE ADAPTATION

KEY FOCUS AREA 2
STORMWATER MANAGEMENT

COMMITMENT

Tame stormwater by **reducing our flood-prone areas**

PERFORMANCE



Flood-prone Areas

CY2019	29
CY2020	28
CY2021	28

LOOKING AHEAD

- Ongoing **enhancements to flood operation systems** and **rainfall forecasting capability**
- Ongoing **drainage improvement works** at Bukit Timah Canal, Siglap Canal, Sungei Selarang, Pulau Punggol Barat (Seletar North Link) and Benoi Road Outlet Drain to **enhance flood protection**
- **Development of catchment level detention tanks** such as Alkaff Lake, a retention pond within Bidadari HDB estate, and an **underground detention tank** beside Syed Alwi Road
- Ongoing review of coastal outlet drains to cater to **higher rainfall intensity** and **rising sea levels**

Besides sea level rise, more frequent and intense rainfall is expected due to climate change, which increases flood risks. To adapt the drainage system to the challenges posed by growing urbanisation and higher-intensity storms, PUB has adopted a system-level approach known as the Source-Pathway-Receptor approach to tame stormwater for a sustainable stormwater management system. Apart from enhancing the “pathways” (i.e., drains and canals through which stormwater flows), measures are implemented at the “source” (i.e., where run-off is generated) and “receptor” (i.e., where floods may occur).



Source



Pathway



Receptor

MANAGING RUN-OFF AT SOURCE

All new developments and re-developments of 0.2 hectares or more are required to implement measures to slow down surface runoff and reduce the peak flow of stormwater into the public drainage system, by implementing on-site detention measures (i.e., “source”) since 2014. Source measures such as detention tanks or ponds and green features like bioretention basins provide temporary storage for the stormwater during a rain event and release stored rain after the rain event. They help control the peak run-off discharged from developments into the public drainage system, thereby reducing the likelihood of the drainage system exceeding its design capacity. They complement the pathway improvement measures (e.g., conventional widening of drains) and reduce the risk of excessive flow in the downstream drainage system which can cause flooding.

ENHANCING THE PATHWAYS

To manage flood risks due to climate change, PUB has been designing public drains to cater for higher rainfall intensity since 2017 where possible. While PUB will continue to implement pathway solutions to improve overall flood resilience ahead of new developments and upgrade existing drainage infrastructure, flooding can still occur. This can be due to more intense rainfall than what the drainage system is designed to cater for or localised depressions in topography.

PUB continues to develop capabilities in monitoring drainage performance and detecting irregularities through data analytics. Implemented in May 2019, the Smart Drainage Grid (SDG) system is a data analytics system that consolidates data from PUB’s hydrometric and hydrometeorological sensor network, including NEA’s rain gauges, into a single database. PUB uses the system to monitor the performance of its drains and identify drains with insufficient and additional capacity. Besides allowing PUB to prioritise drains for upgrading, the insights enable PUB to explore alternative or interim measures such as inter-catchment transfer of storm flows to optimise the drainage network and reduce flood risk. In addition, the system also allows detection of irregular drainage behavioural patterns. Causes of the irregular drainage patterns, such as chokes or blockages, can be investigated on-site and rectified before any flooding occurs at the next major storm event.

PROTECTING THE RECEPTORS

Receptor measures are needed to provide additional flood protection for developments and infrastructures. In 2011, the minimum platform level for buildings and crest level for basements were raised from 3 metres Singapore Height Datum (SHD) to 4 metres SHD and 150 millimetres to 300 millimetres above the minimum platform level, respectively. The crest level for underground MRT stations and road tunnel were also raised from 1 metre to 1.3 metres above the adjacent road/ground level. This stringent crest level is also applied to developments with direct or indirect links to underground MRT stations.

Beyond the Source-Pathway-Receptor approach, PUB also carries out flood monitoring and response. CCTVs at flood-prone areas and hotspots have been installed since 2011 to allow PUB to remotely monitor 24/7 real-time road conditions and canal/drain water levels in these areas. During heavy rainfall events, PUB’s Quick Response Teams (QRTs) are deployed to potential flood locations to keep the public out of harm’s way. PUB manages timely flood operations using its Catchment and Waterways Operations System (CWOS), an integrated dashboard that monitors real-time data from various sensors, namely CCTVs, water level sensors, rain gauges, weather radars and vehicle location trackers. Besides providing real-time rainfall monitoring in the form of radar rainfall maps via the nowcast system, PUB’s X-band weather radar system provides forecasted radar rainfall maps that predict rainfall patterns 30 minutes in advance every 2 minutes which are also fed to the CWOS. The rainfall forecasts and real-time sensor data are used in CWOS to anticipate potential flood locations which improves the efficiency of the deployment of QRTs during flood operations. PUB is also expanding the network of water level sensors and CCTVs to enhance the real-time monitoring of the drainage network.



PUB’s flood response vehicles can drive through higher floodwaters and livestream flood conditions on the road in real time, and aim to quicken response time to potential flash floods.



2

CAPABLE AND ENGAGED WORKFORCE

We recognise our people as the main driving force and cornerstone of PUB's operations, and a Capable and Engaged Workforce forms the second pillar of PUB's Sustainability Framework. PUB is committed to bringing out the best in our people by investing in training and creating a healthy, safe and inclusive working environment.

2-1 HEALTH AND SAFETY

Health and Safety Excellence

2-2 COMPETENT WORKFORCE

Competency-based Training

2-3 INCLUSIVE AND FAIR WORKPLACE

GRI [3-3] [2-7] [2-8] [405-1]

EMPLOYEE PROFILE

PUB relies on a skilled workforce to manage our water resources in a sustainable manner. We adopt a people-centric approach that ensures employees are kept healthy and safe, and their skills and competencies are continually enhanced.

PUB has a larger proportion of male employees due to the operational nature of our work. Nevertheless, both genders are given equal consideration in the recruitment process.

TOTAL EMPLOYEES AS OF 31 MARCH:

Breakdown by Employment Contract and Gender



FY2020



FY2021



TOTAL EMPLOYEES AS OF 31 MARCH:

Breakdown by Employment Type and Gender



FY2020



FY2021



TOTAL EMPLOYEES AS OF 31 MARCH:

Breakdown by Gender



FY2020
(Total: 3300)



FY2021
(Total: 3260)



TOTAL EMPLOYEES AS OF 31 MARCH:

Breakdown by Age Group



FY2020
(Total: 3300)



FY2021
(Total: 3260)



GRI [2-23] [2-24] [2-25] [3-3] [403-1] [403-2] [403-3] [403-4] [403-5] [403-6] [403-7] [403-8] [403-9]

2-1 HEALTH AND SAFETY

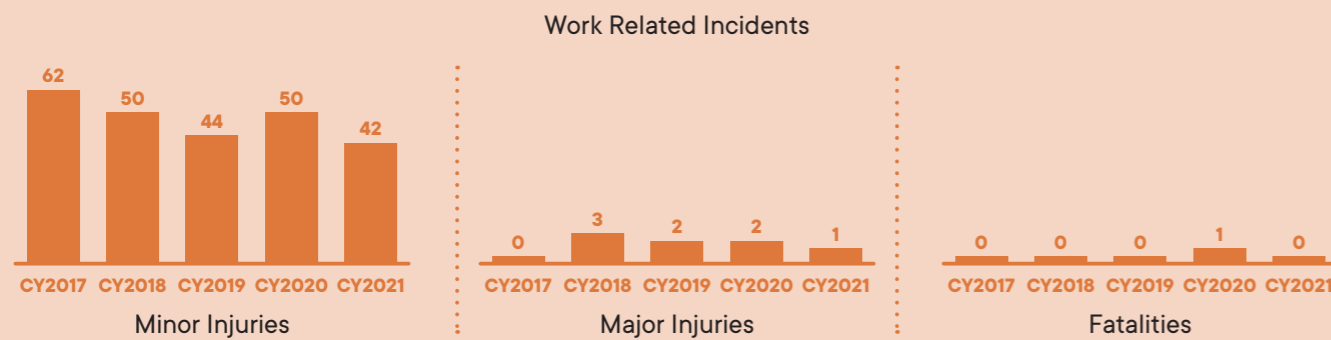
KEY FOCUS AREA 1

HEALTH AND SAFETY EXCELLENCE

COMMITMENT

- Continual improvement of **PUB's safety culture and systems**
- **Zero** work-related injuries and fatalities

PERFORMANCE



Health and Safety statistics have been revised to align with the latest WSHC definitions and compilation methodology of incident statistics as of 2022.

LOOKING AHEAD

- Deployment of **smart safety technology** such as smart wearables
- **Implementation of PUBSafe**, a one-stop safety management system for PUB staff and contractors

Safety lapses can put PUB employees and workers at risk and compromise mission success. Hence, it is critical that all PUB employees and workers feel safe at work and can work safely. PUB has zero tolerance for unsafe behaviour and is committed to ensuring the safety and holistic well-being of all employees and workers.

HEALTH AND SAFETY COMMITTEES

The management of PUB's health and safety strategies and initiatives is overseen by the Health and Safety Board Committee. PUB's Safety Steering Committee, chaired by PUB's Chief Executive, reports to the Board Committee and drives PUB's overall health and safety strategy and initiatives. The Safety Steering Committee is, in turn, supported by various working committees and department safety officers. PUB's safety management system is aligned with the Ministry of Manpower (MOM)'s Workplace Safety and Health Guidelines and covers all activities, employees and workers at PUB.

HEALTH AND SAFETY EXCELLENCE (HSE) 2028

Building on the foundation of PUB's Health and Safety Excellence (HSE) 2020, PUB has launched a second phase of the programme, HSE 2028, to further health and safety outcomes in PUB. HSE2028 focuses on strengthening PUB's safety management system, enhancing safe operation culture, and the health and well-being of our staff for a safe and healthy workplace.

The scope of HSE 2028 covers two new strategic outcomes, namely Ops of the Future and Occupational Health. Under Ops of the Future, PUB aims to explore technological solutions to enhance safety in operational processes and reduce risks to stakeholders working in PUB work sites. This includes exploring the use of robotic devices for tank

cleaning operations, thereby eliminating the need for manual labour and safety risks. Under Occupational Health, PUB has awarded a consultancy in November 2021 to conduct a review of PUB's Occupational Health and Hygiene Management System, which is expected to be completed in November 2022.

MONITORING PUB'S SAFETY PERFORMANCE

PUB monitors, tracks and reviews all workplace incidents. PUB has in place various measures to guard against workplace incidents and ensure that workers and staff can work in a safe manner such as risk assessment to identify hazards, safe work procedures, safety induction courses, compliance to PUB's life-saving rules and regular site inspections, among others. Common work-related hazards include those related to work at height, as well as work in confined areas. Employees and workers are encouraged to report work-related hazards to their supervisors and managers so that proper intervention can be done before an accident occurs. The top three main categories of work-related injuries in CY2021 are:

- Slip, trip and fall
- Fall from height
- Caught in between object

There is an observed 21.6% improvement in number of plant injuries and an observed 12.5% improvement in the number of construction injuries between 2020 and 2021.

GRI [3-3] [404-1] [404-2]

2-2 COMPETENT WORKFORCE

KEY FOCUS AREA 1

COMPETENCY-BASED TRAINING

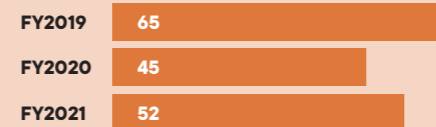
COMMITMENT

Ensure that all PUB officers go through **competency-based training**

PERFORMANCE



Training hours per staff member



Note: Covid-19 slowed down the pace of training in FY2020, but it picked up in FY2021 due to the implementation of more e-learning and virtual classroom training. Training has, overall, not returned to pre-COVID levels as many face-to-face training programmes were suspended during Phase 2 (Heightened Alert) and the Stabilisation Phase. The latest Omicron variant infected more Singaporeans and training placements were affected due to the increasing number of infections and stay-home notices for our staff.

LOOKING AHEAD

SgWA will focus on **broadening and deepening our staff's competencies** to meet organisational and transformation needs and ensure a consistent level of skills and knowledge. We are also developing a new organisational **Competency Framework for Sustainability** to cover emerging major sustainability issues like climate change, environmental impact assessment, energy/water efficiency and resource recovery. Moving ahead, PUB will be rolling **out e-learning training** for our Operations & Maintenance (O&M) contractors in the water industry, as this group is seen as an extension of PUB workforce, partnering with us to deliver our mission

As the world develops rapidly, organisations face the risk of skills shortages. With future-ready skillsets, PUB's workforce can seize growth opportunities, thrive and play a vital role in sustaining mission success. Recognising this, PUB is committed to developing high-performing and resilient staff and giving our people the best training possible throughout their time with us. To achieve this, the Singapore Water Academy (SgWA) was set up in 2016 with the mission to build current and future organisational capability through competency-based training and development for PUB staff and the water industry. PUB is guided by three strategies: (i) Competency Frameworks (CFs), which help identify the knowledge and skills required for every job post in PUB to guide training needs; (ii) curriculum design, where training is designed, curated and conducted to meet the needs of PUB and the water industry; and (iii) programme delivery, in which ways to improve the quality of training delivery and training administration are examined.

COMPETENCY-BASED TRAINING AND DEVELOPMENT

- First day of work: New staff members join the PUB Induction Programme, which provides a high-level overview of the different kinds of work throughout the organisation
- First 6 months: They undergo structured on-the-job training (SOJT) which includes critical topics on safety, procurement and functional skills
- Next 7–24 months: They undergo competency-based training on both technical and non-technical topics
- Year 3 onwards: They undertake the milestone PUB Foundation Programme and other forms of learning and development, including overseas training, leadership programmes and advanced technical courses

SgWA developed the CFs for the entire organisation in phases. There are two types of competencies: (i) functional competencies which are job-specific, pertaining to each of PUB's departments; and (ii) organisational competencies which are mandatory for most, if not all, PUB staff, including customer service, digital skills, procurement, safety and leadership.

Phase 1 was launched in April 2018 when the CFs were completed for the 5 engineering operations departments and customer service. Phase 2 was launched in August 2020 when

LEVERAGING DIGITAL TECHNOLOGY

the CFs were developed for the remaining departments, which mostly cover corporate and other organisational topics. By the end of 2021, about 75% of competency-based training had been completed, with the goal to complete the remaining training by the end of 2023. SgWA will continue to review and update the CFs to ensure the relevant courses are tagged to competencies for each job post and that PUB officers undergo the necessary training in a timely manner.

To level up the awareness, knowledge and skillsets on sustainability topics, PUB is collaborating with agencies within the MSE family to co-develop a Sustainability Competency Framework to cater to the different officers appointed to hold sustainability-related portfolios (i.e., GreenGov.sg coordinators, facility managers, project officers involved in environmental impact assessments and studies).

SgWA continues to pursue digital delivery of training to support PUB's transformation. About 65% of in-house training programmes are now delivered digitally, up from 60% in the previous year. To further enhance our staff's learning experience and cultivate a positive self-directed learning culture, PUB has developed digital platforms to support training, such as our Learning Management System (LMS) called PUBLearn, PUBTube (for PUB-specific video content) and the SgWA mobile learning app to support on-the-go learning. To promote the sharing of expertise, skills and knowledge, live webinars spanning a wide range of topics are conducted on a regular basis. PUB has also explored alternative learning modalities, such as Augmented Reality (AR)/Mixed Reality (MR) and simulators.

Average Training Hours Per Employee by Gender

Gender	FY2020	FY2021
Male	46.8	51.2
Female	44.0	52.2

Average Training Hours Per Employee by Employee Category

Employee Category	FY2020	FY2021
Staff	46.6	50.1
Management	35.8	61.6

In FY2021, the number of training hours per employee across all categories increased. We converted courses to a virtual format wherever possible. However, training has not returned to pre-COVID levels due to limitations arising from safe distancing requirements and other constraints that reduce the effectiveness of learning on a virtual modality.

FEATURE STORIES



APPLY ENHANCED ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND STRATEGIC ENGAGEMENT COURSE

PUB is committed to sustainable development as Singapore transforms into a City in Nature. We carry out detailed environmental studies on developmental projects where necessary to determine and mitigate any potential impacts on the environment.

Launched in September 2021, the Apply Enhanced Environmental Impact Assessment (EIA) & Strategic Engagement Course aims to equip PUB's project officers with the relevant knowledge and skills to carry out comprehensive environmental studies and conduct meaningful engagements with stakeholders. The course includes an outdoor nature experience where staff are brought by wildlife conservationists to nature parks and exposed to the flora and fauna dwelling in our green spaces. This fosters a greater appreciation of Singapore's natural wonders, and contributes to broadening our staff's awareness and competency in environmental sustainability.



PUB staff exploring flora and fauna with wildlife conservationists.

GRI [2-23] [2-24] [2-25] [3-3][2-30] [401-1] [404-3] [405-1]

2-3 INCLUSIVE AND FAIR WORKPLACE

COMMITMENT

Ensure an **inclusive and fair workplace** for all PUB employees

PERFORMANCE



59% of employees covered by collective bargaining agreements

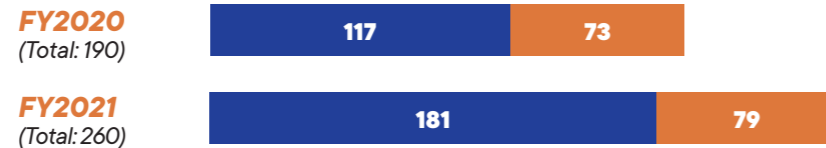
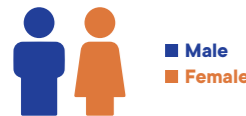
The percentage of employees covered by collective bargaining agreements in CY2020 as reflected in the Sustainability Report 2020/2021 has been amended from 83% to 63%. The earlier disclosure refers to the percentage of staff who are union members, not all of whom are covered under collective bargaining agreements. The number of staff covered by collective bargaining agreements in CY 2021 and 2020 are comparable.

INCLUSIVE RECRUITMENT PRACTICE AND EMPLOYEE RETENTION

In FY2021, the total number of employees in PUB was 3,260 (FY20: 3,300) and the rate of new hires was 8%. PUB continued to recruit employees of all ages and support the re-employment of older workers. In 2021, PUB raised the retirement age to 63 and the re-employment age to 68, in line with recommendations put forth by the Tripartite Workgroup on Older Workers and the Public Service Division. As of 31 March 2021, PUB has 363 employees aged 62 and above. PUB has also implemented a bi-annual performance review process where all officers are to be engaged by their supervisors on their performance, developmental needs and career plans.

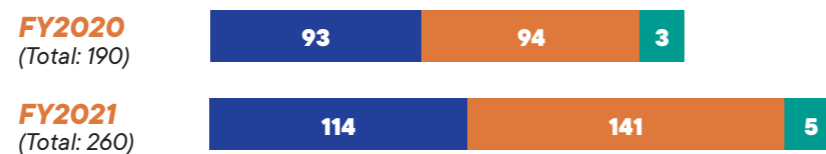
NEW HIRES AS OF 31 MARCH:

Breakdown by Gender



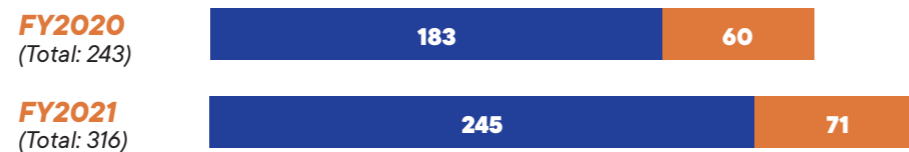
NEW HIRES AS OF 31 MARCH:

Breakdown by Age Group



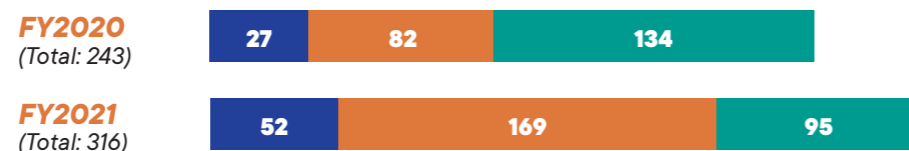
TURNOVER IN FY2021:

Breakdown by Gender



TURNOVER IN FY2021:

Breakdown by Age Group



Note: Turnover figures include all voluntary (resignation) and involuntary exits (e.g., retirement or leaving service on various exit schemes).

Most of the employees who left PUB are between 30–50 years of age and predominantly male. In FY2021, the turnover rate was 9.7%. The public service, as a whole, saw an increase in resignation rate in 2021 as the economy recovered, with the private sector offering more jobs.

FAIR EMPLOYMENT PRACTICES

PUB's employment practices are aligned with Singapore's legislations (Employment Act, Workplace Safety and Health Act, and Retirement and Re-employment Act) and the fair employment principles set out by the Tripartite Alliance for Fair Employment Practices (TAFEP). PUB has adopted the following fair recruitment practices in accordance with TAFEP guidelines:

- i) ensuring that our job advertisements are fair and non-discriminatory, so that candidates are selected based on their skills, experience and abilities;
- ii) revising our application form to only collect information that is relevant to the job (e.g., qualifications, skills, knowledge and experience); and
- iii) instituting fair interview processes that focus on competency-based and non-discriminatory interview questions

LABOUR MANAGEMENT RELATIONS

PUB Senior Management and PUB Employees' Union (PUBEU), which 79% of our staff are members of, maintain good labour management relations through regular engagement on staff matters.

Through the successful negotiation of the Collective Agreement 2021 between PUB management and PUBEU, staff will enjoy enhanced benefits. The collective agreement is negotiated and renewed every 3 years. Strong labour relations support our staff and sustain mission success.

PUB also works closely with PUBEU to engage our staff on the importance and necessity of our transformation efforts. Through engagement sessions such as management and department meetings, PUB and PUBEU work to reach out to staff, foster support for change and ensure that feedback from staff is captured for a more engaged workforce.

PUB's management has been instrumental in strong labour management relations. Deputy Chief Executive (Operations) Harry Seah was conferred the Medal of Commendation at the NTUC May Day 2022, which recognises members of senior management who, besides promoting good industrial relations and initiating workers' training and skills upgrading programmes, have also supported the labour movement and its initiatives.

3

STRONG PARTNERSHIPS

External efforts through partnerships and engagement are crucial to achieving PUB's mission. PUB aims to continuously deliver on our service commitment to our customers, while building a sense of shared purpose around conserving water through engagement and education for a sustainable water system.

CUSTOMER-CENTRIC WATER SERVICE

Service Quality

PARTNERSHIP AND ENGAGEMENT

Encouraging Water Conservation
Protecting Our Water Resources

GRI [3-3]

3-1 CUSTOMER-CENTRIC WATER SERVICE

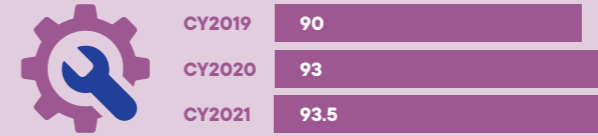
KEY FOCUS AREA 1 SERVICE QUALITY

COMMITMENT

Maintain **high service standards** for our customers

PERFORMANCE

Percentage of all submitted **cases resolved within 3 working days**



As an essential service provider, PUB strives to maintain high standards of customer service and make continuous improvements to customer service infrastructure and processes to better serve our customers. Meeting our customers' needs engenders trust and confidence which sustains PUB as we strive for mission success.

OUR CUSTOMER SERVICE COMMITMENT

PUB is committed to the timely resolution of customer feedback in an effective and efficient manner. Workflows are subject to regular internal and external reviews with agencies, and performance is monitored to ensure prompt resolution of service lapse and general enquiries. For more complex cases, PUB works closely with other agencies and takes a Whole-of-Government approach to address such feedback. More information on PUB's service commitment to address feedback and enquiries can be found at <https://www.pub.gov.sg/about/servicecommitment>.

DIGITALISING OUR SERVICES

PUB is leveraging digitalisation and customer service journeys to enhance customer experience by making it more convenient for customers to access our services, carry out transactions with us and find information they need. As of 2022, 100% of PUB's transactions are completed digitally end-to-end. PUB will also be refreshing our website and e-services, particularly our e-services for business and professional stakeholders; it is targeted to be completed by 2024.

CELEBRATING OUR SERVICE CULTURE AND CAPABILITIES

PUB believes in celebrating our people and rewarding innovation, efficiency and high service standards. The Service Star of the Year was given to 11 individuals and 4 teams at our Service & Innovation Day 2021 ("I Make A Difference").

GRI [3-3]

3-2 PARTNERSHIP AND ENGAGEMENT

KEY FOCUS AREA 1

ENCOURAGING WATER CONSERVATION

COMMITMENT

Continue to engage stakeholders to **conserve and protect** our waters

PERFORMANCE



Engaged stakeholders through various **engagement platforms** (Refer to **page 14** for more info)

Water is a scarce resource. Future water demand is expected to grow in tandem with population and economic growth, even as the lack of land in Singapore limits the amount of rainwater that we can collect and store for our needs. Every little effort to save water counts and encouraging water conservation is key to avoiding unsustainable growth in water demand, which would put undue stress on the nation's access to water. The resultant energy and resource savings from water conservation will also reduce our collective carbon footprint and contribute to climate mitigation efforts.

INCREASING PUBLIC AWARENESS

Increasing public awareness on water conservation and promoting the adoption of water-saving habits and behaviour requires a long-term sustained effort. PUB has several public education and outreach initiatives to promote water conservation among different segments of the community. In CY2021, our water campaign "Make Every Drop Count" focused on fostering a nation of water-conscious citizens to strengthen water resilience and ensure water sustainability for future generations. The campaign highlighted the significance of small water-saving habits in people's everyday lives, and how every effort counts towards Singapore's sustainable water future.

Additionally, PUB works closely with schools and the Ministry of Education to incorporate water-related topics in the school curriculum to deepen students' knowledge of Singapore's water story and inculcate good water-saving habits among our students from young. Students embark on a learning journey through the NEWater Visitor Centre to learn more about NEWater and geographical investigation field studies, where students can practise basic research skills during site visits to PUB's reservoirs and waterways.



Visitors at NEWater Visitor Centre.

ENGAGING THE INDUSTRY THROUGH INCENTIVES

The Water Efficiency Fund (WEF) was introduced in 2007 to incentivise and provide funding support for the implementation of water efficiency projects. The scheme was later enhanced in 2020 to include expanded funding areas, higher funding amounts and shorter disbursement periods, to facilitate the adoption of water-efficient equipment and better cashflow for project implementation. PUB also encourages innovative water recycling solutions through funding schemes such as the Industrial Water Solutions Demonstration Fund (IWSDF) (part of WEF) and National Research Foundation's (NRF) Living Lab (Water) Fund. Companies which have successfully carried out water recycling projects are invited to share their experience at industry forums. In doing so, PUB hopes to expedite the implementation of such solutions in all industrial premises.

For the implementation of water efficiency fittings and measures, building owners are accorded the Water Efficient Building (WEB) Certification, which gains points under the Building Construction Authority (BCA)'s Green Mark Certification Scheme. As of February 2022, 3,092 premises have obtained the WEB (Basic) certification.

NOTABLE PROJECTS IMPLEMENTED

Hoya Electronics Singapore Private Limited

In 2017, a wastewater reclamation system with 96 m³/day capacity was set up in Hoya to treat its wastewater treatment plant (WWTP) effluent for production reuse. Besides reclaiming WWTP effluent, Hoya is also recycling a portion of their electro-deionisation (KCDI) reject for reuse as make-up water to cooling tower, MAU air washer and scrubber systems. The remaining KCDI reject, RO Reject and Pre-Case Cleaner (CC) rinse water are treated using a RO Reject Recovery System and recycled back to the NEWater tank for reuse in their production. Both recycling systems are cost-effective, with simple payback of less than a year.

With all the water conservation measures in place, Hoya achieved a recycling rate of 80% in 2018, which is the highest in the semiconductor industry.

Marina Bay Sands

As one of the Integrated Resorts in Singapore, Marina Bay Sands, which is a large water user, has adopted a condensate water recovery system which was commissioned in February 2017. It collects condensate water from the air-conditioning systems of the three hotel towers, which is channelled to the water feature and irrigation tanks to supplement water used for water features and irrigation. The projected water savings is approximately 2,700 m³ a month. Marina Bay Sands also implemented a smart metering system to monitor water usage in various areas. The system alerts management to irregular water usage and enables Marina Bay Sands to manage waste use and arrest leaks promptly.

DEVELOPING BENCHMARKS AND SETTING STANDARDS

Through the years, PUB has consistently been involved in developing tools and standards to guide the industry towards higher standards of water efficiency.

2015

- Introduced the Water Efficiency Management Practices (WEMP), under which large water users must submit details of their water consumption, business activity indicators and water efficiency plans to PUB annually.

2019

- Launched ISO46001:2019 Water Efficiency Management Systems—Requirements with Guidance for Use, which provides water users with guidance on how to manage and improve water usage and efficiency.

2020

- Collaborated with the Singapore Environment Council (SEC) to launch the Singapore Green Labelling Scheme (SGLS) for commercial water use appliances, which allows non-domestic customers from hotels to town councils to make informed purchasing choices on the water efficiency of their equipment.

2022

- Published new Best Practice Guide (BPG) for Food and Beverage Manufacturing sector and revised BPGs for the wafer fabrication and semiconductor sector, refineries, petrochemicals and chemicals sector, and buildings sector.
- Updated the water efficiency benchmarks for certain sectors.

With the data collected from WEMP and continuous engagement with stakeholders, PUB has been developing various water efficiency benchmarks and best practice guidelines to help companies identify opportunities to improve water efficiency.

FEATURE STORIES



SINGAPORE WORLD WATER DAY 2022



Anderson Bridge turns blue in support of the #GoBlue4SG movement.

Every year in March, PUB celebrates Singapore World Water Day (SWWD) and organises the #GoBlue4SG movement, an initiative to rally the community and businesses to support the water cause through simple acts such as offering promotion deals and donning blue wearables. This year, over 130 schools participated in “Water Wednesdays”, dedicating every Wednesday in March to educate students on the importance of water through fun water-themed activities. In addition, over 65 blue-themed deals and promotions were offered by businesses and retailers such as LiHo, Ya Kun Kaya Toast, LION Corporation, Best Denki, COURTS, Gain City and Harvey Norman throughout the month of March in support of the #GoBlue4SG movement.

This year, a record number of 58 buildings and landmarks across the island lit up in blue for the signature “City Turns Blue” event to commemorate World Water Day and showcase their commitment to water conservation. These include the ArtScience Museum, Marina Bay Sands, Wisma Atria and Gardens by the Bay. New participants who lit up in blue this year in support of water conservation include tertiary institutions such as the Singapore Institute of Technology and the Nanyang Academy of Fine Arts, as well as commercial buildings such as Capitol Singapore, Marina Bay Financial Centre and The Ritz Carlton.

GRI [3-3]

3-2 PARTNERSHIP AND ENGAGEMENT

KEY FOCUS AREA 2
PROTECTING OUR WATER RESOURCES

Any individual or organisation can be a friend of water and take steps to safeguard our water resources. PUB works actively with various stakeholders to steward, protect and sustain the water system so as to ensure there is enough water for generations to come.

PARTNERING THE COMMUNITY IN PROTECTING OUR WATERWAYS

Since its launch in 2006, the ABC Waters programme has created new community spaces and encouraged lifestyle activities on our waterways, bringing people closer to water while cultivating a greater appreciation of our scarce water resources. Sustainable management of our waterways would not be possible without community buy-in, and we constantly engage the community to take ownership of Singapore’s water bodies. PUB encourages schools to develop educational learning trails for various ABC Waters projects so that students appreciate and learn more about our waters, and private companies, grassroots organisations and community groups are also encouraged to carry out various activities such as kayaking and other water sports at our ABC Waters site in a responsible manner.

PROTECTING OUR USED WATER

At PUB, used water is reclaimed through the NEWater treatment process, augmenting our water resources and closing the water loop. Used Water is the foundation of our 3rd National Tap and is hence an important resource. PUB actively engages industry partners to ensure that all discharged trade effluent complies with regulatory limits, thereby protecting used water.

PUB has been continuously engaging both the public and stakeholders of used water via multiple channels to reinforce the importance of used water as a resource. We have regular engagements such as site visits to industry premises and annual dialogue sessions with companies and trade associations to share best practices for trade effluent pre-treatment and the management of chemicals. In addition, we collaborate with other agencies to ensure that our key messages and requirements are included in related course materials, events and lease agreements. We also launched a webpage which documents up-to-date information on trade effluent and a written approval application for the discharge of trade effluent into public sewers, produced collaterals such as guidebooks and brochures, and leveraged social media to maximise outreach.

ENHANCING COMMUNITY FLOOD RESILIENCE

PUB takes every flood incident seriously and assesses the cause of any flood. Even as PUB makes significant investments to improve our drainage infrastructure to better channel stormwater and cope with more frequent and intense storms due to climate change, we engage the community on appropriate flood protection measures to increase community resilience to flash floods. A list of current flash flood hotspots and flood-prone areas is available on our website, and we provide flash flood alerts, monsoon advisories and precautionary tips via various platforms (e.g., Telegram, “myENV” mobile app, etc.) to residents and business owners in low-lying areas so that they can take early action to protect their properties and plan their daily activities. PUB has also been assisting and offering consultative advice to building owners to better protect buildings against flash floods. Developments which are not able to comply with the minimum platform level (for buildings) or crest level (for basements) are required to mitigate the flood risk by installing flood barriers and carry out inspections regularly to ensure they are in good working condition. Together, we can manage stormwater in a sustainable manner.



Automatic Flood Barrier at Fortune Park Condo.



4 BUSINESS EXCELLENCE

As a public agency, the long-term sustainability of PUB's business relies on the support of strong corporate governance and business practices to ensure that we remain responsible and trusted by all our stakeholders in delivering our mission. At the same time, we strive for improvement at every possible avenue.

We focus on 4 key areas:

- TRUST AND TRANSPARENCY
- INNOVATION
- DIGITALISATION AND CYBERSECURITY
- FINANCIAL SUSTAINABILITY

GRI [2-23] [2-24] [2-25] [3-3] [205-2]

4-1 TRUST AND TRANSPARENCY

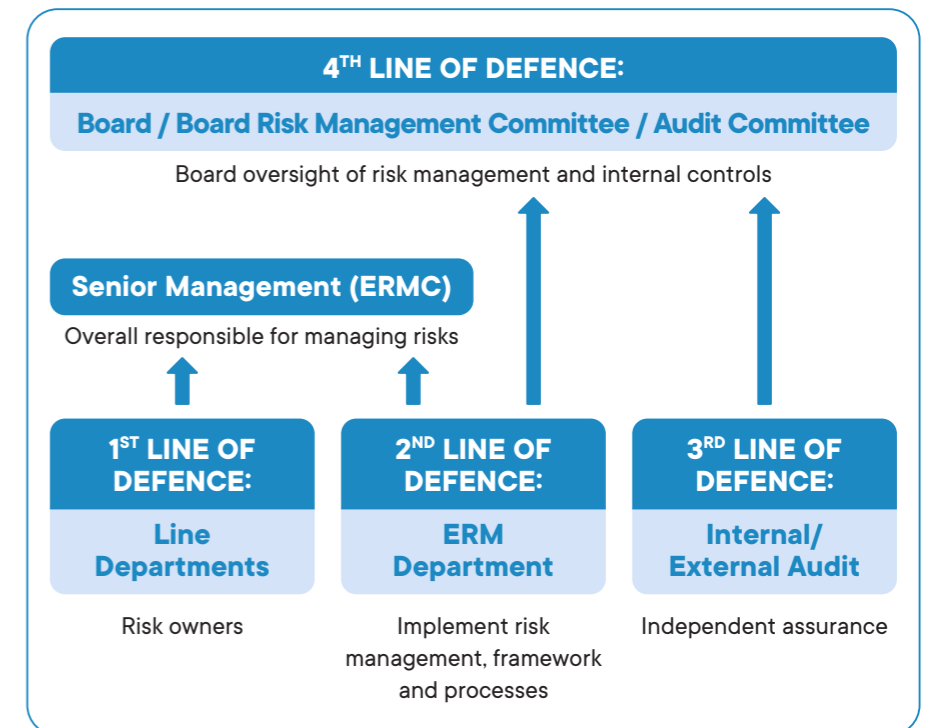
COMMITMENT

Ensure and maintain **transparency** in our business

As a public agency, it is important for PUB to deliver its mission in a responsible and trusted manner. A lack of trust and transparency can result in loss of citizens' confidence, affecting PUB's social license to operate. The following policies and practices are in place to help foster trust in PUB as a responsible business and public agency to sustain mission success.

ENTERPRISE RISK MANAGEMENT (ERM) FRAMEWORK

PUB has an established Enterprise Risk Management (ERM) framework, with risk governance, processes and enablers as its core pillars, to ensure that key risks which may derail our mission and affect public confidence are identified, assessed and managed with mitigating measures. A "four lines" governance structure is adopted to provide assurance that processes, procedures and controls are in place, and ensures that key business risks are reviewed and tested using a robust assurance process. PUB's Board, assisted by the Board Risk Management Committee (BRMC), provides independent oversight over (i) the ERM framework and processes; and (ii) PUB's key risks, such as those pertaining to environmental sustainability and climate change, to ensure that mitigation measures are comprehensive and adequate. Environmental scans are also regularly conducted to identify new/emerging risks which could potentially have strategic impact but with significant uncertainty. Risks with low likelihood but very high impact are also identified and reviewed to ensure that the likelihood of risk occurrence is kept as low as possible.



PUB Risk Governance Structure

CODE OF CONDUCT

PUB has an internal code of conduct and fraud risk management policy that is communicated to all employees. The Code of Conduct articulates the principles by which PUB officers shall conduct themselves to instil public confidence in PUB and uphold the integrity of PUB. In addition, it also sets out the process of ensuring that a conflict of interest is prevented and mitigated. PUB also conducts an annual declaration exercise to ensure all employees adhere to and comply with PUB's Code of Conduct. Additionally, periodic training on the Code of Conduct and fraud risk management policy is carried out to reinforce employees' understanding in a timely manner.

PUB WHISTLEBLOWING CHANNEL

PUB has a whistleblowing channel for staff, external parties such as contractors dealing with PUB, customers and the general public to report any concern or observation of wrongdoing involving actual or suspected fraud, corruption or financial malpractice within PUB. Under the guidelines for the whistleblowing channel, all reports made in good faith will be dealt with in confidence, and whistleblowers are assured that they will be protected from any unfair treatment that could potentially arise as a result of making a report. The channels for reporting are managed independently by the Internal Audit Office. All whistleblowing reports are investigated and reported to the Audit Committee. Guidelines for the whistleblowing channel are readily accessible to all employees through PUB's Intranet and to external parties through the PUB website.

SUSTAINABLE PROCUREMENT

To ensure no disruption to PUB's mission in serving the public in the light of the COVID-19 pandemic, PUB has enhanced our tender evaluation process and adopted various resilience measures in our procurements for our operational and maintenance services tenders. PUB has also embarked on the transformation journey to digitalise the transmission of various procurement documentation and eliminate the need for paper correspondence with business entities. Additionally, as part of our continual effort to support the national environmental sustainability agenda, PUB will increasingly incorporate more environmental sustainability measures into our procurements, including enhanced specifications to ensure compliance with GreenGov.SG measures. For example, buildings that undergo addition and alteration works are to use green-labelled building products and furniture, and indoor events and functions with more than 50 people are to be held at venues with at least a valid Green Mark Platinum rating or equivalent. PUB will continue to leverage on technologies and use environmentally friendly equipment and products to advance our sustainability objectives.

FINANCIAL CONTROLS

The delegation of financial authorities to the respective PUB officers for procurement, payments, revenues and assets are set out in the financial manual. An annual declaration exercise is also in place to remind senior PUB officers of their commitment to the adoption and compliance with financial controls in the course of daily operations. The Board has established the Audit Committee and the Finance & Investment Committee to appraise and report to the Board on financial governance matters. The Audit Committee plays a key role in assisting the Board to fulfil its corporate governance and oversight responsibilities, particularly in the areas of financial reporting, internal control systems, and the internal and external audit functions of PUB. The Finance & Investment Committee assists the Board on matters pertaining to PUB's investments and annual budget.

GRI [3-3]

4-2 INNOVATION

COMMITMENT

Ensure **continuous innovation** in our work

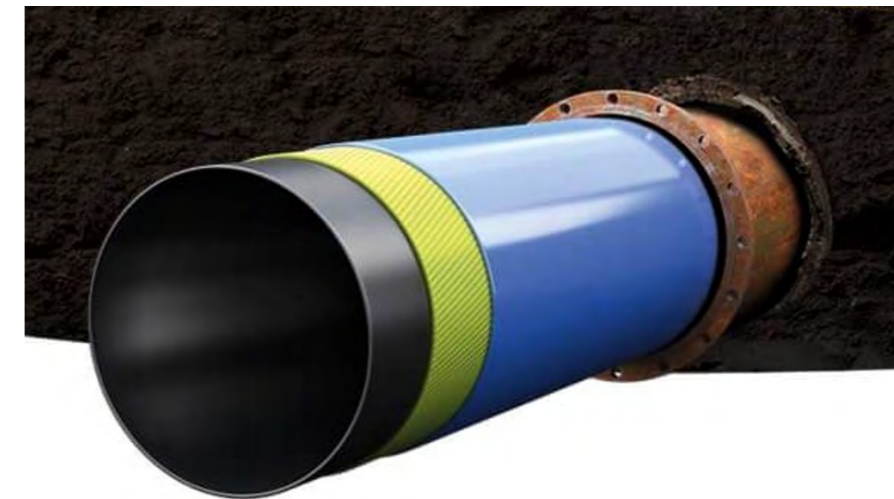
PERFORMANCE



At PUB, innovation is about devising ways to do our everyday work better and more efficiently to yield better outcomes and serve our valued customers. Innovation also reduces operational inefficiencies and disruption in continuity. We believe every PUB employee can innovate, and we take action to transform ideas into reality.

CULTIVATING A CULTURE OF INNOVATION

PUB recognises the importance for all staff to apply innovation in their work and provides an environment for innovation to thrive. Officers regularly review their work processes and implement improvements to cut costs and inefficiencies.



Rehabilitation of pipelines through flexible kevlar-reinforced polyurethane liner.

In 2021, PUB successfully rehabilitated several stretches of leak-prone pipelines using a flexible kevlar-reinforced polyurethane liner. The innovative pipe-in-pipe relining trenchless technology was used to overcome the challenges posed by the congested underground space. Besides reducing transmission losses, the rehabilitation of potable water pipes resulted in significant time and cost savings for PUB. For its ingenuity, this project was awarded the CE Innovation Gold Award.

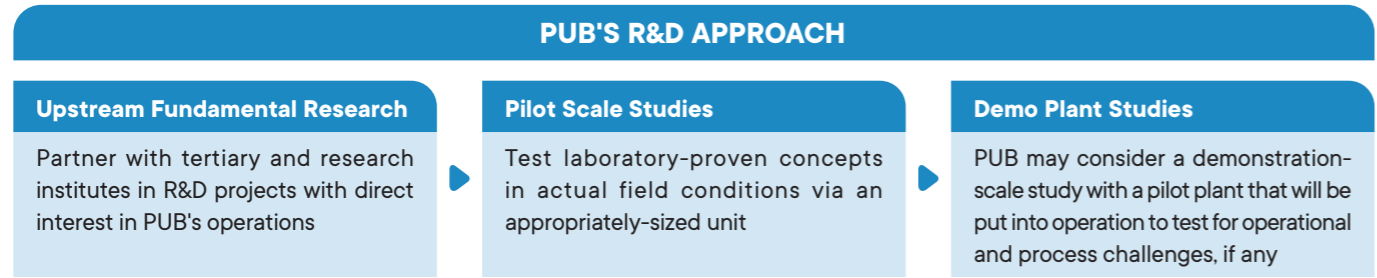
GROWING WATER TECHNOLOGIES THROUGH R&D

Even as PUB nurtures a culture of innovation amongst our staff, PUB seeks to be at the forefront of technological developments in the global water R&D scene. In 2004, a dedicated technology department was set up to drive PUB's R&D efforts. Guided by a technology roadmap which is periodically refreshed, PUB invests wisely in technologies that are needful, applicable and valuable to our operations. Our R&D approach consists of 3 levels and spans across 9 technology domains of interests, while our R&D projects range from fundamental, proof-of-concept studies to demonstration-scale trials in operational domains across the water loop. PUB also works closely with our collaborators and research partners to de-risk and scale up promising technologies.

PUB R&D

- 1 in 2 projects under PUB R&D Fund progresses to implementation phase
- Worked on 724 R&D projects in collaboration with partners (institutions and companies) from 27 countries

Many of these projects have also been featured in "Innovation in Water, Singapore", PUB's regular publication which showcases various R&D projects across our 9 technology domains.



The 9 technology domains of interests are:

- Watershed Management
- Water Treatment, Desalination And Reuse
- Used Water Treatment
- Water Quality and Security
- Network Management
- Industrial Water Solutions
- Digitalisation
- Coastal Protection and Climate Change Adaptation
- Waste Reduction and Resource Recovery

DEVELOPING AN ECOSYSTEM

In addition to implementing technology roadmaps to guide R&D efforts within PUB and with our research partners, PUB needs to develop a strong ecosystem of local and international companies, research institutes and experts to conduct applied R&D to succeed. We do so through 4 main initiatives.

Research, Innovation and Enterprise (RIE) Funding

Since 2006, the National Research Foundation (NRF) has allocated more than S\$650 million to grow the local water research and industry landscape in Singapore. With the strategic thrusts of technology development, cluster development and internationalisation, Singapore has a vibrant and comprehensive water research ecosystem today, comprising approximately 200 water companies and 25 public and private research centres.

In 2021, further NRF funding will be allocated over the next 5 years to continue developing high-impact solutions to meet strategic national water needs, with a stronger focus on commercialisation and wider adoption of new water technologies. This will be achieved through 4 key thrusts: (i) technology development; (ii) technology translation; (iii) capability development; and (iv) enterprise development.

Singapore International Water Week (SIWW)



Participants at Singapore International Water Week 2022.

As one of the leading global water events in the world, the biennial Singapore International Water Week gathers leaders, experts and practitioners from governments, utilities, industry, academia and international organisations to share best practices and solutions, showcase the latest innovation, build partnerships and harness business opportunities to solve the emerging water challenges facing the world today.

To achieve these objectives, PUB works closely with its network of local and international partners to curate the line-up of content during the event, including:

- **Water Leaders Summit:** Gathering of global water leaders to share solutions, innovation and policy interventions to solve the world's pressing urban water challenges.
- **Water Convention:** A technical conference for water experts and practitioners to share knowledge and engage in discussion and debates through high-quality presentations. These showcase sustainable technological solutions, processes and management strategies that address current and emerging water issues.
- **Water Expo:** An exhibition featuring state-of-the-art solutions, cutting-edge technologies, services and products from international country pavilions, individual participating companies and start-ups.
- **TechXchange:** A platform for innovators to connect with buyers and investors to accelerate the commercialisation of new water technologies from lab to market.
- **Thematic & Business Forums:** Forums to discover trends, solutions and business opportunities and challenges across various themes and markets in the water sector.

A key highlight of SIWW is the award of the Lee Kuan Yew Water Prize. This prestigious, internationally recognised prize honours outstanding contributions by individuals or organisations towards solving the world's water problems by developing or applying innovative technologies or implementing policies and programmes which benefit humanity. The 2020 Lee Kuan Yew Water Prize was awarded to Professor Kazuo Yamamoto for his pioneering work in developing the world's first operationally viable submerged Membrane Bioreactor (MBR) prototype in 1988. His pioneering invention has since benefitted millions worldwide with enhanced public health and water security.

Singapore adopted MBR technology in our used water treatment processes since 2006, currently implemented in three water reclamation plants – Changi, Ulu Pandan and Jurong. Highly energy efficient, the submerged MBR's ability to produce particle-free filtrate currently provides the most cost effective and efficient way to achieve the high standards required of NEWater feedstock for potable reuse, which facilitates water recycling and reclamation. Submerged MBR technology improves the efficiency and optimises the costs of water reclamation efforts, and PUB constantly pushes the frontier of water technology to reduce the energy consumption of our MBR plants. PUB commissioned the Integrated Validation and Demonstration Plant (IVP) in 2017 to test and validate advanced wastewater treatment technologies, which include the use of a biologically enhanced primary treatment facility and an energy-efficient MBR to

shorten the process of used water treatment, reduce energy usage and plant footprint and maximise biogas production. Advances in submerged MBR technology have helped PUB build more energy-efficient and compact water reclamation plants, such as the upcoming Tuas WRP.

Singapore Water Exchange (SgWX)



Singapore Water Exchange (SgWX).

The Singapore Water Exchange (SgWX) is a global marketplace for innovative water companies. Located within PUB's WaterHub, it was purpose-built in 2018 to provide a conducive environment for water companies to collaborate and co-innovate. In addition, SgWX also hosts a range of activities to allow water professionals to come together, build networks and forge partnerships to tackle global water challenges.

Today, SgWX has grown to become a vibrant ecosystem of 34 companies from 12 countries. These companies leverage mutual strengths and uncover potential synergies to push the frontiers of water innovation and business growth.

SgWX is also challenging itself to be more sustainable. It was awarded the BCA Greenmark Platinum (Super Low Energy Building) in 2022, and will further improve its sustainability performance through the implementation of new energy and water-saving technologies.

Technology Deployment and Commercialisation

Technology deployment and commercialisation are essential to capture value from PUB's research investments. Besides providing the lead demand, PUB works collaboratively with other government agencies to bring these technologies to the market.

With advice from the Water Technology Advisory Panel (WTAP) that comprises government and industry leaders, PUB has rolled out key initiatives in 2021/22 to enhance commercialisation outcomes. These include Water Technology Roadshows, leveraging private sector venture-builders to develop spin-offs, and partnering an established accelerator to run a Commercialisation Programme for promising start-ups. The aim of such initiatives is to bring research from lab to market as quickly as possible, so that PUB and the rest of world can benefit from the cutting-edge research that is being done in Singapore.

The industry has shown keen interest in the technologies that have been profiled, and are evaluating the technologies for licensing. At the same time, the start-ups are also making inroads into key markets, for example, in the Philippines and Vietnam, where discussions are ongoing to test the technologies.

Research Programme Partnerships

PUB actively welcomes collaboration partners for research projects which will enable us to increase Singapore's water resources, improve water quality, and reduce energy consumption, chemical usage, waste production and reliance on manpower. Some notable projects that we have accomplished include:

i) Detection of heavy metals and cyanide in PUB's sewerage network using microbial electrochemical sensors (MES)

Heavy metals that are illegally discharged by industries can inhibit microbial growth and affect the biological treatment processes in downstream WRPs. The microbial electrochemical sensor (MES) system developed by NUS provides real-time monitoring of heavy metals and cyanide in used water network, hence deterring the illegal discharges of these contaminants. In the MES system, alarms are triggered during voltage drops, which occur when bacteria are subjected to toxicants. A translational grant call in 2016 enabled EnvironSens (a spin-off from NUS in 2018) to further improve the sensor's operation and maintenance regime. Today, PUB has installed 175 of these units in various parts of its sewerage network to provide a round-the-clock alert on toxic materials discharged into the sewers.

ii) Rainfall forecasting capabilities with radar technology

In 2016, PUB started working with the Hydroinformatics Institute Pte. Ltd and Furuno Singapore Pte. Ltd to develop a rainfall monitoring and prediction system capable of providing heavy rainfall warnings, enhancing its response time to potential flash floods that might occur across Singapore. The system merges the rainfall monitoring capability of X-band radars and a nowcast model that forecasts the movement, growth and decay of rainclouds, enabling it to produce a forecast 30 minutes ahead of a rainfall event. To-date, 6 X-band radars, which can monitor rainfall within a range of 30–50 kilometres, have been implemented across the island to predict the locations where heavy rainfall is expected, allowing the PUB Joint Operations Centre (JOC) to deploy PUB's Quick Response Team (QRT) vehicles early to potential flood locations.

GRI [3-3]

4-3 DIGITALISATION AND CYBERSECURITY

COMMITMENT

Ensure **robust IT and cybersecurity** management

PERFORMANCE



100% completion of cybersecurity literacy training (CSC Learn course) in FY2021

DIGITAL MASTER PLAN

Digitalisation is key to PUB's transformation into a smart utility of the future. In line with Singapore's vision of a Smart Nation and to keep up with higher public expectations as we strive to enhance productivity, safety and security and improve service delivery, PUB's adoption of digital solutions in the internet of things, data analytics, artificial intelligence, autonomous systems and digital twin technology areas aims to improve our operational effectiveness and efficiency.

These digital initiatives enable PUB to improve service delivery and safety and reduce operational costs and energy consumption. Improved connectivity and automation, both in operations and corporate processes, also improves the productivity of our workforce.

While it is critical that PUB continues to adopt smart technologies, it is equally important that our staff possess the necessary skills to capitalise on the benefits of technology and increased digitisation for sustained mission success. In 2021, 100% of PUB staff completed basic digital literacy and cybersecurity literacy training. 96% of PUB staff also completed basic data literacy training.

CYBERSECURITY

Effective cybersecurity starts with our staff. To help officers develop awareness of cybersecurity threats and risks and apply the appropriate risk management actions to protect the organisation, digital literacy programmes have been formulated according to the Digital Literacy Framework set out by the Public Service Division. All employees who use digital devices at work are required to complete basic cybersecurity refresher training annually, which covers basic cyber and data security awareness and hygiene practices. Additionally, PUB sends out regular notices regarding phishing emails and encourages users to report phishing emails.

GRI [3-3]

4-4 FINANCIAL SUSTAINABILITY

COMMITMENT

Ensure **economic and financial sustainability**

PERFORMANCE



Refer to **PUB's Annual Report 2021/2022, page 44** for more details on our financial results

As a partially self-funded statutory board funded by government grants and revenue from water tariffs, PUB has in place various business practices to ensure that we make financially responsible and sustainable decisions throughout our operations. These include the following:

ANNUAL BUDGET REVIEW EXERCISE

Before the start of each financial year, an annual budget review exercise is conducted before the budget is presented and approved by the PUB Board and the Ministry of Sustainability and the Environment. To ensure accountability and responsible budgeting, we aim to maximise our budget utilisation rate for all our projects across all departments. Regular review of budget marksmanship performance is conducted, and PUB's overall financial performance is regularly reported to the Board.

PROJECT REVIEW PANEL WITH LIFE-CYCLE COST APPROACH

A project review panel comprising senior management thoroughly reviews the needs and technical aspects of every new capital project. A life-cycle cost approach is implemented for relevant capital projects to provide more comprehensive visibility of our overall long-term resourcing requirements such as operating and renewal costs. This facilitates better decision-making across project options and improves long-term budget planning.

WATER PRICE REVIEW

Coupled with PUB's cost management practices, regular reviews of water prices are also carried out to ensure the financial sustainability of our water systems. In Singapore, water is priced to reflect its scarcity and encourage consumers to use it wisely.

GREEN FINANCING FRAMEWORK AND THE ISSUANCE OF GREEN BONDS

To advance our sustainability agenda, PUB has established a Green Financing Framework in accordance with the ICMA Green Bond Principles 2021 and ASEAN Green Bond Standards 2018 to fund existing and future projects in sustainable water and wastewater management and renewable energy. Projects must be able to achieve a reduction in greenhouse gas emissions or show improvements to the environment from baseline to qualify as green projects.

In August 2022, PUB raised \$800 million through the issuance of 30-year fixed rate green bonds. Proceeds from the issuance of green bonds could be used to finance eligible green projects such as Floating Solar Photovoltaic (PV) systems on reservoirs. The issuance of green bonds will help PUB deliver our mission responsibly amidst the challenges of climate change and support the national agenda to achieve a low-carbon future.

REPORTING FUNDAMENTALS

METHODOLOGICAL REVIEW

ENVIRONMENTAL

ENERGY AND GREENHOUSE GAS (GHG) EMISSIONS

FY2021 ENERGY CONSUMPTION AND GHG EMISSIONS					
Total energy consumption (Terajoules)			Direct (Scope 1) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 2) GHG emissions (ktCO ₂ e)	Indirect (Scope 3) GHG emissions (ktCO ₂ e)
2923.8			7.3	271.7	93.3
Total energy consumption from non-renewable sources (Terajoules)	Total electricity consumption from renewable sources (Terajoules)	Grid electricity consumption (Terajoules)	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O
20.6 TJ	505.9 TJ (140.5 GWh)	2397.3 TJ (665.9 GWh)			
Energy Sources: Diesel, Petrol	Energy Sources: Solar and biogas from used water sludge				

FY2020 ENERGY CONSUMPTION AND GHG EMISSIONS					
Total energy consumption (Terajoules)			Direct (Scope 1) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 2) GHG emissions (ktCO ₂ e)	Indirect (Scope 3) GHG emissions (ktCO ₂ e)
2933.1 TJ			8.5 kt	289.8 kt	96.6
Total energy consumption from non-renewable sources (Terajoules)	Total electricity consumption from renewable sources (Terajoules)	Grid electricity consumption (Terajoules)	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O
32.9 TJ	346.0 TJ (96.1 GWh)	2554.2 TJ (709.5 GWh)			
Energy Sources: Diesel, Petrol	Energy Sources: Solar and biogas from used water sludge				

FY2019 ENERGY CONSUMPTION AND GHG EMISSIONS					
Total energy consumption (Terajoules)			Direct (Scope 1) GHG emissions (ktCO ₂ e)	Energy indirect (Scope 2) GHG emissions (ktCO ₂ e)	Indirect (Scope 3) GHG emissions (ktCO ₂ e)
2,771.2 TJ			8.4 kt	271.8 kt	Data not available
Total energy consumption from non-renewable sources (Terajoules)	Total electricity consumption from renewable sources (Terajoules)	Grid electricity consumption (Terajoules)	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	Gases included in calculation: CO ₂ , CH ₄ , N ₂ O	-
31.9 TJ	344.4 TJ (95.7 GWh)	2394.9 TJ (665.3 GWh)			
Energy Sources: Diesel, Petrol	Energy Sources: Solar and biogas from used water sludge				

Reporting Scope, Period and Approach

While PUB adopts the operational control approach as outlined in the GHG protocol corporate standard, the scope and sources of reported GHG emissions are aligned with PUB's GreenGov.SG Reporting Submissions. Data for energy and GHG emissions consumption has been compiled for Financial Year 2019, 2020 and 2021.

Energy Consumption within the Organisation

Energy consumption is derived from grid electricity, solar energy, biogas from used water sludge and non-renewable fuel sources such as diesel across all PUB-owned operational and corporate facilities that are covered under PUB's GreenGov.SG Reporting Submissions, including fuel consumption from PUB's vehicle fleet. The total energy consumption is expressed in terajoules (TJ).

GHG Emissions

This report discloses Scope 1, 2 and 3 GHG emissions. Global Warming Potential (GWP) values were sourced from the 2014 IPCC Fifth Assessment Report (AR5).

- Scope 1 emissions are emissions from sources that are owned or controlled by the organisation. For PUB's report, they include CO₂, CH₄ and N₂O from diesel use from operational facilities and vehicles (diesel) as well as wastewater treatment, expressed in tonnes of CO₂-equivalent. Emission factors for direct energy consumption are taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (i.e., 74.1 tCO₂/TJ for diesel, 69.3 tCO₂/TJ for petrol or motor gasoline). N₂O emissions are calculated based in IPCC 2006 Guidelines for wastewater treatment at advanced wastewater treatment plants.
- Scope 2 emissions are indirect emissions that result from the generation of purchased or acquired electricity, heating, cooling and steam consumed by the organisation. Scope 2 emission factors for the calculation of FY2019 and FY2020 electricity consumption in Singapore are taken from the Singapore Energy Statistics 2019 published by the Energy Market Authority in Singapore (0.4085 kilograms CO₂/kWh), while calculation of FY2021 electricity consumption in Singapore is taken from the Singapore Energy statistic 2020 published by the Energy Market Authority in Singapore (0.408 kilograms CO₂/kWh).
- Scope 3 emissions are all other indirect emissions that are a consequence of the activities of the organisation, but occur from sources not owned or controlled by the organisation. For PUB's report, they include emissions from diesel use and electricity consumption at NEWater and Desalination Design, Build, Own and Operate (DBOO) Facilities, and emissions from the incineration of wastewater sludge.

Waste

Waste generated is expressed in kilotonnes. It includes operational waste from used water and water treatment, and hazardous laboratory and operational waste. PUB engages private companies to help manage all waste generated by our operations. They ensure that the wastes are properly collected, transported, incinerated (where required) and disposed at the landfill, complying with all contractual requirements and prevailing regulations. PUB does not currently track the amount of waste generated from corporate functions.

	Waste from Used Water Treatment (tons)	Waste from Water Treatment (tons)	Total (tons)
FY2019	208,672	16,611	225,283
FY2020	187,677	13,753	201,430
FY2021	181,269	12,124	193,393

Hazardous wastes generated from PUB's laboratory work are stored in purpose-built containers and designated areas before they are collected by licensed waste collectors for disposal off-site to prevent contamination to the environment.

Categories of Hazardous Wastes	FY2019	FY2020	FY2021
Biohazardous laboratory waste (e.g., cultures and media)	(Data not available)	23,040L	29,538L
Laboratory waste water (e.g., spent chemicals)	7000 L	11400 L	9,225L
Laboratory solid waste (e.g., broken glassware, radiochemistry planchets, solid waste associated with chemical spillage)	104KG	104KG	197.5KG
Used UV lamps	440 pieces	0	440 pieces

SOCIAL

Employee Profile

Employees are individuals who are in an employment relationship with PUB.

New hires are employees who have joined PUB during the year.

Turnover includes all voluntary (resignation) and involuntary exits (e.g., retirement or leaving service on various exit schemes).

Health and Safety

Workers are individuals whose work, or workplace, is controlled by PUB including PUB's employees and contractors.

Major Injuries are non-fatal but severe injuries. They are defined by the nature of injury, part of the body injured, incident type and duration of medical leave. Examples include amputation, blindness, deafness, paralysis, crushing, fractures and dislocations of head, back, chest and abdomen, neck, hip and pelvis.

Minor injuries refer to non-severe injuries with any instance of medical leave or light duties.

Reportable work-related accidents are any work-related accident, workplace accidents, Dangerous Occurrences and Occupational Diseases.

Fatality and work injury rates are calculated using number of fatalities or injuries divided by the number of workers, multiplied by 100,000.

Health and Safety statistics have been revised to align with the latest WSHC definitions and compilation methodology of incident statistics as of 2022.

PUB's workforce (Employees+Contractors)	CY2020		CY2021	
	Number	Rate	Number	Rate
Estimated number of Workers	11464		13708	
Fatalities	1	8.7	0	0
Major injuries	2	17.4	1	7.3
Minor injuries	50	436.2	42	306.4
Main types of work-related injuries	<ul style="list-style-type: none"> Slip, trip and fall Motorbike Traffic Accident 		<ul style="list-style-type: none"> Slip, trip and fall Caught in between object Fall from height 	

Training hours

The average training hours are calculated using the total number of training hours in the year divided by the total number of employees at the end of the reporting period.

GRI CONTENT INDEX



For the Content Index - Essentials Service, GRI Services reviewed that the GRI content index is clearly presented, in a manner consistent with the Standards, and that the references for disclosures 2-1 to 2-5, 3-1 and 3-2 are aligned with the appropriate sections in the body of the report.

Statement of Use: PUB has reported in accordance with the GRI Standards for the period 1 April 2021 to 31 March 2022.

GRI 1 Used: GRI 1: Foundation 2021

GENERAL DISCLOSURES (GRI 2: GENERAL DISCLOSURES 2021)

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
ORGANISATION AND ITS REPORTING PROCESS			
2-1	Organisational details	About PUB: Our Vital Role	4
2-2	Entities included in the organisation's sustainability reporting	About this Report	2
2-3	Reporting period, frequency and contact point	About this Report	2
2-4	Restatements of information	Key Focus Area 1: <ul style="list-style-type: none"> Reducing Our Energy and Carbon Footprint; Reporting Fundamentals: Environmental; Reporting Scope, Period and Approach 	25; 58-59
2-5	External assurance	<i>External assurance has not been sought for this report. We may consider seeking external assurance for future reports.</i>	
ACTIVITIES AND WORKERS			
2-6	Activities, value chain and other business relationships	<ul style="list-style-type: none"> About PUB: Our Vital Role Chairman's Message Chief Executive's Message 	4, 5-7
2-7	Employees	Employee Profile	35
2-8	Workers who are not employees	<ul style="list-style-type: none"> Employee Profile; Reporting fundamentals: Social 	35; 60
GOVERNANCE			
2-9	Governance structure and composition	Sustainability Governance	15
2-10	Nomination and selection of the highest governance body	The Board comprises members who as a group provide core competencies such as accounting or finance, business or management experiences, industry knowledge, strategic planning experience, and customer-based experience or knowledge. Approved by the Singapore Cabinet, the Board is guided by PUB's Code of Board Governance to uphold their duties with care, skill and diligence.	
2-11	Chair of the highest governance body	The chair of the Board is not a senior executive of the organisation.	
2-12	Role of the highest governance body in overseeing the management of impacts	Sustainability Governance	15
2-13	Delegation of responsibility for managing impacts	Sustainability Governance	15
2-14	Role of the highest governance body in sustainability reporting	Sustainability Governance	15
2-15	Conflicts of interest	Processes to ensure that conflicts of interest are prevented and mitigated are set out in PUB's Code of Board Governance. This includes sensitive information of PUB's business affairs and are not to be disclosed.	
2-16	Communication of critical concerns	This covers confidential information of PUB's business affairs and are not to be disclosed due to confidentiality reasons.	

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
2-17	Collective knowledge of the highest governance body	Sustainability Governance	15
2-18	Evaluation of the performance of the highest governance body	This includes sensitive information of business affairs and are not to be disclosed due to confidentiality reasons.	
2-19	Remuneration policies		
2-20	Process to determine remuneration		
2-21	Annual total compensation ratio		
STRATEGY, POLICY AND PRACTICES			
2-22	Statement on sustainable development strategy	<ul style="list-style-type: none"> Chairman's Message Chief Executive's Message 	5-7
2-23	Policy commitments	<ul style="list-style-type: none"> About PUB: Our Vital Role Health and Safety Inclusive and Fair Workplace Trust and Transparency 	4; 36; 40-41; 49-50
2-24	Embedding policy commitment	<ul style="list-style-type: none"> Health and Safety Inclusive and Fair Workplace Trust and Transparency 	36; 40-41; 49-50
2-25	Processes to remediate negative impacts	<ul style="list-style-type: none"> Health and Safety Inclusive and Fair Workplace Trust and Transparency 	36; 40-41; 49-50
2-26	Mechanisms for seeking advice and raising concerns	<ul style="list-style-type: none"> Our Stakeholder Engagement; Trust and Transparency 	14; 49-50
2-27	Compliance with laws and regulations	This includes sensitive information of business affairs and are not to be disclosed due to confidentiality reasons.	
2-28	Membership associations	<ol style="list-style-type: none"> International Water Association (IWA) Governing Council Member International Water Association (IWA) Corporate Member International Desalination Association (IDA) Corporate Member World Water Council (WWC) Member Asia Pacific Water Forum (APWF) Member Asia Water Council (AWC) Member Global Water Partnership Southeast Asia (GWP-SEA) Observing Member Leading Utilities of the World (LUOW) Advisory Member World Health Organisation (WHO) American Water Works Association (AWWA) Member Global Water Research Coalition (GWRC) World Water Innovation Forum (WWIF) K2i established by Booky Oren Global Water Technologies (BOGWT) WaterShare by KWR Water Research Institute 	
STAKEHOLDER ENGAGEMENT			
2-29	Approach to stakeholder engagement	Our Stakeholder Engagement	14
2-30	Collective bargaining agreements	Inclusive and Fair Workplace	40

MATERIAL TOPICS (GRI 3: MATERIAL TOPICS 2021)

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
3-1	Process to determine material topics	Materiality Assessment	16
3-2	List of material topics	Materiality Assessment	16

PILLAR 1: WATER AND SUSTAINABLE MANAGEMENT

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
SUSTAINABLE WATER SYSTEM			
3-3	Management of material topics	Sustainable Water System	18-24
RESOURCE EFFICIENCY AND CIRCULARITY			
3-3	Management of material topics	Resource Efficiency and Circularity	25-29
GRI 302: ENERGY 2016			
302-1	Energy consumption within the organisation	<ul style="list-style-type: none"> Reducing our energy and carbon footprint Reporting Fundamentals 	25; 58-59
302-4	Reduction of energy consumption	<ul style="list-style-type: none"> Reducing our energy and carbon footprint Reporting Fundamentals 	25; 58-59
GRI 305: EMISSIONS 2016			
305-1	Direct (Scope 1) GHG Emissions	<ul style="list-style-type: none"> Reducing our energy and carbon footprint Reporting Fundamentals 	25; 58
305-2	Energy indirect (Scope 2) GHG emissions	<ul style="list-style-type: none"> Reducing our energy and carbon footprint Reporting Fundamentals 	25; 58
305-3	Other indirect (Scope 3) GHG emissions	Reporting Fundamentals	58
GRI 306: WASTE 2020			
306-1	Waste generation and significant waste-related impacts	Maximising resource circularity	28
306-2	Management of significant waste-related impacts	Maximising resource circularity	28-29
306-3	Waste generated	<ul style="list-style-type: none"> Maximising resource circularity Reporting Fundamentals 	28; 59
CLIMATE CHANGE ADAPTATION			
3-3	Management of material topics	Climate Change Adaptation	30-33

PILLAR 2: CAPABLE AND ENGAGED WORKFORCE

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
HEALTH AND SAFETY			
3-3	Management of material topics	Health and Safety	36-37
GRI 403: OCCUPATIONAL HEALTH AND SAFETY 2018			
403-1	Occupational health and safety management system	Health and Safety	36-37
403-2	Hazard identification, risk assessment, and incident investigation	Health and Safety	36-37
403-3	Occupational health services	Health and Safety	36-37
403-4	Worker participation, consultation, and communication on occupational health and safety	Health and Safety	36-37
403-5	Worker training on occupational health and safety	Health and Safety	36-37
403-6	Promotion of worker health	Health and Safety	36-37
403-7	Prevention and mitigation of occupational health and safety impacts directly linked by business relationships	Health and Safety	36-37
403-8	Workers covered by an occupational health and safety management system	Health and Safety	36-37
403-9	Work-related injuries	<ul style="list-style-type: none"> Health and Safety Reporting Fundamentals 	36-37; 60

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
COMPETENT WORKFORCE			
3-3	Management of material topics	Competent Workforce	38-39
GRI 404: TRAINING AND EDUCATION 2016			
404-1	Average hours of training per year per employee	Competency-based training	38-39
404-2	Programmes for upgrading employee skills and transition assistance programmes	Competency-based training	38-39
INCLUSIVE AND FAIR WORKPLACE			
3-3	Management of material topics	Inclusive and Fair Workplace	40
404-3	Percentage of employees receiving regular performance and career development reviews	Inclusive and Fair Workplace	40
GRI 401: EMPLOYMENT 2016			
401-1	New employee hires and employee turnover	Inclusive and Fair Workplace	40-42
GRI 405: DIVERSITY AND EQUAL OPPORTUNITY 2016			
405-1	Diversity of governance bodies and employees	<ul style="list-style-type: none"> • Sustainability Governance • Employee Profile 	15; 35

PILLAR 3: STRONG PARTNERSHIPS

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
CUSTOMER-CENTRIC WATER SERVICE			
3-3	Management of material topics	Customer-centric Water Service	43
PARTNERSHIP AND ENGAGEMENT			
3-3	Management of material topics	Partnership and Engagement	44-47

PILLAR 4: BUSINESS EXCELLENCE

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
TRUST AND TRANSPARENCY			
3-3	Management of material topics	Trust and Transparency	49-50
GRI 205: ANTI-CORRUPTION 2016			
205-2	Communication and training about anti-corruption policies and procedures	<ul style="list-style-type: none"> • Trust and Transparency • Specific to disclosure 205-2 (a) and (d), PUB has an internal code of board governance that articulates the responsibilities and conduct of the Board, and is communicated to the Board. Currently, PUB has not identified a need for dedicated anti-corruption training to be provided for the Board. Hence, the total number and percentage of governance body members that have received training on anti-corruption were not reported. 	49
INNOVATION			
3-3	Management of material topics	Innovation	51-55
DIGITALISATION AND CYBERSECURITY			
3-3	Management of material topics	Digitalisation and Cybersecurity	56
FINANCIAL SUSTAINABILITY			
3-3	Management of material topics	Financial Sustainability	57

