

## GLOSSARY

---

Agency for Science, Technology and Research (A*STAR)	A statutory board of the Ministry of Trade and Industry whose mission is to raise the level of science and technology in Singapore. A*STAR was established in 1991 as the then National Science and Technology Board.
Agri-Food and Veterinary Authority (AVA)	A statutory board of the Ministry of National Development which seeks to ensure a resilient supply of safe food, safeguard the health of animals and plants, and facilitate agri-trade for the well-being of the nation. The AVA was formerly known as the Primary Production Department.
aquifers	An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which ground-water can be usefully extracted.
averaging time (for air pollution concentration)	The time period over which the air pollutant concentration readings taken are averaged.
brackish water	Water that has higher salinity than fresh water, but lower salinity than seawater.
brine	Water that is saturated or nearly saturated with salt.

Building and Construction Authority (BCA)	A statutory board of the Ministry of National Development, which champions the development of an excellent built environment for Singapore.
bumboat/lighter	A boat used to ferry goods to and from ships moored away from shore.
carbon monoxide (CO)	A colourless, odourless, and tasteless gas formed when there is incomplete combustion of fuels containing carbon.
catchment	Catchment or catchment area is the term used to describe the area which is drained by a river.
catchments (fringe)	Refers to catchments which are not drained by major rivers. It is, therefore, cost-ineffective to tap water from such catchments through the creation of estuarine reservoirs.
catchments (non-protected)	Refers to catchments outside of the protected catchments.
catchments (protected)	Refers to catchments within the Central Catchment Natural Reserve, where no developments are allowed.
catchments (urbanized)	Refers to catchments outside the protected catchments which are highly urbanized with residential, commercial, and industrial developments.
Chassis Dynamometer Smoke Test (CDST)	The CDST measures the smoke emission from a vehicle under simulated driving conditions. During the test, the vehicle is brought up to a specific speed on a chassis dynamometer and the power delivered by the engine is checked by a computer. Load is then gradually added to the engine to simulate actual driving conditions before smoke measurements at its exhaust are taken.
Chikungunya fever	A viral infection transmitted by infected <i>Aedes</i> mosquitoes. Symptoms include fever, rashes and arthritis affecting multiple joints.

---

cistern water-saving bags	Bags that are water displacement devices which, when installed in conventional 9-litre flushing cisterns, can help to reduce the amount of water used in each flush by about 1.5–2 litres per flush.
City Council	The City Council of Singapore, known as the Municipal Council before 1951, was the administrative council that was responsible for the provision of water, electricity, gas, roads and bridges, and street lighting in Singapore.
Code of Practice on Pollution Control (COPPC)	A publication that summarizes the environmental requirements for developments in Singapore and interprets the relevant legislation in a manner that can be readily referred to by industry players.
Common Services Tunnel	A network of tunnels that will house and distribute various utility services to the developments at Marina Bay in Singapore. The tunnels will house electrical and telecommunication cables, district cooling pipes, NEWater and potable water pipes, and will also provide for the future installation of a pneumatic refuse conveyance system.
Community Development Councils (CDC)	The CDCs of Singapore function as local administrations of their district, initiating, planning, and managing community programmes to promote community bonding and social cohesion, as well as provide various community and social assistance services.
conventional water treatment	Water treatment by the use of flocculation, sedimentation, sand filtration, and chlorination.
conveyance function	The effectiveness of a drain in collecting and conveying storm water away during heavy rain to prevent flooding.
culvert	A drain under a road or embankment.
Design, Build, Own and Operate (DBOO)	A form of public-private partnership (PPP) to achieve cost efficiencies. <i>See also</i> PPP.

---

Deep Tunnel Sewerage System (DTSS)	A long-term solution to meet the needs for used water collection, treatment and disposal to serve the development of Singapore through the 21st century. The project consists of two large, deep tunnels criss-crossing the island, feeding to two centralized water reclamation plants by gravity, deep sea outfalls and a link-sewer network.
dengue	A viral infection transmitted by infected female <i>Aedes</i> mosquitoes (principally <i>Aedes aegypti</i> ). Symptoms include fever, with severe headaches, muscle and joint pain.
desalination	The processes by which salt and other minerals are removed from seawater to produce freshwater suitable for human consumption or irrigation.
diversion canal	A man-made drainage channel that conveys water during a storm event from one drainage catchment to another, usually to avert flooding.
Drainage capacity	The rate and volume of storm water that a drain can convey.
Drainage reserve	Any land set aside for drainage works as a result of development proposals approved by a competent authority.
Earth streams	A naturally formed earth-lined drain with flowing water and vegetation along its embankments.
Economic Development Board (EDB)	A statutory board of the Ministry of Trade and Industry that plans and executes strategies to sustain Singapore as a leading global hub for business and investment.
El Nino (1997)	El Nino is the result of the interaction between the surface layers of the ocean and the overlying atmosphere in the tropical Pacific. The El Nino in 1997 resulted in drought-like conditions in Southeast Asia in 1997.
Energy Market Authority (EMA)	A statutory board of the Ministry of Trade and Industry which regulates the electricity and piped

---

	gas industries and district cooling services in designated areas. EMA is also responsible for ensuring the security, reliability, and adequacy of electricity supply, overseeing the operation of the wholesale electricity market, and facilitating competition in the electricity and piped gas industries.
Environmental Impact Assessment (EIA)	An assessment of the likely positive and/or negative influence a project may have on the environment.
epidemiology	The study of factors affecting the health and illness of populations.
estuary	A semi-enclosed coastal body of water with one or more rivers or streams flowing into it, and with a free connection to the open sea. <i>See also</i> reservoir (estuarine).
first flush	Refers to the first part of a run-off during a rainfall.
float-boom	A floating structure that traps debris and flotsam.
fluidized bed incinerators	Fluidized bed incinerators utilize a refractory-lined vessel containing inert granular materials with heated air and combustion gases blown through the material at a rate sufficiently high to cause the bed to expand and act as a fluid. Waste is then added to this fluid to be burned. The technology uses pre-separation and shredding to provide a more uniform feedstock.
Free Acceleration Smoke Test (FAST)	FAST measures the smoke emission from a diesel-driven vehicle with the transmission disengaged, i.e., in neutral gear, with the accelerator pedal pressed down so that the engine increases to its maximum governed speed.
Geographical Information System	A system for collecting, storing, managing, and analysing spatial (geo-referenced) data.
groundwater	Water located beneath the ground surface in soil pore spaces and in the fractures of rock formations.

---

Hantavirus	A rodent-borne virus that is associated with the disease known as haemorrhagic fever with renal syndrome (HFRS).
Housing and Development Board (HDB)	A statutory board of the Ministry of National Development that is responsible for public housing in Singapore.
hydrocarbons	Chemical compounds that contain hydrogen and carbon. Most traditional fuel sources, such as oil, natural gas, and diesel are hydrocarbon-based. Hydrocarbon pollution occurs as a result of incomplete fuel combustion when unburnt or partially burnt fuel is released into the air, or when fuel evaporates into the atmosphere.
hydrological factors	Factors such as rainfall distribution, paved up surface areas, topographical and soil data used in the study of water occurrence, distribution, movement, and balances in ecosystems.
hydrophobic membrane	A membrane that only allows water vapour to pass through, and not water in the liquid state.
industrial water	A source of non-potable water for industries, which is produced by treating effluent. It is of a lower quality and grade compared with NEWater.
International Desalination Association (IDA)	A non-profit association of over 2,000 members in fifty-eight countries, committed to the development and promotion of the appropriate use of desalination and desalination technologies worldwide.
International Water Association (IWA)	A global network of water professionals, spanning the continuum between research and practice and covering all facets of the water cycle.
Japanese encephalitis	Acute inflammation of the brain caused by a viral infection transmitted by infected <i>Culex</i> mosquitoes.

---

Jurong Town Corporation (JTC)	A statutory board of the Ministry of Trade and Industry which executes the planning, promotion, and development of high quality industrial facilities in Singapore. JTC was originally founded in 1968 to develop the Jurong area of Singapore into an industrial area.
Jurong Island	A man-made island located to the southwest of the main island of Singapore. It was formed from the amalgamation of seven offshore islands, and serves as an industrial zone.
Land Transport Authority (LTA)	A statutory board of the Ministry of Transport that spearheads, plans, and develops the long-term public and private transport needs of Singapore.
leachate	Liquid that drains or “leaches” from a landfill.
lead	A toxic metal which is released into the air through the burning of fuels that contain lead.
<i>Legionella</i>	A bacterial species that causes a respiratory infection known as Legionnaires’ disease and is transmitted through the inhalation of mist droplets or aerosols containing bacteria that are generated from cooling towers, domestic hot-water systems, and fountains.
malaria	A parasitic infection transmitted by infected female <i>Anopheles</i> mosquitoes. The parasites multiply within red blood cells, causing symptoms that include symptoms of anaemia (light headedness, shortness of breath, tachycardia, etc.), as well as other general symptoms such as fever, chills, nausea, flu-like illness, and in severe cases, coma and death.
Mass Rapid Transit (MRT) system	The MRT system is a rapid transit system that is fast, efficient, and comfortable, and forms the backbone of the railway system in Singapore, spanning the entire city state.

---

membrane technology	<i>See</i> microfiltration; ultrafiltration; reverse osmosis.
microfiltration	A filtration process which removes contaminants from water by passage through a microporous membrane of pore size range of 0.1 to 10 micrometres ( $\mu\text{m}$ ).
Ministry of the Environment and Water Resources (MEWR)	The Ministry of the Environment (ENV) was established in 1972. It was renamed the Ministry of the Environment and Water Resources in 2004. Its mission is to deliver and sustain a clean and healthy environment and water resources for all in Singapore.
Ministry of Finance (MOF)	The Ministry of Finance ensures the government's long-term fiscal sustainability through the efficient allocation of government resources to achieve Whole-of-Government objectives and overseeing the optimal management of Singapore's reserves. The Ministry also seeks to put in place a pro-growth fiscal system and create a conducive business environment in Singapore.
Ministry of Health (MOH)	The Ministry of Health oversees health issues in Singapore. Its mission is to promote good health and reduce illness, ensure access to good and affordable health care, and pursue medical excellence.
Ministry of National Development (MND)	The Ministry of National Development directs the formulation and implementation of policies related to the national development of Singapore. Its mission is to develop world-class infrastructure, create a vibrant and sustainable living environment, and build rooted and cohesive communities.
Ministry of Trade and Industry (MTI)	The Ministry of Trade and Industry directs the formulation and implementation of policies related to the trade and industry of Singapore. Its mission is to promote economic growth and create

---

	jobs so as to achieve higher standards of living for all.
multiple-barrier	The production process of NEWater that includes microfiltration, reverse osmosis, and ultraviolet disinfection.
multi-stage flash distillation (MSF)	A desalination process that distills seawater by heating water into steam. Heated water from the first stage is sent through subsequent stages of lower ambient pressure where water boils at lower temperatures. Relatively little heat is lost as heat from the waste stream is used to heat cold seawater flowing into the process.
National Environment Agency (NEA)	A statutory board of the Ministry of the Environment and Water Resources which focuses on the implementation of environmental policies.
National Parks Board (NParks)	A statutory board of the Ministry of National Development which is responsible for providing and enhancing greenery in Singapore.
nature reserve (Central Catchment)	The largest nature reserve in Singapore, acting concurrently as a catchment area for four reservoirs within its boundaries.
New Towns	The town planning concept adopted in Singapore, where each new town is designed to be completely self-sustainable.
NEWater	Trade name for the high grade recycled water produced by PUB using a multiple-barrier process. <i>See also</i> multiple-barrier.
NEWater Expert Panel	Formed in January 1999 to provide independent advice to PUB and ENV on the NEWater Study, and consisting of both local and foreign experts in engineering, biomedical science, chemistry, and water technology.
NS1	A non-structural protein that is expressed on the surface of cells infected by a dengue virus; it is a

	target of the human antibody response to dengue virus infection.
outlet drain	A drain which conveys storm water from roadside drains to a major canal or river.
oxides of nitrogen	Chemical compounds containing a combination of oxygen and nitrogen. They are released into the air through high temperature combustion processes, fuel burning equipment, and motor vehicles.
ozone (O <sub>3</sub> )	A molecule containing three oxygen atoms. It occurs naturally in the upper atmosphere where it filters harmful ultraviolet light from reaching the Earth's surface. Ozone near ground level, however, is an air pollutant with harmful health effects. It is formed by chemical reactions in the presence of sunlight, involving compounds such as nitrogen dioxide and chemically reactive hydrocarbons.
ozonation	An alternative disinfection process to chlorination. Ozone does not form organochlorine compounds, nor does it remain in the water after treatment.
Particulate Matter (PM)	Small particles in the air such as dust or soot. PM10 is particulate matter of size 10 microns in diameter or smaller. PM2.5, a subset of PM10, is very fine particulate matter of size 2.5 microns in diameter or smaller.
People's Association (PA)	The PA of Singapore brings people together to take ownership of and contribute to community well-being.
Pollutant Standards Index (PSI)	An index developed by the United States Environmental Protection Agency (USEPA) to provide accurate, timely, and easily understandable information about daily levels of air pollution. It takes into account the ambient concentrations of the key air pollutants such as

---

	<p>sulphur dioxide, particulate matter (PM10), ozone, carbon monoxide, and nitrogen dioxide, and translates them into an overall index ranging from 0 to 500. Based on the health impact of different concentration levels of the various air pollutants, PSI levels between 0 and 50 are considered to be good, and levels from 51 to 100 are moderate. Index levels above 100 are assessed to be unhealthy.</p>
polymerase chain reaction	<p>A technique widely used in molecular biology, which amplifies a single copy of a piece of DNA to generate millions or more copies of the DNA piece.</p>
ponding	<p>A stagnant pool of water that is formed in a localized depressed area.</p>
Port of Singapore Authority (PSA)	<p>A statutory board which regulated maritime and shipping activity in Singapore and operated Singapore's port and wharf facilities. PSA was corporatized in 1997. The corporatized entity, PSA Corporation, operates port infrastructure in Singapore and overseas. PSA's regulatory functions were transferred to a new statutory board, the Maritime and Port Authority (MPA), under the Ministry of Transport. The MPA promotes the use and development of the port, controls vessel movements and ensures navigational safety, and regulates marine services and facilities.</p>
Primary Production Department	<p><i>See</i> AVA.</p>
public-private partnership (PPP)	<p>A government service or private business venture which is funded and operated through a partnership of government and one or more private sector companies.</p>
Public Utilities Board (PUB)	<p>A statutory board of the Ministry of the Environment and Water Resources (MEWR). PUB</p>

	was set up to ensure an efficient, adequate, and sustainable supply of water for Singapore.
pumping station	A pumping station is a facility with pumping installation and pump sump to lift water from a lower level to a higher level, for boosting pressure and/or pressurized conveyance purposes.
pyrolysis	Pyrolysis is the thermal decomposition of organic materials (in the absence or near absence of oxygen) into simpler molecules or smaller molecular weights that can be more easily combusted than the initial waste. It works in a temperature range of between 150°C and 9,000°C.
reverse osmosis (RO)	A separation process that uses pressure to force raw water through a membrane that retains the impurities on one side and allows clean water to pass to the other side.
reservoir (estuarine)	A reservoir created by constructing a dam at the mouth of a river.
reservoir (impounding)	A reservoir created by forming an inland dam to store water.
run-off	The flow of water, from rain, snowmelt, or other sources, over the land.
rivulet	A small stream.
scuppers	Drainage holes along the road kerb that collect and discharge rainwater from the road into a roadside drain.
self-closing delayed action taps	A tap that automatically closes its valve after a preset period.
serotype	A classification of micro-organisms according to the difference in their surface proteins. The dengue virus, for example, has four serotypes.
Severe Acute Respiratory Syndrome (SARS)	A respiratory disease caused by the SARS-coronavirus (SARS-CoV)

---

Singapore Municipality	<i>See</i> City Council.
standpipe	A standpipe is a freestanding pipe fitted with a tap that is installed outdoors to dispense water in areas which do not have a running water supply to the buildings.
storage pond	A pond with sufficient storage capacity to retain excess storm water, which is subsequently released either by pumping, or by gravity flow through gates into a drain.
subsidiary drains	A network of drains that channel storm water to a major canal or river.
subsoil pipes	Perforated pipes that are laid in the soil lying immediately below the surface layer to channel water away and prevent sogginess.
sulphur dioxide (SO <sub>2</sub> )	A colourless gas that smells like burnt matches. It is released into the air through the burning of fuels which contain sulphur and, to a lesser extent, from petroleum refining processes.
surface water drainage	A system of drains to carry away excess rainwater effectively and prevent flooding.
tide gates	Movable gates constructed in a drain or waterway that will close to prevent the ingress of sea water from inundating low-lying grounds during high tide. The gates will open to discharge storm water during heavy rain.
Town Council	A corporate body established to control, manage, maintain, and improve the common property of public housing estates.
toxicology	The study of the adverse effects of chemicals on living organisms, especially the poisoning of people.
treated effluent	Effluent that has been treated in used water treatment plants.

turbidity	The cloudiness or haziness of a fluid caused by individual particles (suspended solids). The measurement of turbidity is a key test of water quality.
ultrafiltration (UF)	A filtration process which removes contaminants from water by passage through a microporous membrane of pore size range of 0.001 to 0.1 micrometres ( $\mu\text{m}$ ).
unaccounted-for water (UFW)	The difference between the amount of water supplied from the waterworks as measured through its meters and the total amount of water accounted for.
unconventional sources	Refers to water sources other than catchment reservoirs.
Urban Redevelopment Authority (URA)	A statutory board of the Ministry of National Development. The URA is Singapore's national land use planning authority.
USEPA	The United States Environmental Protection Agency is an agency of the federal government of the United States charged with protecting human health and safeguarding the natural environment: air, water, and land.
Utilities Save (U-Save)	A scheme designed specifically to help lower and middle-income Singaporeans with their utilities bills. Lower-income households living in smaller-type flats will get more help and receive higher rebates, which are credited to their utilities account.
vector	Any organism carrying or causing or capable of causing any disease to human beings.
Variable Salinity Plant	A plant that uses microfiltration and reverse osmosis membrane processes to treat feed water with varying concentrations of salt.
water conservation tax (WCT)	A tax imposed by the Singapore Government to encourage water conservation, and reflect the higher incremental cost of additional supplies.

---

Water Master Plan	A master plan prepared by PUB that sets out the long-term plan towards self-sufficiency.
waterworks	A facility to remove contaminants from a raw water source to produce water for human consumption (drinking water).
WHO	The World Health Organization (WHO) is a specialized agency of the United Nations (UN) that acts as a coordinating authority on international public health.
West Nile viral encephalitis	Acute inflammation of the brain caused by a viral infection transmitted by infected <i>Culex</i> mosquitoes.
yield (reservoir)	Refers to the amount of water that can be reliably extracted from a reservoir such that the reservoir does not fail.

