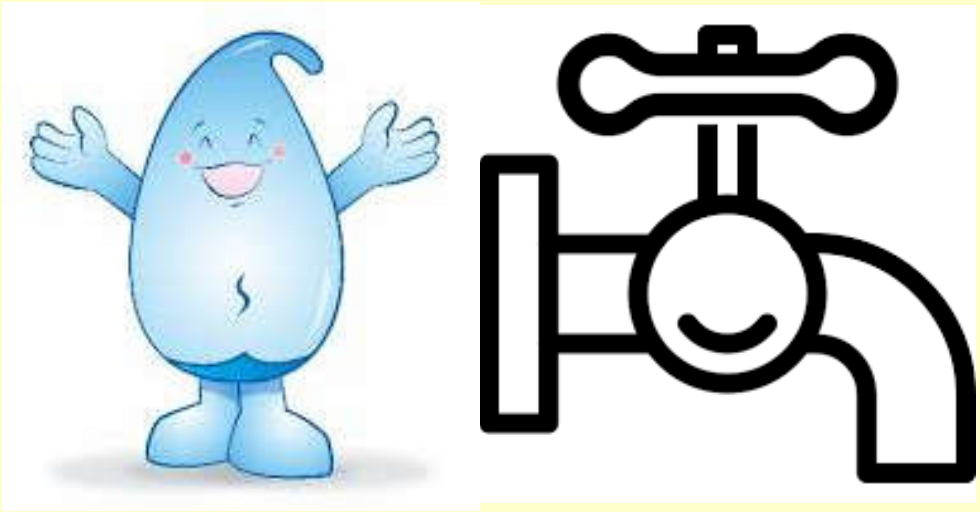
IBTM5660 Utility Services

http://ibse.hk/IBTM5660/



Cold Water Supply

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E-mail: sam.cmhui@gmail.com

http://ibse.hk/cmhui/

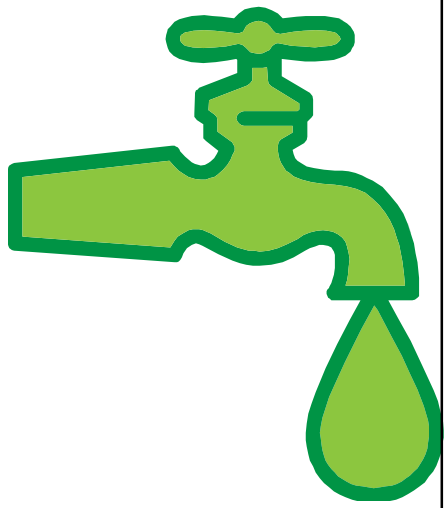
Jan 2024

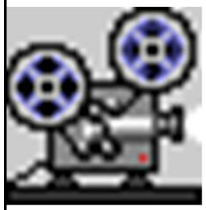
Contents

- Water supply in Hong Kong
- Water sources & treatment
- Water supply distribution
- Water tanks & pumps
- Water quality & management

Water supply in Hong Kong

- Early history of water supply in Hong Kong
  - 1851: sinking of 5 wells in the “City of Victoria”
  - 1860: tanks constructed at Bonham Road
  - 1863: Pok Fu Lam Reservoir (first one)
  - 1889: Tai Tam Reservoir
  - 1910: Kowloon Reservoir
  - 1917: Tai Tam Tuk Reservoir
  - 1937: Shing Mun Reservoir





- Video: TVB HK Historical Site’s feature story on water supplies history (7 June 2020) 無綫電視《探古尋源》供水歷史專題故事（2020年6月7日）(3:30) https://www.bilibili.com/video/BV1nh411o71g

Water supply in Hong Kong

- Milestones of Hong Kong Water Supply
  - https://www.wsd.gov.hk/en/about-us/our-milestone/
  - Water wells & water streams
  - Building of reservoirs (for storing rainwater)
  - Droughts & hygiene conditions
  - Water rationing
  - Import water from Mainland China (Dongjang)
  - Desalination technology
  - Reclaimed water & seawater for flushing

(See also: 150 Years of Water Supply in Hong Kong 香港供水一百五十年
https://web.archive.org/web/20060516074137/http://www.info.gov.hk/water150/index.htm)

History of water supply in Hong Kong (1946-2007)

1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974

1957
Use of seawater for toilet flushing in Shek Kip Mei and Lei Cheng Uk Estate

1960
Water Supply Agreement with Guangdong Supply from Shenzhen Reservoir

1963
Completion of Shek Pik Reservoir
24.5 mcm capacity

1968
Completion of Plover Cove Scheme and Extension in 1973
230 mcm capacity

1959
Completion of Tai Lam Chung Reservoir
20.5 mcm capacity

June 1963 - May 1964
Severe Water Rationing
4 hours of supply every 4 days

1965
Completion of Lower Shing Mun Reservoir
4.3 mcm capacity

1965
Water Supply Agreement with Guangdong
68.2 mcm/year of Dongjiang water supply

(Source: Water Supplies Department www.wsd.gov.hk)

History of water supply in Hong Kong (1946-2007) (cont'd)

1978
Completion of High Island Scheme
281 mcm capacity

1989
Water Supply Agreement
with Guangdong
Maximum 1,100 mcm/year
of Dongjiang water supply

2006
Water Supply Agreement
with Guangdong
Flexible supply of Dongjiang water

1981-1982
Last water rationing
in Hong Kong

2003
Commissioning of 83km dedicated
aqueduct for delivery of Dongjiang water

1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007

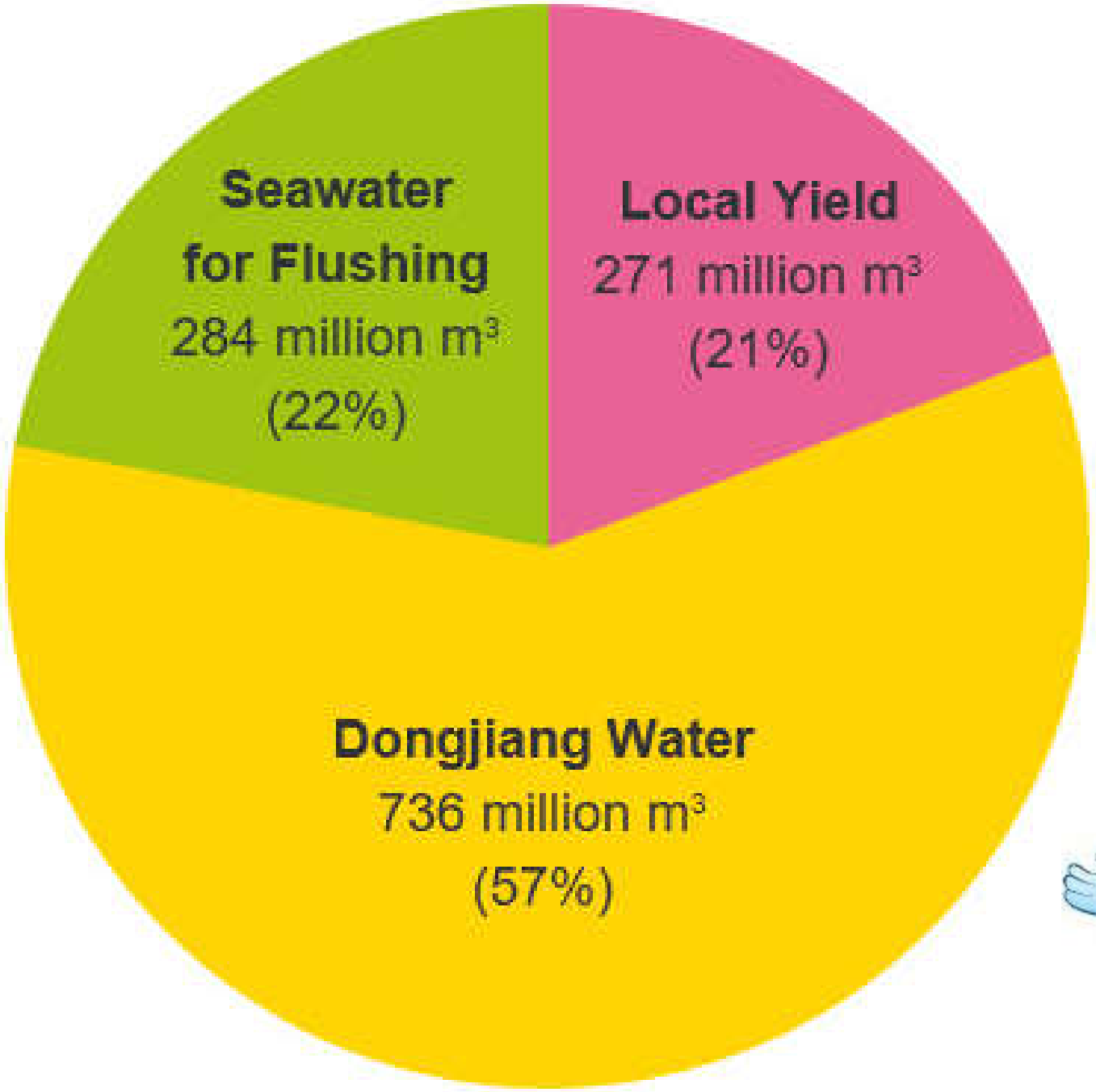
(Source: Water Supplies Department www.wsd.gov.hk)

Water supply in Hong Kong

- Water Supplies Department (WSD)
  - To plan & manage water resources & water supply systems
  - To design & construct waterworks projects
  - To operate & maintain water supply & distribution systems
  - To control the quality of water supply to customers
  - To enforce the Waterworks Ordinance & Regulations
    - Include vetting plumbing proposals for buildings (from 'Licensed Plumbers')
- Water resources in HK
  - Rainfall from natural catchment + supply from Guangdong
    - 70% of water demand is now met by water from Dongjiang River
  - Sea water for flushing toilets (for over 80% population)

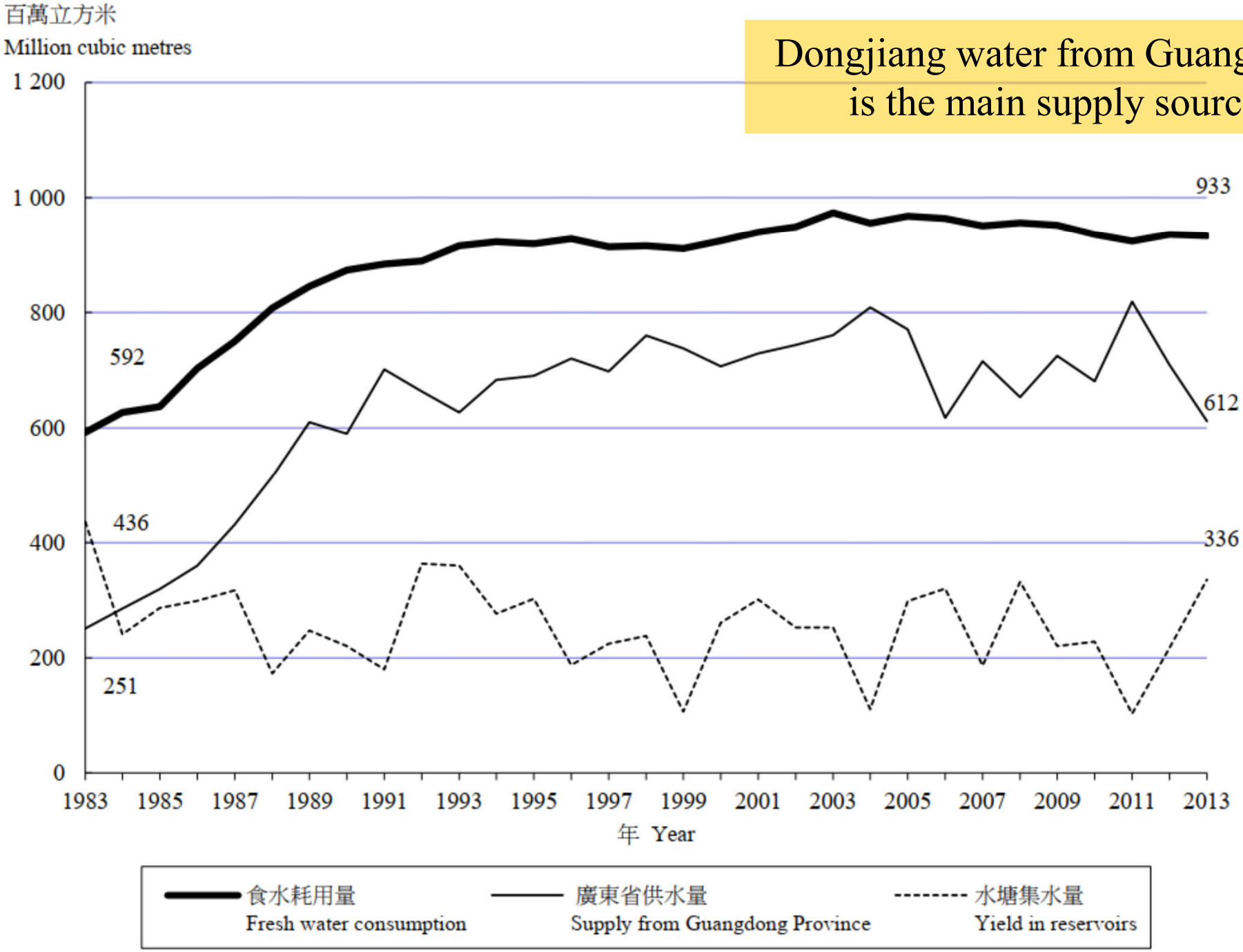
(See also: Water Resources https://www.wsd.gov.hk/en/core-businesses/water-resources/)

Water consumption in Hong Kong in 2018 (1.292 billion m^3)



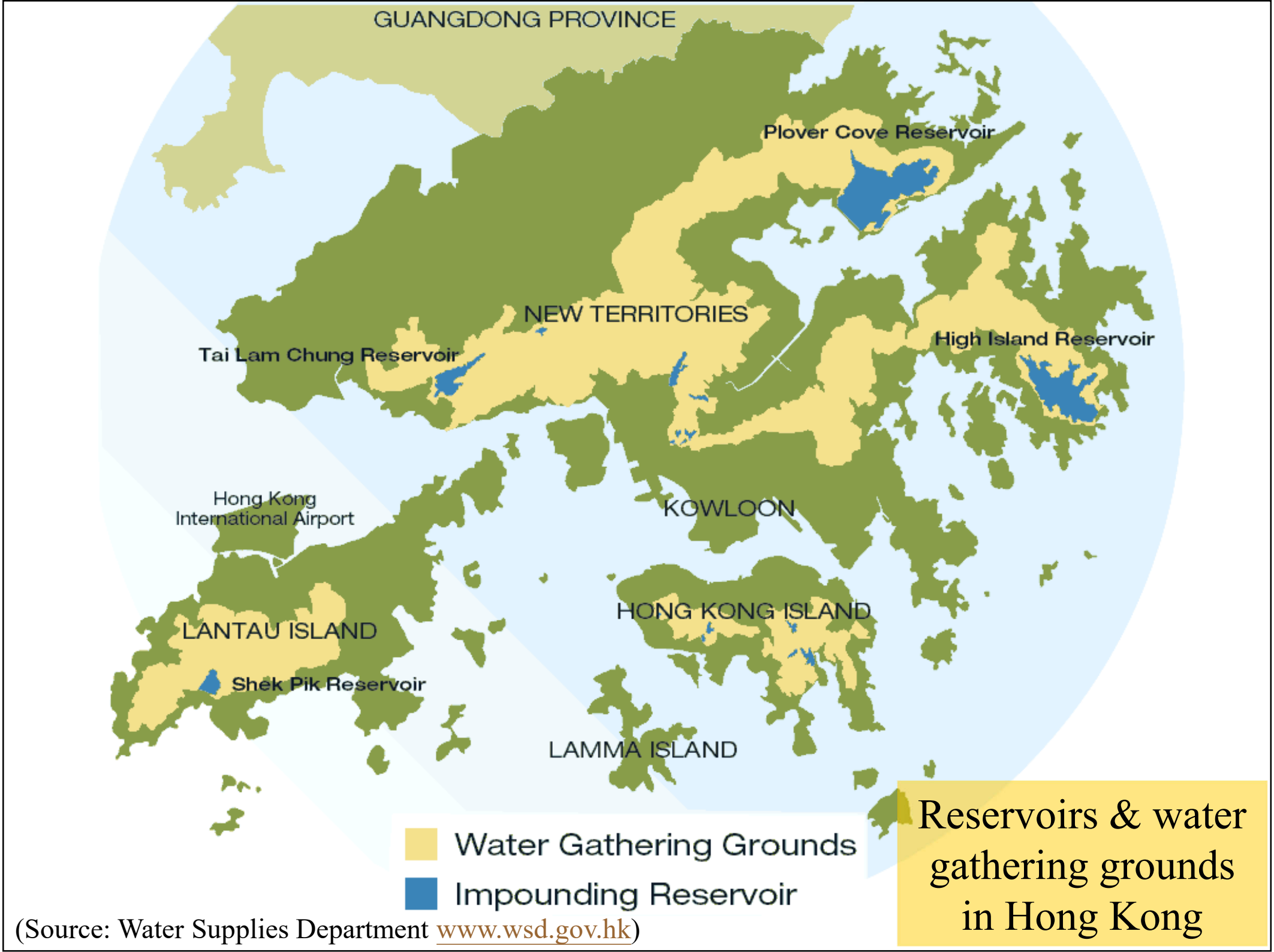
(Source: Water Supplies Department www.wsd.gov.hk)

Fresh water consumption and supply in Hong Kong



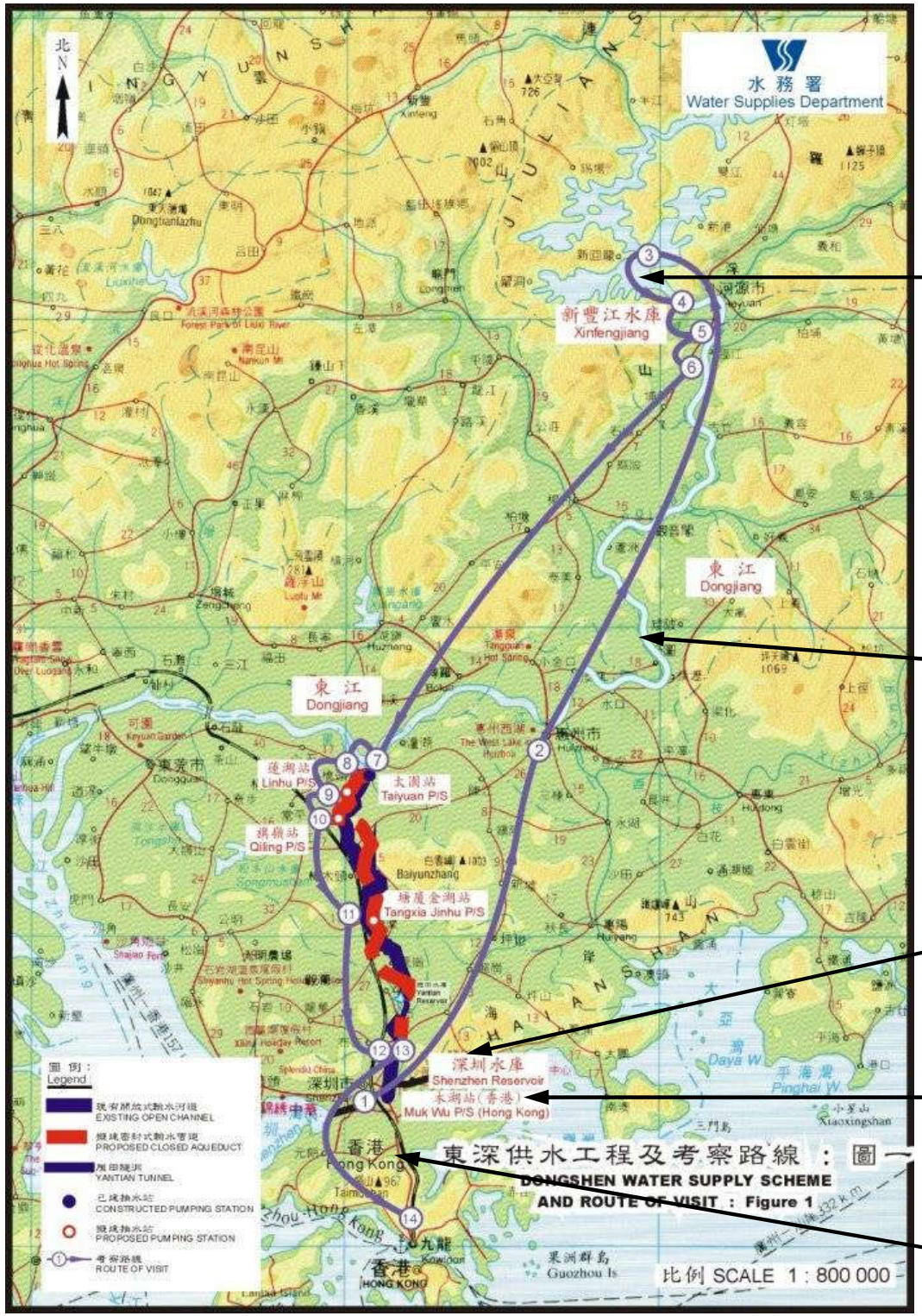
Dongjiang water from Guangdong is the main supply source

(Source: Hong Kong Monthly Digest of Statistics, Feature Article: An Overview of Water Supplies in Hong Kong, April 2015. https://www.statistics.gov.hk/pub/B71504FB2015XXXXB0100.pdf)



Reservoirs & water gathering grounds in Hong Kong

(Source: Water Supplies Department www.wsd.gov.hk)



Xinfengjiang Reservoir
新豐江水庫

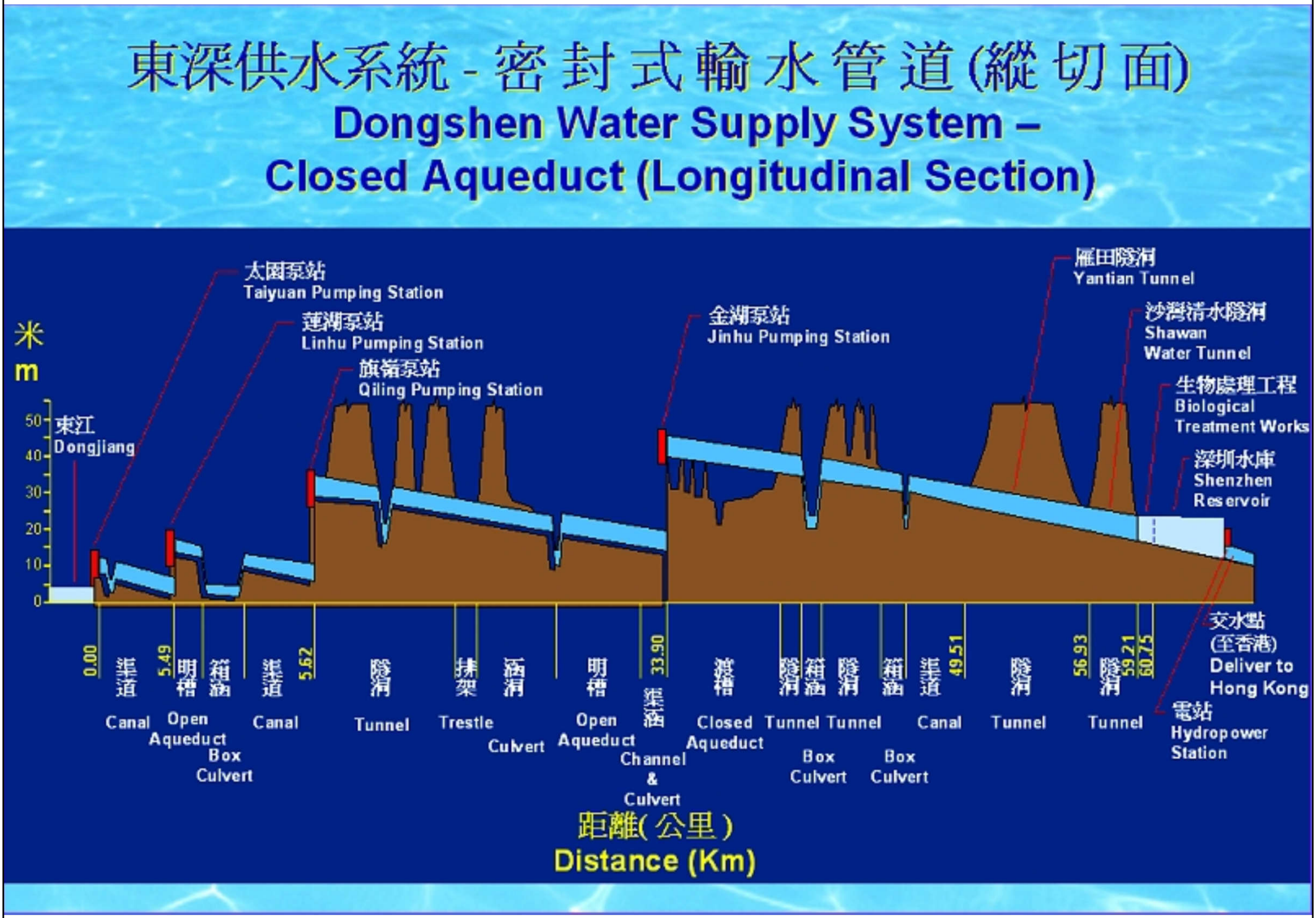
Dongjiang 東江

Shenzhen Reservoir
深圳水庫

Muk Wu Pump Station (HK)
木湖泵站(香港)

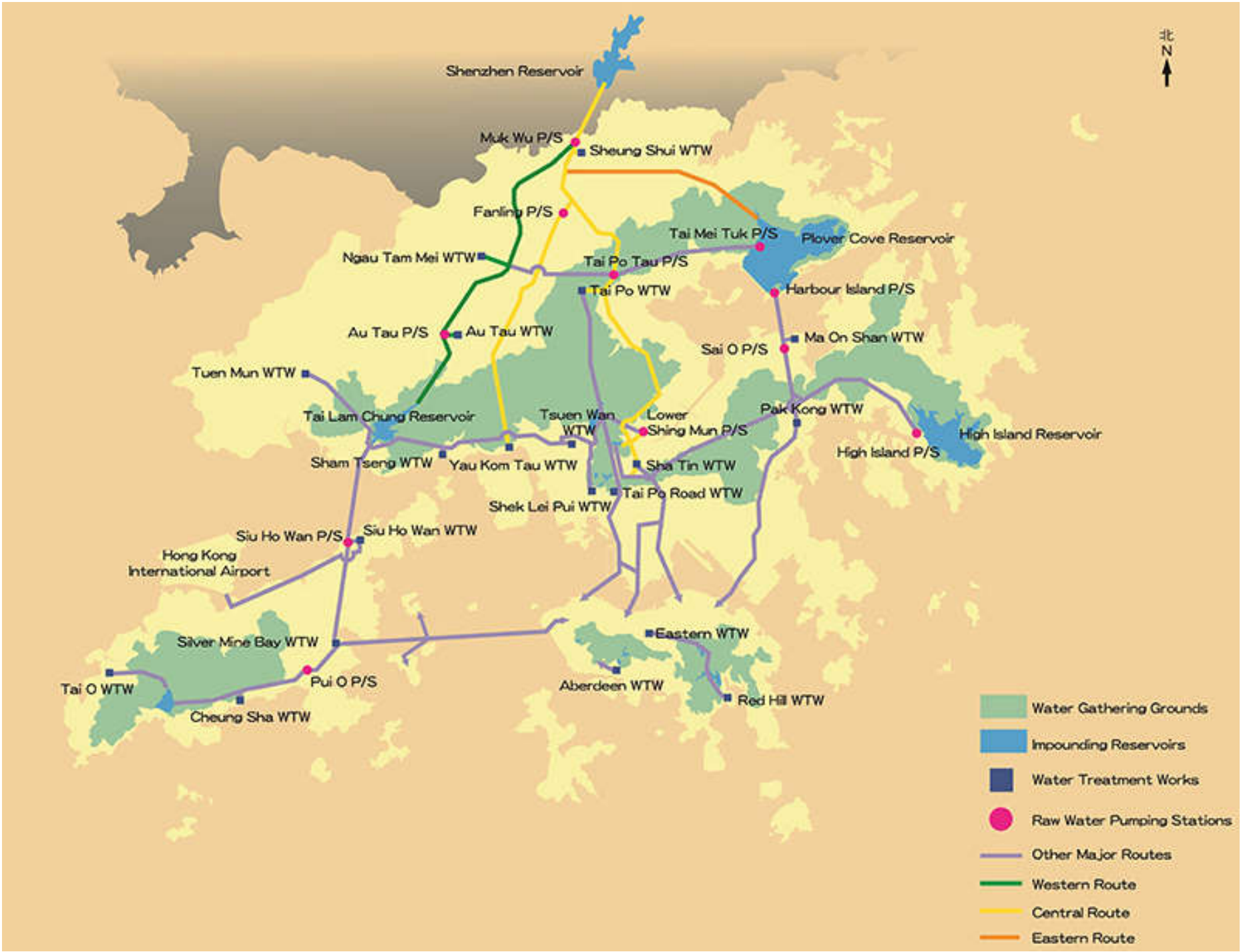
Water pipes along the railway line

(Source: Water Supplies Department www.wsd.gov.hk)

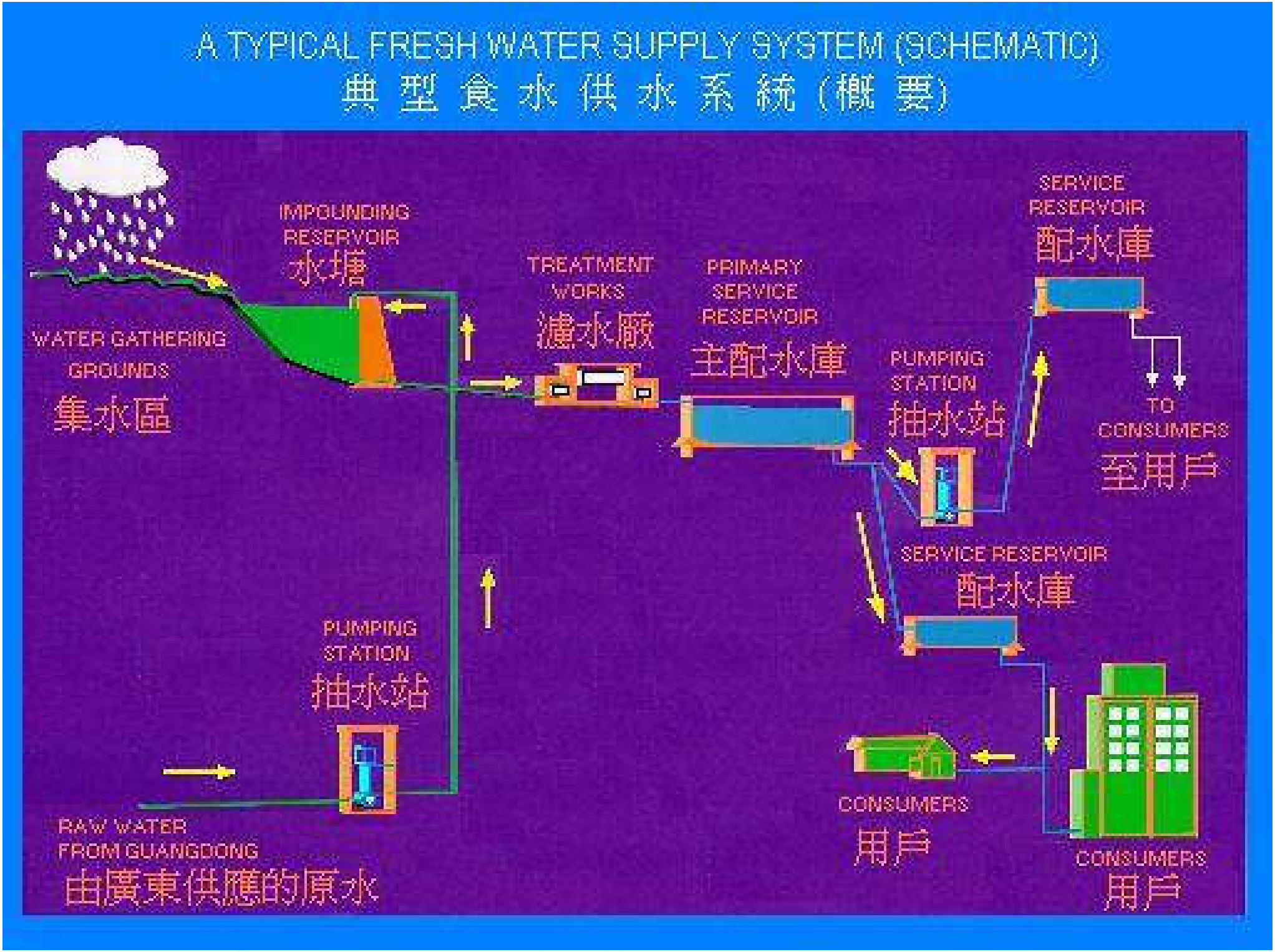


(Source: Water Supplies Department www.wsd.gov.hk)

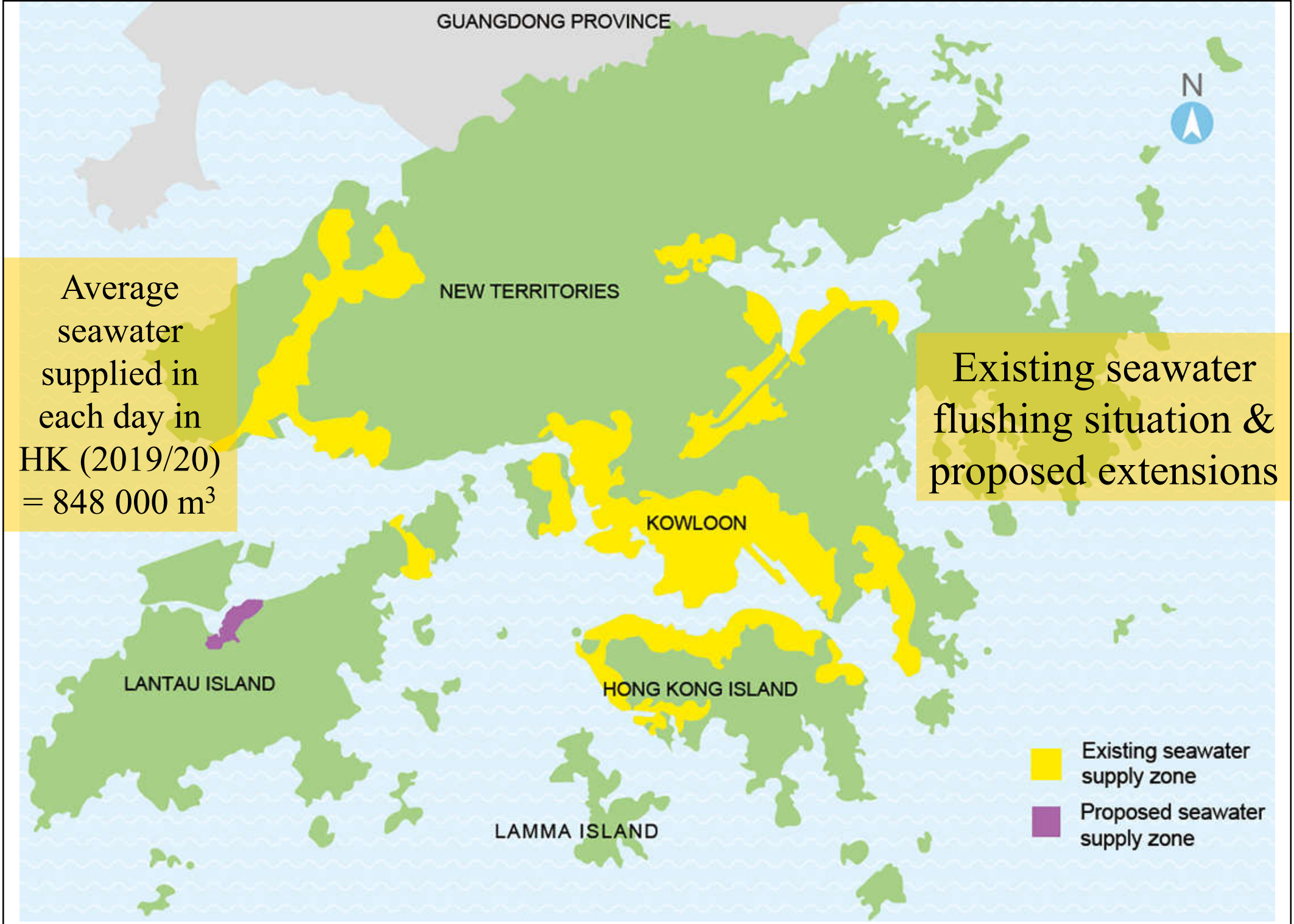
Principal water supply system in Hong Kong



(Source: Water Supplies Department www.wsd.gov.hk)

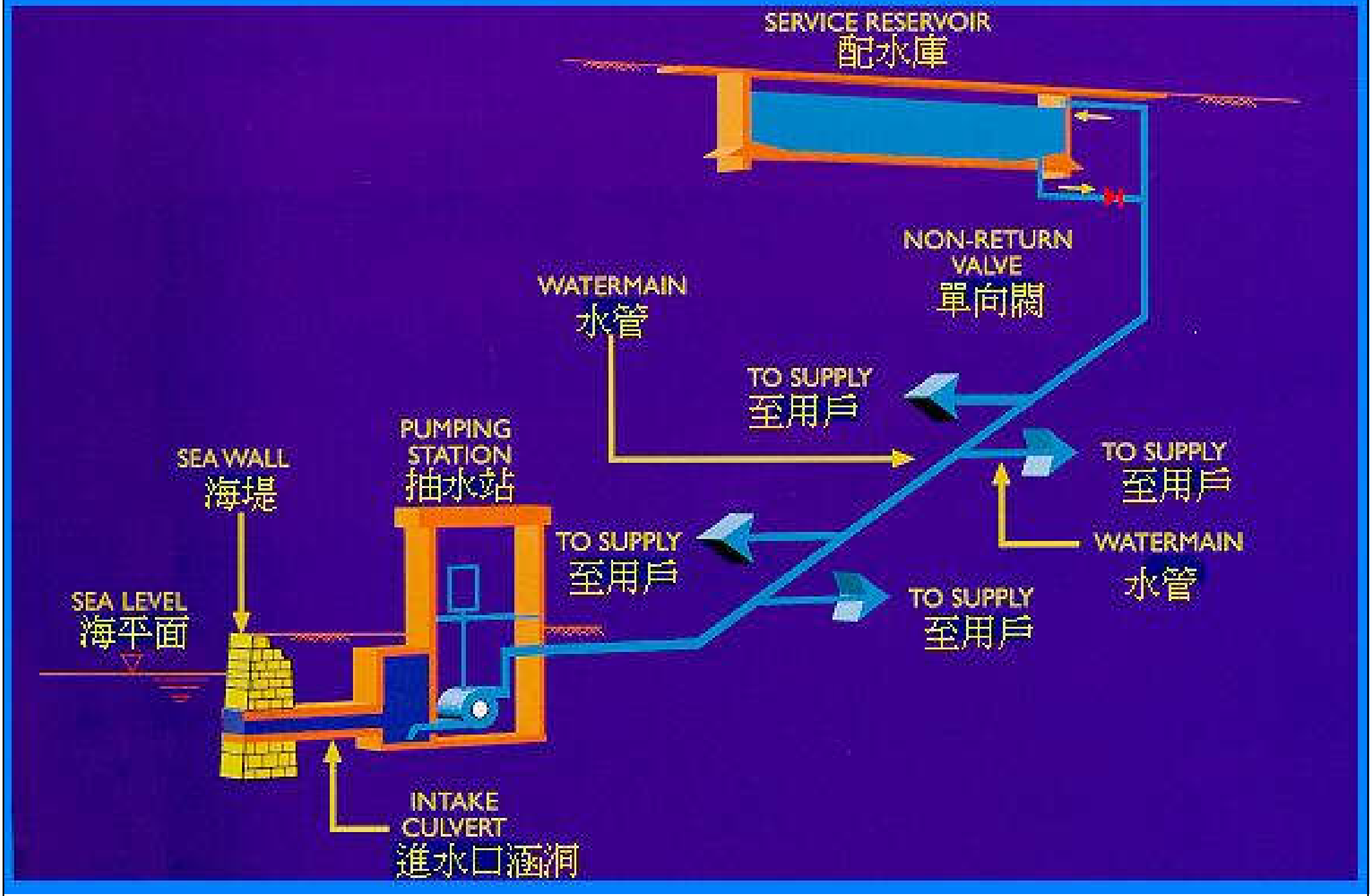


(Source: Water Supplies Department www.wsd.gov.hk)



(Source: Water Supplies Department www.wsd.gov.hk)

A TYPICAL SEA WATER SUPPLY SYSTEM (SCHEMATIC) 典型海水供水系統（概要）



(Source: Water Supplies Department www.wsd.gov.hk)

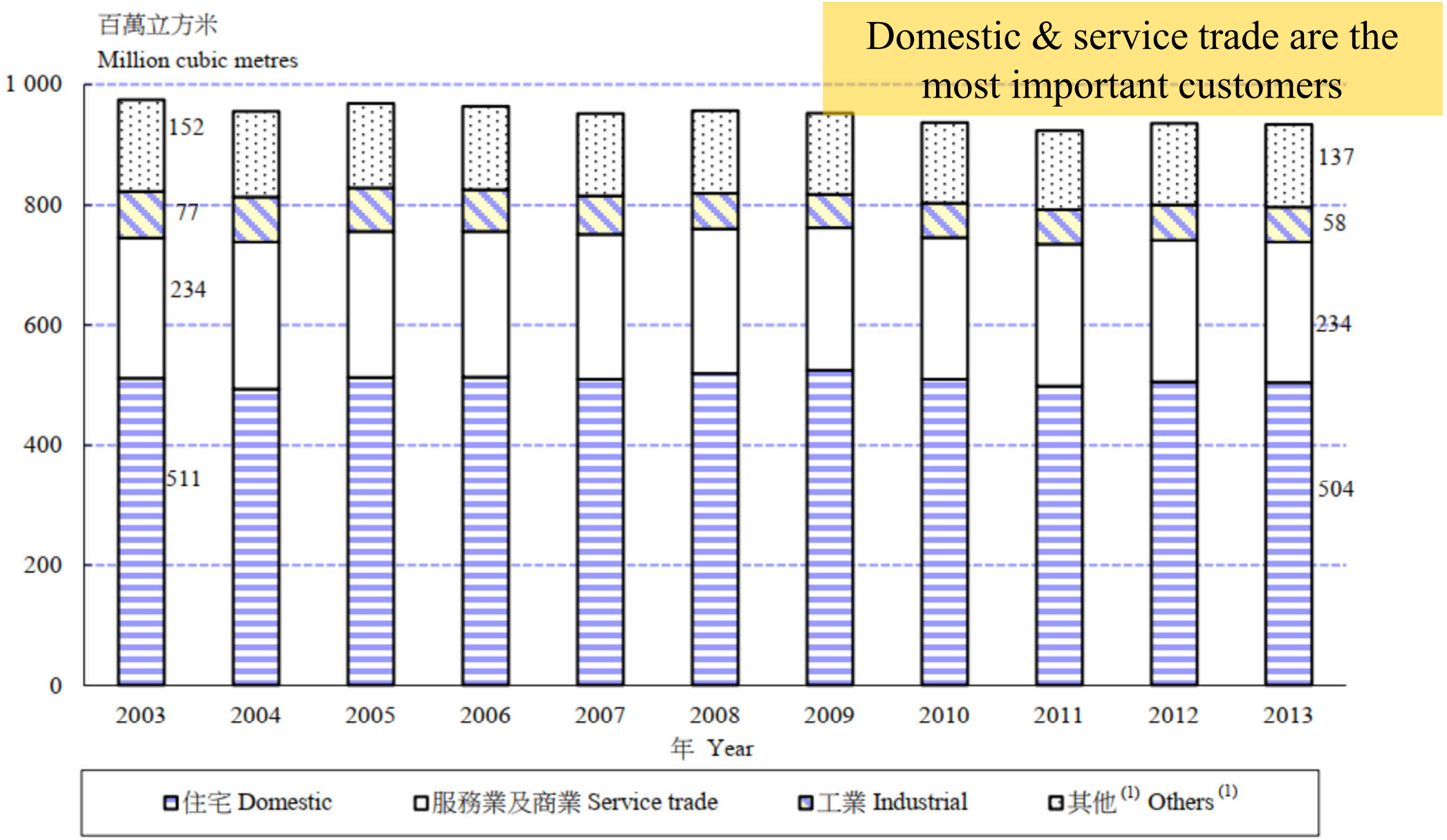
Waterworks installations in Hong Kong

WATERWORKS INSTALLATIONS: *(as at 31 March 2020)*		水 務 設 施： *(截至 2020 年 3 月 31 日止)*	
Impounding Reservoirs	17 nos.	水 塘	17 個
Total storage capacity	586.05 Mm^3	*總 容 量*	586.05 百萬立方米
Water Treatment Works	20 nos.	濾 水 廠	20 座
Total capacity	4.68 Mm^3/d	*日 產 量*	4.68 百萬立方米
Pumping Stations / Houses		抽 水 站/ 泵 房	
Fresh Water	151 nos.	食 水	151 座
Total installed capacity	32.14 Mm^3/d	*日 產 量 (裝機容量計)*	32.14 百萬立方米
Salt Water	35 nos.	海 水	35 座
Total installed capacity	2.09 Mm^3/d	*日 產 量 (裝機容量計)*	2.09 百萬立方米
Fresh Water and Salt Water (Combined)	7 nos.	食 水 及 海 水 (合併)	7 座
Total installed capacity	0.30 Mm^3/d	*日 產 量 (裝機容量計)*	0.30 百萬立方米
Service Reservoirs		配 水 庫	
Fresh Water	178 nos.	食 水	178 座
Total storage capacity	4.35 Mm^3	*總 容 量*	4.35 百萬立方米
Salt Water	54 nos.	海 水	54 座
Total storage capacity	0.26 Mm^3	*總 容 量*	0.26 百萬立方米
Water Mains		水 管	
Fresh Water (20mm - 2,400mm diameter)	7,016 km	食 水 (直徑 20 毫米 - 2,400 毫米)	7,016 公里
Salt Water (20mm - 1,200mm diameter)	1,800 km	海 水 (直徑 20 毫米 - 1,200 毫米)	1,800 公里
Catchwater	120 km	引 水 道	120 公里
Water Tunnel	199 km	輸 水 隧 道	199 公里

(Mm^3 - million cubic metre)

(Source: Water Supplies Department www.wsd.gov.hk)

Fresh water consumption by major customer sector, 2003 to 2013



Domestic & service trade are the most important customers

註釋： (1) 包括政府單位、建築地盤及船舶用水，以及淡水沖廁用水。

Note: (1) Including fresh water consumption of government units, construction sites and ships, and for flushing.

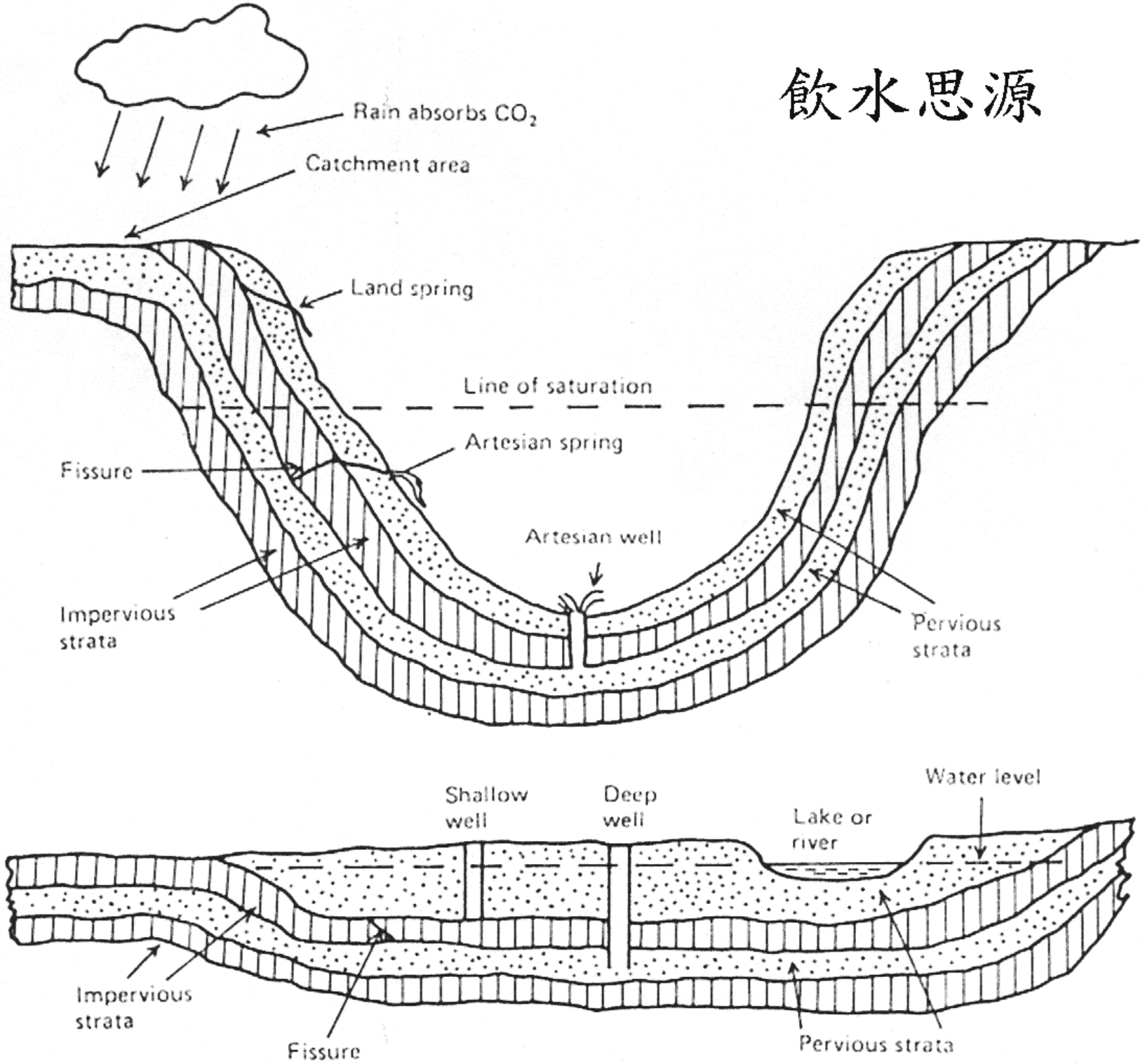
(Source: Hong Kong Monthly Digest of Statistics, Feature Article: An Overview of Water Supplies in Hong Kong, April 2015. https://www.statistics.gov.hk/pub/B71504FB2015XXXXB0100.pdf)

Water sources & treatment

- Surface & underground water sources:
  - Shallow wells
    - Sinkings in top water-bearing strata
  - Intermittent or land springs
    - From top water-bearing strata
  - Deep wells
    - Sinkings below the first impervious strata
  - Artesian wells and springs
    - The same source as deep wells
  - Lakes & rivers
    - Catchment of surface and subsoil water

飲水思源

飲水思源



(Source: Hall, F. and Greeno, R., 2007. *Building Services Handbook*)

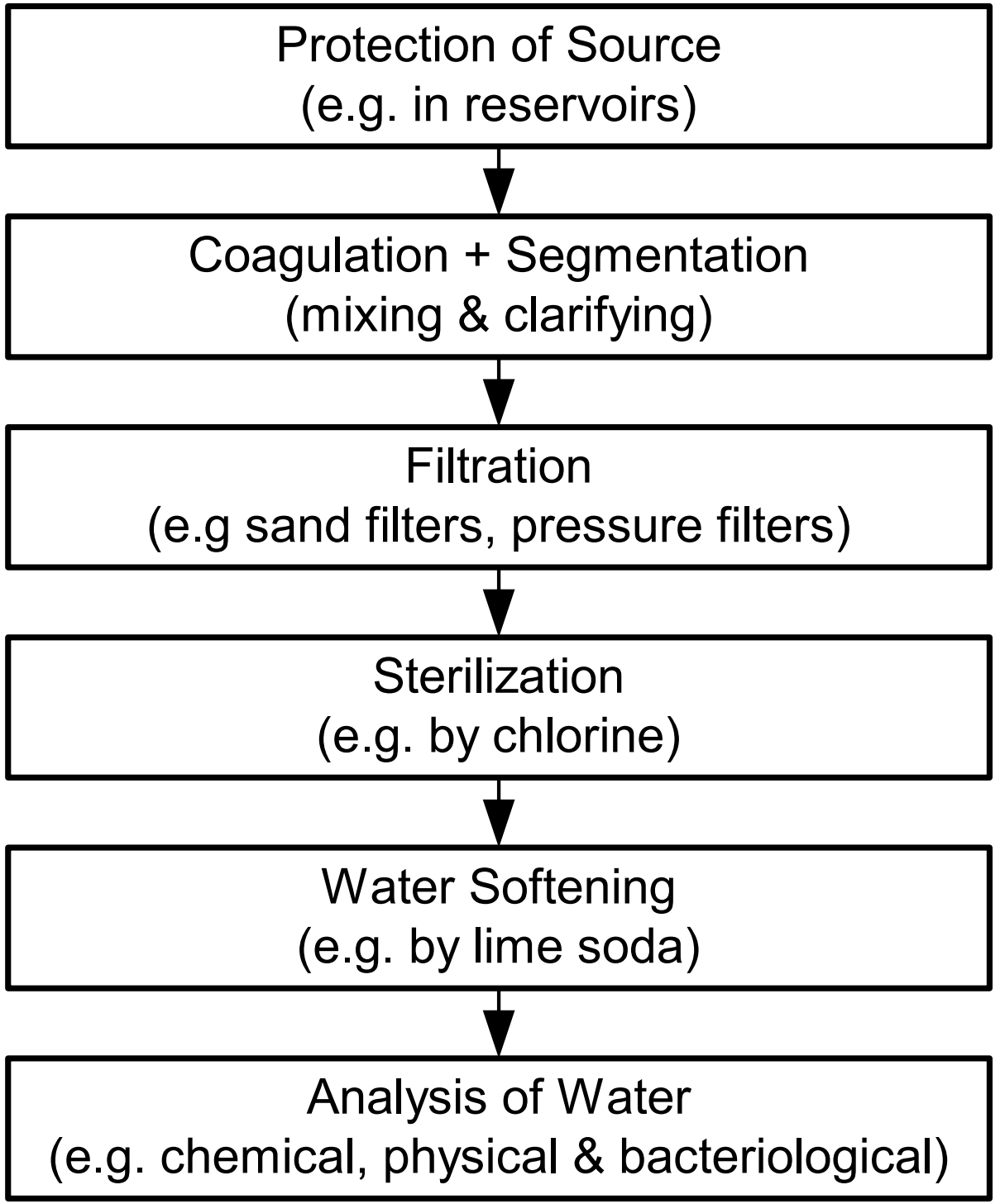
Water sources & treatment

- Water for human consumption must be:
  - Free from harmful bacteria & suspended matter
  - Colourless
  - Pleasant to taste
  - For health reasons, moderately ‘hard’ ($CaCO_3$)

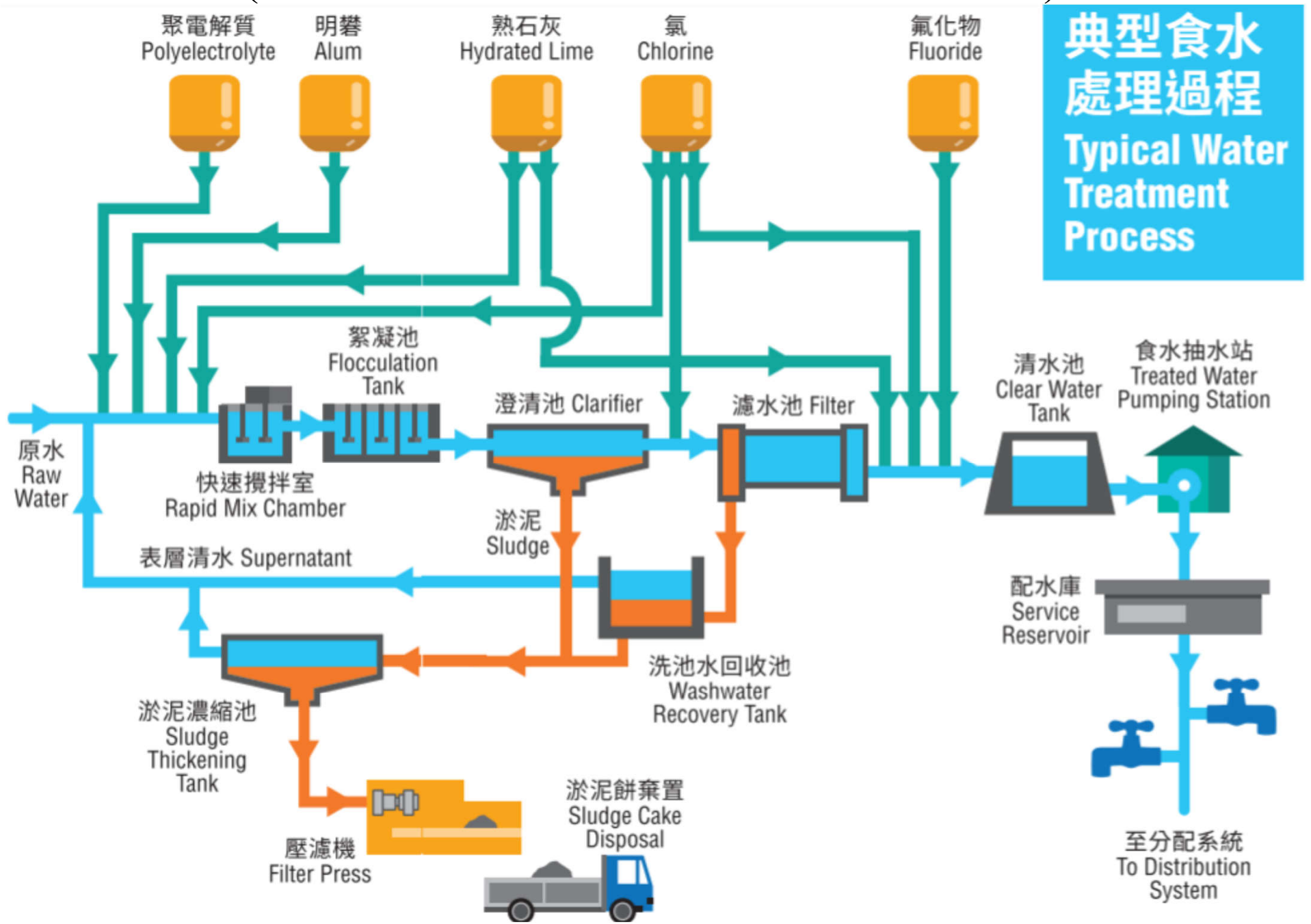
- Water storage & treatment process to ensure good water quality
  - Complies with World Health Organization (WHO) guidelines for drinking water*

(* Available at https://www.who.int/publications/i/item/9789241549950)

Typical water treatment process



Typical water treatment process in Hong Kong (clarification >> filtration >> disinfection)



(Source: https://www.wsd.gov.hk/filemanager/en/share/pdf/water_treat.pdf)

Water sources & treatment

- Water treatment process in HK
  - 1. Raw water
    - Comes from different sources, including reservoir(s) and Dongjiang water of Guangdong
  - 2. Mixing
    - Raw water is dosed at the mixing chamber with
      - Hydrated lime to precondition the raw water
      - Chlorine to control algae
      - Alum to coagulate impurities
      - Polyelectrolyte to improve the coagulation and flocculation of impurities

(See also: https://www.wsd.gov.hk/en/core-businesses/operation-and-maintenance-of-waterworks/water-treatment/)

Water sources & treatment

- Water treatment process in HK (cont'd)
  - 3. Flocculation and Sedimentation
    - After mixing, water is passed to the clarifiers where coagulation and flocculation of the impurities in the water will occur
    - The dissolved alum coagulate impurities in the water into large particles where settle as sludge
    - The sludge is collected and conveyed to sludge thickening tanks for further treatment before disposal

Water sources & treatment

- Water treatment process in HK (cont'd)
  - 4. Rapid Gravity Filtration

    - Settled water from the clarifiers flows to the constant rate sand filters for removal of more finely divided suspensions
    - Periodically the filter beds are cleaned by backwashing with air and then water
  - 5. Clear Water Tanks
    - Chorine, fluoride and lime are dosed into the filtered water in the contact tanks and disinfect, fluoridate and control the alkalinity of the final treated water
    - The treated water is stored in the clear water tank before conveying to service reservoirs for distribution to people

Water sources & treatment

- Water treatment process in HK (cont'd)
  - 6. Pumping Facilities

    - Pumping station in the treatment to pump the water to the distribution
  - 7. Environmental Friendly Facilities

    - The washwater is collected in the recovery tanks for repumping to the inlet for recycling
    - Sludge produced is thickened by three circular sludge thickening tank using electrolyte as coagulant
    - Thickened sludge is compressed by membrane type filter presses into cakes for disposal at landlfill sites

Water sources & treatment

- Water treatment process in HK (cont'd)
  - 8. Water Quality Control
    - The quality of water is closely monitored by means of chemical, bacteriological and biological examinations of water samples taken
    - To comply with the Guidelines for Drinking Water Quality recommended by WHO, to ensure a safe and wholesome potable supply

Water sources & treatment

- Water charges in Hong Kong
  - Domestic supplies
    - Billed at 4-monthly intervals (121.64 days)
    - 4 tiers with progressively increasing prices
    - To discourage excessive and unnecessary use of water
    - First tier: 12 cubic metres: free of charge
    - Second tier: 31 cubic metres: $4.16 per cubic metre
    - Third tier: 19 cubic metres: $6.45 per cubic metre
    - Fourth tier: > 62 cubic metres: $9.05 per cubic metre

(Source: https://www.wsd.gov.hk/en/customer-services/manage-account-and-water-bills/water-sewage-tariff/)

Water sources & treatment

- Water charges in Hong Kong (cont'd)
  - Non-domestic supplies
    - Billed at 4-monthly intervals (for large consumption consumers, billed at monthly intervals)
    - At a flat rate dependent on the purpose of the supply
    - For trade: $4.58 per cubic metre
    - For construction: $7.11 per cubic metre
    - For non ocean-going shipping: $4.58 per cubic metre
    - For ocean-going shipping: $10.93 per cubic metre

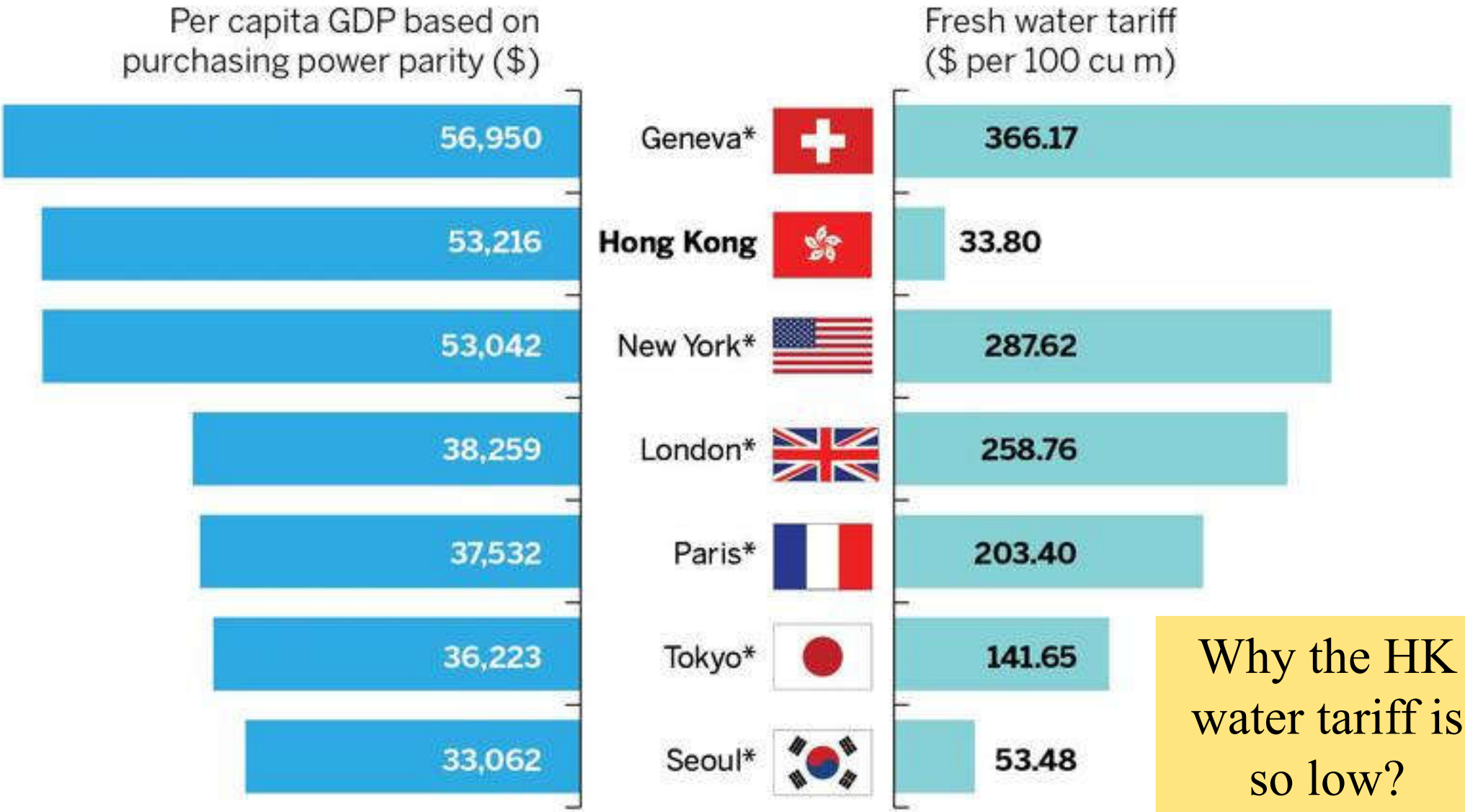
Water sources & treatment

- Water charges in Hong Kong (cont'd)
  - Flushing supplies
    - Sea water supply for flushing is free of charge
    - Fresh water supply for flushing is usually billed at 4-monthly intervals
      - First tier: 30 cubic metres per flat: free of charge
      - Second tier: > 30 cubic metres per flat: $4.58 per cubic metre
    - Only one meter installed in each building to record the total consumption of all flats in the same building
      - Billed separately to the management office, agent, incorporated owner or development company

Water sources & treatment

- Water charges in Hong Kong (cont'd)
  - Sewage charges
    - For domestic consumers: at a 4-month interval: $2.92 per cubic metre, with an exemption for the first 12 cubic metres
    - For trade, business and manufacture consumers: $2.92 per cubic metre. Some trades are eligible for 30% discount (e.g. bleaching & dyeing, restaurants, softdrinks & ice-making industries)
    - For 27 types of trade/business/manufacture which discharge trade effluent, the consumer shall also pay a Trade Effluent Surcharge

HK water tariff is much less than that in cities of comparable or lower per capita GDP



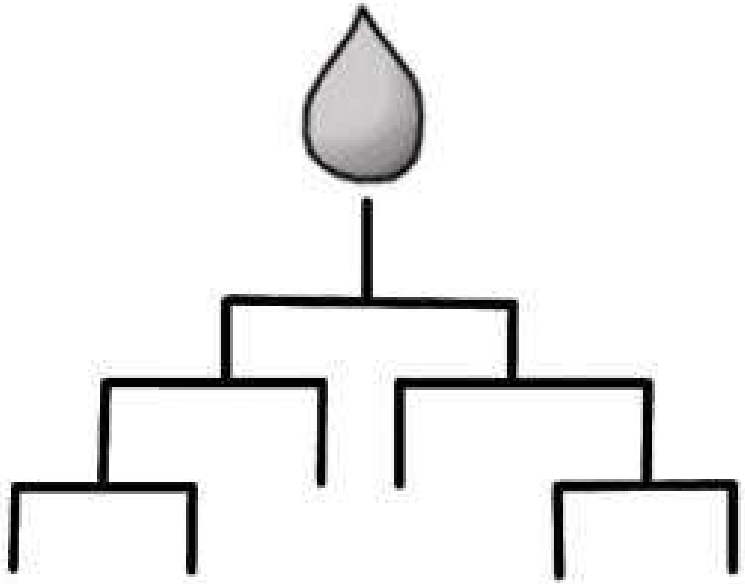
* Per capita GDP is country/region-wide figure whereas fresh water tariff is city-specific figure.

Why the HK water tariff is so low?

(Source: https://www.chinadailyhk.com/articles/70/137/218/1509961687569.html)

Water supply distribution

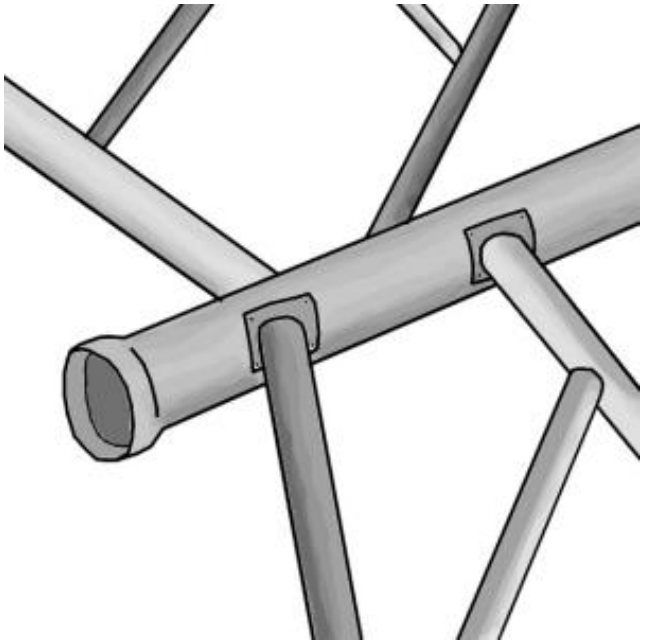
- Distribution network of water supply
  - Main reservoir
  - Pumping stations
  - Water treatment plants
  - Pumping substations
  - Service reservoirs
  - Trunk mains or service trunks
  - Street mains or water mains (into buildings)

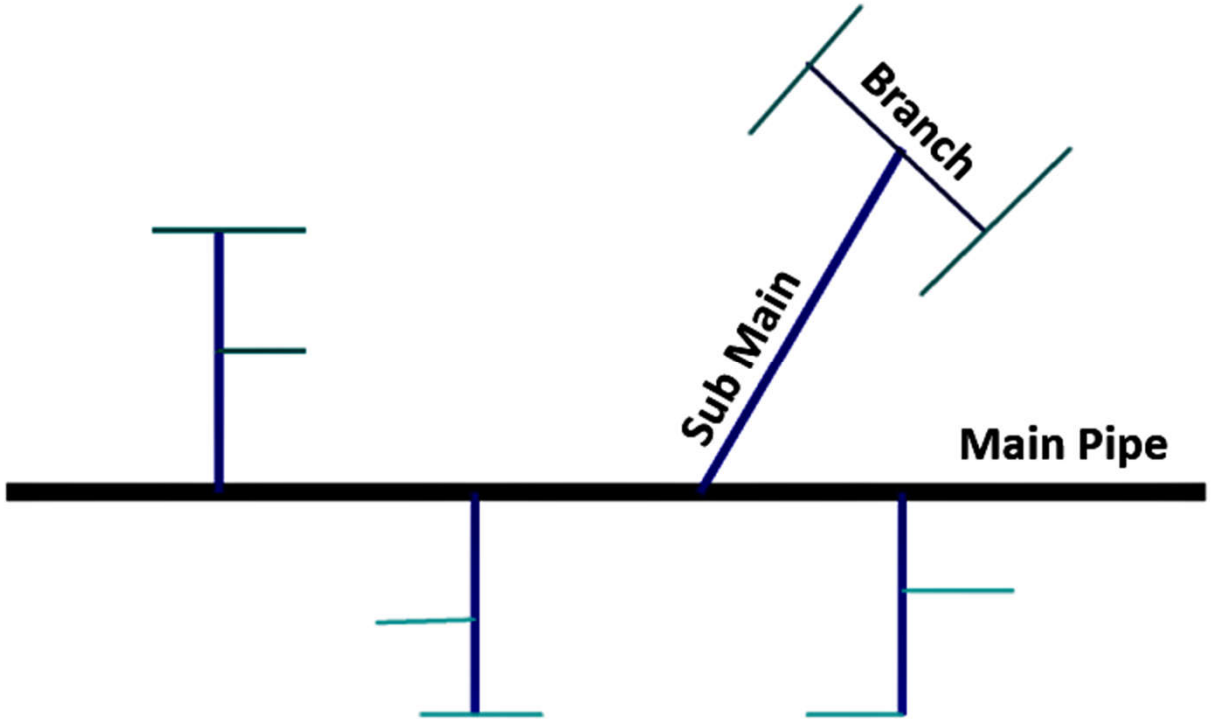


- For fresh/flushing water supply & fire services

Three categories of water supply mains

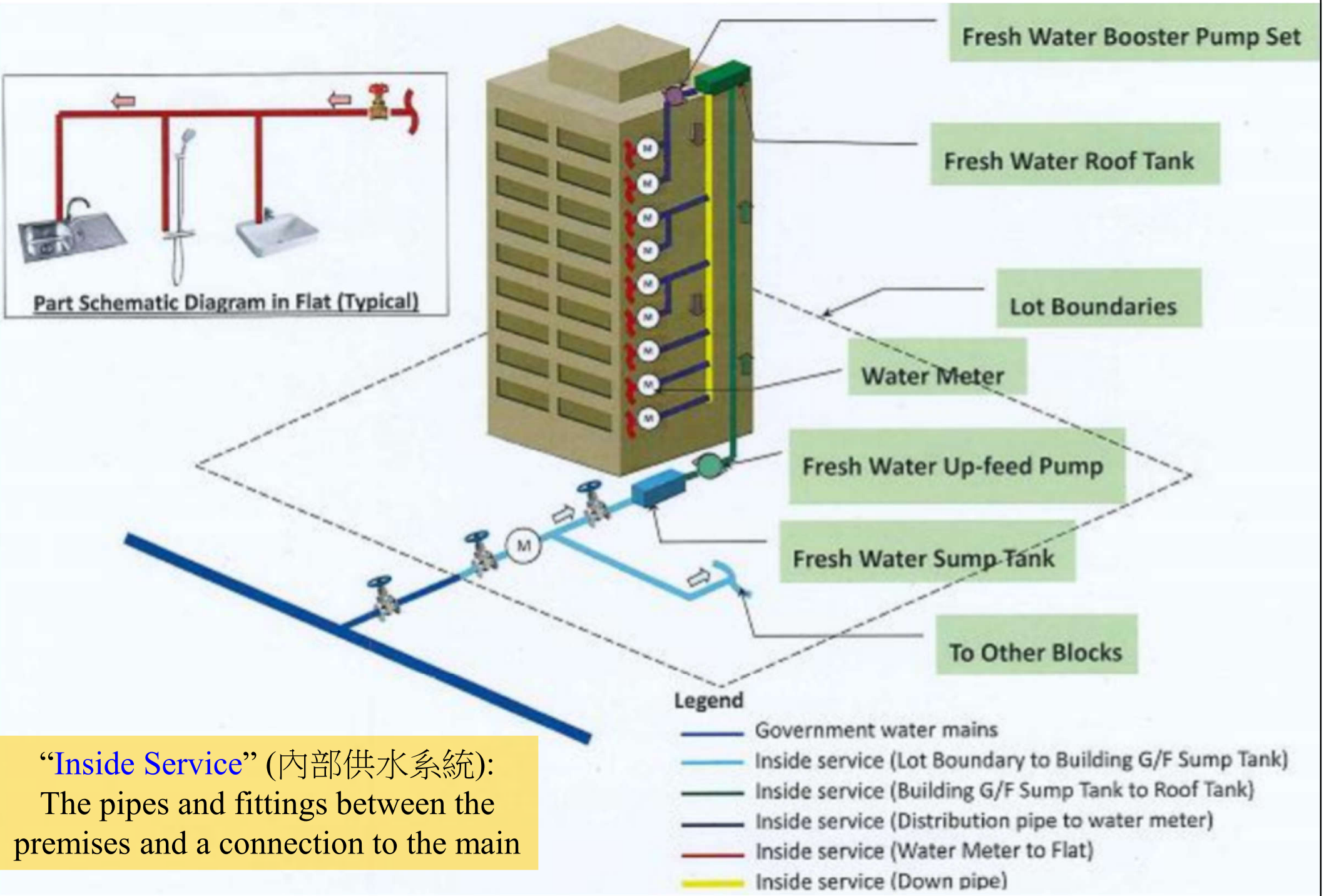
(a) Trunk mains	Generally described as those which convey water from a source of supply (reservoir, pumping station etc.) to a district without supplying consumers en route
(b) Secondary mains	The distribution mains in any district, usually fed from a trunk main and supplying the consumers' connections in the district
(c) Service pipes	The branch supplies from the secondary mains which serve individual consumers or premises





(Source: CIBSE, 2014. *Public Health and Plumbing Engineering*, CIBSE Guide G)

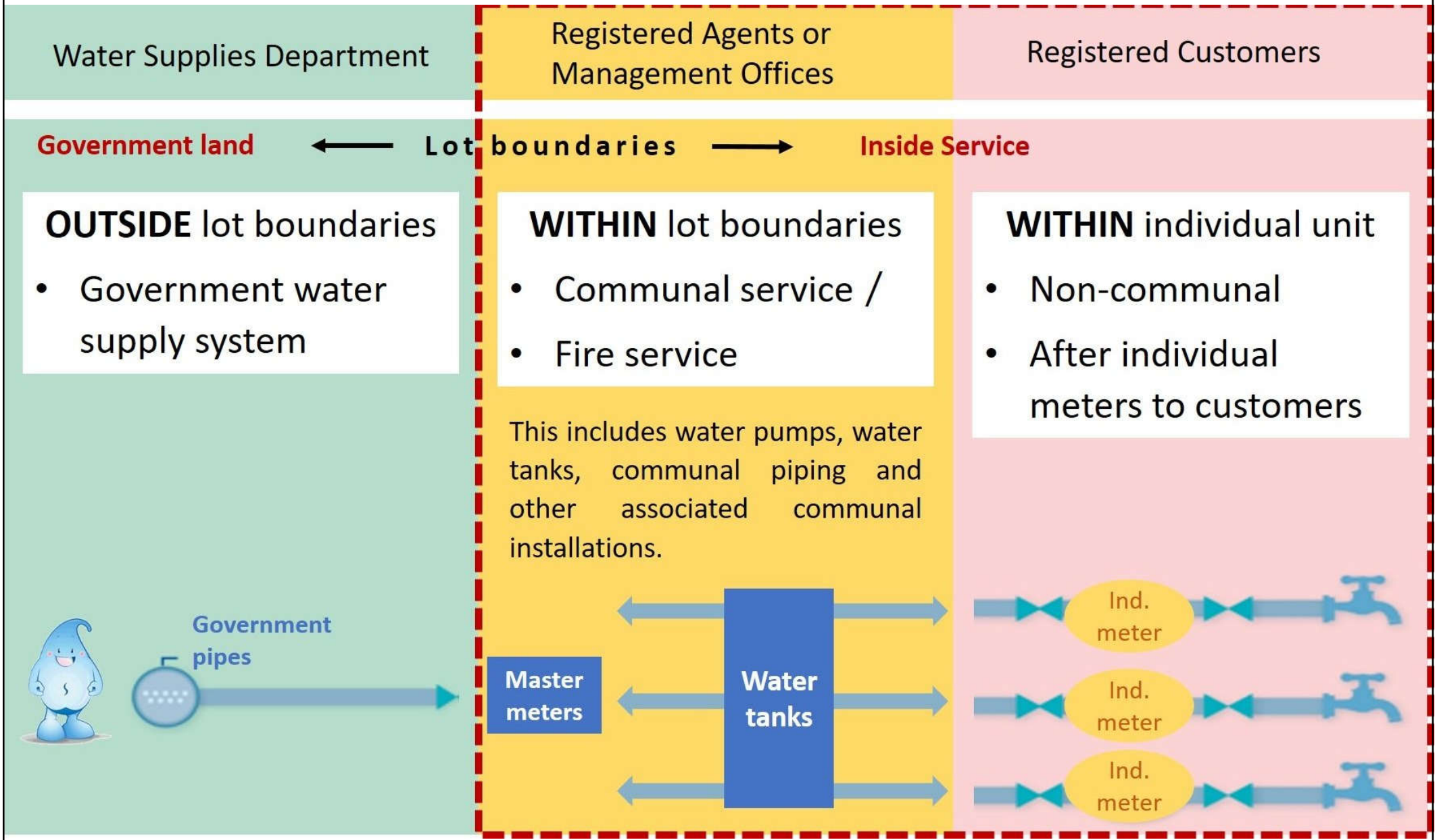
Schematic diagram of a typical inside service



"Inside Service" (內部供水系統): The pipes and fittings between the premises and a connection to the main

(Source: https://www.devb.gov.hk/filemanager/en/Content_3/TF_Final_Report.pdf)

Maintenance responsibility of government waterworks and inside service

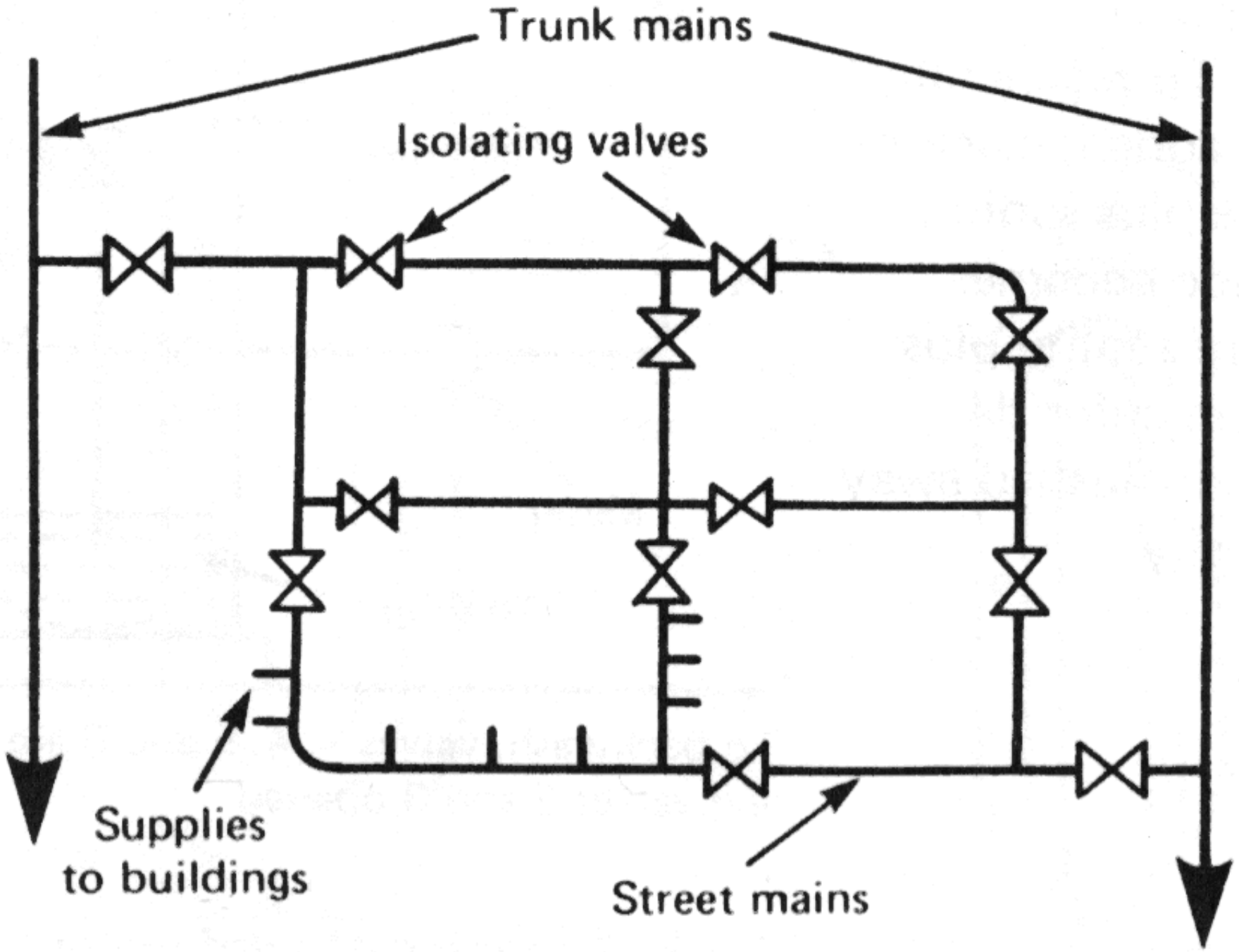


(Source: https://www.brplatform.org.hk/en/defects-and-orders/common-building-defects/defective-fresh-water-pipe)

Water supply distribution

- Mains water supply
  - Size of the water mains
    - Such as a 75 mm diameter pipe fed from both ends or a 100 mm diameter pipe fed from one end
  - Pressure (or head) of water (20 or 30m head) & pressure fluctuations
    - Min. head of 30 m head for firefighting purposes
    - Max. head of 70 m head to limit wastage and pipe noise
- A ring circuit & a grid of pipes
  - To increase reliability & facilitate maintenance

Ring main distribution (with water fed from both ends)



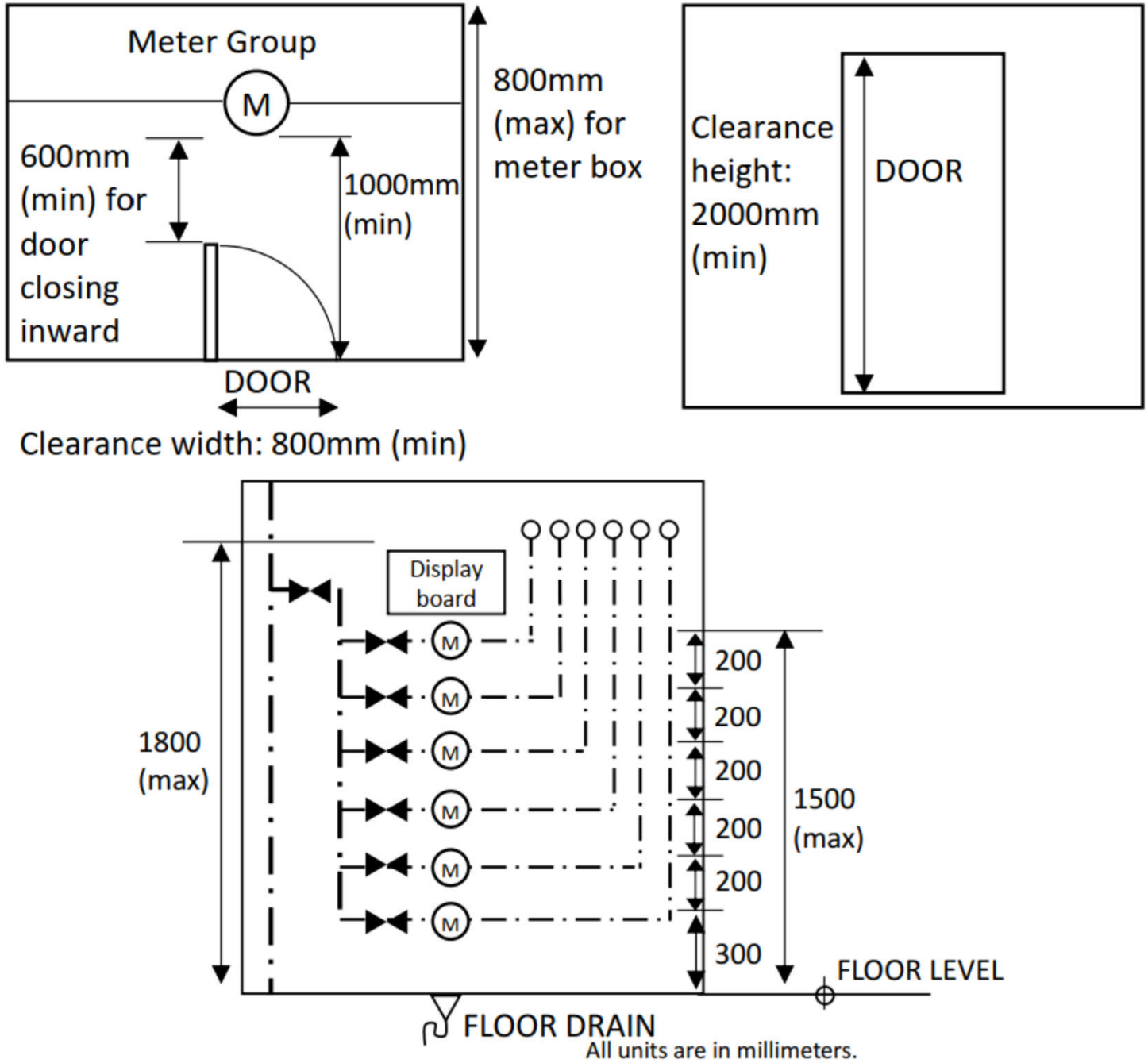
(Source: Hall, F. and Greeno, R., 2007. *Building Services Handbook*)

Water supply distribution

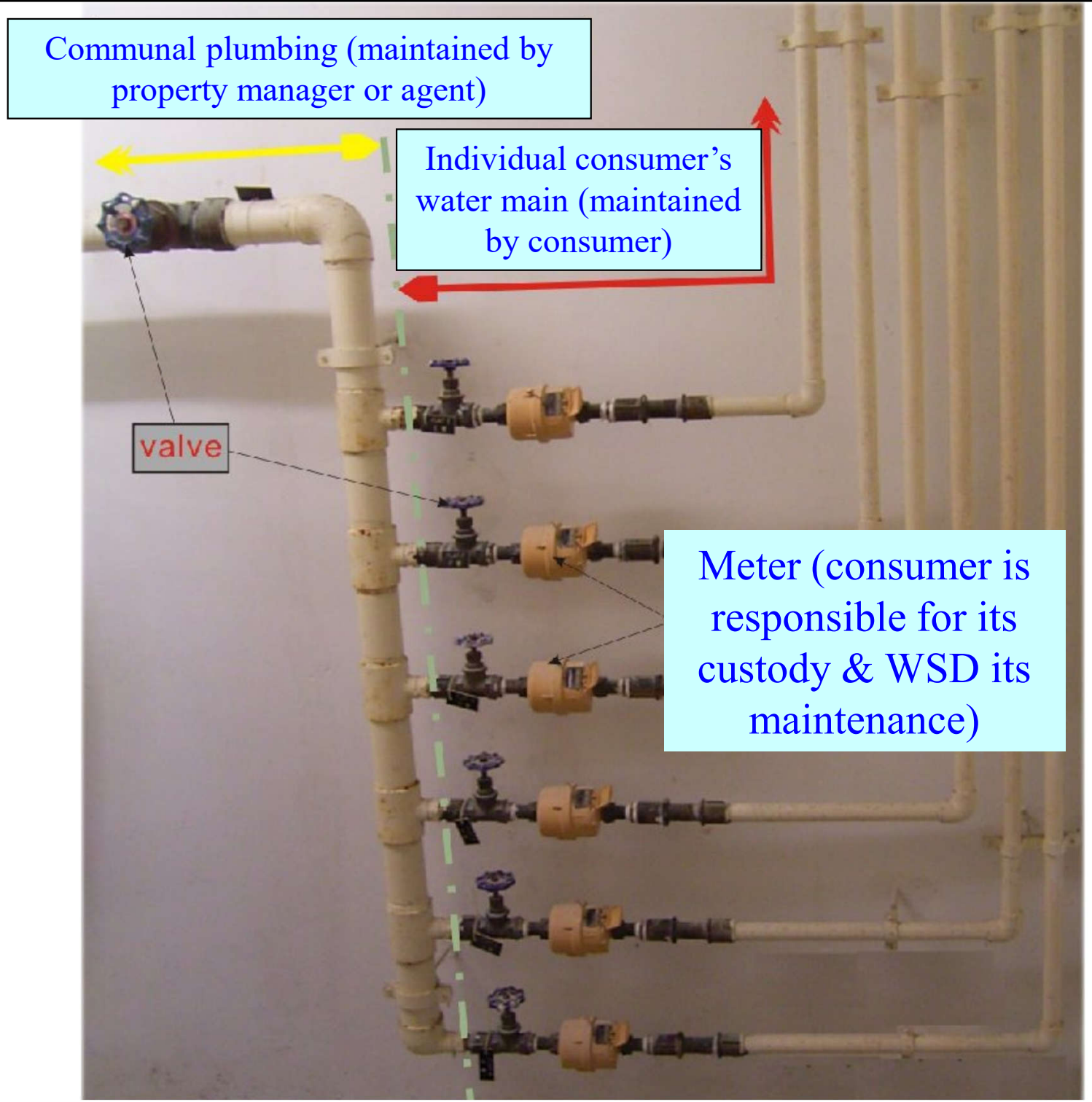
- Pressure of water supplies in HK
  - Fresh water supply: 15-30 metres head
  - Salt water supply: 15 metres head
  - They are maintained in the distribution systems except at their extremities
  - Reduction of the minimum residual pressure (since 2007): lower from 30- to 20-metre head
- Master meter, sub-meters & check meters

(See also: WSD, 2018. *Handbook on Plumbing Installation for Buildings*, Water Supplies Department (WSD), Hong Kong. https://www.wsd.gov.hk/en/plumbing-engineering/requirements-for-plumbing-installation/handbook-on-plumbing-installation/)

Typical arrangement of water meters in a meter box/chamber/room



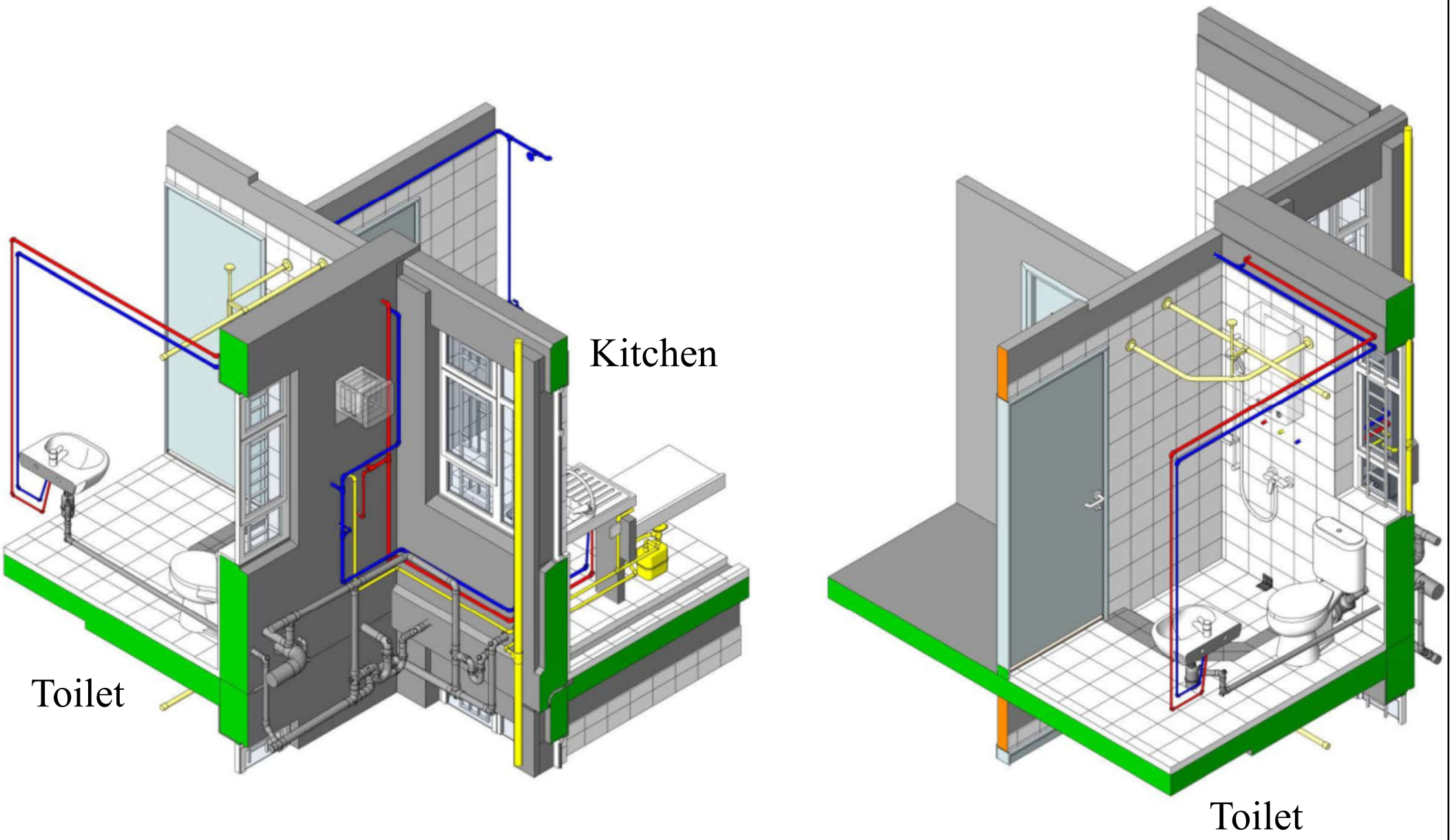
(Source: WSD, 2020. *Technical Requirements for Plumbing Works in Buildings (November 2020 version)*, Water Supplies Department (WSD), Hong Kong. https://www.wsd.gov.hk/en/plumbing-engineering/requirements-for-plumbing-installation/technical-requirements-for-plumging-works-in-bldgs/)



(Source: Water Supplies Department www.wsd.gov.hk)

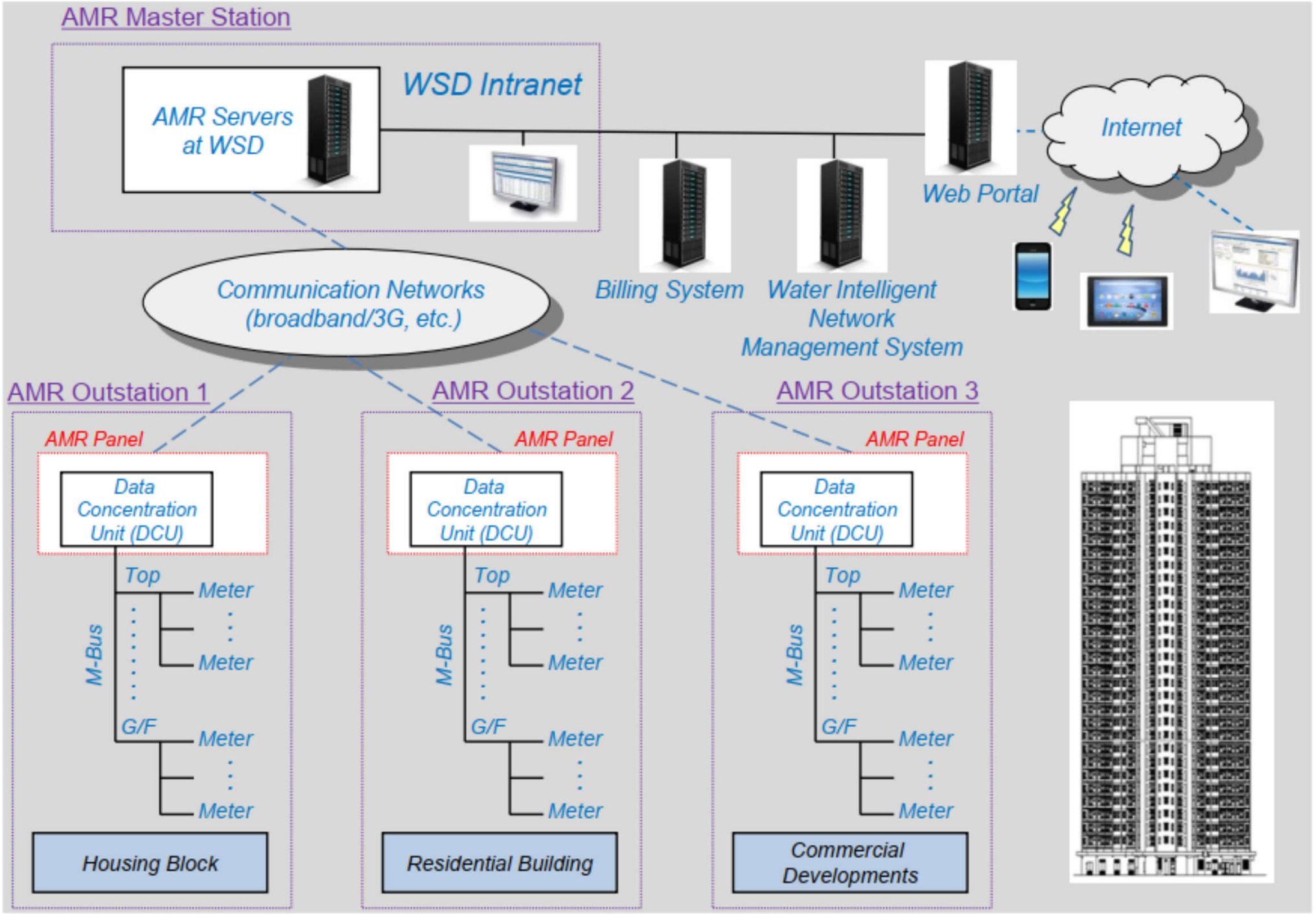
(Source: Water Supplies Department www.wsd.gov.hk)

Typical plumbing layout inside a residential flat



(Source: Housing Authority Hong Kong)

Automatic Meter Reading (AMR) system



(Source: Water Supplies Department www.wsd.gov.hk)

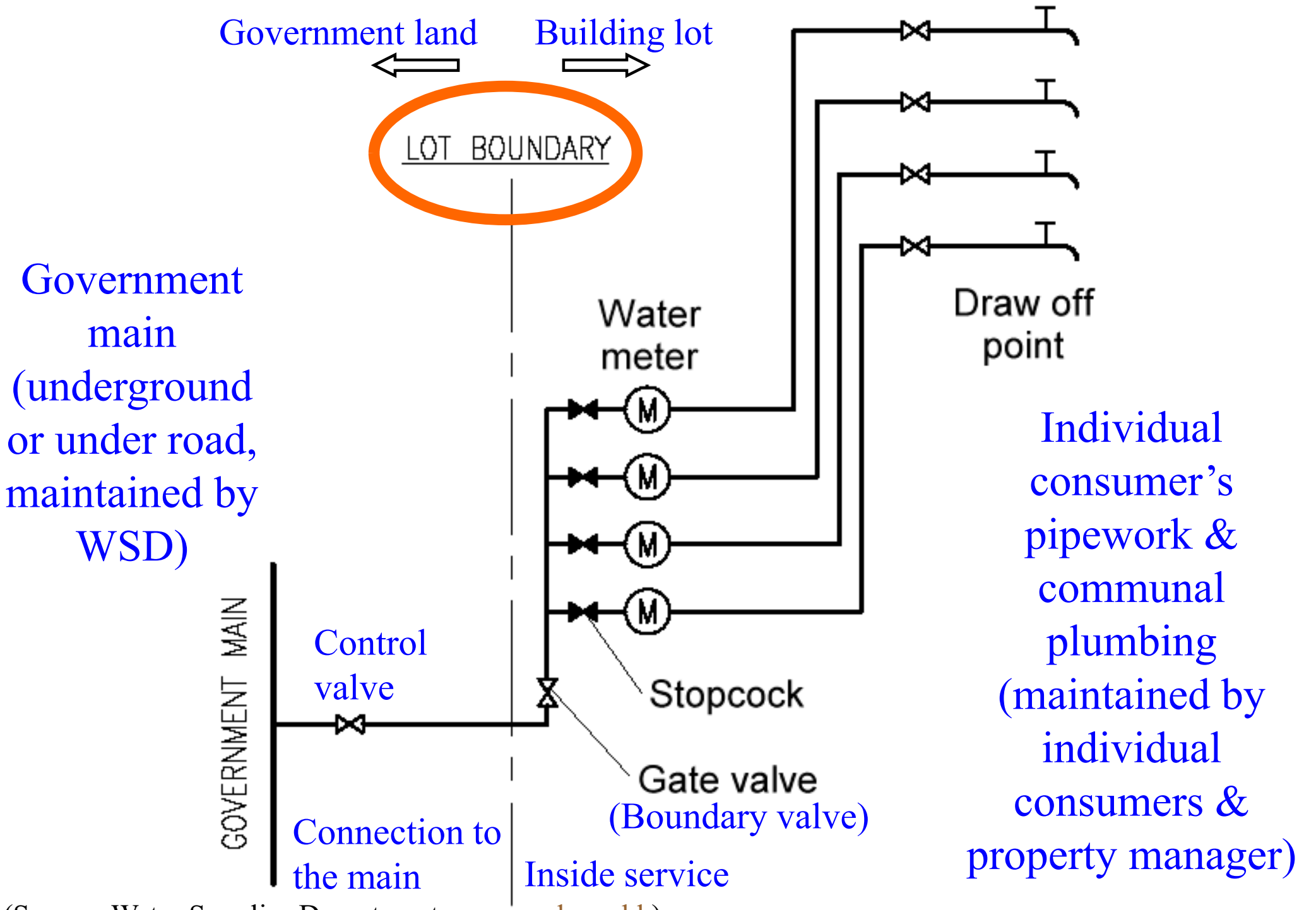
Water supply distribution

- Benefits of automatic meter reading (AMR):
  - Improve meter reading efficiency (i.e. automatic reading of water meters & reduce human error)
  - Detection of abnormal water consumption (e.g. leakage of customers' piping)
  - Better planning & management of water supplies
  - Enhancing customer services through provision of timely water consumption information via Internet and mobile phone
  - Platform for promotion of water conservation

Water supply distribution

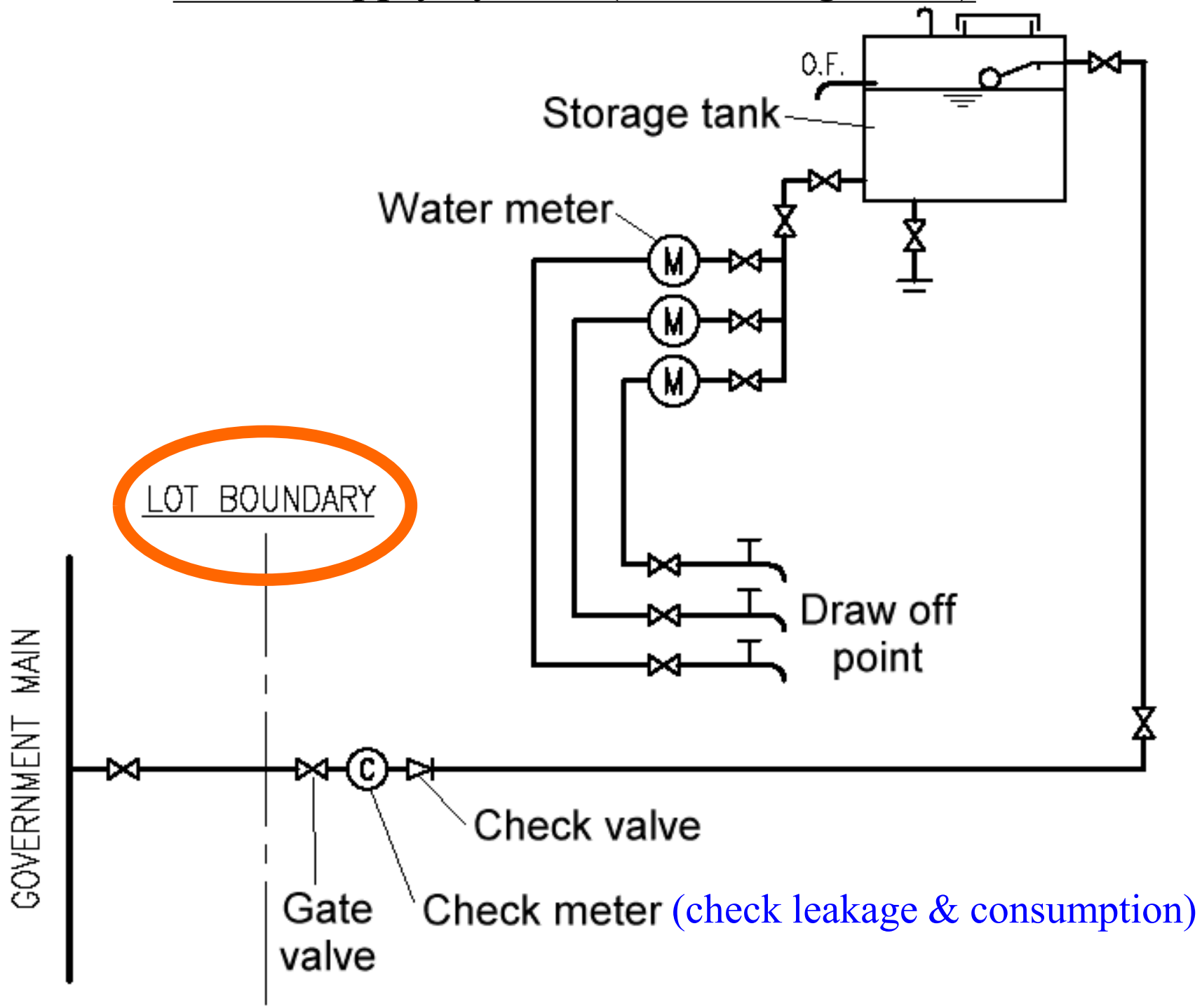
- Water supply systems in buildings
  - *Direct supply system*: conveys water directly from water mains to the point of usage without any transit water storage tanks
  - *Indirect supply system*: conveys water from water mains to the point of usage through a transit water storage tank (usually a sump water tank and a roof water tank)
- Potable/fresh water, flushing/salt water and water for fire services (e.g. FH/HR, sprinkler)

Direct supply system (without storage tank)



(Source: Water Supplies Department www.wsd.gov.hk)

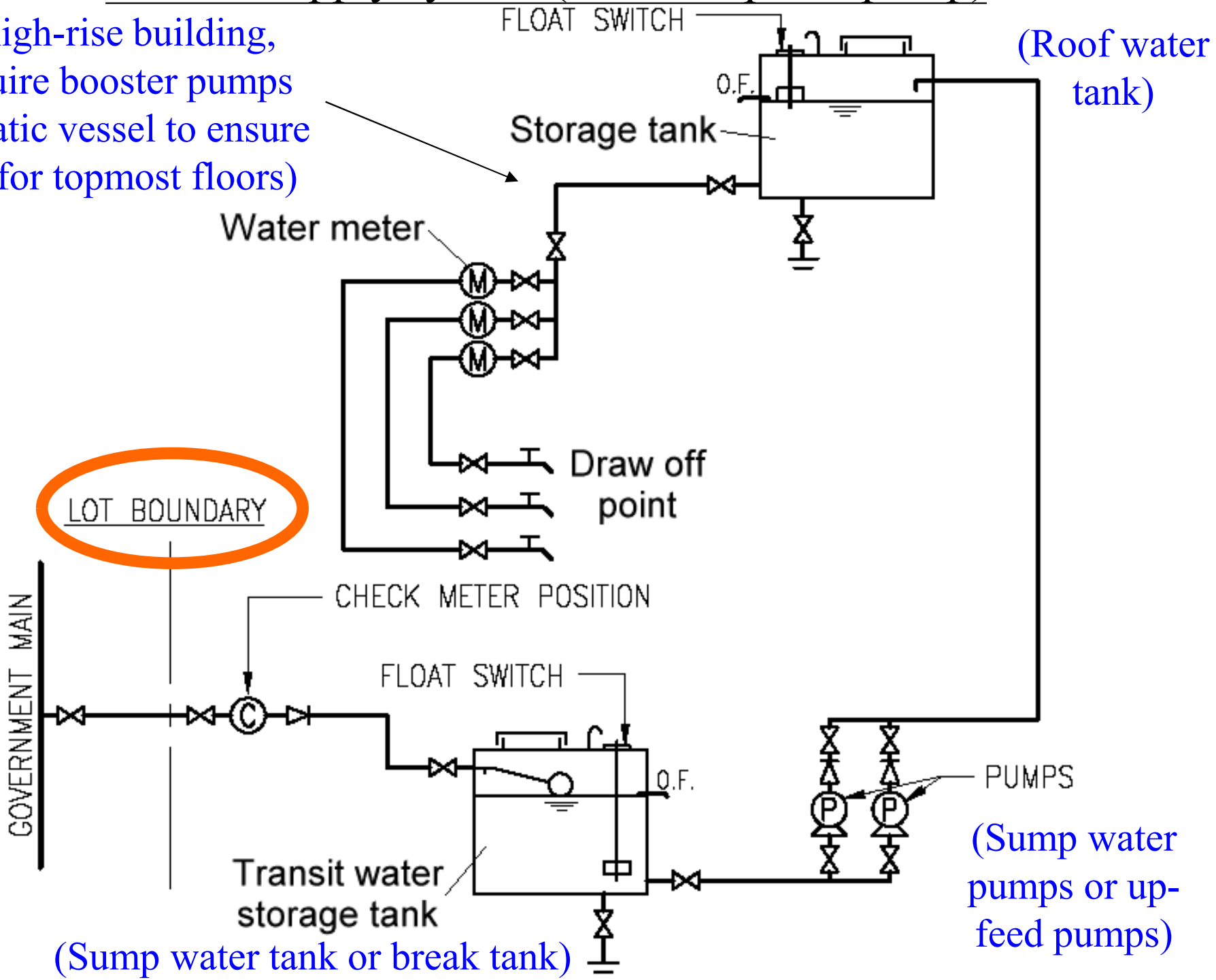
Direct supply system (with storage tank)



(Source: Water Supplies Department www.wsd.gov.hk)

Indirect supply system (with sump and pump)

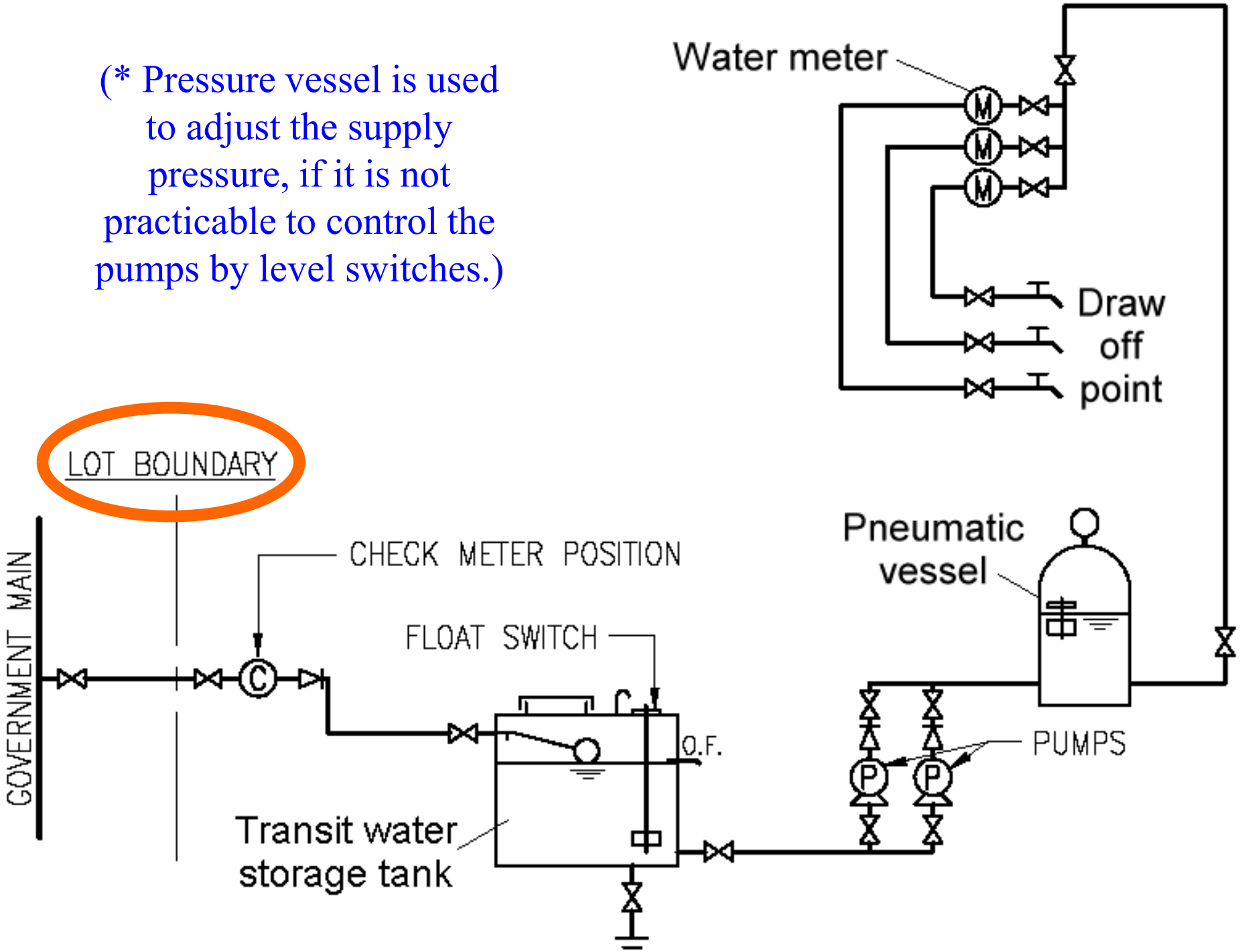
(For a high-rise building, may require booster pumps & pneumatic vessel to ensure pressure for topmost floors)



(Source: Water Supplies Department www.wsd.gov.hk)

Indirect supply system (with pneumatic vessel)

(* Pressure vessel is used to adjust the supply pressure, if it is not practicable to control the pumps by level switches.)

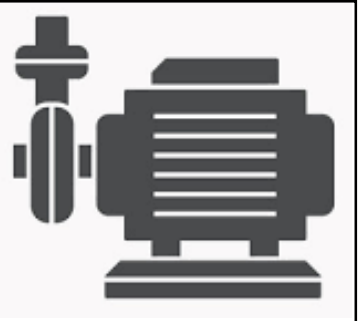


(Source: Water Supplies Department www.wsd.gov.hk)

Comparison of direct and indirect water supply systems

Direct supply	Indirect supply
- Less pipework, smaller or no water tank	- More pipework, large water storage tank
- No storage to satisfy peak demand period	- Water storage to meet peak demand
- Risk of contamination and pressure fluctuation of mains	- Less risk of adverse effects by water mains
- Not feasible for high-rise buildings due to main pressure	- Can be used in high-rise buildings

Water tanks & pumps



- Water tanks
  - Materials: reinforced concrete, fibre glass, etc.
    - Reinforced concrete is the most common material used
    - Fibreglass storage cistern for potable water shall be of an approved type or certified, with no toxic materials and suitable for storage of potable water
  - Storage capacities:
    - Assessment of water consumption & demand
    - Proportion:- Sump tank : Roof tank = 1 : 3
    - Recommend to meet one-day (24 hours) demand
    - Domestic supply – follows WSD recommendations

Recommended storage capacities in water supply systems

Domestic water supply with sump and pump		**Flushing supply using salt water***	**Temporary mains fresh water for flushing (TMF)**
Up to 10 flats	> 10 flats		
135 litres/flat (total storage including sump tank)	90 litres for each additional flat	Minimum 1/2 day consumption	45 litres per flushing apparatus, minimum 250 litres

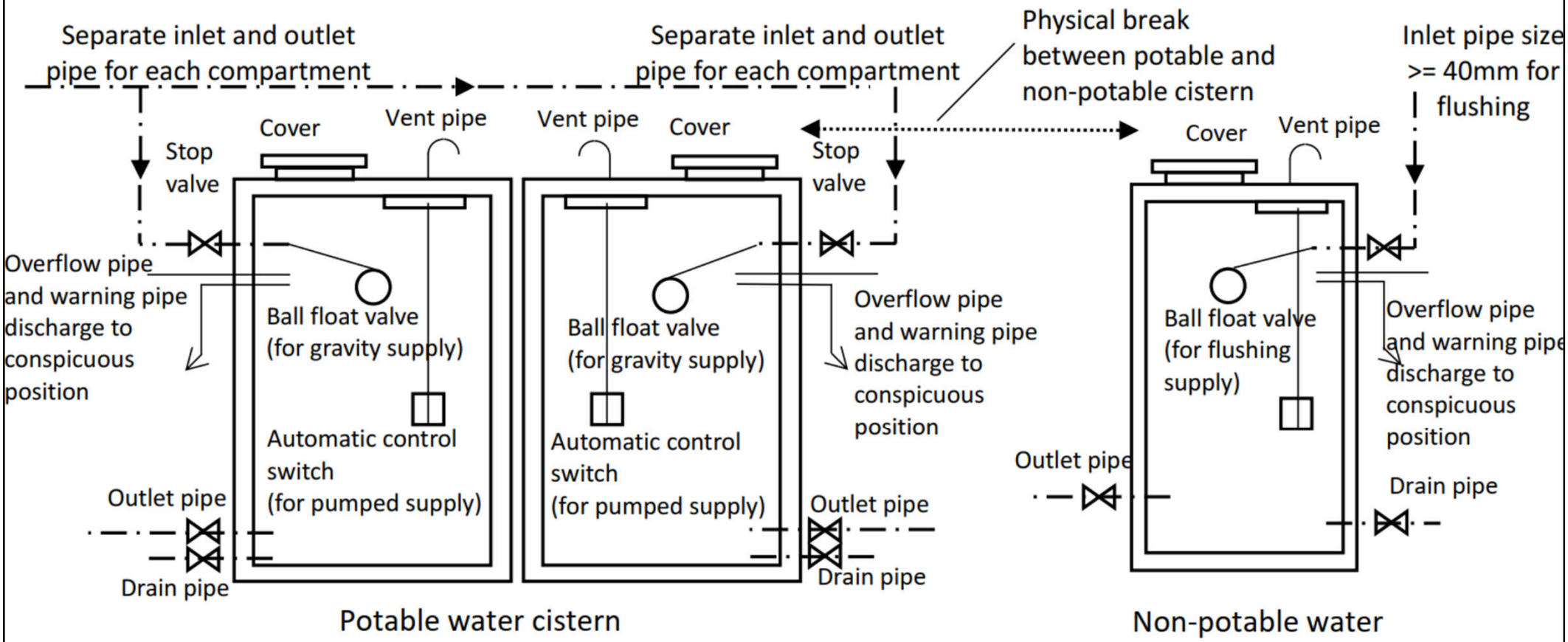
* For industrial use, recommended storage capacity is one-day demand.

Design criteria for flushing water storage: (Litres per flushing apparatus) [minimum capacity = 250 litres]

1. Residential: - Water closet	30
2. Commercial - Urinal - Water closet	30 40

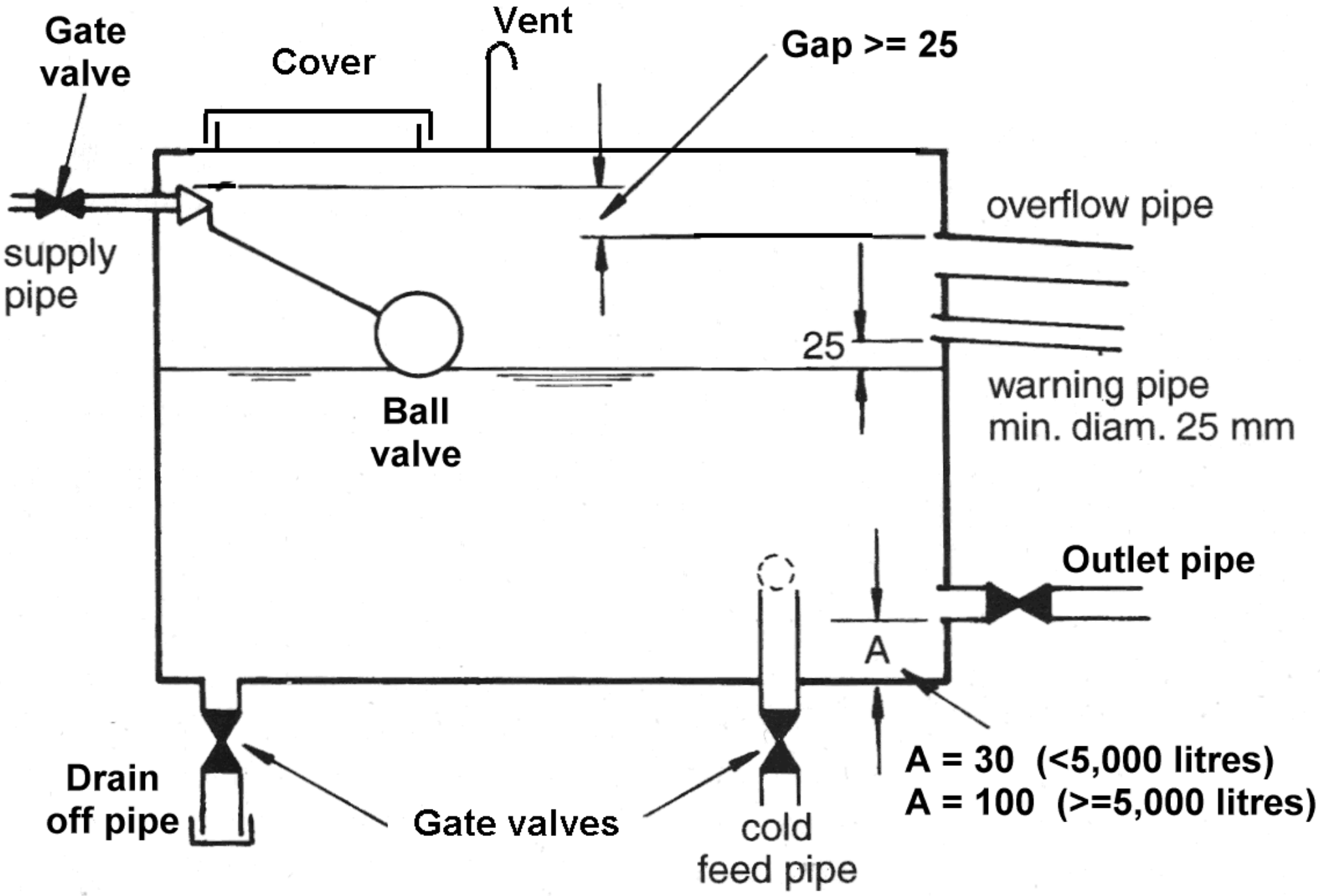
(Source: WSD, 2020. *Technical Requirements for Plumbing Works in Buildings (November 2020 version)*, Water Supplies Department (WSD), Hong Kong. https://www.wsd.gov.hk/en/plumbing-engineering/requirements-for-plumbing-installation/technical-requirements-for-plumging-works-in-bldgs/)

Typical components of water cisterns (storage tanks)



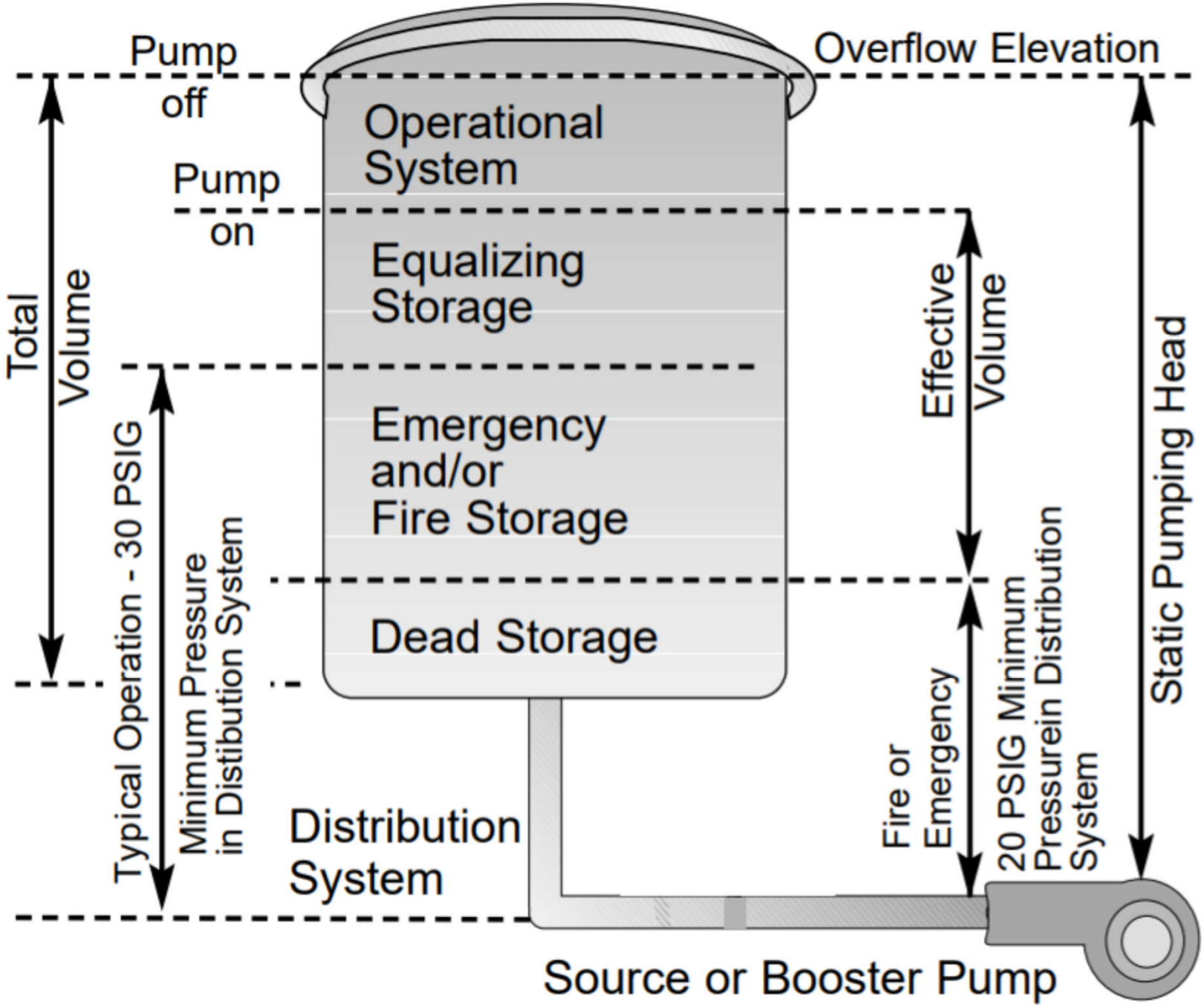
(Source: WSD, 2020. *Technical Requirements for Plumbing Works in Buildings (November 2020 version)*, Water Supplies Department (WSD), Hong Kong. https://www.wsd.gov.hk/en/plumbing-engineering/requirements-for-plumbing-installation/technical-requirements-for-plumging-works-in-bldgs/)

Water tank basic requirements (for a gravity supply)



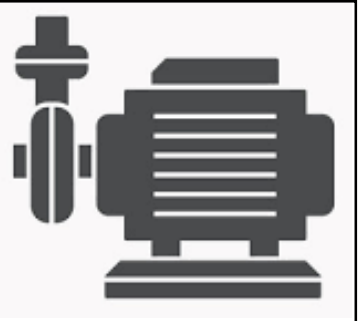
(Source: Garrett, R. H., 2008. *Hot and Cold Water Supply*)

Storage volume classification



(Source: https://sswm.info/sites/default/files/reference_attachments/BHARDWAJ%20and%20METZGAR%202001.%20Tech%20Brief%20-%20Reservoirs%2C%20towers%20and%20tanks.pdf)

Water tanks & pumps



- Cleansing of water storage tanks
  - Such as sump tank & roof tank
  - They should be cleansed once every three months
- Maintenance of internal plumbing
  - WSD maintains the water supply distribution system up to the building lot boundaries
  - Internal & communal plumbing are maintained by the consumers

Common problems for maintenance of water storage tanks

Double sealed tank cover with lock

Damaged water tank cover

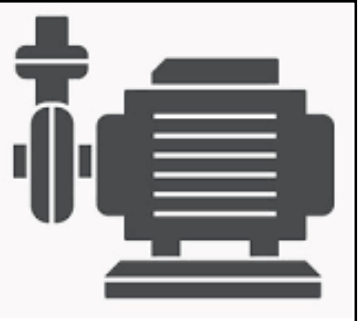
Water tank not cleaned

Rusty water tank cover

Storage tank without proper maintenance & management

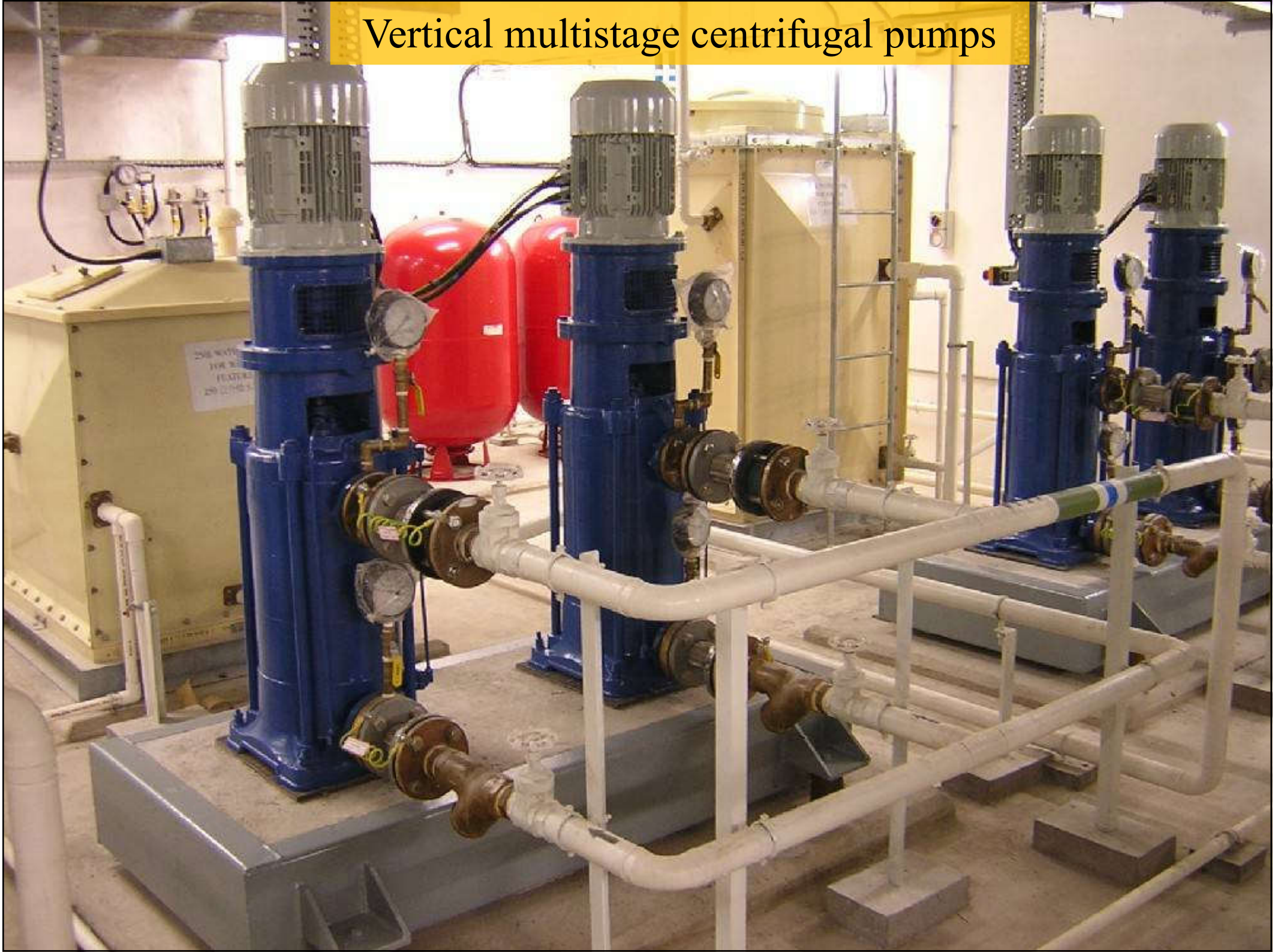
(Source: Water Supplies Department www.wsd.gov.hk)

Water tanks & pumps

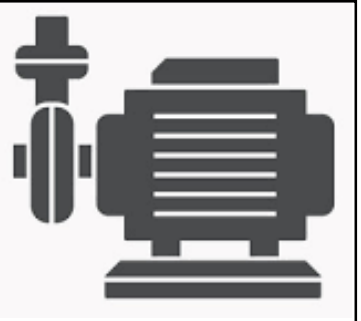


- Water pumps
  - Provide a duplicate set (duty + standby)
  - Pumping capacity >= designed out-flow of tank
  - Minimise vibration and noise problems
    - Adequate pipework support & anchor
    - Solid foundation
- Common pump types
  - Horizontal end suction centrifugal
  - Vertical multistage centrifugal

Vertical multistage centrifugal pumps

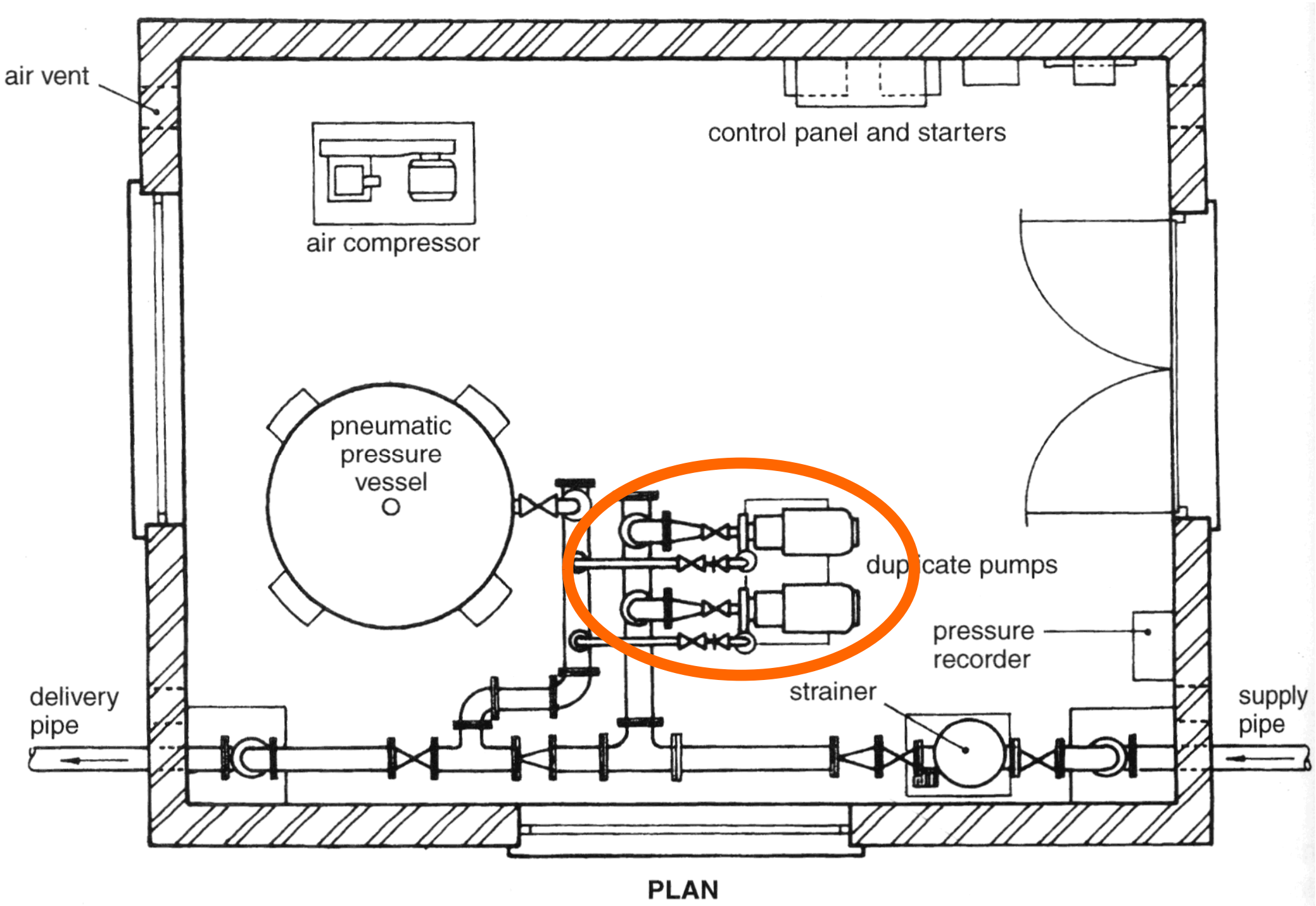


Water tanks & pumps



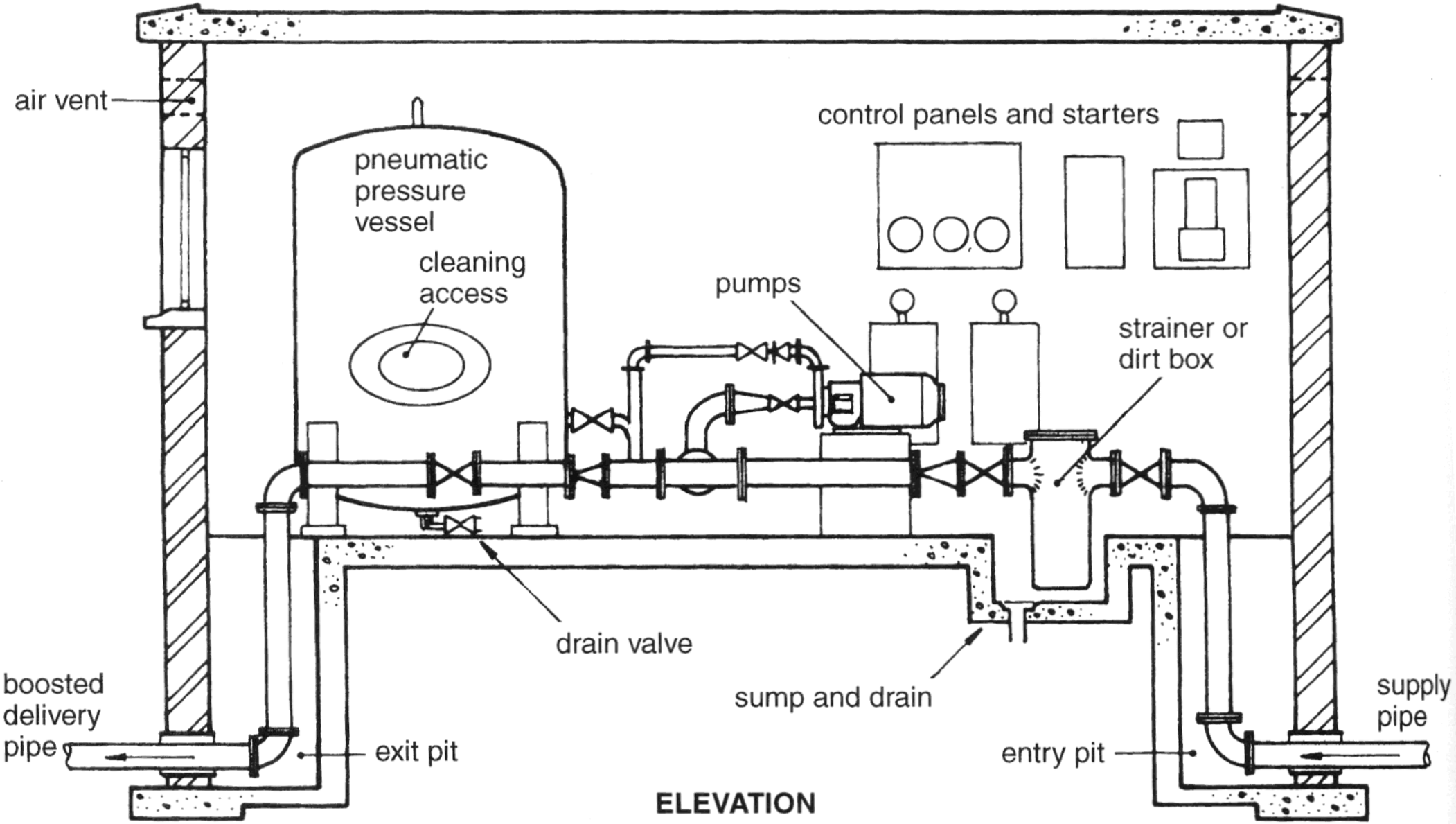
- Pump control
  - Automatic control using pressure switches, level switches, high-level & low-level electrodes
  - Pump selector switch & ON/OFF/AUTO
  - Low-speed preferred (longer life & quiet)
- Pump motor
  - Such as squirrel cage induction type
  - Overload protection (electrical)

Typical pump room (layout plan)



(Source: Garrett, R. H., 2008. *Hot and Cold Water Supply*)

Typical pump room (elevation)



(Source: Garrett, R. H., 2008. *Hot and Cold Water Supply*)

Water quality & management

- Water Safety Plan (WSP)
  - Developed by WSD in 2007 in accordance with WHO's recommendations
  - Launched an integrated Drinking Water Quality Management System (DWQMS) in 2017
    - Water quality policy
    - Principle of water quality management
    - Health-based targets
    - Water safety plans
    - Surveillance

(Source: https://www.wsd.gov.hk/en/core-businesses/water-quality/action-plan-for-enhancing-of-drinking-water-safety/water-safety-plans/)

Drinking Water Quality Management System

(Source: Water Supplies Department www.wsd.gov.hk)

Water quality & management

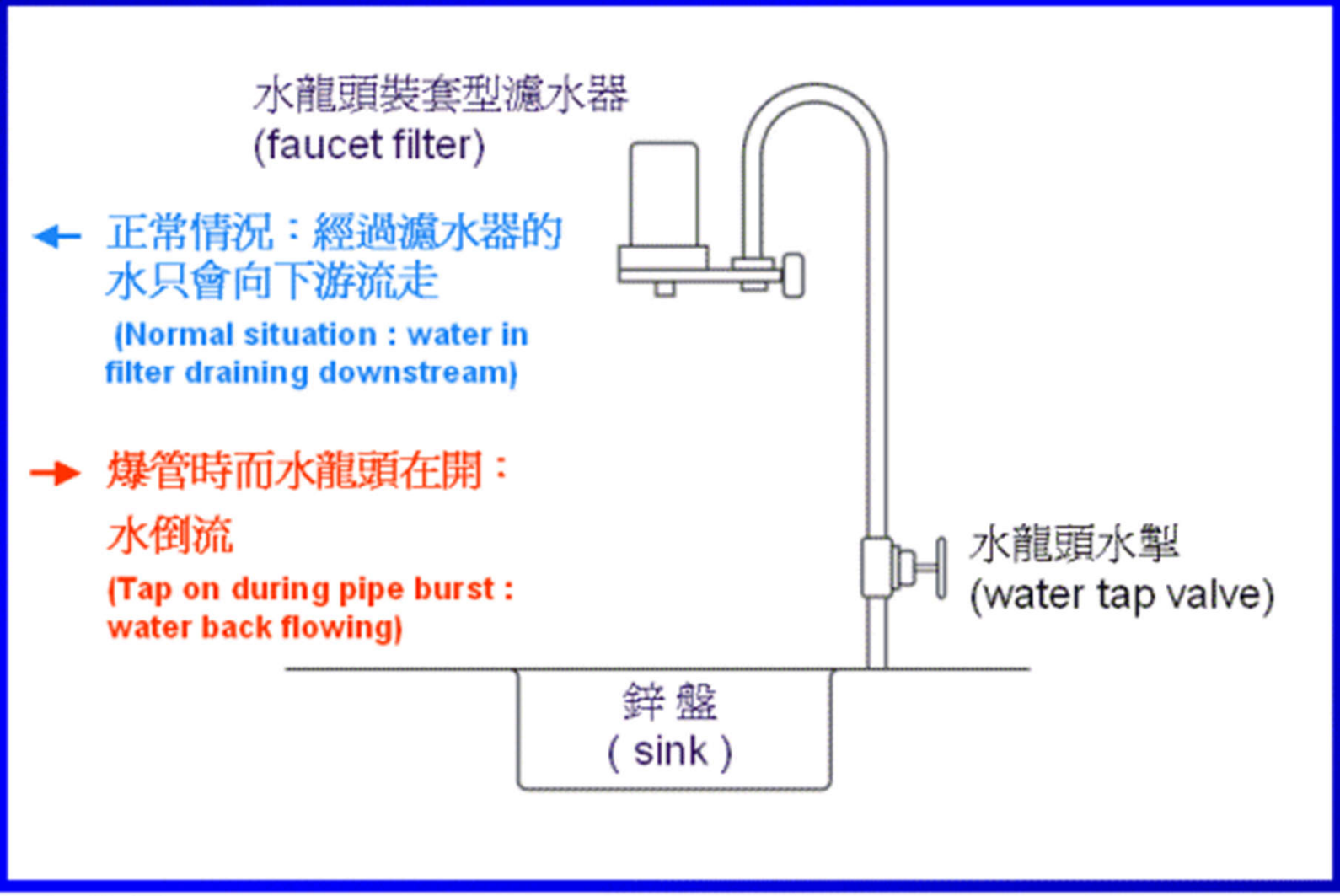
- Quality Water Supply Scheme for Buildings
  - https://www.wsd.gov.hk/en/core-businesses/water-quality/buildings/
  - To encourage building owners to maintain their plumbing systems properly
    - Fresh Water (Management System)
    - Fresh Water (Plus)
    - Flushing Water
  - There are 3 grades of certificates:
    - Blue Certificates: New application or renewal with < 3 years
    - Silver Certificates: Continuous participation 4-6 years
    - Gold Certificates: Continuous participation >= 6 years

(Source: https://www.wsd.gov.hk/en/core-businesses/water-quality/buildings/)

Water quality & management

- Treated water supplied by WSD at the connection points fully complies with the WHO guidelines for drinking water
- If the water is free from contamination within the plumbing system in a building, it is not necessary to use filter or purifier
- If a filter or purifier is used, it should be properly cleaned & maintained. Non-return valve may be needed to prevent back-flowing

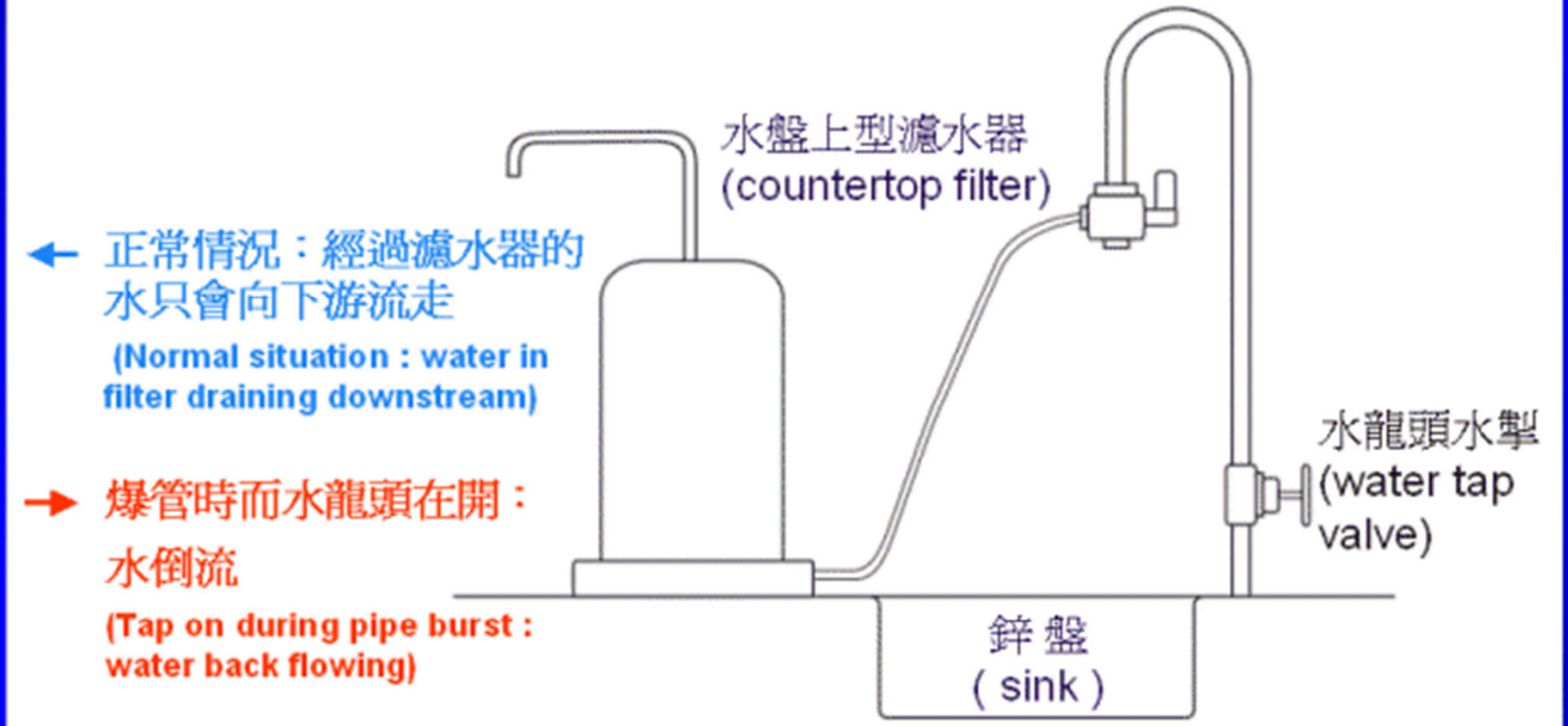
圖二：水龍頭裝套型濾水器
(Fig 2 : Faucet filter)



香港水務署

(Source: Water Supplies Department www.wsd.gov.hk)

圖三：水盤上型濾水器
(Fig 3 : Countertop filter)



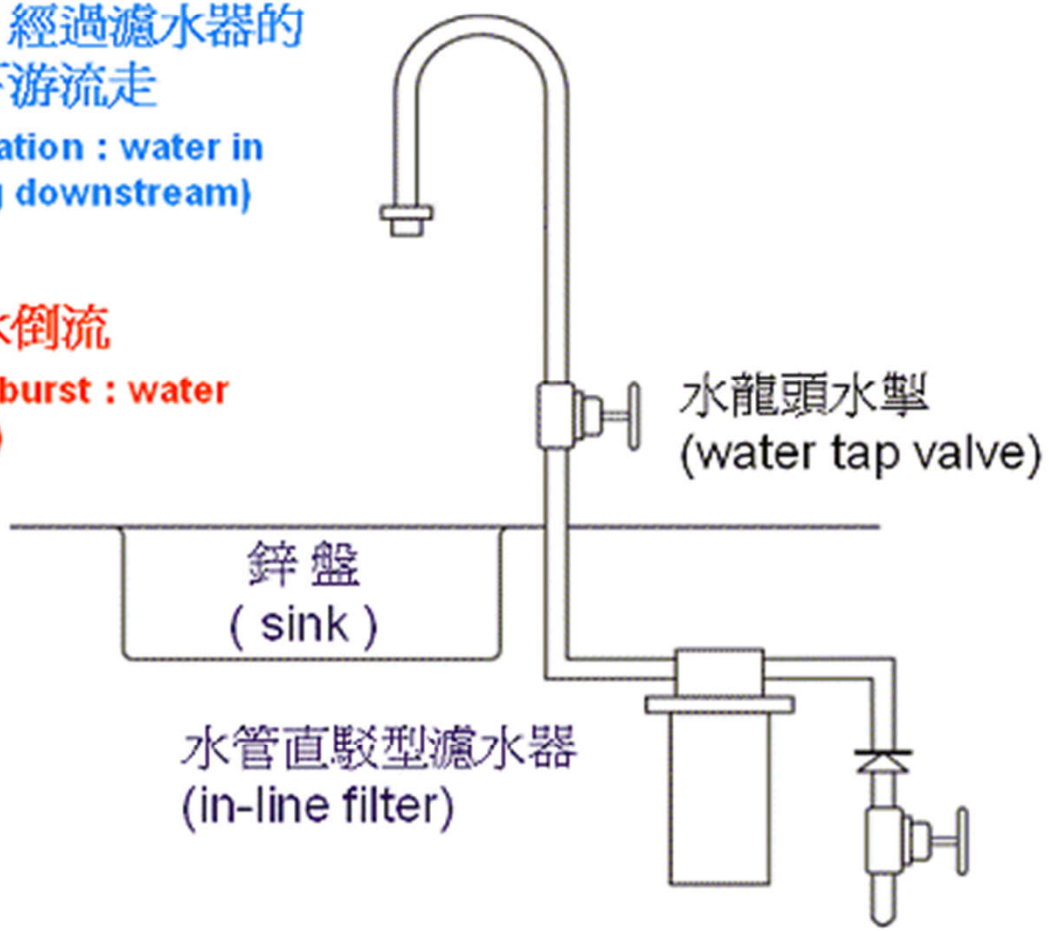
香港水務署

(Source: Water Supplies Department www.wsd.gov.hk)

圖六：水管直駁型濾水器
(Fig 6 : In-line filter)

← 正常情況：經過濾水器的水只會向下游流走
(Normal situation : water in filter draining downstream)

→ 爆管時：水倒流
(During pipe burst : water back flowing)



香港水務署

(Source: Water Supplies Department www.wsd.gov.hk)

Water quality & management

- In 2000-2015, WSD has launched a programme to replace or rehabilitate the aged water mains in stages
  - For both fresh water & salt water supplies
  - About 3,000 km of water mains (in a network of 7,600 km) were completed in 15 years

(Source: https://www.wsd.gov.hk/en/core-businesses/major-infrastructure-projects/r-r-projects/)

Water quality & management

- Total Water Management (TWM) strategy

全面水資源管理策略

  - Water demand management
    - To enhance public education on water conservation
    - To promote use of water saving devices
    - To enhance water leakage control
    - To extend use of seawater for toilet flushing
  - Water supply management
    - To strengthen protection of water resources
    - To actively consider water reclamation (reuse of greywater & rainwater harvesting)
    - To develop the option of seawater desalination

(Source: https://www.wsd.gov.hk/en/core-businesses/total-water-management-strategy/)

Outlook of the future water resources in Hong Kong

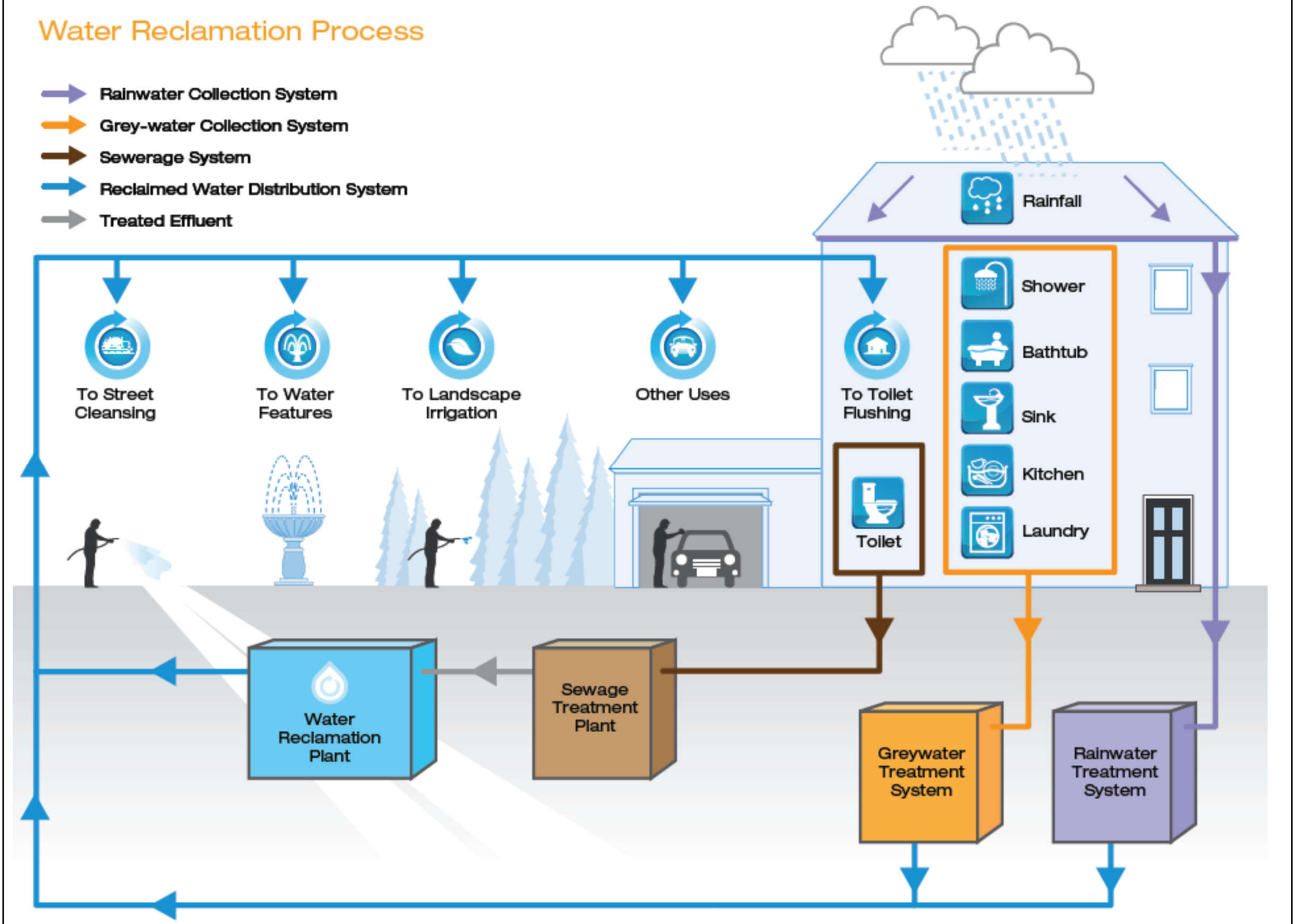
Future fresh water resources in Hong Kong*:

Dongjiang water with water supply ceiling of 820 mcm per annum	~ 60% - 80% depending on the amount of local yield
Local yield	~ 15% - 35%
Desalinated water up to 50 mcm per annum	~ 5%

* While the above fresh water resources will account for about 75% of the total water consumption in Hong Kong, the lower grade water (namely seawater and recycled water) for non-potable uses will account for the remaining 25%.

- Dongjiang Water 東江水
- Local Yield 本地集水
- Desalination 海水化淡
- Seawater for Flushing 海水沖廁
- Recycled Water 循環再用水

(Source: https://www.wsd.gov.hk/en/core-businesses/total-water-management-strategy/twm-review/)



(Source: Water Supplies Department www.wsd.gov.hk)

Water quality & management

- Development of new water supply sources
  - Seawater desalination
    - Using reverse osmosis (RO) technology
  - Reclaimed water
    - Primarily for non-potable uses
    - Convert the tertiary treated sewage effluent into reclaimed water for toilet flushing
  - Grey water reuse and rainwater harvesting
  - Stormwater management and harvesting

Water quality & management

- Promoting water conservation
  - Water Efficiency Labelling Scheme (WELS)
  - Automatic meter reading
  - Public education
  - Water use efficiency guidelines
  - Water loss management (reduce leakages)
  - Water intelligent network (WIN) (monitor water loss)
  - Underground asset (water mains) management
  - Expand the use of low grade water (e.g. seawater flushing)

Water conservation

Water loss management

Expansion of use of lower grade water for non-potable uses

(See also: https://www.waterconservation.gov.hk/)

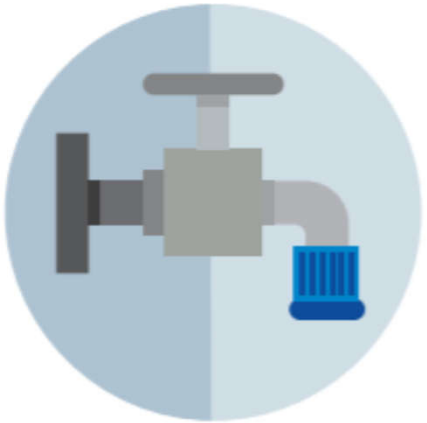
Voluntary Water Efficiency Labelling Scheme (WELS)

Showers for Bathing

Water Taps

Urinal Equipment

Washing Machines

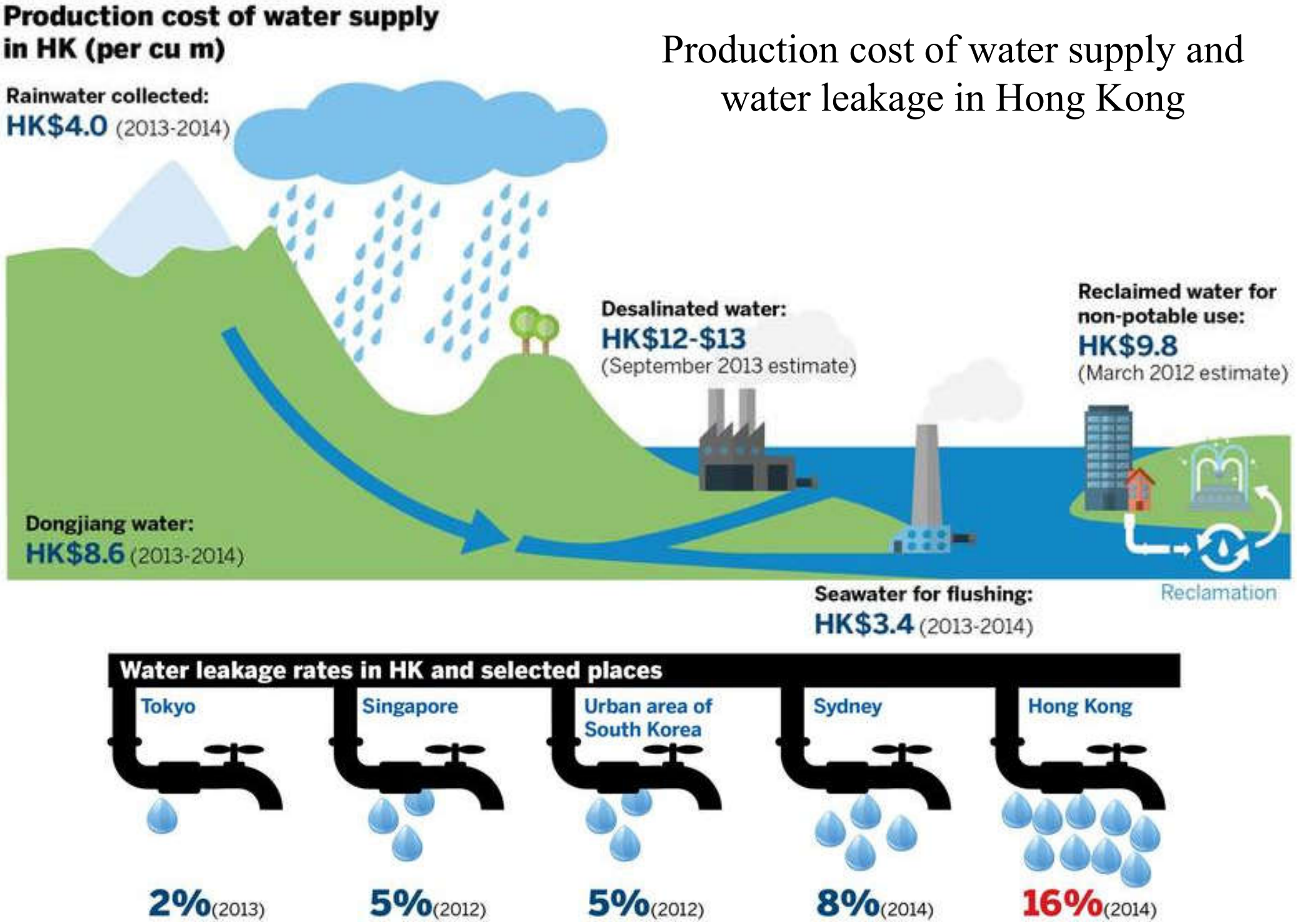


Flow Controllers

Water Closets

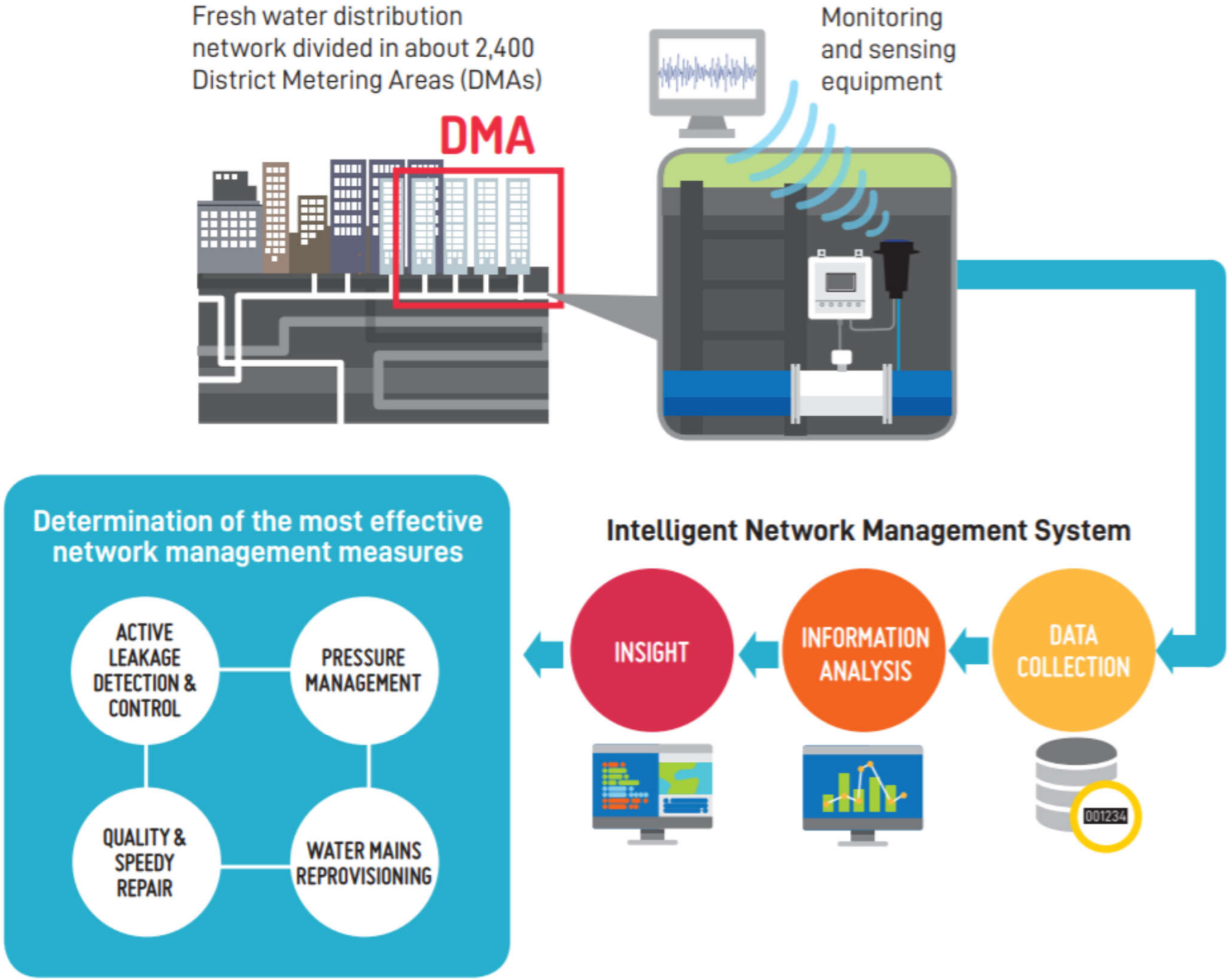
(Source: https://www.wsd.gov.hk/en/plumbing-engineering/water-efficiency-labelling-scheme/)

Production cost of water supply and water leakage in Hong Kong



(Source: https://www.chinadailyhk.com/articles/70/137/218/1509961687569.html)

Water intelligent network (WIN) (monitor water loss)



(Source: https://www.wsd.gov.hk/en/core-businesses/operation-and-maintenance-of-waterworks/reliable-distribution-network/)

Water quality & management

- Inspect & maintain plumbing to prevent water leaks
- Checking of water leakage: simple method
  - Turn off all water taps
  - Compare the water meter reading over a 30-minutes period
  - If the water meter registers flow when all water taps are turned off, it implies leaking
- However, this method cannot detect very small leakage (seepage)

Further Reading

- Water supply and sanitation in Hong Kong - Wikipedia
  - https://en.wikipedia.org/wiki/Water_supply_and_sanitation_in_Hong_Kong
- Water Treatment in Hong Kong
  - https://www.wsd.gov.hk/filemanager/en/share/pdf/water_treat.pdf
- WSD & CIC, 2017. *Good Practice Guide on Plumbing Works*, Water Supplies Department (WSD) & Construction Industry Council (CIC), Hong Kong.
  - https://www.wsd.gov.hk/en/plumbing-engineering/good-practice-guide-on-plumbing-works/
- Total Water Management Strategy
  - https://www.wsd.gov.hk/en/core-businesses/total-water-management-strategy/

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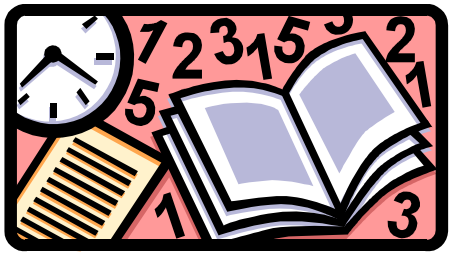

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- Hall F. & Greeno R., 2017. *Building Services Handbook*, 9th ed., Routledge, Oxon & New York.
- Hong Kong Monthly Digest of Statistics, Feature Article: An Overview of Water Supplies in Hong Kong, April 2015.
  - https://www.statistics.gov.hk/pub/B71504FB2015XXXXB0100.pdf

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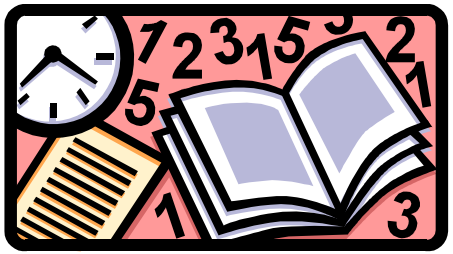

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- WSD, 2021. *Technical Requirements for Plumbing Works in Buildings (December 2021 version)*, Water Supplies Department (WSD), Hong Kong. https://www.wsd.gov.hk/en/plumbing-engineering/requirements-for-plumbing-installation/technical-requirements-for-plumging-works-in-bldgs/
- WSD, 2018. *Handbook on Plumbing Installation for Buildings*, Water Supplies Department (WSD), Hong Kong. https://www.wsd.gov.hk/en/plumbing-engineering/requirements-for-plumbing-installation/handbook-on-plumbing-installation/