

SUSTAINABILITY

YEAR 2020/21

REPORT



ABOUT THIS REPORT

GRI 102-53

With the publication of this first sustainability report, PUB acknowledges the role we play as Singapore's national water agency in sustainably and responsibly managing our activities and impacts. 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 2020/2021.

For any questions or feedback on the report, please email Mr Lennis Seow at lennis_seow@pub.gov.sg.

REPORTING SCOPE AND PERIOD

GRI 102-50 • 102-51 • 102-52

This is PUB's first sustainability report. The report covers our performance from 1 April 2020 to 31 March 2021 ("FY2020/21"), unless otherwise stated. Where available, prior year ("FY2019/20") data has been included for comparison.

REPORTING STANDARDS

GRI 102-54

This report has been prepared in accordance with the GRI Standards: Core option.

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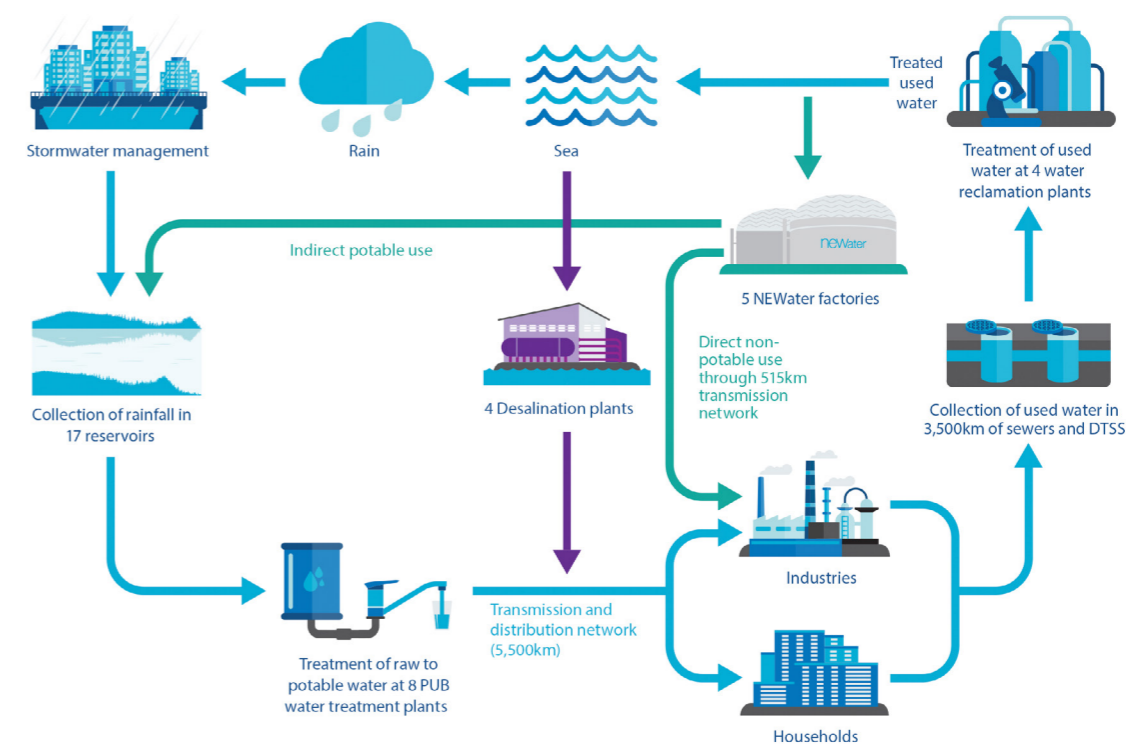
ABOUT PUB: OUR VITAL ROLE

GRI 102-1 • 102-2 • 102-3 • 102-4 • 102-5 • 102-6 • 102-7 • 102-9 • 102-16

- **OUR MISSION**
Supply Good Water. Reclaim Used Water. Tame Storm Water. 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). It is the national water agency, which manages Singapore’s water supply, water catchment and used water in an integrated way. From April 2020, PUB also took on the responsibility of protecting Singapore’s coastline from sea level rise as the national coastal protection agency.

PUB has ensured a diversified and sustainable supply of water for Singapore with the Four National Taps (local catchment water, imported water, NEWater and desalinated water). PUB leads and coordinates Whole-of-Government efforts to protect Singapore from the threat of rising seas and the holistic management of inland and coastal flood risks.

PUB calls on everyone to play a part in conserving water, keeping our waterways clean and caring for Singapore’s precious water resources. If we all do our part, there will be enough water for all our needs — for commerce and industry, for living and for life.



CHAIRMAN'S MESSAGE

GRI 102-14

Sustainability has always been an integral part of the Singapore Government's policies. As a country, we have implemented numerous sustainability initiatives such as the vision of a "Garden City" and the first Singapore Green Plan in 1992. As Singapore's national water agency, sustainability has always been central to PUB's work. In the 1960s, Singapore experienced some of the nation's most severe droughts. Water had to be rationed islandwide. We had our fair share of floods too in the early years when many homes and lives were lost. Our water policies and infrastructures were therefore implemented in response to these floods to ensure the survival of our nation. We kept our water catchments and rivers clean, started reclaiming our used water to create NEWater in 2003 and started desalinating seawater in 2005. These efforts would eventually become commonly known to all Singaporeans as our "Four National Taps". Today, we are much more confident in managing our valuable water resources for the sustainability of our country.

In our continued bid to safeguard water security, we launched Singapore's fourth desalination plant, Keppel Marina East Desalination Plant, in June 2020. The plant was recognised as the "Desalination Plant of the Year" at the Global Water Awards 2021 for its innovative dual-mode capability to treat either seawater or freshwater. This marked our fourth consecutive win at the annual Awards which was established by the Global Water Intelligence (GWI) in 2006. In 2018, the Ulu Pandan Wastewater Treatment Demonstration Plant was named "Water/Wastewater Project of the Year" while the PUB-owned Tuas Desalination Plant was conferred "Desalination Plant of

the Year" in 2019. Last year, the upgraded Choa Chu Kang Waterworks, home to the world's largest ceramic membrane system, was named "Water Project of the Year". These awards are testament to PUB's commitment towards operational excellence, with continual investments in innovation and technology to further our vision of becoming a "Smart Utility of the Future".

While our quest for water has come a long way, we must not be complacent, especially in the face of global challenges which may disrupt our water sustainability. In 2020, the COVID-19 pandemic took the world by surprise, crippling global economies and trade routes. With widespread disruptions in manpower and supply chains, PUB's operations were not spared. We responded quickly and initiated a crisis management plan to ensure the continuity of water operations and the safety of our staff. PUB was named "Resilient Water Agency of the Year" at the Global Water Awards 2021 in recognition of our robust responses to COVID-19. The pandemic is far from over, however, and so we will continue to ensure that we do our utmost to deliver our mission.

With a national focus on the sustainability agenda and the recent launch of the Singapore Green Plan 2030 which outlines Singapore's latest national roadmap towards sustainable development, PUB can do more to support the national agenda, and this inaugural sustainability report is timely. As we step into an era of global uncertainties, we must plan ahead and continue the good work of our predecessors in ensuring the sustainability of our water system for future generations.

“
While our quest for water has come a long way, we must not be complacent, especially in the face of global challenges which may disrupt our water sustainability.”

CHIANG CHIE FOO
CHAIRMAN, PUB



CHIEF EXECUTIVE'S MESSAGE

GRI 102-14

PUB's planners always expect to achieve three things when they draw up designs and schemes for Singapore's water system: adequacy, resilience and sustainability. Our system operators also only care about this trio of outcomes. Adequacy, resilience and sustainability make up the tripod foundation for PUB's continued success as an integrated water utility. Minus any one and the complex we run collapses.

Adequacy should be most obvious, as it is driven by Singapore's poor endowment in water resources. Adequacy just means having enough. In our case, it is having the capacity to produce enough water to meet demand, being able to treat every drop of sewage, and having enough drainage to deal with storms and prevent flooding. And looking ahead, having enough coastal protection in place to ensure rising seas fuelled by a warming climate, do not overwhelm our crowded little island. Achieving adequacy despite scarcity is challenging, to say the least.

The second thing that we care about in PUB is resilience. Resilience is about being tough, being resistant to shocks to the larger water system and being able to recover quickly should there be a disruption or a disturbance. Possessing resilience means being hard to knock down and being able to recover quickly should one get struck.

Becoming resilient requires clarity on what can kill us, which then informs the requisite hardening required and an appropriate response that would allow for expeditious recovery. Of course, the newest existential threat we all face is that posed by climate change. We have no choice but to be totally clear-eyed about the danger of global warming. Pancake flat, it would not take a lot for the ocean to rise in order to turn Singapore into a new Atlantis.

Last, but not least, is sustainability, the subject of this report.

In our minds, sustainability just means endurance. The kind of endurance that carries a runner in a marathon footrace to the finish line. For PUB, sustainability demands that our entire system be easily operable for long periods, rather than one that becomes too expensive or too cumbersome to work after a short while.

Sustainability might already have been permanently implanted inside PUB's DNA. Perhaps more than anywhere else in the world, Singapore has long realised that the H₂O molecule is never lost, and thinks of water as an endlessly reusable resource — one that can always be reclaimed and retreated so that it can be consumed again. PUB is a world leader in potable reuse. For decades, our secret sauce for a sustainable water supply has been to operate the entire water system as an integrated whole. In this way, the Singapore water economy became a fully circular one, long before it was trendy to speak of circularity.

With an eye on the future, we see various and specific impediments which threaten PUB's operational sustainability. Not least among these are challenges relating to energy and carbon.

Singapore imports almost the entirety of its energy needs in the form of fossil fuels, including that required to produce water and to treat sewage. This may be alright in the past, but cannot be viable anymore in a climate-threatened future. The unrestrained burning of fossil fuels is no longer a sustainable thing to do.

To reduce our carbon emissions, PUB has to reduce our energy consumption. Then we have to, as much as we can, replace the energy we do consume with zero-carbon renewables. But to be carbon-neutral, which is our ultimate aim, we would also have to capture the carbon that we are releasing into the atmosphere. To accomplish all these will certainly entail research, innovation, new technologies and new operating methods.

This sustainability report — PUB's first one — outlines how we are going about this, and much more. It also contains details of how we strive to create a capable and engaged workforce, to build strong business and community partnerships, and to achieve enduring financial sustainability and business excellence.

Prepared in accordance with standards set by the Global Reporting Initiative, I hope the reader will find the contents within this report enlightening, insightful and, perhaps, even inspirational.

“
For PUB, sustainability demands that our entire system be easily operable for long periods, rather than one that becomes too expensive or too cumbersome to work after a short while.”

NG JOO HEE
CHIEF EXECUTIVE, PUB



KEY PERFORMANCE SNAPSHOT FOR FY2020/21

WATER AND SUSTAINABLE MANAGEMENT

- 100%** of water quality tests meeting WHO drinking water guidelines¹
- 154L** per capita per day of household water consumption¹
- 466.6kt** CO₂-eq of emissions
- 1ha** of flood prone areas reduced from 2019¹

CAPABLE AND ENGAGED WORKFORCE

- 45** hours of training per staff
- 83%** of employees covered by collective bargaining agreements

STRONG PARTNERSHIPS

- 93%** of customer feedback resolved within 3 working days¹

BUSINESS EXCELLENCE

- 168** ideas submitted by staff¹
- \$813 mil** of total value of R&D projects since 2002

¹ Data reported is for CY2020

FY2020/21 ACHIEVEMENTS

PILLAR 1: WATER AND SUSTAINABLE MANAGEMENT

Keppel Marina East Desalination Plant – Singapore’s first dual-mode desalination plant

The Keppel Marina East Desalination Plant, Singapore’s first large scale, dual-mode desalination plant, was officially opened on 4 February 2021. For more information, please refer to page 20.



Aerial view of Keppel Marina East Desalination Plant. (Photo credit: Keppel)



PUB named "Resilient Water Agency of the Year" at the Global Water Awards 2021

PUB has won the inaugural "Resilient Water Agency of the Year" award, in recognition of our response to the challenges posed by the COVID-19 pandemic. For more information, please refer to page 20.

PUB officers continued to work and provide essential service to the nation throughout the COVID-19 pandemic.

Coastal Protection

In April 2020, PUB took on the role as Singapore’s coastal protection agency. The Coastal Protection Department was formed to lead and coordinate the Whole-of-Government effort to protect Singapore from the threat of rising sea levels. For more information, please refer to pages 29–30.



Composite stepped revetment, as seen along East Coast Park.

PILLAR 2: CAPABLE AND ENGAGED WORKFORCE

Health and Safety Excellence (HSE) 2028

In 2020, PUB announced the transition of its two-year campaign in HSE 2020 to HSE 2028, with the vision to create a healthy and safe workplace with zero accidents and zero occupational diseases. HSE 2028 will focus on shaping mindsets towards a culture of safety, inculcating behavioural safety and leveraging on technology to support its workforce. For more information, please refer to page 36-37.



A PUB officer conducting a safety investigation on-site.

PILLAR 3: STRONG PARTNERSHIPS



Singapore World Water Day (SWWD) 2021

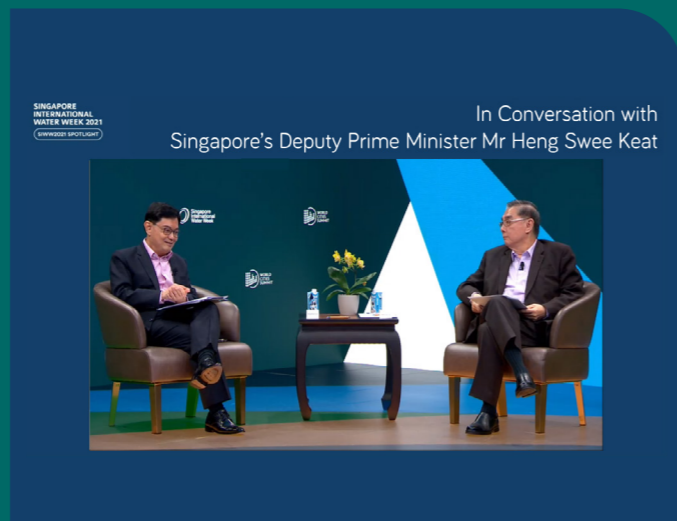
Annually, PUB celebrates the SWWD in the month of March, which reminds and rallies the public to appreciate and understand the need to conserve water, through a variety of community events held in partnership with schools, retailers and other corporate partners. For more information, please refer to page 43.

Singapore World Water Day 2021.

PILLAR 4: BUSINESS EXCELLENCE

Singapore International Water Week (SIWW) Online

With the COVID-19 pandemic affecting international travels, SIWW was rescheduled from July 2020 to June 2021. Organised from 21 June to 2 July 2021, the fully virtual SIWW2021 was attended by close to 5,000 international water leaders, experts and practitioners from 91 countries and regions. More than 140 hours of online content were presented in themes that cover the entire urban water cycle, along with a virtual expo with 124 international exhibitors and six pavilions offering the latest urban water solutions and technologies. For more information, please refer to page 53.



SIWW2021 Spotlight Session.

SUSTAINABILITY IN PUB

Sustainability is not new to PUB. Since the formation of PUB in the 1960s, every one of our milestones serves to strengthen Singapore's water security and sustainability.

1970s

BUILDING UP OUR WATER RESOURCES
The "Water is Precious" public education campaign was launched in 1971. This was followed by Singapore's first Water Master Plan which was drawn up in 1972, outlining the strategies for water resources to ensure a diversified and adequate supply that could meet future requirements.

1980s

A CLEANER CITY AND RIVER
The Singapore River clean-up was launched in 1977 and spanned over a decade before it was finally completed in 1987. The last night soil bucket was phased out in 1987 and replaced by an alternative on-site sanitation system.

1990s

MODERNISING WATER MANAGEMENT AND EXPLORING UNCONVENTIONAL SOURCES
The Water Conservation Tax was introduced in 1991 as a pricing tool to encourage water conservation. In 1995, the electricity and gas entities were corporatised as Singapore Power, while PUB continued to manage water. By 1997, 100% of Singapore's population were served by modern sanitation. While plans to reclaim used water began in the 1970s, it was not until the late 1990s that membrane technology matured enough to enable a reliable and cost-efficient water source. In 1998, a demonstration-scale NEWater plant was commissioned to confirm its feasibility, paving the way for its eventual large-scale roll-out.

2000s

DIVERSIFYING OUR WATER RESOURCES
PUB's first NEWater Factories at Bedok and Kranji were launched in 2003, while Singapore's first desalination plant was opened in 2005. In 2006, the Active, Beautiful, Clean Waters (ABC Waters) Programme was launched to transform Singapore's water bodies beyond their utilitarian purpose and bring people closer to water. In 2008, the Deep Tunnel Sewerage System (DTSS) Phase 1 was completed.

2010s

EXPANDING AND INNOVATING FOR WATER RESILIENCE
Building on the success of our desalination and NEWater technologies, within a decade, PUB launched several water infrastructures such as the Changi NEWater Factory 1 and 2, Tuas Desalination Plant, Tuas South Desalination Plant, and the Punggol and Serangoon Reservoirs, greatly boosting our water resources. We continued to expand our research and development (R&D) efforts such as the launch of the Ceramic Membrane Demonstration Plant at Choa Chu Kang Waterworks and the Upflow Anaerobic Sludge Blanket-Membrane Bioreactor Demonstration Plant at Jurong Water Reclamation Plant.

MOVING FORWARD

TOWARDS A SMARTER AND MORE SUSTAINABLE PUB
As we move into a new decade, PUB must transform and adapt to the ever-changing global landscape as we face new, emerging challenges such as climate change. Our priorities are as follows:

- RESISTING RISING SEAS**
As Singapore's coastal protection agency to protect Singapore from the threat of rising sea levels, PUB is developing a national coastal protection master plan underpinned by Holistic Risk Assessment, Adaptive and Flexible Pathways, and Integrated Planning.
- INCREASING ENERGY EFFICIENCY AND RENEWABLE ENERGY GENERATION**
To reduce reliance on fossil fuels and mitigate the impacts of climate change, PUB is exploring technologies, such as biomimicry and pressure-retarded osmosis, to bring down the desalination energy requirement from the current 3.5kWh/m³ to close to 1kWh/m³ at the system level in the long term. We also launched one of the world's largest inland floating solar photovoltaic (PV) systems in Tengeh Reservoir and will be increasing our solar generation capabilities with new upcoming projects such as deployment at Pandan and Lower Seletar Reservoirs.
- EMBRACING 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 to maximise energy efficiency and generation, and resource recovery, while maintaining a small footprint.
- TRANSFORMING INTO A SMART UTILITY**
The digital wave is affecting traditional business models globally, but it also presents immense opportunities. We are actively adopting suitable digital technologies to improve operational resilience and service delivery, such as the Smart Water Meter Programme.

PUB SUSTAINABILITY APPROACH

At the heart of PUB's sustainability framework are our mission and vision, which inform all business decisions. Sustainability is not just a priority at PUB; it is also a purpose, as we work towards ensuring a sustainable water supply for Singapore and protecting her coastline from rising sea levels.

Being a country scarce in natural resources, Singapore has always striven to make the best use of what we have. With no natural water resources, Singapore has, since the 1970s, progressively created more surface water reservoirs, building on the first three reservoirs at MacRitchie, Seletar and Peirce, to 17 reservoirs. Today, two-thirds of the island state is water catchment. Using urban areas as water catchment requires close collaboration and careful city planning to ensure that run-offs from urbanised water catchment remain fit for treatment for potable use.

Besides local catchment, Singapore depends on three other water resources — imported water, NEWater and desalinated water, to meet its day-to-day needs. Other than technological advancements, other factors such as being a fully sewerred country, strict regulations and enforcement on trade effluent discharge standards, as well as intensive public outreach, are key to the successful implementation of water reuse. Not only are we now able to use a drop of water more than once, water reuse and desalination are able to withstand the virulence of extreme drought potentially brought about by climate change.

As PUB seeks to diversify Singapore's water resources, we rely on a skilled workforce, effective work processes and technologies to ensure that the entire water system is well maintained and operated, and in a resource-efficient and responsible manner. PUB works to ensure that treatment processes are reliable and resilient; there is minimal loss of precious water through the distribution network; and resources are optimised throughout our operations.

PUB cannot do this alone. Just as water is a precious resource for all, ensuring the sustainability of water resources is a shared responsibility. Everyone has a part to play in conserving and protecting our waters. From the general public to the private sector, PUB actively reaches out to raise awareness, and identify opportunities to conserve and recycle water. Every drop not used is a drop that does not have to be produced.

With these in mind, PUB has founded our sustainability framework on four main pillars: (1) Water and Sustainable Management; (2) Capable and Engaged Workforce; (3) Strong Partnerships; and (4) Business Excellence. This framework serves to guide PUB forward, as we strive to be a responsible and trusted public agency, and continuously innovate to be future-ready, in the face of an ever-changing global landscape.

Delivering Our Mission Responsibly

**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

**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

**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

**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

OUR STAKEHOLDER ENGAGEMENT

GRI 102-40 • 102-42 • 102-43 • 102-44

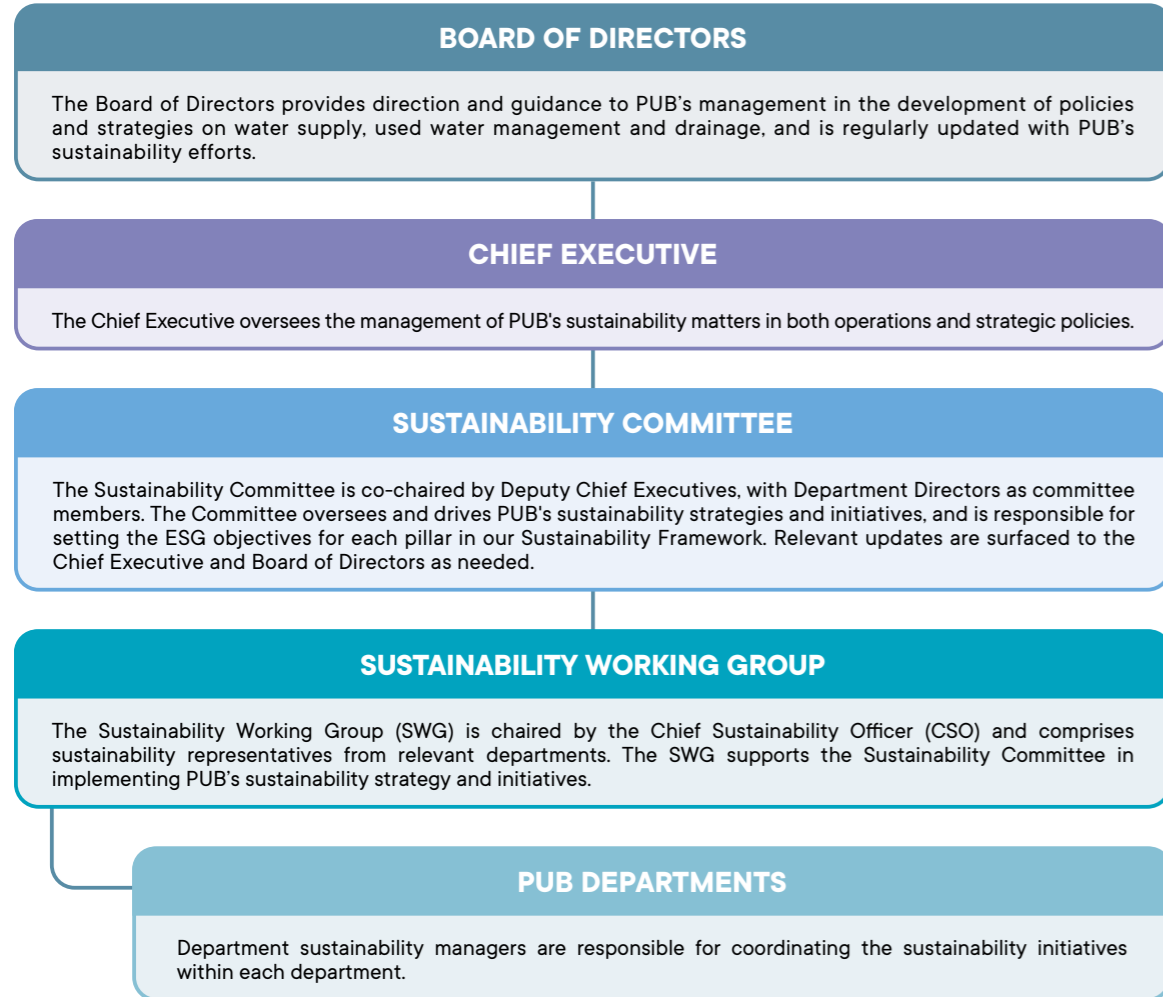
Engaging our stakeholders is a key part of the work done at PUB. We identify and select stakeholder groups based on the mutual impact of our activities on the group and vice versa.

Key Stakeholder Groups	Engagement Platforms and Details	Frequency of Engagement
Public Sector Agencies and Ministries	Organise and participate in various inter-agency meetings and workgroups to facilitate and enable a Whole-of-Government approach in the public service	<ul style="list-style-type: none"> • Monthly • Workstream-dependent
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	<ul style="list-style-type: none"> • At least once a year
	Organise technical briefings and events to keep business and industrial stakeholders abreast with information on latest PUB regulations and practices on various topics (e.g. water conservation and technologies)	<ul style="list-style-type: none"> • Several times a year
	Initiate grant calls, and organise information sessions and sharing sessions with industries on the Technology Roadmap and Focus Areas	<ul style="list-style-type: none"> • Several times a year
Non-governmental organisations (NGOs) / Nature Groups	Collaborate with NGOs in events to celebrate the importance of water (e.g. Singapore World Water Day)	<ul style="list-style-type: none"> • Regularly with major event in March
	Conduct specific project engagements to solicit feedback on measures to mitigate the environmental impact of PUB's projects	<ul style="list-style-type: none"> • Project-dependent
Public and the Community	Carry out specific project engagements to keep the public aware of PUB's projects, solicit feedback and source for partnership opportunities	<ul style="list-style-type: none"> • Project-dependent
	Organise events to celebrate water and promote water conservation (e.g. regular campaigns and roadshows, Singapore World Water Day)	<ul style="list-style-type: none"> • Yearly in March
Schools	Organise 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)	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Polytechnics' academic cycles
Media	Organise 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)	<ul style="list-style-type: none"> • Bi-monthly
Employees	Carry out surveys, dialogue sessions and fireside chats with Management, roadshows, department town halls, and virtual and physical staff engagement sessions to keep employees engaged and facilitate feedback	<ul style="list-style-type: none"> • Varies from monthly to yearly
	Provide competency-based training and various technical knowledge webinars through Intranet portal and mobile application to improve sharing and retention of knowledge	<ul style="list-style-type: none"> • Varies from monthly to yearly
	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	<ul style="list-style-type: none"> • Several times a month

SUSTAINABILITY GOVERNANCE

GRI 102-18 · 102-20 · 102-26

Good governance, clear decision-making and responsibility structures are critical in enabling PUB to deliver on our mission. PUB's sustainability efforts are mainly driven by our Sustainability Committee, which was set up in August 2020 and is supported by a Sustainability Working Group.



PUB'S MATERIAL ISSUES

GRI 102-46 · 102-47

MATERIALITY ASSESSMENT

For PUB's inaugural sustainability report, we undertook a phased approach towards the identification of the topics that matter most to our stakeholders. Potential material issues were identified with reference to megatrends, peer benchmarking and PUB's risks under the Enterprise Risk Management (ERM) framework. A stakeholder survey was also conducted with key internal and external stakeholder groups. PUB will regularly review our material topics to ensure areas critical to mission success are covered.

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 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 through approaches and solutions that enable her to transcend uncertainties brought about by climate risks.
Capable and Engaged Workforce	Health and Safety	All PUB employees and workers must feel safe at work and be able to work safely.
	Competent Workforce	Our people are the main driving force and cornerstone of PUB's operations. With an ageing population and eminent manpower constraints, our people will remain, if not become more, critical in sustaining PUB's operations.
	Inclusive and Fair Workplace	An inclusive culture promotes a sense of well-being which increases engagement, and in turn, supports strong performance.
Strong Partnerships	Customer-centric Water Service	As an essential service provider, customer service is the core of PUB's business. PUB's interactions with customers also serve as a key touchpoint in promoting water conservation to manage demand and in protecting our water resources.
	Partnership and Engagement	With limited water resources, everyone in the community must play a part in protecting our waters and environment to ensure PUB's sustainability.
Business Excellence	Trust and Transparency	As a public agency, the sustainability of PUB's business depends on ensuring that we remain responsible and trusted by all our stakeholders in delivering our mission.
	Innovation	PUB must keep finding ways to do our everyday work better, more easily and more efficiently to produce better outcomes and better service.
	Digitalisation and Cybersecurity	While PUB adopts digital technologies to enhance operations, we need effective cybersecurity management to ensure efficient and secure operations of our systems and handling of data.
	Financial Sustainability	As PUB is partially self-funded, we must make financially responsible and sustainable decisions.

1

WATER AND SUSTAINABLE MANAGEMENT

GRI 103-1 • 103-2 • 103-3

As Singapore's national water agency, water is an important resource for PUB's operations and an essential service for every household, business and organisation. As the first pillar of the sustainability framework and in the face of the impacts of climate change, the sustainable management of water is founded on three core beliefs:

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
- Stormwater Management



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 in **FY2020/21**



Two-thirds of Singapore's land as local water catchment area in **FY2020/21**

THE YEAR AHEAD

Jurong Island Desalination Plant slated to be completed in 2021

Ongoing works for the **Changi NEWater Factory 3** and **Deep Tunnel Sewerage System Phase 2** projects slated to be completed in 2023 and 2025 respectively

Water is a key natural resource for human survival, and we must ensure that there will always be enough water to meet the needs of our growing nation. Despite plentiful rain, the lack of land to capture and store rainwater fundamentally constrains Singapore from achieving water sufficiency in a conventional way. Hence, we must diversify our water sources, including using unconventional sources to meet water demand. This is achieved with the following strategies:

COLLECT EVERY DROP OF WATER

OUR RESERVOIRS

Singapore uses two separate systems to collect rainwater and used water, ensuring that its waterways are free of pollution. Rainwater collected in local catchments is stored in 17 reservoirs and treated into potable water by seven waterworks. With limited land to collect rainwater, one of PUB's strategies is to create estuarine reservoirs by damming up major rivers. To maximise local water supply, PUB also collects rainwater from urbanised catchment. Since 2011, the water catchment area has increased from half to about two-thirds of Singapore's land surface with the completion of the Marina, Punggol and Serangoon Reservoirs.

REUSE WATER ENDLESSLY

OUR WATER RECLAMATION PLANTS AND NEWater FACTORIES

Water can always be reclaimed and retreated for reuse. PUB is a world leader in this. The water reclamation process recycles Singapore's used water into ultra-clean, high-grade NEWater, cushioning its water supply against the impacts of dry weather and moving Singapore and PUB a step closer towards water sustainability by closing the water loop. The used water is treated and further put through microfiltration and reverse osmosis (RO) to remove contaminants, bacteria and viruses, and then disinfected with ultraviolet light as an additional barrier.

While NEWater is mainly used for industrial and commercial purposes, it is also used to replenish local reservoirs during dry months and the blended water is further treated at the waterworks for potable water supply.

DESALINATE MORE SEAWATER

OUR DESALINATION PLANTS

As Singapore is an island surrounded by sea, desalination is thus a natural option, especially when membrane technology has made it economically viable. Being a weather-resilient source of water, desalination further protects our supply from the impacts of climate change, such as prolonged drought. However, this is the most energy-intensive and expensive source of water. Therefore, PUB is continuing to invest in research and technology to find better and less expensive ways of desalting seawater.

FEATURE STORIES



PUB named "Resilient Water Agency of the Year" at the Global Water Awards 2021

PUB has won the inaugural "Resilient Water Agency of the Year" award, a new award category under the annual Global Water Awards, in recognition of our efforts in ensuring Singapore's water security amidst challenges posed by the COVID-19 pandemic.

When the pandemic struck in early 2020, we formulated a crisis management plan to ensure operations go on as usual and plants continue to perform their functions. Work arrangements such as telecommuting, split teams, staggered work hours, as well as safe distancing and sanitation measures at all workplaces, were implemented to keep staff safe. We also responded quickly to manpower challenges and took steps to ensure adequate stockpile of materials and supplies for our operations, maintenance and construction projects.



PUB officer at Changi Water Reclamation Plant working during the COVID-19 pandemic.



Aerial view of Keppel Marina East Desalination Plant. (Photo credit: Keppel)



Keppel Marina East Desalination Plant Singapore's first dual-mode desalination plant

The Keppel Marina East Desalination Plant, Singapore's fourth desalination plant, was officially opened by Prime Minister Lee Hsien Loong, along with Minister for Sustainability and the Environment, Ms Grace Fu, on 4 February 2021. It is recognised for two unique features:

INNOVATIVE DUAL-MODE CAPABILITY

It was conferred "Desalination Plant of the Year" at the Global Water Awards 2021, for its innovative capability to treat either seawater or freshwater drawn from the Marina Reservoir, enabling greater operational flexibility and strengthening Singapore's water supply resilience in the face of climate change.

INNOVATIVE AND SUSTAINABLE DESIGN

It is the first desalination plant that incorporates environmentally friendly landscaping elements to bring water closer to the people. These include the lush 20,000m² Green Roof which is accessible via the Park Connector from East Coast Park or Gardens by the Bay.

1-1 | SUSTAINABLE WATER SYSTEM

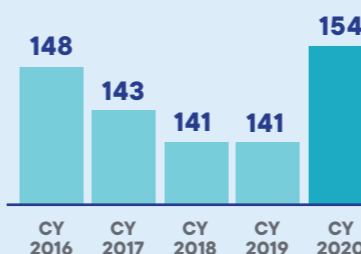
**KEY FOCUS AREA 2
WATER DEMAND MANAGEMENT**

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

Per capita Household Water Consumption (LPCD)



Water Supply (mil m³)

CY	2016	2017	2018	2019	2020
Sale of potable water in Singapore					
Domestic					
	301.4	294.8	294.2	297.6	320.7
Non-domestic					
	215.6	204.5	201.3	202.6	180.5
Sale of NEWater					
	126.9	140.2	140.5	145.5	141.1
Sale of Industrial Water					
	21.0	19.9	20.6	17.9	13.0

The average household water consumption increased to 154 LPCD in 2020 from 141 LPCD in 2019, with more staying home during the government-imposed circuit breaker (stay-home and movement restriction order) period and working from home after the circuit breaker, and an increase in the frequency of cleaning in homes, which led to increased water usage. The total water sale remained relatively constant between 2019 and 2020.

Working towards a robust and sustainable water supply through infrastructural improvements 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. **A multi-pronged approach** is adopted with the following measures:

PRICING WATER TO REFLECT ITS SCARCITY VALUE

In Singapore, water is priced to encourage consumers to use water wisely. The price considers the entire water system's costs, including those of rainwater collection, reservoir management, NEWater production, desalination, raw water treatment and the network of water pipes and sewers. The potable water price also reflects the higher costs of producing water from the next available sources, specifically NEWater and desalination. It also includes a Water Conservation Tax to underline the message that every drop of water is precious and that everyone must help to conserve this resource.

MANDATING WATER EFFICIENCY STANDARDS

Advances in technology have led to appliances and fittings that are more water-efficient. As a regulator, PUB has mandated measures to ensure households and industries 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 serves to help consumers make more informed purchasing decisions and to encourage suppliers to introduce more water-efficient products into the market. Since July 2009, suppliers have been required to label the water efficiency of their water fittings and appliances on all displays, packaging and advertisements under the MWELS which is a grading system with a "0/1/2/3/4" tick rating denoting the water efficiency level of a product. The higher the tick rating, the more water-efficient the product is. Washing machines and dishwashers for household use have also been included in 2011 and 2018 respectively. 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. From January 2022, MWELS will be extended to include water closet flush valves with a minimum rating of 2 ticks. Minimum water efficiency standards for commercial equipment (i.e. washer extractors, dishwashers and high-pressure washers) will also be introduced from January 2022.

WATER EFFICIENCY MANAGEMENT PLAN (WEMP)

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 meet the water use threshold of 60,000m³ 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 breakdown of water consumption, thereby allowing better management of water usage and development of water conservation measures.

THE YEAR AHEAD

From 1 January 2022: **MWELS to be extended** to include water closet (WC) flush valves, and all WC flush valves for sale and supply to be labelled with **2-tick or 3-tick ratings**

From January 2022: **Minimum water efficiency requirements** for the sale and supply of new commercial equipment (i.e. washer extractors, commercial dishwashers and high-pressure washers) to be introduced

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. To be certified as a Water Efficiency Manager, WEMP representatives have to attend the two-and-a-half-day Water Efficiency Manager Course (jointly conducted by PUB and Singapore Polytechnic) and pass an assessment.

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 46.

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.

With smart water meters, water consumption will be read automatically and transmitted back to PUB daily. Through a web portal, customers will have easy access to their daily water usage data, empowering them to track their daily consumption and adopt water-saving habits.

PUB is rolling out the first phase of the Smart Water Meter Programme in Singapore. 300,000 smart water meters will be installed in new and existing residential, commercial and industrial premises by 2023. PUB will review this first phase rollout, build up its capabilities and expertise, and consider the advances in technology before implementing it nationwide.

Customers will be able to track their daily water usage anywhere they go.

1-1 | SUSTAINABLE WATER SYSTEM

KEY FOCUS AREA 3 PROTECTING OUR INFRASTRUCTURE

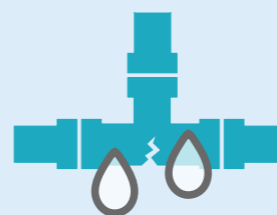
COMMITMENT

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

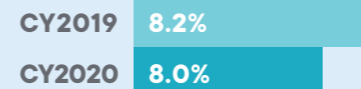
PERFORMANCE



Maintained **100%** water quality tests meeting WHO Guidelines for Drinking Water Quality



% Distribution Losses for Potable Water



THE YEAR AHEAD

Installation of additional leak detection monitoring sensors in PUB's water supply network

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

While ensuring a sustainable supply and demand of water, PUB also needs to ensure that this precious resource is not lost nor contaminated as it travels through the water loop. This is done through a holistic management and protection of its water infrastructure at source and distribution via the following measures:

RESERVOIR MANAGEMENT

To manage pollutant load within reservoirs, it is important to first strategise upstream land use planning at a catchment scale. PUB works with various government agencies at the planning stage to site developments with high pollution risk outside water catchment areas. For potentially pollutive developments within water catchment, such as farms, PUB also works with relevant agencies to require developers or owners to implement best management practices. This is to prevent spillage of hazardous or toxic substances and contaminated run-off from affecting catchment raw water quality.

PUB also has in place a comprehensive raw water quality monitoring system to ensure that the water quality is fit for treatment. Water samples are collected from reservoirs and tested at PUB's Water Quality Laboratory. With eight of PUB's 17 reservoirs and two waterways open for recreational activities, key water quality parameters related to recreational activities are also monitored and compared against NEA's recreational water quality guidelines.

WATER NETWORK MANAGEMENT (LEAK MANAGEMENT)

Besides the reservoirs, it is important to ensure that 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, including good design and construction, effective leak detection and surveillance, and enhanced network renewal and replacement.

PUB has 300 permanent leak detection monitoring sensors in our network. By end FY2021/22, PUB targets to increase the number of sensors to 1,200, which will continuously monitor about 500km (about 40%) of transmission pipelines. These sensors are able to accurately identify and pinpoint the location of leaks (within ±3m) along the pipeline. By tapping on intelligent leak monitoring and detection technologies, PUB is taking a smarter approach and moving away from resource-intensive leak detection operations.

To ensure good drinking water quality, water samples are also collected from waterworks and at various points in the distribution system and tested. Online sensors also monitor water quality at each stage of the treatment process and service reservoirs. Over 500,000 tests are conducted annually on various parameters. The quality of Singapore's drinking water is regulated by the Environment Public Health (EPH) (Water Suitable for Drinking) (No.2) Regulations 2019 which are based on the World Health Organisation (WHO) Guidelines for Drinking-Water Quality.

USED WATER NETWORK MANAGEMENT

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;

(1) WATER AND SUSTAINABLE MANAGEMENT

(ii) protecting the sewerage infrastructure from damage and misuse; and (iii) controlling 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 islandwide 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 centralised system to monitor construction activities near sewerage infrastructure and to protect it from damage.
- System for Geo-fencing of Sewerage Network and Tracking of Construction Machinery, a monitoring system to track the location of piling rigs using Global Positioning System (GPS) devices, providing real-time alerts to PUB officers when the rigs enter the geo-fenced sewer corridor.
- Sewer Analytics and Management System (SAMS), a smart system to reduce service disruptions and optimise sewer maintenance through data analytics and machine learning.

A Trade Effluent Plan is also in place to manage the discharge quality in the sewers to ensure that every drop collected is fit for recycling as 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 has also deployed 40 Volatile Organic Compound (VOC) monitoring units in the sewer network and 100 Microbial Electrochemical Sensor (MES) units at high-risk factories to control at source and deter factories from discharging illegally. Plans to deploy an additional 60 VOC monitoring units and 75 MES units, as well as an integrated dashboard for centralised monitoring and data analysis (i.e. Discharge Effluent Analytical Monitoring System), are currently underway. 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.

FEATURE STORIES



Active, Beautiful, Clean Waters (ABC Waters) Programme

Being a largely urbanised catchment, it is important to manage the quantity and quality of Singapore's rainwater run-off. We encourage developers to adopt ABC Waters design features such as rain gardens and bioretention basins, which aim to detain 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.

To promote this concept, PUB has developed the ABC Waters Design Guidelines to guide developers 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 March 2021, there are 76 registered ABC Waters Professionals and 75 ABC Waters Certified projects, out of which two have achieved Gold certification.



Rain Garden at Holland-Bukit Timah Plain.

(1) WATER AND SUSTAINABLE MANAGEMENT

1-2 | RESOURCE EFFICIENCY AND CIRCULARITY

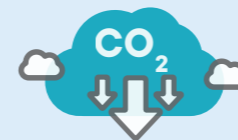
KEY FOCUS AREA 1
REDUCING OUR ENERGY AND CARBON FOOTPRINT

GRI 302-1 • 302-4 • 305-1 • 305-2

COMMITMENT

Peak carbon emissions by 2025

PERFORMANCE



Total Carbon Emissions (ktCO₂e)

FY2019/20	466.2ktCO ₂ e
FY2020/21	467.6ktCO ₂ e



Grid Electricity Consumption and Electricity Met by Renewables (GWh)

FY2019/20	877.5	95.7
FY2020/21	845.8	96.1

- Grid Electricity Consumption
- Electricity Met by Renewables

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. The total carbon emissions remained relatively constant in FY2020/21.

THE YEAR AHEAD

Development of Floating Solar PV Systems at Pandan and Lower Seletar Reservoirs

Procurement of six electric commercial vehicles to support PUB's operations

As PUB moves towards more diversified and climate-resilient sources of water, i.e. desalinated water and NEWater, their large energy footprint poses the greatest barrier to their sustainable use. Coupled with increasing water demand, which is expected to double by 2060, Singapore's energy demand for water supply is expected to quadruple, greatly increasing its carbon footprint. In line with the national agenda to peak emissions by 2025, PUB is actively exploring solutions to reduce dependency on fossil fuels and eventually greenhouse gas emissions. These solutions include:

INCREASING RENEWABLE ENERGY GENERATION

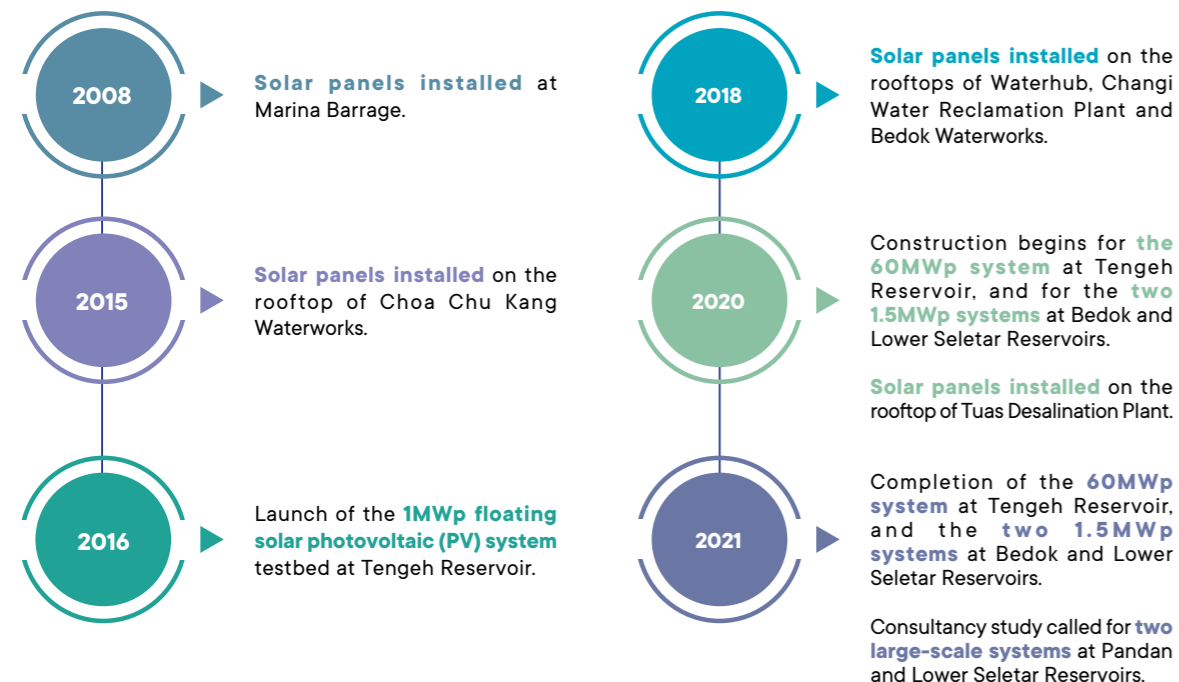
Solar energy is the most viable source of renewable energy in Singapore. PUB actively deploys solar photovoltaic (PV) systems on the rooftops of our installations and on our reservoirs. In land-scarce Singapore, vast reservoir surfaces have great potential to harness solar energy through floating solar PV systems, serving as both water catchment and storage, as well as for clean electricity generation. 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. The clean energy generated is sufficient to power PUB's local water treatment plants and the Marina Barrage, offsetting 7% of our annual energy needs and reducing carbon emissions by about 32kt per year.

As a major by-product of used water treatment, used water sludge serves as a natural source of renewable energy and contributes to the energy self-sufficiency needs of our Water Reclamation Plants (WRPs). The sludge is treated in digesters to produce biogas which is used 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 Changi WRP. PUB is continuously looking and testing new technologies and ideas to increase our energy recovery rate.



Aerial view of Tengeh Floating Solar Farm. (Photo credit: Sembcorp Industries)

PUB'S SOLAR JOURNEY



Rooftop solar PV system at Choa Chu Kang Waterworks.

REDUCING ENERGY CONSUMPTION AND EMISSIONS

PUB actively explores more energy-efficient technologies to be adopted in its new plants and infrastructure. On the research and development (R&D) front, PUB is exploring technologies, such as biomimicry and pressure-retarded osmosis, to bring down the desalination energy requirement from the current 3.5kWh/m³ to close to 1kWh/m³ at the system level in the long term. This translates to carbon emission reductions equivalent to 0.4kg of CO₂ for every cubic metre of water produced.

PUB also aims to make its existing plants energy-efficient. To ensure that its equipment maintains its efficiency over time, PUB follows an equipment replacement regime where equipment is replaced and possibly retrofitted with more efficient technologies. PUB currently adopts the national minimum energy performance standards (MEPS) class of IE3 (Premium) for motors. 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.

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. Aligned with the Whole-of-Government's effort to take the lead towards achieving this vision, PUB is progressively replacing its diesel-powered vehicles with electric vehicles to do its part in reducing energy consumption and emissions. The electrification of PUB's vehicle fleet had started with the first batch of six operational electric vehicles on the roads by end 2021.

1-2 | RESOURCE EFFICIENCY AND CIRCULARITY

KEY FOCUS AREA 2
MAXIMISING RESOURCE CIRCULARITY

GRI 306-1 • 306-2 • 306-3

COMMITMENT

Minimise waste generation and improve resource circularity

PERFORMANCE



Total Amount of Waste Generated from PUB-owned Operational Facilities ('000 tons)

FY2019/20	277.6
FY2020/21	260.0

The bulk of PUB's waste consists mainly of water and used water sludge which are by-products of water and used water treatment processes. Hence, the amount of the waste generated is largely dependent on the amount of water consumed, as well as the used water quantity and quality discharged by residents and the industries.

PUB's operations generate significant amounts of waste such as treatment sludge. However, we believe that one man's trash may be another man's treasure. With limited land and resources in Singapore, we must strive to reduce our waste disposed and look for ways to reuse them at the system level.

IMPROVING NEWATER RECOVERY RATES

Recycling water is the most sustainable and cost-effective way to increase our water supply and it also does so exponentially. To increase recycling rate and maximise resource circularity, PUB aims to raise NEWater recovery rates at its NEWater factories. The Flow Reversal Reverse Osmosis (RO) technology demonstrated at the Kranji NEWater Factory allows NEWater recovery to increase from 75% to 90% with no increase in 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. The waterworks sludge and incinerated sewage sludge ash make up about 6% of Singapore's total landfill waste today. Singapore has limited space for waste disposal and therefore it is imperative that PUB reduces waste generation and increases resource reuse and recovery, where possible. These initiatives include:

- The use of alternative coagulant for water treatment to reduce sludge generated from waterworks.
- Exploring and testing technologies such as anaerobic Membrane Bioreactor (MBR), mainstream Anaerobic Ammonium Oxidation (ANAMMOX) and thermal hydrolysis process to reduce the amount of sludge produced from the WRPs.
- Exploring alternative technologies to convert PUB's waste into higher value products. These technologies include: (i) high temperature slagging gasification to produce slag for construction and land reclamation filling materials; and (ii) pyrolysis to produce biochar for soil amendment and as adsorbent for odour control.

In terms of liquid waste streams, effluent discharges from the desalination plants, NEWater plants and WRPs should not adversely affect the quality of surrounding seawaters. PUB therefore carries out routine monitoring of effluent quality to ensure that the 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 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 SYNERGIES

ENERGY SYNERGIES



DIRECT POWER SUPPLY

Electricity generated by the Waste-to-Energy process is used to sustain the operations of both IWMF and Tuas WRP, with excess for export to the grid.



BIOGAS

Biogas from Tuas WRP is combusted at IWMF's external superheaters to enhance IWMF's power generation.



STEAM

Steam from IWMF is supplied to Tuas WRP to support its thermal hydrolysis process and generate hot water for greasy waste treatment.

WATER SYNERGIES



WATER SUPPLY

Treated effluent from Tuas WRP is sent to IWMF for its process needs.



SLUDGE DRYER CONDENSATE

Condensate from the sludge drying process at IWMF is sent to Tuas WRP for used water treatment.



CHILLED WATER

Chilled water from IWMF is sent to Tuas WRP's Administration Building for cooling.

MATERIAL HANDLING SYNERGIES



FOOD WASTE

Food Waste from IWMF is sent to Tuas WRP for co-digestion with used water sludge to produce more biogas.



SLUDGE

Dewatered Sludge from Tuas WRP is incinerated at IWMF's Sludge Incineration Facility.



GRIT / SCREENINGS

Grit and screenings from Tuas WRP are sent to IWMF for thermal treatment directly instead of disposing at Semakau Landfill.

1-3 | CLIMATE CHANGE ADAPTATION

KEY FOCUS AREA 1 COASTAL PROTECTION

COMMITMENT

Protect Singapore's coastlines from the rising seas

By 2100, sea level is projected to rise by up to 1m, while more intense and frequent heavy rainfall events are also expected, due to climate change. In an extreme event when very high tides and storm surges come together, transient sea levels could reach 4m above the current mean sea level, or even higher. Without timely action, low-lying coastal areas and landmarks could be flooded, affecting homes and livelihoods. To future-proof Singapore against coastal and inland flooding due to the impacts of climate change, PUB has developed a national coastal protection masterplan underpinned by the following three approaches:

THE YEAR AHEAD

Development of Coastal-Inland Flood Model

Ongoing development of new policies and regulatory framework for coastal protection

Ongoing Site-specific Study for Changi, East Coast Marina Stretch and part of the Greater Southern Waterfront district

Feasibility Study for Coastal Barrier

Commencement of Site-specific Study for North-west Coast in 2022

1. HOLISTIC RISK ASSESSMENT

To strengthen Singapore's overall resilience against climate change, there is a need to study the combined effects of inland and coastal flooding, and optimise inland and coastal adaptation measures. Hence, a Coastal Inland Flood Model will be developed to simulate flood events under the combined effects of higher sea levels and intense rainfall. The model serves fit-for-purpose uses ranging from adaptation planning to operations management. It will also enable PUB to understand flood risks holistically and allow continuous review of flood risks based on the latest available data.

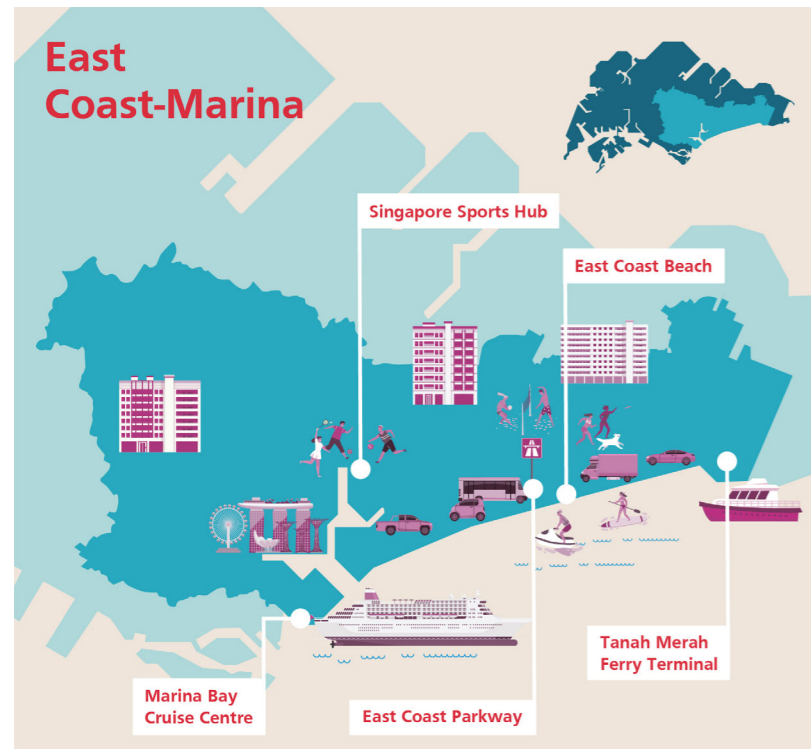
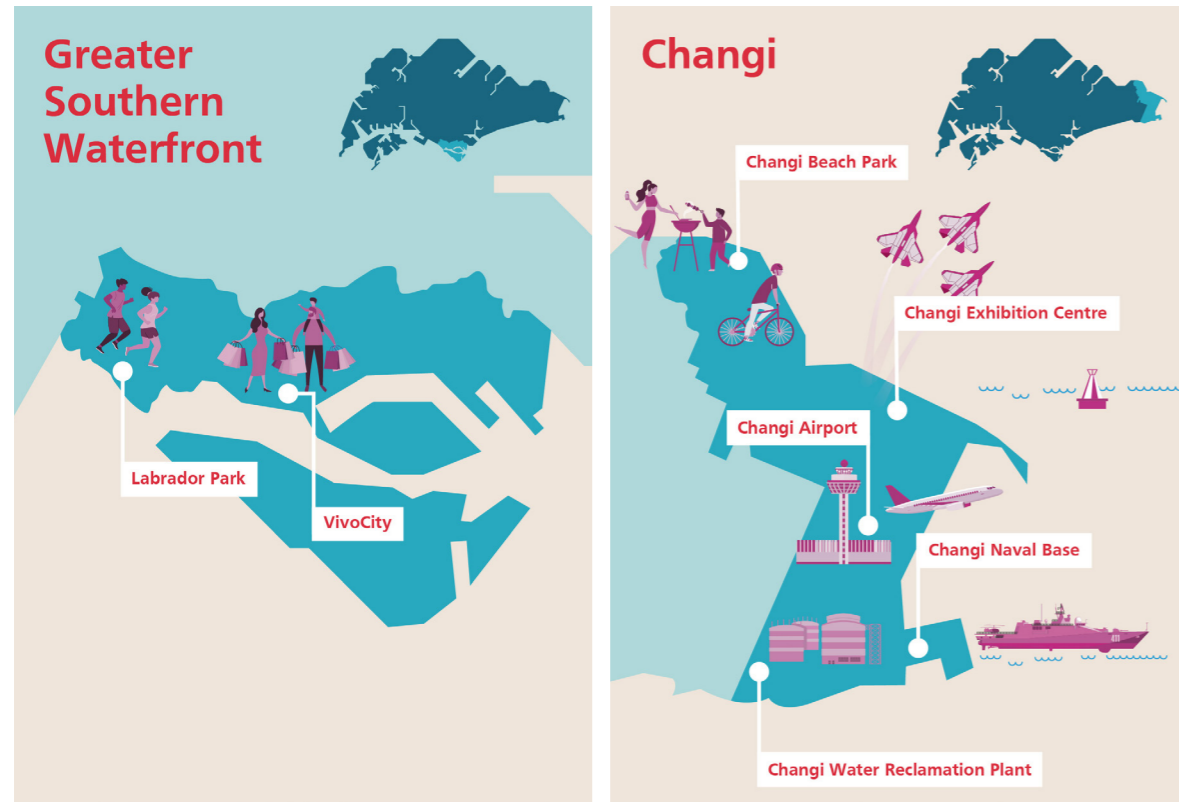
2. DEVELOPING ADAPTIVE AND FLEXIBLE PATHWAYS

With current climate science, the exact rate and magnitude of sea level rise remains uncertain. Nonetheless, it is imperative to start preparations now to formulate plans and implement them progressively as development of coastal protection measures requires long lead-time and substantial investment. To cater for uncertainties, PUB's coastal protection strategies will have to be flexible to allow for adjustments according to new developments in climate science.

Policy frameworks and planning parameters will also be established to guide the implementation of coastal protection measures. Through the use of adaptation pathways in PUB's strategy, our coastal protection approach ensures adequate protection while retaining the ability to adapt to changes in climate projections.

3. INTEGRATED PLANNING

Earlier studies had ascertained varying vulnerabilities across various segments of the coasts. Accordingly, PUB will progressively carry out conceptual design of coastal adaptation measures for the various segments of our coastlines. When doing so, we will explore opportunities for value creation and develop innovative solutions that are multi-functional, integrated with land use and development plans, as well as enhance the natural environment. Stakeholder outreach and engagement will be carried out to seek inputs and feedback to achieve solutions that best meet the needs of the stakeholders.



Our coastal protection projects in the City-East Coast areas.

1-3 | CLIMATE CHANGE ADAPTATION

KEY FOCUS AREA 2
STORMWATER MANAGEMENT

GRI 102-11

COMMITMENT

Tame stormwater by reducing our flood prone areas

PERFORMANCE



Flood Prone Areas (ha)

CY2019	29
CY2020	28

THE YEAR AHEAD

Enhancements to flood operations systems and rainfall forecasting capability

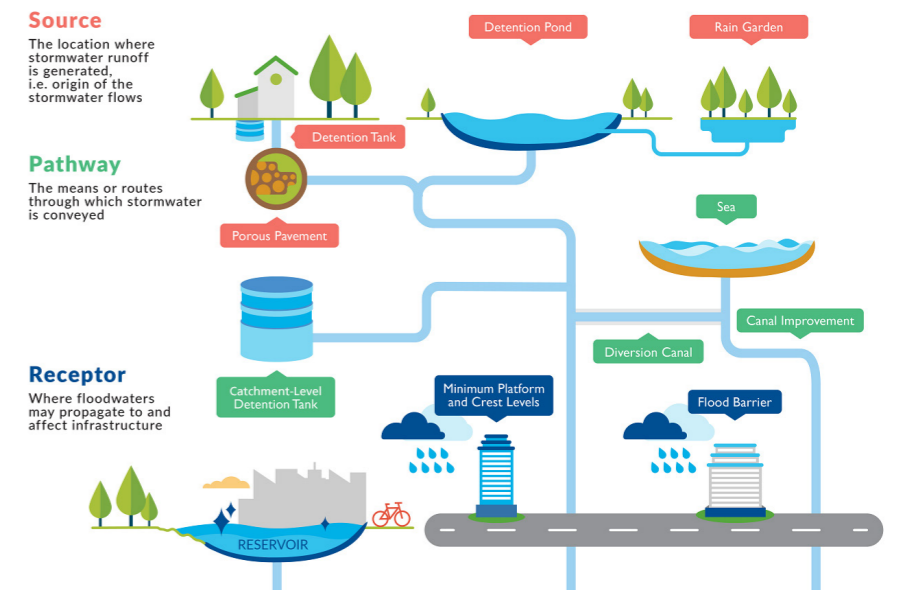
Ongoing drainage improvement works at Bukit Timah Canal, Sungei Tampines, Bayshore Park Outlet Drain to enhance flood protection

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, climate change also brings about more frequent and intense rainfalls, thereby increasing flood risks. To adapt the drainage system to the challenges posed by growing urbanisation and increasing weather uncertainties, PUB has adopted a system-level approach known as the "Source-Pathway-Receptor" approach. 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 at the "Receptor" (i.e. where floods may occur).

PUB'S SOURCE-PATHWAY-RECEPTOR APPROACH



MANAGING RUN-OFF AT SOURCE

In January 2014, Source measures such as detention tanks and green features like bioretention basins were introduced for new commercial, residential, industrial and institutional developments, and re-developments that are 0.2 hectares and larger. Source measures provide temporary storage for the stormwater during a rain event and release stored rain after the rain event. They help to 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 help to raise the level of flood protection of the catchment.

ENHANCING THE PATHWAYS

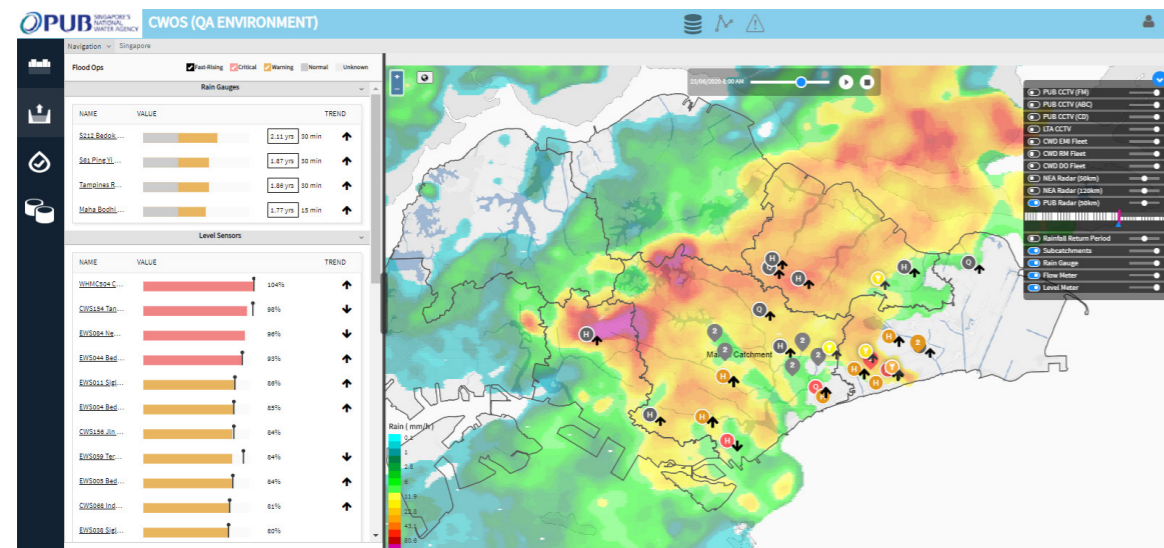
To manage flood risks, PUB implements Pathway solutions, such as building new drains, increasing the conveyance capacities of existing drains, rehabilitating old drains and building catchment-level detention ponds. These serve one or more of the following purposes for flood prevention, flood alleviation or preventive upgrading. PUB is cognisant of the challenges of climate change and has been designing public drains to cater for higher rainfall intensity since 2017.

(1) WATER AND SUSTAINABLE MANAGEMENT

PROTECTING THE RECEPTORS

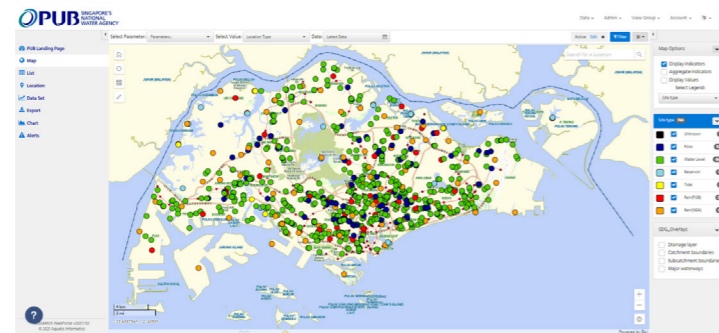
Receptor measures provide additional flood protection to infrastructure. In 2011, the minimum platform level and crest level were raised from 3m Singapore Height Datum (SHD) to 4m SHD and 150mm to 300mm above minimum platform level respectively. The crest protection level for underground MRT stations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

When structural improvements are limited or overwhelmed, PUB responds with effective flood operations. CCTVs at flood prone areas and hotspots have been installed since 2011 to allow PUB to remotely monitor road conditions in these areas in real time, 24/7. During heavy rainfall events, flood response crew are deployed to flooded roads to keep the public out of harm's way. However, as floods can occur very quickly, response time is key. PUB's Catchment and Waterways Operations System (CWOS) features an integrated dashboard that supports the management of flood operations by allowing PUB to monitor real-time data from various sensors, namely CCTVs, water level sensors, rain gauges, weather radars, as well as vehicle location trackers. Besides providing real-time rainfall monitoring in the form of radar rainfall maps, PUB's X-band weather radar system provides forecasted radar rainfall maps with a 30-minute lead time, which are also fed to the CWOS. The rainfall forecasts and real-time sensor data are used in CWOS to forecast potential flood locations which improves efficiency of the deployment of flood response vehicles during flood operations. PUB is also expanding the network of water level sensors and CCTVs to enhance real-time monitoring of the drainage network.



The Catchment and Waterways Operations System, used in PUB's flood operations.

To complement PUB's predictive capabilities, data analytics is utilised to monitor drainage performance and detect irregularities before any flooding occurs at the next storm event. Implemented in May 2019, the Smart Drainage Grid (SDG) system is a data analytics system that consolidates all of the data from PUB's hydrometric and hydrometeorological sensor network into a single database. PUB uses the system to monitor the performance of its drains, identify undersized drains and drains with additional capacity. This enables 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 and its causes, such as choke or blockage, to be investigated and rectified before any flooding occurs at the next major storm event.



Mapview of the Smart Drainage Grid.

2

CAPABLE AND ENGAGED WORKFORCE

GRI 103-1 · 103-2 · 103-3

We recognise our people as the main driving force and cornerstone of PUB's operations. This therefore forms the second pillar, where our efforts are focused on bringing out the best in our people by creating a healthy, safe, inclusive and fair working environment, as well as investing in their training.

2-1 Health and Safety

Health and Safety Excellence

2-2 Competent Workforce

Competency-based Training

2-3 Inclusive and Fair Workplace



EMPLOYEE PROFILE

GRI 102-7 • 102-8 • 401-1

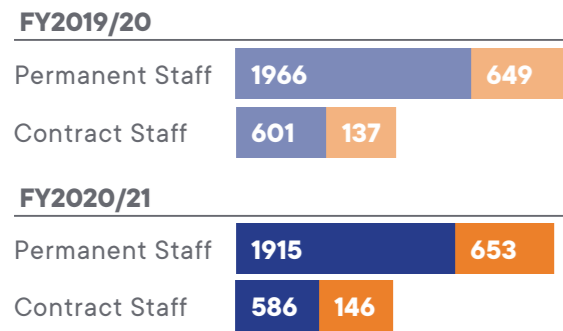
People are the driving force behind PUB's operations. We adopt a people-centric approach that ensures employees are kept healthy and safe, and that their capabilities are continually enhanced.

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 by Employment Contract and Gender



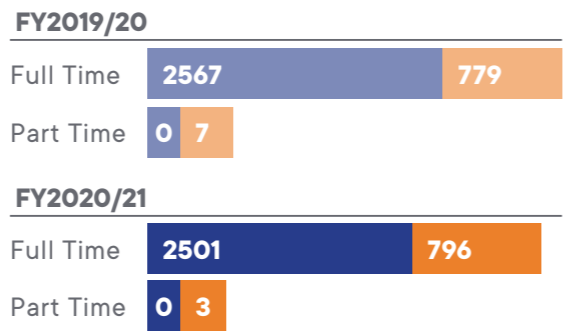
• Male • Female



Total employees as of 31 March by Employment Type and Gender



• Male • Female

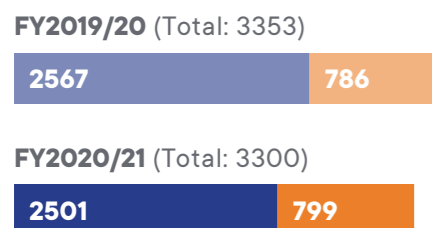


In FY2020/21, the total number of employees in PUB was 3,300 (FY2019/20: 3,353). PUB continued to recruit employees of all ages. There is an equal proportion of new hires who are below 30 years of age, and between 30 to 50 years.

Total employees as of 31 March by Gender



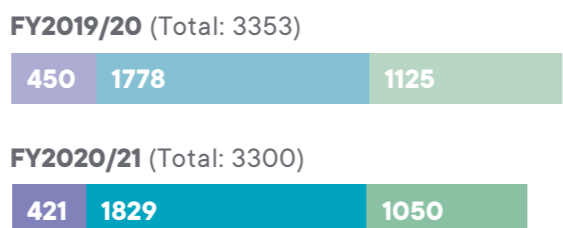
• Male • Female



Total employees as of 31 March by Age Group



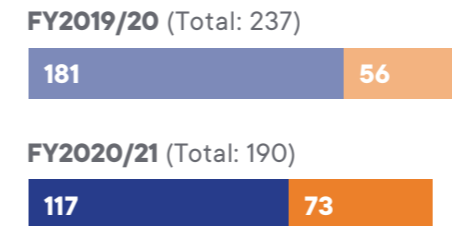
• <30 years old • 30-50 years old • >50 years old



New hires as of 31 March by Gender



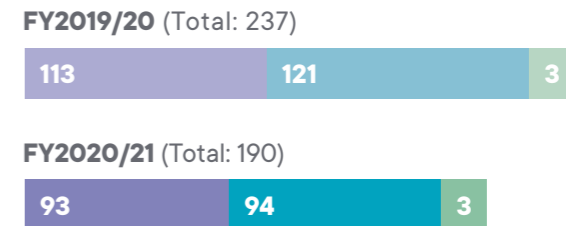
• Male • Female



New hires as of 31 March by Age Group



• <30 years old • 30-50 years old • >50 years old

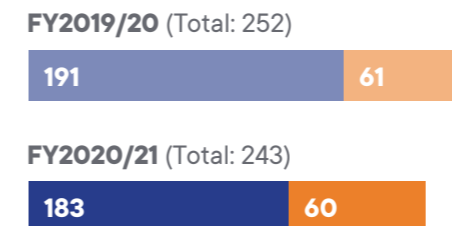


From FY2019/20 to FY2020/21, the rate of new hires decreased slightly from 7.1% to 5.6%. Most of the employees who left PUB are above 50 years of age and predominantly male.

Turnover as of 31 March by Gender



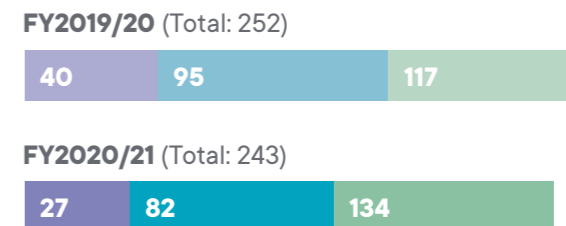
• Male • Female



Turnover as of 31 March by Age Group



• <30 years old • 30-50 years old • >50 years old



From FY2019/20 to FY2020/21, the turnover rate remained relatively constant, decreasing slightly from 7.5% to 7.4%. Turnover figures include all voluntary (resignation) and involuntary exits (e.g. retirement or leaving service on various exit schemes).

2-1 | HEALTH AND SAFETY

KEY FOCUS AREA 1

HEALTH AND SAFETY EXCELLENCE

GRI 403-1 • 403-2 • 403-3 • 403-4 • 403-5 • 403-6 • 403-7 • 403-9

COMMITMENTS

Continual improvement of PUB's safety culture and systems

Zero work-related injuries and fatalities

PERFORMANCE



Fatalities and injuries as a result of work-related incidents of employees and workers

CY 2016	CY 2017	CY 2018	CY 2019	CY 2020
Injuries				
32	34	34	20	26
Fatalities				
1	0	0	0	1

THE YEAR AHEAD

Deployment of smart safety technology such as smart wearables

It is critical that all PUB employees feel safe at work and are able to work safely. PUB has zero tolerance for unsafe behaviour and is committed to ensuring the holistic well-being of all our employees.

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, drives PUB's overall health and safety strategy and initiatives. The committee's work is supported by various working committees and department safety officers.

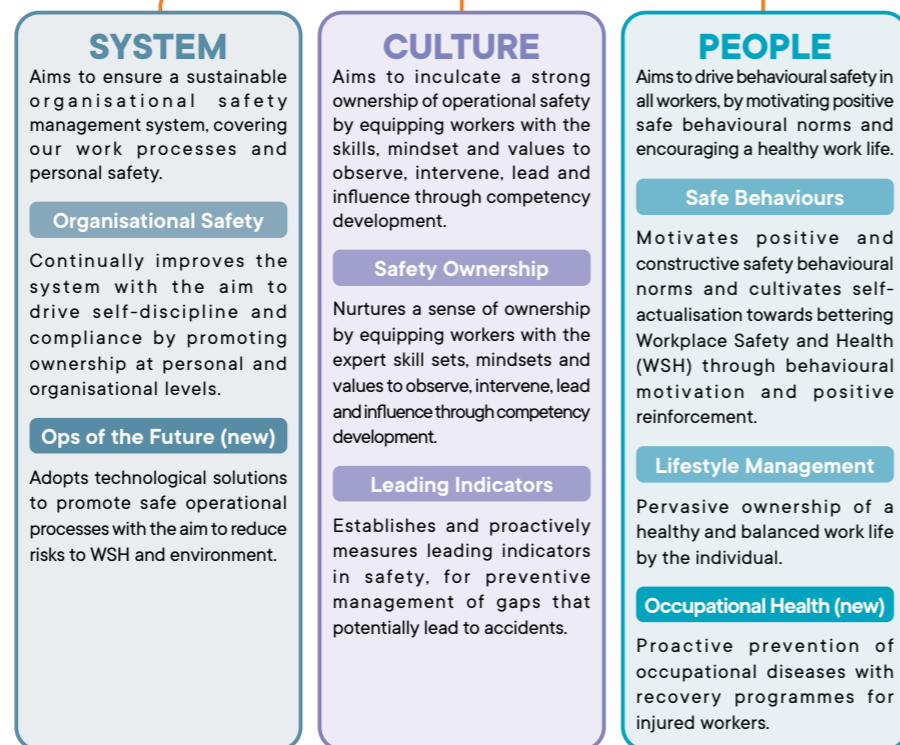
HEALTH AND SAFETY EXCELLENCE (HSE) 2020

PUB's safety culture and governance is outlined in the Health and Safety Excellence (HSE) 2020 programme, which was conceptualised in 2018 as a two-year campaign, in line with PUB's vision to create a healthy and safe workplace with zero accidents. There are three key areas in HSE 2020 — System, Culture and People.

VISION ZERO

Safety. Health. Wellbeing.

A Sustainable and Healthy Workplace with Zero Accidents and Occupational Diseases



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. Building on the foundation of HSE 2020, the second edition of PUB's HSE programme, HSE 2028, was launched in August 2020 during PUB's Health and Safety Day and will be in force from 2021 to 2028. The scope of HSE 2028 will cover two new strategic outcomes, namely Ops of the Future and Occupational Health. PUB will endeavour to develop our people's capabilities and sense of ownership towards health and safety as we believe that our people are our greatest asset towards achieving a sustained safe and healthy workplace.

PUB'S SAFETY PERFORMANCE

PUB monitors, tracks and reviews all workplace incidents. To prevent such incidents, PUB has in place various measures to prevent these incidents such as risk assessment to identify hazards, safe work procedures, taking a safety moment before commencement of work and regular site inspections. 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 main categories of work-related injuries in CY2020 are:

- Slip, Trip and Fall
- Cut / Stabbed / Struck by Object
- Caught in between Object
- Motorbike Traffic Accident

PUB saw an increase in the number of safety incidents in 2020 from 2019, mainly due to an increase in motorbike traffic accidents. There was one fatality due to a slip and fall incident in 2020. A comprehensive investigation and review of the risk assessment and safe work procedure was carried out, together with the implementation of preventive measures such as deployment of mobile CCTVs for high-risk activities.

ENSURING THE HEALTH AND SAFETY OF OUR PEOPLE DURING THE COVID-19 PANDEMIC

When the pandemic struck in early 2020, PUB formulated a crisis management plan to ensure PUB's work continues and our people are protected. Work arrangements such as telecommuting, split teams and staggered work hours have been implemented to minimise physical interactions. Safe distancing and workplace hygiene measures have also been implemented at all workplaces to keep staff safe.



PUB officers at work during the COVID-19 pandemic.

2-2 | COMPETENT WORKFORCE

KEY FOCUS AREA 1

COMPETENCY-BASED TRAINING

GRI 404-1 • 404-2

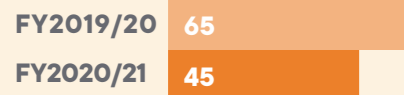
COMMITMENT

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

PERFORMANCE



Training hours per staff



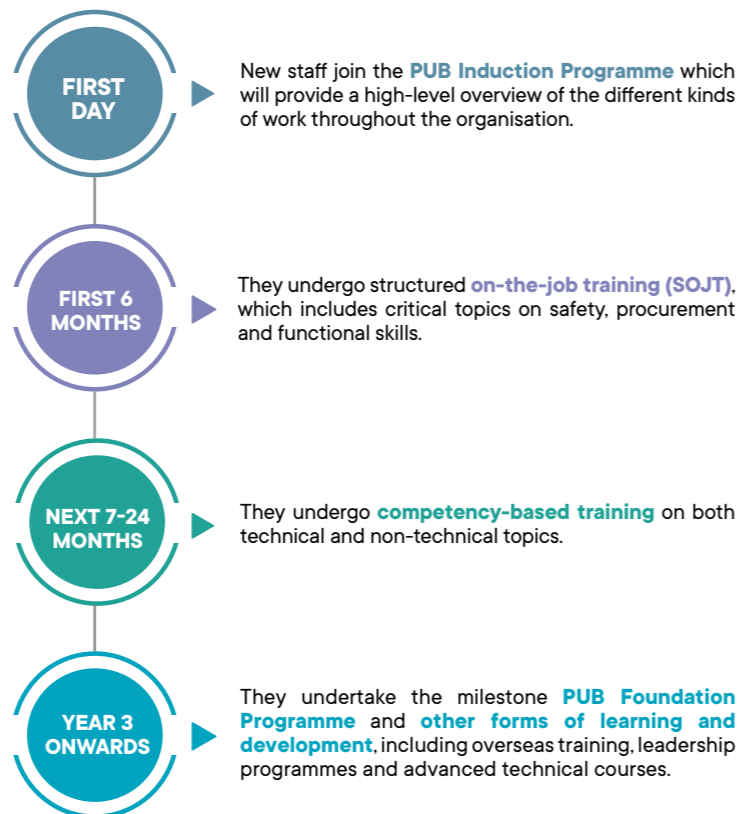
COVID-19 has slowed down the pace of training in FY2020/21. Since February 2020, training has been restricted due to COVID-19 measures such as safe distancing and split team arrangements. Training programmes were suspended from March 2020 to early May 2020 (Phase 1). During Phase 2 (Mid-June to December 2020), efforts were focused on converting suitable courses to a virtual format. Face-to-face external courses were discontinued till Q3 2020 and class sizes reduced in light of safe-distancing measures. Constraints were also imposed by operations and staffing requirements, making it more challenging to place trainees and form adequate class sizes. These challenges resulted in lower overall training hours in FY2020/21.

THE YEAR AHEAD

Training for **Competency Framework Phase 2** (non-operations departments) to be implemented for PUB officers

PUB is committed to building high-performing and resilient staff, and giving our people the best training and development 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: (1) Competency Frameworks, which help to identify knowledge and skills required for every job post in PUB in order to guide training needs; (2) Curriculum Design, where training is designed, curated and conducted to meet the needs of PUB and the water industry; and (3) Programme Delivery, in which ways to improve the quality of training delivery and training administration are examined.

COMPETENCY-BASED TRAINING AND DEVELOPMENT



SgWA developed the Competency Frameworks (CFs) for the entire organisation in phases. There are two types of competencies: (1) functional competencies which are job-specific, pertaining to each of PUB's departments; and (2) organisational competencies which are mandatory for most, if not all, of 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 five engineering operations departments and customer service. Phase 2 was launched in August 2020 when the CFs were developed for the remaining departments, mostly corporate and the other organisational topics. Moving ahead, PUB will be rolling out CF Phase 3 which covers our Operations & Maintenance (O&M) contractors in the water industry, as this group is seen as an extension of PUB officers, partnering us to deliver our mission. SgWA will continue to review and update the CFs to ensure that relevant courses are tagged to competencies for each job post and that PUB officers undergo the necessary training in a timely manner.

LEVERAGING DIGITAL TECHNOLOGY

SgWA is pursuing digital delivery of training to support PUB's transformation. PUB has developed digital platforms to support training, including PUBLearn, our Learning Management System (LMS) launched in August 2019 and mobile learning applications. PUB has also explored alternative learning modalities, such as Augmented Reality (AR) / Virtual Reality (VR) and simulators, e-learning, video conferencing and webinars.

Average training hours per employee by Gender



Average training hours per employee by Employee Category



In FY2020/21, the number of training hours per employee across all categories decreased due to restrictions from the COVID-19 pandemic and the time needed to convert suitable courses to a virtual format.

2-3 | INCLUSIVE AND FAIR WORKPLACE

GRI 102-41

COMMITMENT

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

PERFORMANCE



83% of employees covered by collective bargaining agreements.

FAIR EMPLOYMENT PRACTICES

PUB's employment practices are reviewed regularly for alignment with the fair employment principles set out by the Tripartite Alliance for Fair Employment Practices (TAFEP). Our terms of employment are also guided by Singapore's legislations, including the Employment Act, the Workplace Safety and Health Act, and the Retirement and Re-employment Act.

In line with TAFEP guidelines, PUB has adopted the following fair recruitment practices:

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

Following the Singapore Public Service's lead to raise the retirement age ahead of national schedule, PUB has revised the retirement age and re-employment age from 62 to 63 and from 67 to 68 respectively, with effect from 1 July 2021. This is to support older workers to continue working longer and to be more financially independent.

LABOUR MANAGEMENT RELATIONS



PUB and PUBEU at an MOU signing ceremony.

Strong labour management relationships are maintained through regular engagements between PUB Senior Management and PUB Employees' Union (PUBEU) on staff matters. Currently, 83% of our staff are Union members.

PUB actively partners PUBEU in the engagement of staff on change and transformation efforts to ensure that communication on change is effective and feedback from staff is incorporated for improvement. These regular engagements take the form of management and department meetings for the discussion of staff matters and employees' issues. They provide a platform for PUB to seek PUBEU's inputs and support before the implementation of any change and allow us to leverage PUBEU's network on the ground to communicate policy or process changes to staff more effectively. In addition, the Collective Agreement is also negotiated and renewed every three years.

PUB's Chief Executive, Mr Ng Joo Hee, was conferred the Medal of Commendation at the NTUC May Day 2020. This award is conferred on 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

GRI 103-1 · 103-2 · 103-3

Building upon our internal focus on sustainability, our external efforts through partnerships and engagement are also 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.

3-1 Customer-centric Water Service

Service Quality

3-2 Partnership and Engagement

Encouraging Water Conservation
Protecting Our Water Resources



3-1 | CUSTOMER-CENTRIC WATER SERVICE

KEY FOCUS AREA 1
SERVICE QUALITY

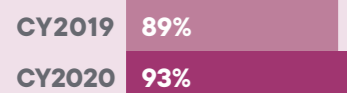
COMMITMENT

Maintain **high service standards** for our customers

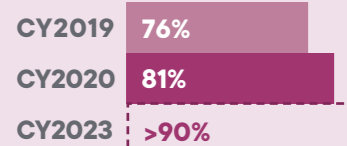
PERFORMANCE



% Submitted cases resolved within **3 working days**



% Services completed **digitally end-to-end**



With water being an essential good, PUB is constantly striving for the highest standards of customer service through continual improvements to customer service infrastructure and processes.

OUR CUSTOMER SERVICE COMMITMENT

PUB is committed to resolving customers' feedback efficiently and effectively. Workflows are regularly reviewed, both internally and externally with agencies, and performance monitored to ensure prompt resolution of service lapses and general enquiries. For more complex cases, PUB takes a Whole-of-Government approach and works closely with other agencies to address the feedback. For more information on PUB's service commitment, please visit <http://pub.gov.sg/about/servicecommitment>.

DIGITALISING OUR SERVICES

PUB is leveraging digitalisation to enhance the customer experience by making it more convenient for customers to access our services, carry out transactions with us and find information they need. To this end, PUB will digitalise more than 90% of our transactions with customers and businesses by 2023, in line with the Digital Government Blueprint. PUB has also been working closely with SP Services to encourage customers to switch to e-billing for a better and more interactive customer experience, and to be more environmentally friendly by reducing paper waste. We also provide informative alerts for flood and water disruptions, water level sensor alerts and a CCTV feed through the newly launched myENV app, which provides a one-stop platform for citizens' environmental, water and food information needs.

CELEBRATING OUR SERVICE CULTURE AND CAPABILITIES

PUB believes in publicly celebrating our people and rewarding innovation, efficiency and high service standards. The Service Star of the Year was given to 11 individuals and three teams at our Service & Innovation Day 2020 ("I Make A Difference!").



PUB Service & Innovation Day 2019. (Photo taken before the COVID-19 pandemic)

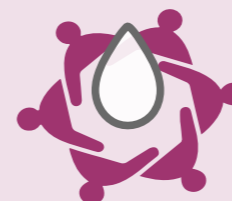
3-2 | PARTNERSHIP AND ENGAGEMENT

KEY FOCUS AREA 1
ENCOURAGING WATER CONSERVATION

COMMITMENT

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

PERFORMANCE



Engaged with stakeholders through various **engagement platforms** (Refer to page 15 for more info)

With Singapore's limited water resources, everyone must play their part in protecting our waters and the environment to ensure sustainability. Singapore's lack of land not only constrains us from collecting and storing enough water for our needs, but also prevents us from continuously expanding our water infrastructure. At the same time, future water demand is expected to almost double in tandem with population and economic growth. By only using what we need, we can work together to ensure that water demand does not rise at an unsustainable rate, and the resultant energy and resource savings can go towards reducing our collective carbon footprint.

INCREASING PUBLIC AWARENESS

Making water conservation a way of life requires long-term sustained effort. PUB has several public education and outreach initiatives to promote water conservation among different segments of the community. In FY2020/21, our water campaign "The Climate is Changing", focused on the impacts of climate change on our water resources, and PUB's efforts to address these challenges by enhancing flood resilience, implementing coastal protection, ensuring water security and reducing Singapore's carbon footprint by harnessing green energy. The campaign also aimed to heighten public awareness of the need for us to take action early to protect our homes and livelihoods.

Every year in March, PUB also 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. While events were scaled down due to COVID-19, more than 400 partners came on board in 2021, with over 60 schools dedicating every Wednesday in March to holding water-themed activities for students (Water Wednesdays) and some 50 retailers and businesses offering blue-themed discounts and promotions. On 22 March 2021, to commemorate World Water Day, a total of 43 prominent buildings and landmarks across the island, including the Singapore Flyer, Gardens by the Bay, Singapore Sports Hub and the newly opened Keppel Marina East Desalination Plant, were turned blue at night for the signature "City Turns Blue" event.



Athletes from the Singapore Waterski and Wakeboard Federation joined in the Singapore World Water Day 2021 celebration.

Additionally, PUB works with 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. Students are also able to learn about water sustainability in Singapore and how NEWater is produced through interactive tours and educational workshops at the NEWater Visitor Centre and the Singapore Sustainability Gallery at the Marina Barrage.

(3) STRONG PARTNERSHIPS

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. These include feasibility studies, water audits, recycling efforts and the use of alternative sources of water. 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 also 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 at March 2021, 3,043 premises have obtained the WEB (Basic) certification.

NOTABLE PROJECTS IMPLEMENTED

SYSTEMS ON SILICON MANUFACTURING COMPANY (SSMC)

As the first wafer fabrication company in Singapore to use NEWater for wafer processing in 2003, SSMC remains fully committed to water conservation and has seen a reduction in its annual water consumption, even as its operations expanded to more than double in capacity over the years. In 2012, SSMC tapped onto PUB's WEF to install a local scrubber reuse system to recycle the local scrubber wastewater back into its local scrubber systems, resulting in annual savings of more than 300,000m³.

CARLTON CITY HOTEL SINGAPORE

As part of the hotel's sustainability initiatives, Carlton City Hotel Singapore closely monitors its water consumption and has developed a systematic fault-reporting system and enforced daily inspections to prevent water wastage through leakages. In efforts to conserve water, the hotel adopted 3-tick fittings in their guestrooms and common area toilets, and actively educated guests and staff on the importance of water conservation by placing water conservation posters all around the premises. The hotel also recovers Air Handling Unit (AHU) condensate and reuses it for the cooling tower. Through these efforts, Carlton City Hotel Singapore has seen a drop of about 4,233m³ in water consumption between 2014 and 2016.

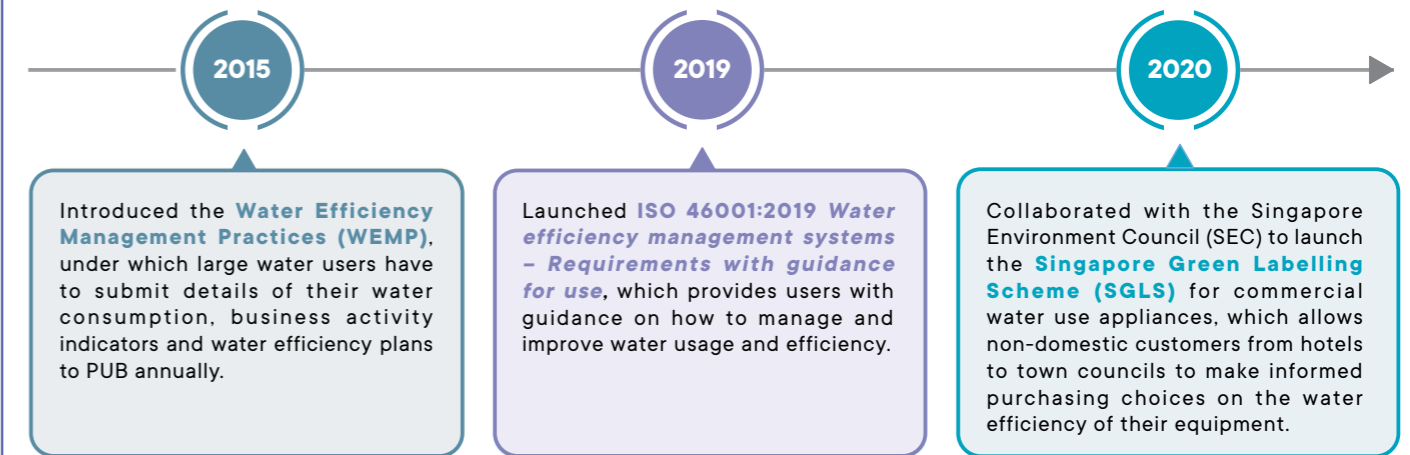
LEADING THE PUBLIC SECTOR

The Singapore Public Service is committed to leading sustainable development by example via the GreenGov.SG initiative, under the Singapore Green Plan 2030. In line with this, PUB sets the water conservation measures and Water Efficiency Index (WEI) targets at the Whole-of-Government level for the public service. The public service has exceeded the 5% WEI improvement target for FY2020/21 and achieved a 5.5% reduction in WEI from FY2013/14. Moving forward, the new target is to reduce WEI by 10% from the 2018 - 2020 levels by 2030.

(3) STRONG PARTNERSHIPS

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.



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



Introducing Water Sally

In December 2020, PUB introduced its new water mascot, Water Sally, to boost outreach efforts to pre-schoolers and young children. Water Wally and Sally Club, a new water-themed club, was launched for children to learn about climate change and water-related topics. Other exciting initiatives include a new three-part storybook series titled "The Adventures of Water Wally & Sally" in partnership with local author Adeline Foo, storytelling sessions via social media platforms and a new music video "Turn Off The Tap" produced together with Pinkfong, the company behind the popular song "Baby Shark". These efforts were part of PUB's curation of fun and educational programmes to help parents, educators and children learn about water conservation and good water habits.



3-2 | PARTNERSHIP AND ENGAGEMENT

KEY FOCUS AREA 2

PROTECTING OUR WATER RESOURCES

Everyone in the community plays an important role not only as responsible consumers, but also as protectors of our water resources. PUB actively strengthens our relationships and works with various stakeholders to ensure that the water system is protected and sustainable.

PARTNERING THE COMMUNITY IN PROTECTING OUR WATERWAYS

Since its inception, the ABC Waters programme has been highly successful in bringing the community closer to water and engendering greater appreciation of our waterways. We collaborate with the public in caring for our community spaces by encouraging our partners to adopt a reservoir, waterway, canal or drain. Through partner-driven initiatives such as PAssion WaVe's "Project Blue WaVe", members of the public can help to clean up the reservoirs and waterways while kayaking. PUB's focus is also on educating the next generation on the importance of protecting our waters. Our PUB Splash Lab programme aims to engage and empower youths to champion water sustainability in collaboration with other Institutes of Higher Learning (IHLs). Besides the public, we also partner agencies, not only at the infrastructural and policy level, but also on cross-agency matters such as pollution control.



ABC Waters at Jurong Lake Gardens.

PROTECTING OUR USED WATER

Used water is also an important and valuable resource for Singapore. At PUB, used water is reclaimed and reused through the NEWater treatment process, augmenting our water resources and closing the water loop. PUB thus actively engages our industry partners to ensure that all trade effluent discharged complies with regulatory limits, thereby protecting used water.

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 management of chemicals. We also collaborate with other agencies to ensure that our key messages and requirements are included in related course materials, events and lease agreements.

PROTECTING OUR COASTLINES AGAINST RISING SEAS

Protecting against rising sea levels is a complex and long-term undertaking. PUB will adopt a collaborative approach as we develop the strategies and solutions to protect Singapore's coastlines. We will be working closely with the community and relevant stakeholders, including agencies, nature groups and businesses, to seek their feedback on the proposed coastal protection measures and explore opportunities to create a vibrant living environment in harmony with nature.

ENHANCING COMMUNITY FLOOD RESILIENCE

PUB takes every flood incident seriously. We investigate the cause of each flood incident, and act swiftly to reduce future flood risk. Over the years, PUB has put in substantial investment to improve our drainage infrastructure and network to better channel stormwater and cope with more intense storms due to climate change.

At the same time, PUB aims to strengthen the community's resilience to potential flash flood events. We provide monsoon advisories and precautionary tips to residents and business owners in low-lying areas, so that they can be prepared and take early actions to protect their properties and plan their daily activities. PUB has been loaning out portable flood protection devices to homes and shophouses since 2019 that can be used to keep out rainwater during heavy storms.



A PUB officer helping a resident to install a flood barrier.

To boost community preparedness, PUB also provides timely information to the community via accessible technology-based platforms. Heavy rain and flood risks alerts are also promptly issued through social media channels to keep the public informed. For example, real-time CCTV images of flood-prone areas and hotspots, and level sensor information can be accessed by the public freely on our website and "myENV" mobile app. The public can also subscribe to PUB's [SMS alert services](#) to receive personalised alerts on high water levels in waterways and drains and heavy rain warnings. Building owners are also advised to install physical structures to protect basement levels from floodwaters.

4

BUSINESS EXCELLENCE

GRI 103-1 • 103-2 • 103-3

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 improvements at every possible avenue.

We focus on four key areas:

4-1 Trust and Transparency

4-2 Innovation

4-3 Digitalisation and Cybersecurity

4-4 Financial Sustainability



4-1 | TRUST AND TRANSPARENCY

GRI 205-2

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. The following policies and practices are in place to help foster trust in PUB as a responsible business:

ENTERPRISE RISK MANAGEMENT (ERM) FRAMEWORK

Given the broad array of risks PUB is exposed to amidst an ever-changing operating environment, PUB takes a proactive approach in managing risks that could disrupt our mission and affect public confidence. PUB has developed an ERM framework to manage risks across the organisation in an integrated and systematic manner.

MISSION



Supply
Good Water



Reclaim
Used Water



Tame
Storm Water



Resist
Rising Seas

OBJECTIVE

High reliability and strong public confidence in our ability to fulfil our mission.

STRUCTURE

- Risk Governance
- Risk Appetite

Risk governance is integral to effective risk management. The Board Risk Management Committee has been established since 2018 to provide independent oversight of the effectiveness of the ERM framework and the management of key risks, while the Management is overall responsible for ensuring risks are effectively managed and within the established risk appetite.

PROCESSES

- Understand Operating Environment
- Identify Risks
- Assess Risks
- Treat Risks
- Monitor Risks
- Report Risks

Key methods and processes are set out to proactively identify, assess, treat and monitor PUB's risks. Risks are prioritised using a heat map to ensure optimal resource allocation.

ENABLERS

- Risk Culture
- Tools and Technology

Every PUB staff is responsible for managing risks. To build a strong risk culture, PUB has a programme in place to enhance risk awareness, ownership, communication and competency across functions and at all staff levels. An IT system has been developed to manage and report risk information in an efficient manner.

(4) BUSINESS EXCELLENCE

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. PUB also conducts an annual declaration exercise to ensure all employees adhere to and comply with PUB's Code of Conduct. Additionally, an e-learning quiz on the Code of Conduct was launched in 2020 to help employees review these rules and regulations 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 then 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.

TRANSPARENCY IN PROCUREMENT

All PUB Departments are required to comply with the guidelines in the Instruction Manual (IM) on Procurement and in-house Procurement Manual to ensure transparency and consistent practices in our procurement and contract management processes. PUB adopts open tenders and quotations as the primary procurement approach mode, and only considers limited procurement if it fits within one of the reasons prescribed in the IM on Procurement. The adoption of appropriate price and quality evaluation frameworks depending on the types and nature of the procurement helps to ensure that PUB achieves the optimal balance of benefits and costs, while taking into account the suitability, quality and reliability of the services and/or goods.

To ensure fairness and proper conduct of our contractors and suppliers, PUB adopts standard terms within contracts that require them to comply with the prevailing regulations and laws.

In recent years, we have placed a higher emphasis on the adoption of technologies and environmentally-friendly products such as smart lighting in our procurements. Separately, market reviews and studies have also been conducted to explore possibilities for adoption of technologies in various operational and maintenance scopes in the longer term. This is to reduce the need for manpower and material resources, as well as to reduce adverse environmental impact.

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 adopting and complying 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.

(4) BUSINESS EXCELLENCE

4-2 | INNOVATION

COMMITMENT

Ensure **continuous innovation** in our work

PERFORMANCE



Ideas submitted

CY2019	118
CY2020	168



Worked on **710** R&D projects with a total value of **\$813 mil** since 2002

THE YEAR AHEAD

Refer to the latest "**Innovation in Water, Singapore**" publication for more details on PUB's latest innovation and R&D efforts

At PUB, innovation is about devising ways to do our everyday work better, more easily and more efficiently to yield better outcomes and ultimately provide better service. We believe every PUB employee can innovate, and we take action to turn 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.

FOSTERING AND CELEBRATING INNOVATION



PUB IDEAS Exchange

One-stop platform to submit innovative ideas



Annual Service and Innovation Day

To recognise and celebrate staff contribution in innovation

• CE Innovation Awards

For the best ideas implemented

• Innovation Champion Awards

For innovation advocates and role models

FEATURE STORIES

CE Innovation Awards:
Ulu Pandan Biogas Holder

Biogas holder at Ulu Pandan Water Reclamation Plant.

In 2020, the Ulu Pandan Water Reclamation Plant innovatively converted one of its end-of-life digesters into a biogas holder to store biogas for electricity generation, in a first-ever project of its kind. For its originality and ingenuity, this project was awarded the CE Innovation Gold Award.

(4) BUSINESS EXCELLENCE

GROWING WATER TECHNOLOGIES THROUGH R&D

Apart from supporting in-house initiatives to enhance our work processes, PUB also seeks to be at the forefront of technological developments in the global water R&D scene. PUB has been actively investing in R&D from as early as 2002, with the successful R&D and launch of our third national tap, NEWater. In 2004, a dedicated Technology Department was set up to lead PUB's R&D efforts. Guided by a technology roadmap, which is periodically refreshed, PUB strives to invest wisely in technologies that are needful, applicable and valuable to our operations.

Our R&D approach consists of three levels and spans across nine 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 to de-risk and scale up promising technologies.

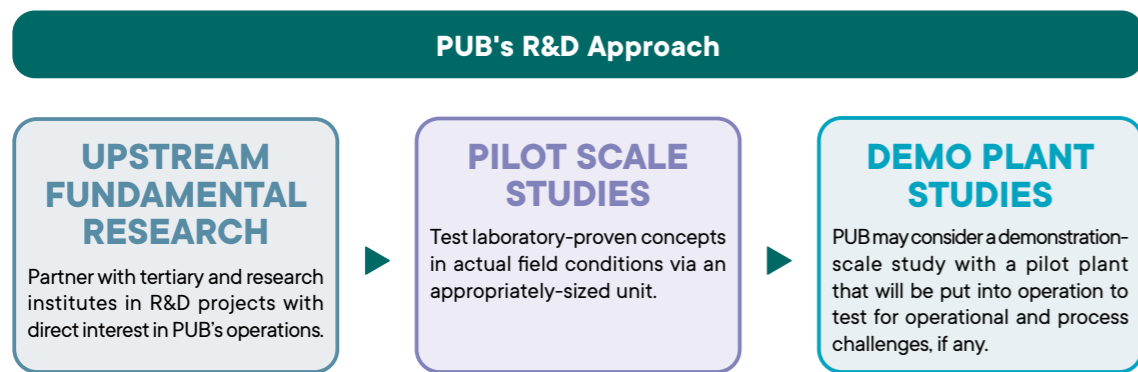
Many of these projects have also been featured in "Innovation in Water, Singapore", PUB's regular publication which showcases various R&D projects across our nine technology domains.



1 in 2 projects under PUB R&D Fund progresses to implementation or the next developmental phase



Worked on 710 R&D projects, in collaboration with partners (institutions and companies) from 27 countries



The nine technology domains of interests are:

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

(4) BUSINESS EXCELLENCE

DEVELOPING AN ECOSYSTEM

We acknowledge, however, that we cannot accomplish this alone. PUB needs to develop a strong ecosystem of local and international companies, research institutes and experts to conduct applied R&D, in addition to implementing technology roadmaps to guide R&D efforts within PUB and with our research partners. Nonetheless, as Singapore's national water agency, PUB is well poised to guide and direct the local and global water scene. We do these through five main initiatives:

INNOVATION FUNDS

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, the Urban Solutions and Sustainability (USS) (Water) has overseen the growth of a vibrant and comprehensive water research ecosystem. With the R&D capabilities developed over the years, Singapore today has built strengths in areas such as membranes for seawater desalination and water reuse. Moving into the next five-year funding cycle till 2025, the focus area of Water under USS will continue developing high-impact solutions to meet strategic national water needs, with a stronger focus on commercialisation and wider adoption of new water technologies.

SINGAPORE INTERNATIONAL WATER WEEK (SIWW)



Singapore International Water Week 2021.

SIWW is the global platform to share and co-create innovative water solutions. This biennial event gathers thought leaders and stakeholders from the global water industry to share best practices and solutions, showcase the latest technologies and harness business opportunities. As part of efforts to promote, grow and commercialise technologies, PUB leverages SIWW to profile our leading local water companies, small and medium-sized enterprises (SMEs) and start-ups. Events at SIWW supporting these efforts include:

- **Water Convention:** A platform for water leaders and practitioners to share knowledge and engage in discussions 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 and individual participating companies. It also includes an innovation showcase of R&D projects and promising technologies.
- **Lee Kuan Yew Water Prize:** A prestigious, internationally recognised award conferred on an individual or organisation for outstanding contributions towards solving the world's water problems by developing or applying innovative technologies, policies or programmes which benefit humanity.

(4) BUSINESS EXCELLENCE

SINGAPORE WATER EXCHANGE (SgWX)

The SgWX is a global marketplace for innovative water companies. Located within PUB's WaterHub, it provides a conducive environment for water companies to collaborate and co-innovate. Currently, it houses a vibrant ecosystem of close to 30 water companies from 10 countries that leverages mutual strengths to push the frontiers of water innovation and business growth.



PUB Singapore Water Exchange.

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. A Water Technology Advisory Panel (WTAP) was established in 2019 to provide advice to accelerate the commercialisation of locally-developed water technologies to create economic value for Singapore. The Panel comprises representatives from the government and industry, who guide the commercialisation efforts via a structured framework that covers technology translation, scaling up, enterprise development, and expansion into overseas markets and adjacent industry sectors.

PUB GLOBAL INNOVATION CHALLENGE

The PUB Global Innovation Challenge seeks to accelerate PUB's discovery and adoption of digital solutions and innovative technologies to solve real operational and technical challenges that PUB officers have encountered or anticipate in future. Incentives include providing pilot funding of up to S\$250,000 to validate the shortlisted solution, mentorship from our operations experts, the opportunity to access real-world testbeds, and enabling the commercialising and scaling of the validated solution with PUB. In collaboration with companies, researchers and innovators from around the world, we strive to improve operational excellence and meet the future water needs of our nation.

RESEARCH PROGRAMME PARTNERSHIPS

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

CO-DIGESTION OF FOOD WASTE AND USED WATER SLUDGE TO ENHANCE BIOGAS PRODUCTION FOR ENERGY GENERATION

This two-year trial started in 2016 and was conducted at the Ulu Pandan Water Reclamation Plant (UPWRP). Up to 40 tonnes of used water sludge and food waste from 23 premises were treated daily at the demonstration facility in UPWRP. Results showed that synergistic effects in the co-digestion of used water sludge and food waste can increase biogas production by up to 40%, compared to the separate digestion of the two inputs. With this technology, used water treatment plants can potentially be energy self-sufficient.

LAUNCH OF A 1MWP FLOATING SOLAR PHOTOVOLTAIC (PV) TESTBED AT TENGEH RESERVOIR

This 2016 study explored the feasibility of deploying floating solar PV systems on Singapore's reservoirs. The project was led by the Economic Development Board (EDB) and PUB, and managed by the Solar Energy Research Institute of Singapore (SERIS). The systems were found to perform 5% to 15% better than conventional solar PV rooftop systems due to the cooler reservoir environment. Studies conducted also showed no observable change in the reservoir's water quality and no significant impact on the surrounding wildlife.

COMPREHENSIVE TRIAL AT CHOA CHU KANG WATERWORKS (CCKWW)

This 18-month demonstration trial in 2011 validated the benefits of ceramic membranes. Results showed that, compared to polymeric membranes, ceramic membranes are more energy-efficient while occupying a smaller footprint and are more cost-efficient with a longer lifespan of 20 years. In addition, water loss is reduced significantly from 5% to 1% with ceramic membranes. PUB subsequently collaborated with PWN Technologies (PWNT) to develop a full-scale plant in 2019, with a capacity of 40 million gallons per day. This is the largest ceramic membrane filtration plant in the world for the treatment of drinking water.

(4) BUSINESS EXCELLENCE

4-3 | DIGITALISATION AND CYBERSECURITY

COMMITMENT

Ensure robust IT and cybersecurity management

PERFORMANCE



100% completion of digital and cybersecurity literacy training (CSC Learn course) in FY2020/21

THE YEAR AHEAD

All employees to complete the cybersecurity refresher training and basic literacy training

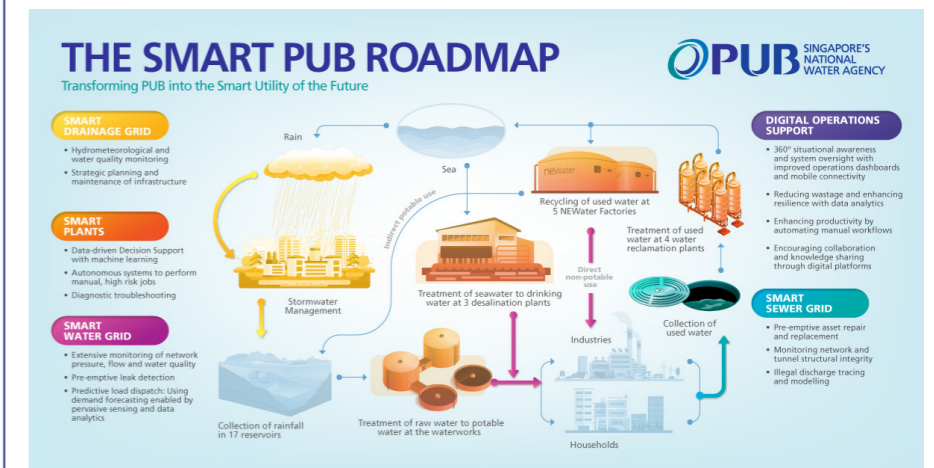
2021 Digital Master Plan Review

DIGITAL MASTER PLAN

Along with innovation, digitalisation is key to PUB's transformation and sustainability efforts. In line with Singapore's vision of a Smart Nation, PUB strives to adopt digitalisation to create value through new capabilities, foster a better work environment, improve customer service and generate more efficient operations.

In 2018, PUB first announced our SMART PUB Roadmap, which laid the blueprint for the adoption of digital solutions across the value chain to improve operational effectiveness and efficiency. The roadmap outlined digital initiatives in four major areas:

1. Smarter water quality management with artificial intelligence and automation;
2. Key network improvements with predictive intelligence (e.g. acoustic leak detection);
3. Integrated customer engagement with water usage data (e.g. Smart Water Meter Programme); and
4. Smarter work redesign with automation and robotics.



SMART PUB Roadmap (view enlarged version).

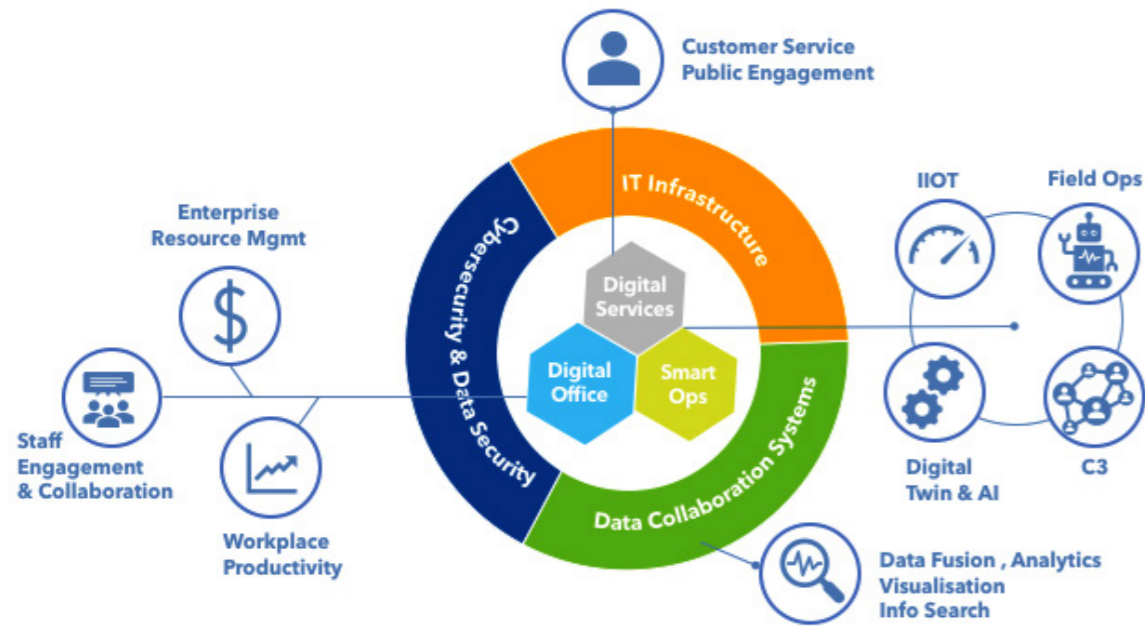
These initiatives leverage digitalisation, sensor deployments and data analytics to improve PUB's oversight of our systems and networks, allowing us to be more responsive to operational challenges and optimise our operations for greater efficiency. Digitalisation has also enabled greater connectivity and automation, both in operations and corporate processes, thereby improving the productivity of our workforce and providing us with the platform to meet unexpected challenges like the COVID-19 pandemic.

In line with the Whole-of-Government push towards a Smart Nation, PUB has also begun to leverage digitalisation to reinvent our service delivery and deliver greater value to our customers through greater convenience, better awareness of their own water consumption and improved service outcomes.

In 2021, PUB is embarking on a comprehensive Digital Master Plan review, focusing on three approaches:

1. New frameworks to identify new opportunities for digitalisation, strengthen our ICT governance and guide project development
2. An enterprise level review of our digital systems to identify synergies across existing and new digital solutions so that we can deploy our digital solutions more cost-effectively through economies of scale
3. Leveraging ecosystems and building capabilities within PUB to meet the needs of a digital PUB

KEY AREAS OF THE 2021 DIGITAL MASTER PLAN REVIEW



As at 2021, 100% of PUB staff have completed basic digital literacy and cybersecurity literacy training. PUB will also be conducting more advanced training in data competencies for selected staff to increase the adoption of modern data analytics and tools across the organisation and improve operational outcomes.

CYBERSECURITY

PUB understands that an effective and robust cybersecurity system must consider the three pillars of processes, people and technology. To support our people in guarding against cyber-attacks, digital literacy programmes have been formulated according to the Digital Literacy Framework set by the Public Service Division for staff at three different tiers. The courses include technology and data literacy, data protection, cybersecurity, technologies shaping digital transformations, applications of data analytics and hands-on training in data collection.

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 email and encourages users to report phishing emails.

4-4 | FINANCIAL SUSTAINABILITY

COMMITMENT

Ensure **economic and financial sustainability**

PERFORMANCE

Refer to [PUB's Annual Report 2020/2021](#) on page 50 for more details on our financial results for FY2020/21

THE YEAR AHEAD

Exploration of **green financing tools**

As a partially self-funded statutory board funded by both 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:

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 to encourage consumers to use it wisely..

GREEN FINANCING

To further advance PUB's as well as Singapore's sustainability agenda, PUB is also exploring green financing tools such as green bonds to help enable sustainability efforts.

REPORTING FUNDAMENTALS METHODOLOGICAL REVIEW

ENVIRONMENTAL

ENERGY AND GREENHOUSE GAS (GHG) EMISSIONS

FY2020/21 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)
3,390.8			81.2	386.4
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
128.0	346.0 (96.1 GWh)	3,044.9 (845.8 GWh)		
ENERGY SOURCES: DIESEL, PETROL	ENERGY SOURCES: SOLAR AND BIOGAS FROM USED WATER SLUDGE			

FY2019/20 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)
3,503.2			66.8	399.4
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
116.7	344.4 (95.7 GWh)	3,158.8 (877.5 GWh)		
ENERGY SOURCES: DIESEL, PETROL	ENERGY SOURCES: SOLAR AND BIOGAS FROM USED WATER SLUDGE			

REPORTING SCOPE, PERIOD AND APPROACH

PUB adopts the Operational Control Approach, as outlined in the GHG Protocol Corporate Standard, to determine organisational boundaries. This attributes accountability for 100% of the GHG emissions from operations over which the organisation has control. Data for energy and GHG emissions consumption has been compiled for the financial years 2019/20 and 2020/21.

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 in Singapore and Johor, Malaysia, including fuel consumption from PUB's vehicle fleet. The total energy consumption is expressed in terajoules (TJ).

GHG EMISSIONS

This report discloses the Scope 1 and Scope 2 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).
- Scope 2 emissions are emissions that result from the generation of purchased or acquired electricity, heating, cooling and steam consumed by the organisation. For PUB's report, they include emissions from the consumption of grid electricity in Singapore and Johor, expressed in tonnes of CO₂-equivalent. Scope 2 emission factors for the calculation of electricity consumption in Singapore are taken from the Singapore Energy Statistics 2019 published by the Energy Market Authority in Singapore (0.4085kg CO₂/kWh). Emission factors for the calculation of electricity consumption in Malaysia are taken from IGES List of Grid Emission Factors version 10.10 published in February 2021 (Malaysia 2017: 0.6448 tCO₂e/MWh).

WASTE

Waste generated is expressed in kilotonnes, and includes waste from used water and water treatment, and hazardous laboratory wastes. 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)
FY2019/20	208,784	68,781	277,565
FY2020/21	187,743	72,303	260,046

Hazardous wastes are generated from PUB's laboratory work. PUB has put in place strict disposal processes to prevent contamination of the environment. The hazardous wastes are stored in purpose-built containers and designated areas before they are collected by licenced waste collectors.

CATEGORIES OF HAZARDOUS WASTES	FY2019/20	FY2020/21
BIOHAZARDOUS LABORATORY WASTE (E.G. CULTURES AND MEDIA)	*Data not available	96 (NO. OF 240L CONTAINERS)
LABORATORY WASTEWATER (E.G. SPENT CHEMICALS)	7000L	11400L
LABORATORY SOLID WASTE (E.G. BROKEN GLASSWARE, CUPPED STAINLESS STEEL PLANCHET FROM RADIOLOGY LAB, CHEMICAL SPILLAGE SOLID WASTE)	104KG	104KG

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. PUB's workers currently include contractors only.

High-consequence work-related injuries are those that result in a fatality or in an injury from which the worker cannot, does not, or is not expected to recover fully to pre-injury health status within six months.

Recordable work-related injuries are work-related injuries that result in any of the following: death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid or loss of consciousness; or significant injury diagnosed as such by a physician or other licenced healthcare professional, even if it does not result in death, days away from work, restricted work or job transfer, medical treatment beyond first aid or loss of consciousness.

Fatality and work injury rates are calculated using number of fatalities or injuries divided by the number of hours worked, multiplied by 1,000,000 hours worked.

FOR EMPLOYEES	CY2019		CY2020	
ESTIMATED NUMBER OF MAN-HOURS WORKED	6,038,424		6,075,474	
	NUMBER	RATE	NUMBER	RATE
FATALITIES AS A RESULT OF WORK-RELATED INJURY	0	0	0	0
HIGH-CONSEQUENCE WORK-RELATED INJURIES (EXCLUDING FATALITIES)	0	0	0	0
RECORDABLE WORK-RELATED INJURIES	5	0.83	4	0.66
MAIN TYPES OF WORK-RELATED INJURIES	<ul style="list-style-type: none"> • SLIP, TRIP AND FALL • CUT / STABBED BY OBJECT 		<ul style="list-style-type: none"> • SLIP, TRIP AND FALL • MOTOBIKE TRAFFIC ACCIDENT 	

FOR WORKERS (INCLUDES CONTRACTORS)	CY2019		CY2020	
ESTIMATED NUMBER OF MAN-HOURS WORKED	31,032,894		24,266,526	
	NUMBER	RATE	NUMBER	RATE
FATALITIES AS A RESULT OF WORK-RELATED INJURY	0	0	1	0.04
HIGH-CONSEQUENCE WORK-RELATED INJURIES (EXCLUDING FATALITIES)	0	0	0	0
RECORDABLE WORK-RELATED INJURIES	15	0.48	22	0.91
MAIN TYPES OF WORK-RELATED INJURIES	<ul style="list-style-type: none"> • SLIP, TRIP AND FALL • CUT / STABBED BY OBJECT 		<ul style="list-style-type: none"> • SLIP, TRIP AND FALL • STRUCK BY OBJECT • CUT / STABBED BY OBJECT • CAUGHT IN BETWEEN OBJECT 	

TRAINING HOURS

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

GRI CONTENT INDEX

GRI 102-55



For the Materiality Disclosures Service, GRI Services reviewed that the GRI content index is clearly presented and the references for Disclosures 102-40 to 102-49 align with appropriate sections in the body of the report.

GENERAL DISCLOSURES (GRI 102: GENERAL DISCLOSURES 2016)

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
GRI 101: FOUNDATION 2016			
101	Foundation 2016	This report complies with all requirements in Section 2 of GRI 101: Foundation ('Using the GRI Standards for sustainability reporting')	
GRI 102: GENERAL DISCLOSURES – ORGANISATIONAL PROFILE			
102-1	Name of the organisation	• About PUB: Our Vital Role	5
102-2	Activities, brands, products and services	• About PUB: Our Vital Role	5
102-3	Location of headquarters	• About PUB: Our Vital Role	5
102-4	Location of operations	• About PUB: Our Vital Role	5
102-5	Ownership and legal form	• About PUB: Our Vital Role	5
102-6	Markets served	• About PUB: Our Vital Role	5
102-7	Scale of the organisation	<ul style="list-style-type: none"> • About PUB: Our Vital Role • Employee Profile For information on net revenues and total capitalisation, please refer to PUB's Annual Report 2020/2021.	5, 34-35
102-8	Information on employees and other workers	• Employee Profile	34-35
102-9	Supply chain	• About PUB: Our Vital Role	5
102-10	Significant changes to the organisation and its supply chain	Please refer to PUB's Annual Report 2020/2021 on pages 4, 12-19 and PUB press releases at https://www.pub.gov.sg/Pages/PressReleases.aspx for more information.	
102-11	Precautionary principle or approach	• Climate Change Adaptation	29
102-12	External initiatives	PUB aligns itself to Singapore's national sustainability initiatives such as the GreenGov.SG (previously known as Public Sector Taking the Lead in Environmental Sustainability, PSTLES) initiative and Singapore Green Plan 2030. PUB also aligns its practices with the fair employment principles set out by the Tripartite Alliance for Fair Employment Practices, and the workplace safety and health obligations and principles set out by the Ministry of Manpower.	
102-13	Membership of associations	<ul 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-SWA) observing member • Leading Utilities of the World (LUOW) advisory member • World Health Organization (WHO) • American Water Works Association (AWWA) member • Global Water Research Coalition (GWRC) • World Water Innovation Fund (WWIF) • K2i established by Booky Oren Global Water Technologies (BOGWT) • WaterShare by KWR Water Research Institute 	

GRI CONTENT INDEX

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
GRI 102: GENERAL DISCLOSURES — STRATEGY			
102-14	Statement from senior decision-maker	<ul style="list-style-type: none"> Chairman's Message Chief Executive's Message 	<ul style="list-style-type: none"> 6-7 8-9
GRI 102: GENERAL DISCLOSURES — ETHICS AND INTEGRITY			
102-16	Values, principles, standards and norms of behaviour	<ul style="list-style-type: none"> About PUB: Our Vital Role 	5
GRI 102: GENERAL DISCLOSURES — GOVERNANCE			
102-18	Governance structure	<ul style="list-style-type: none"> Sustainability Governance 	16
102-20	Executive-level responsibility for economic, environmental and social topics	<ul style="list-style-type: none"> Sustainability Governance 	16
102-26	Role of highest governance body in setting purpose, values and strategy	<ul style="list-style-type: none"> Sustainability Governance 	16
GRI 102: GENERAL DISCLOSURES — STAKEHOLDER ENGAGEMENT			
102-40	List of stakeholder groups	<ul style="list-style-type: none"> Our Stakeholder Engagement 	15
102-41	Collective bargaining agreements	<ul style="list-style-type: none"> Inclusive and Fair Workplace 	40
102-42	Identifying and selecting stakeholders	<ul style="list-style-type: none"> Our Stakeholder Engagement 	15
102-43	Approach to stakeholder engagement	<ul style="list-style-type: none"> Our Stakeholder Engagement 	15
102-44	Key topics and concerns raised	<ul style="list-style-type: none"> Our Stakeholder Engagement 	15
GRI 102: GENERAL DISCLOSURES — REPORTING PRACTICE			
102-45	Entities included in the consolidated financial statements	The entities included in the consolidated financial statements are PUB and its subsidiaries, PUB Consultants Private Limited ('PUBC') and Singapore International Water Week Pte. Ltd. ('SIPL', wholly owned by PUBC). The scope of this report does not include either subsidiary. Please refer to PUB's Annual Report 2020/2021 on page 50 for the consolidated financial statements.	
102-46	Defining report content and topic Boundaries	<ul style="list-style-type: none"> PUB's Material Issues 	17
102-47	List of material topics	<ul style="list-style-type: none"> PUB's Material Issues 	17
102-48	Restatement of information	This is PUB's first sustainability report.	
102-49	Changes in reporting	This is PUB's first sustainability report.	
102-50	Reporting period	<ul style="list-style-type: none"> Reporting Scope and Period 	3
102-51	Date of most recent report	<ul style="list-style-type: none"> Reporting Scope and Period 	3
102-52	Reporting cycle	<ul style="list-style-type: none"> Reporting Scope and Period 	3
102-53	Contact point for questions regarding the report	<ul style="list-style-type: none"> About This Report 	3
102-54	Claims of reporting in accordance with the GRI Standards	<ul style="list-style-type: none"> Reporting Standards 	3
102-55	GRI content index	<ul style="list-style-type: none"> GRI Content Index 	61-64
102-56	External assurance	External assurance has not been sought for this report. We may consider seeking external assurance for future reports.	

GRI CONTENT INDEX

PILLAR 1: WATER AND SUSTAINABLE MANAGEMENT

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
GRI 302: ENERGY 2016			
103-1 to 103-3	Management approach	<ul style="list-style-type: none"> Water and Sustainable Management 	18-32
302-1	Energy consumption within the organisation	<ul style="list-style-type: none"> Reducing Our Energy and Carbon Footprint 	25-26
302-4	Reduction of energy consumption	<ul style="list-style-type: none"> Reducing Our Energy and Carbon Footprint 	25-26
GRI 305: EMISSIONS 2016			
103-1 to 103-3	Management approach	<ul style="list-style-type: none"> Water and Sustainable Management 	18-32
305-1	Direct (Scope 1) GHG Emissions	<ul style="list-style-type: none"> Reducing Our Energy and Carbon Footprint 	25-26
305-2	Energy Indirect (Scope 2) GHG Emissions	<ul style="list-style-type: none"> Reducing Our Energy and Carbon Footprint 	25-26
GRI 306: WASTE 2020			
103-1 to 103-3	Management approach	<ul style="list-style-type: none"> Water and Sustainable Management 	18-32
306-1	Waste generation and significant waste-related impacts	<ul style="list-style-type: none"> Maximising Resource Circularity 	27
306-2	Management of significant waste-related impacts	<ul style="list-style-type: none"> Maximising Resource Circularity 	27
306-3	Waste generated	<ul style="list-style-type: none"> Maximising Resource Circularity 	27

PILLAR 2: CAPABLE AND ENGAGED WORKFORCE

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
GRI 401: EMPLOYMENT 2016			
103-1 to 103-3	Management approach	<ul style="list-style-type: none"> Capable and Engaged Workforce 	33-40
401-1	New employee hires and employee turnover	<ul style="list-style-type: none"> Employee Profile 	34-35
GRI 403: OCCUPATIONAL HEALTH AND SAFETY 2018			
103-1 to 103-3	Management approach	<ul style="list-style-type: none"> Capable and Engaged Workforce 	33-40
403-1	Occupational health and safety management system	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37
403-2	Hazard identification, risk assessment and incident investigation	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37
403-3	Occupational health services	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37
403-4	Worker participation, consultation, and communication on occupational health and safety	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37
403-5	Worker training on occupational health and safety	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37
403-6	Promotion of worker health	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37
403-7	Prevention and mitigation of occupational health and safety impacts directly linked by business relationships	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37
403-9	Work-related injuries	<ul style="list-style-type: none"> Health and Safety Excellence 	36-37

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
GRI 404: TRAINING AND EDUCATION 2016			
103-1 to 103-3	Management approach	• Capable and Engaged Workforce	33-40
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

PILLAR 3: STRONG PARTNERSHIPS

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
GRI 103: MANAGEMENT APPROACH 2016			
103-1 to 103-3	Management approach	• Strong Partnerships	41-47

PILLAR 4: BUSINESS EXCELLENCE

GRI STANDARDS	DISCLOSURE	REPORT SECTION AND REMARKS	PAGE REFERENCE
GRI 205: ANTI-CORRUPTION 2016			
103-1 to 103-3	Management approach	• Business Excellence	48-57
205-2	Communication and training about anti-corruption policies and procedures	• 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.	50

