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DRINKING WATER SAFETY ADVISORY COMMITTEE

Drinking Water Quality Management System of Water Supplies Department

Introduction

This paper introduces the Drinking Water Quality Management System (DWQMS) of Water Supplies Department (WSD) including its water safety plan (WSP), water quality monitoring programme and surveillance arrangement.

I. Fresh Water Supply System in Hong Kong

2. Hong Kong has been importing raw water from Dongjiang (DJ) (the East River) in the neighbouring Guangdong province since 1965 in addition to collecting local yield for the fresh water supply in Hong Kong[1]. Currently, around 70-80% of our fresh water supply comes from DJ, whilst 20-30% is from the yield collected in the local water gathering grounds. The DJ water supply agreement between the Hong Kong Special Administrative Region Government and the Guangdong authorities stipulates that the quality of DJ water would be maintained to meet the national standard for Type II waters (applicable for the abstraction for human consumption in first class protection area) in the "Environmental Quality Standards for Surface Water, GB 3838-2002" (see **Annex 1**). The raw water including DJ water and local yield will go through a series of rigorous water treatment processes at water treatment works in Hong Kong to ensure that the drinking water quality supplied to customers complies chemically, bacteriologically and radiologically with the Hong Kong Drinking Water Standards[2] (see **Annex 2**).

3. There are 21 water treatment works in Hong Kong. In a typical water treatment works, raw water is dosed with chemicals such as alum and hydrated

[1] Hong Kong also uses seawater for flushing. Currently, about 85% of the population in Hong Kong is covered by the seawater supply network.

[2] The Hong Kong Drinking Water Standards have adopted the corresponding guideline values/provisional guideline values in the fourth edition of the World Health Organization's Guidelines for Drinking-water Quality ("WHO Guidelines") published in 2011.

lime for coagulation and flocculation to remove the impurities in the raw water, and pre-chlorination to oxidise the impurities and suppress proliferation of algae. Clarified water then flows into filters of sand/anthracite for removal of the fine particles. Chlorine and hydrated lime are then added to the filtered water collected in the contact tanks for disinfection and pH adjustment respectively. Fluoride is also added as directed by the Department of Health (DH) to minimise the risk of dental decay. A small amount of chlorine at around 1 mg/L is dosed in the treated water before leaving the water treatment works to maintain residual chlorine to prevent bacterial re-growth during its delivery to consumers' taps.

4. Advanced technologies have also been adopted such as the ozonation and biological filtration in Tai Po and Ngau Tam Mei Water Treatment Works. The upcoming project "Reprovisioning of Sha Tin Water Treatment Works – South Works" would adopt ozonation, deep bed biological filtration and ultra-violet (UV) disinfection to reduce the use of chlorine and enhance treated water quality.

II. Drinking Water Quality Management System

5. WSD has developed and implemented its WSP following the WHO Guidelines to ensure drinking water quality from source to distribution up to the connection points to the consumers (connection points) since 2007. WSD has followed the preventive risk management and multiple-barrier approach advocated by the WHO Guidelines in its development and implementation of the WSP. In regard to the internal plumbing systems, WSD has spelt out in the WSP its regulatory, monitoring and advisory role; while building owners should be responsible for the proper maintenance of the internal plumbing system (i.e. beyond the connection points) which should be taken care by a separate WSP (i.e. the WSP for Buildings).

6. With reference to overseas experience and following the advice of an expert consultant, WSD has enhanced its WSP and established and implemented the DWQMS that has embraced the enhanced WSP since July 2017.

7. The DWQMS is developed based on the Framework for Safe Drinking Water advocated by the WHO Guidelines as an effective means to assure the quality of drinking water for protection of public health. The

DWQMS (Figure 1) comprises the following key components:

(i) water quality policy and health-based targets which explain WSD's commitment on drinking water quality and specify its goals of water quality management based on an evaluation of health risks;

(ii) WSP which is the management tool used to assist in meeting the health-based targets; and

(iii) a system of independent surveillance that verifies that the health-based targets and WSP are fulfilled or operating properly.

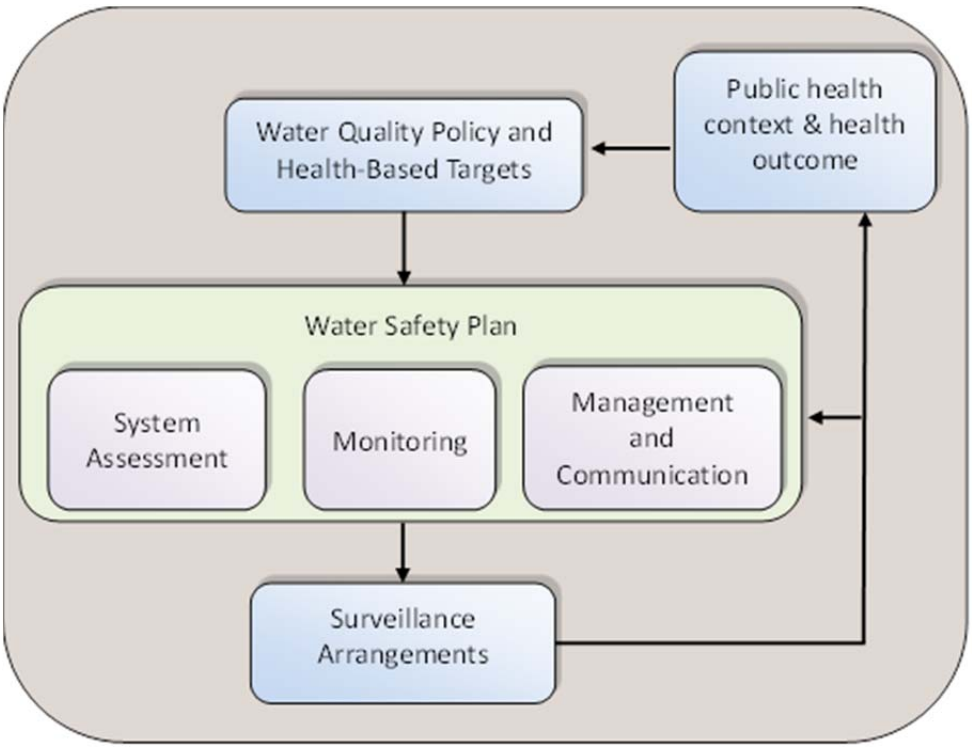

Figure 1: Structure of DWQMS

8. WSD is committed to supplying wholesome and clean drinking water to its consumers. The department is also committed to providing regulatory control on the inside services as well as promoting public awareness on drinking water safety. Regarding the health-based targets, the Department of Health (DH) agreed that the quality of treated water in Hong Kong has been maintained at a high level and there is practically no measurable burden of water-related disease. The guideline values/provisional guideline values specified in the WHO Guidelines are taken as the health-based targets to ensure the chemical, microbial and radiological quality of treated water.

Water Safety Plan

9. As the central component of the DWQMS, the WSP acts as a water quality management tool and comprises:

(i) a system assessment to determine whether the drinking water supply meets the health-based targets;

(ii) operational monitoring of the control measures in the drinking water supply; and

(iii) management plans documenting the system assessment and monitoring plans and describing actions to be taken in normal operation and incident conditions.

10. As part of the DWQMS, the drinking water supply system has been thoroughly assessed from raw water sources through water treatment works, storage and distribution infrastructure up to the connection points with a view to identifying potential hazards or hazardous events that would undermine safety of drinking water.

11. Beyond the connection points, the role of WSD focuses on the assessment of general hazards/hazardous events arising from the design of, or materials used for, the internal plumbing systems of new buildings. WSD has implemented a number of measures to tighten up plumbing material control and management and training of licensed plumbers since 2015. In addition, WSD has been promoting the WSP for Buildings to building owners and property management agents; and a set of guidelines and templates have also been developed and piloted for use to assist building owners and property management agents in the development and implementation of WSP for Buildings to safeguard the drinking water quality in their buildings.

12. The potential hazards/hazardous events in the drinking water supply system and internal plumbing system are characterized based on the likelihood and severity of occurrence followed by derivation of the corresponding control measures, critical limits and monitoring procedures. Corrective actions are also predetermined for implementation upon deviations of performance of the control measures and exceedance of critical limits as detected by the operational monitoring. The above assessment results are summarized in the risk summary tables for each stage of the water supply system as illustrated in

an example given in **Annex 3**.

13. Procedures for normal operation are documented to ensure that the drinking water supply systems are operating at optimum levels. Contingency plans have also been put in place for operations under emergency or incident situations. Furthermore, supporting programmes including staff training are included in the DWQMS to ensure that the relevant officers have the competence to play their roles in assuring the safety of drinking water.

14. Dedicated officers have been assigned to promote awareness of water safety and handle media enquiries and questions in the event of water quality incidents to enhance communications. Among other activities, the water quality data of DJ water and drinking water are published at half-yearly intervals in the public domain with a view to enhancing the dissemination of information and transparency of data.

15. The DWQMS will be reviewed on an annual basis by a DWQMS Steering Group chaired by an assistant director of WSD. In addition to updating of procedures and documents, the review will also take into account surveillance or audit findings (please see below) and lessons learnt during implementation with a view to improving preparedness and planning for any future events.

Water Quality Monitoring Programme

16. The effectiveness of the WSP can be verified by WSD's comprehensive water quality monitoring programme covering each stage of the supply process from water sources to consumers' tap. The Water Science Division (WScD) of WSD with its laboratories is responsible for the water quality monitoring programme.

17. For monitoring of raw water sources, the quality of DJ water supply received at Muk Wu Pumping Stations (MWPS) and local yield gathered in large impounding reservoirs is monitored through continuous on-line water quality monitoring systems. Regular detailed laboratory analyses are also conducted for water samples collected at MWPS, impounding reservoirs and strategic locations in the water gathering grounds. In addition, WSD has developed a Biosensing Alert System using zebrafish and a light-emitting bacterium to detect any abnormalities in the quality of raw water (in particular the DJ water received).

18. At water treatment works, the water quality is monitored through a three-tier system consisting of:

(i) on-line water quality monitoring system providing continuous monitoring of key operational parameters such as turbidity, pH and fluoride and free residual chlorine to allow rapid responses to variation of water quality;

(ii) primary control tests such as pH, turbidity, fluoride, ammonia, manganese, free residual chlorine and jar test carried out regularly by works operators for verification of the on-line water quality analysers as well as adjustment of chemical dosages; and

(iii) laboratory testing of regular samples taken from different stages of treatment at designated sampling and testing schedule to ensure that the treatment process is optimized and to verify that the treated water quality is in compliance with WSD's final treated water quality targets (see **Annex 4**).

19. Quality of treated water after leaving water treatment works is monitored throughout the distribution system by taking regular samples from strategic locations including service reservoirs, connection points, and from randomly selected publicly accessible consumers' taps[3] to check the microbial[4] and general chemical quality[5] of water supply. Samples taken at randomly selected publicly accessible consumers' taps can serve as a surrogate for treated water quality at connection points as well as an indication of the cleanliness of the internal plumbing systems of consumers' premises.

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[3] The sampling locations, which are randomly selected from the database of the Laboratory Information Management System of the WScD of WSD, include shopping centres, clinics, community facilities, sports grounds, markets, government offices, estate management offices, etc.

[4] In view of the tropical climate, high population density and prevalence of high rise buildings as well as the potential consequence of a large outbreak of waterborne diseases in Hong Kong, it is of paramount importance and a top priority for the dense Hong Kong urban context that an adequate number of treated fresh water samples are taken from the distribution system for bacteriological testing for public health protection. About 26 000 (of which about 16 000 from publicly accessible consumers' taps) drinking water samples have been taken annually for microbiological testing including *E.coli*, total coliforms and heterotrophic plate counts (HPC) from water treatment works, service reservoirs, accessible connection points and randomly selected publicly accessible consumer taps.

[5] Test results of turbidity, conductivity, free residual chlorine indicate the general cleanliness and maintenance conditions of the internal plumbing systems, and test result of fluoride can be used to check against the target level in drinking water as recommended by DH.

20. On 21 September 2017, the Government announced the Action Plan for Enhancing the Drinking Water Safety in Hong Kong which includes, inter alia, an enhanced water quality monitoring programme (Enhanced Programme) to collect random water samples from consumers' taps for testing the six metals (viz. lead, cadmium, chromium, nickel, copper, and antimony) which could be present in the internal plumbing system. Following the international practice, about 670 premises will be randomly selected over the territory each year calculated according to the population. The collection and testing of water samples under the Enhanced Programme has commenced in December 2017.

Surveillance Arrangement

21. An important component of the DWQMS is the surveillance. According to WHO Guidelines, surveillance is the continuous and vigilant public health assessment and overview of the safety and acceptability of the drinking water supply. The surveillance agencies are responsible for an independent and periodic review of all aspects of the drinking water quality and public health safety.

22 In gist, there are three main parties involving in the surveillance of drinking water quality in Hong Kong. They are the Special Duty Unit (SDU) of WSD, the Drinking Water Safety Unit (DWSU) of the Development Bureau (DEVB) and DH.

23. The SDU established within WSD is directly under the Director of Water Supplies (DWS) and is to, inter alia, impartially review the water quality monitoring reports of the WScD at regular intervals before submitting to DEVB and the DH, conduct internal audits of the water quality monitoring work and other activities of the DWQMS, and represent WSD in liaising with DEVB and DH on drinking water quality issues. SDU will also alert DWS, DWSU and DH immediately upon detection of non-compliant water quality monitoring results and drinking water quality incidents.

24. DWSU, a dedicated team set up in the DEVB, is to oversee the performance of WSD on the quality of drinking water including conducting surveillance inspections and auditing WSD's daily operations. When necessary, DWSU will engage independent auditing firms to conduct additional external audits on WSD's DWQMS.

25. The DH, through the current establishment of the Task Group for Health-related Issues of Drinking Water Supply (Task Group), advises the DWS on the health-related issues of drinking water supply in general, and necessary actions when the drinking water quality exceeds the Hong Kong Drinking Water Standards as a trend or on occasions. Task Group meetings are held among the DWSU, WSD and DH on a half-yearly basis or as needed to review and discuss the drinking water quality and related public health issues, including how best to strengthen its role in the surveillance of these issues.

26. Upon the establishment of Drinking Water Safety Advisory Committee (the Committee), DWSU, who will provide secretariat support to the Committee, will prepare regular summary of water quality monitoring data and inspection reports for deliberation in the Committee with a view to enhancing the impartiality of the water safety assurance.

Development Bureau
Water Supplies Department
January 2018

Dongjiang Water Quality for the Period of October 2016 - September 2017
as received in Hong Kong at Muk Wu Pumping Station

Comparison with GB3838-2002 Type II Standard for Surface Water

General Points

- The Guangdong authorities commenced the construction of a dedicated aqueduct from Taiyuan along Dongjiang to the Shenzhen Reservoir in 2000. Since its commissioning in 2003, the quality of Dongjiang water transferred to Hong Kong has significantly improved.
- In the agreement on Dongjiang water supply to Hong Kong signed on 28 May 2015, the Guangdong authorities would maintain the quality of the water delivered to Hong Kong to meet the national standard set out for Type II waters (applicable to the abstraction for human consumption in first class protection area) in the "Environmental Quality Standards for Surface Water (GB3838-2002)".
- Compliance of water quality is based on the annual average of monitoring data in accordance with international practice. There might be occasional deviations of certain water quality parameters from the standard values of GB3838-2002 Type II waters, such as in July and August of 2017 there were heavy rainfall at Huizhou and other upstream areas of Dongjiang River Basin and flood discharge at Shenzhen Sha Wan River due to rainstorms, thus leading to deviations of certain water quality parameters in a short period of time. However, the Dongjiang water with temporary deviations from the relevant water quality standard values was still well within the treatment capability of water treatment works of the Water Supplies Department. In fact, all raw water including Dongjiang water has to go through a series of stringent treatment processes at water treatment works, including filtration and disinfection, prior to distribution to consumers. During this period, the chemical, bacteriological and radiological quality of treated water fully complied with the World Health Organization's Guidelines for Drinking-water Quality (2011). For details, please refer to the information on drinking water quality data.
- All samples were taken at Muk Wu Pumping Station where Dongjiang water was received.
- The Dongjiang water quality for this period complied with the standard set out for Type II waters in the "Environmental Quality Standards for Surface Water (GB3838-2002)".

Parameters	Unit	Monitoring Data (10/2016 - 09/2017)			GB3838-2002 Type II Standard Value	Compliance (Please see general points above)
		Minimum	Maximum	Average		
pH	pH	7.1	8.3	7.4	6 - 9	✓
Dissolved Oxygen	mg/L	5.1	10	7.6	≥ 6	✓
Permanganate Index	mg/L	1	2	2	≤ 4	✓
Chemical Oxygen Demand (COD)	mg/L	< 5	10	5	≤ 15	✓
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	< 2.0	2.8	< 2.0	≤ 3	✓
Ammoniacal Nitrogen	mg/L	< 0.02	0.16	0.04	≤ 0.5	✓
Total Phosphorus (as P)	mg/L	0.019	0.100	0.051	≤ 0.1	✓
Copper	mg/L	< 0.003	0.005	< 0.003	≤ 1.0	✓
Zinc	mg/L	< 0.01	0.04	< 0.01	≤ 1.0	✓
Fluoride (as F^-)	mg/L	< 0.10	0.27	0.20	≤ 1.0	✓
Selenium	mg/L	< 0.003	< 0.003	< 0.003	≤ 0.01	✓
Arsenic	mg/L	< 0.001	0.002	0.001	≤ 0.05	✓
Mercury	mg/L	< 0.00005	< 0.00005	< 0.00005	≤ 0.00005	✓
Cadmium	mg/L	< 0.001	< 0.001	< 0.001	≤ 0.005	✓
Chromium (VI)	mg/L	< 0.001 (Note 1)	0.002 (Note 1)	< 0.001 (Note 1)	≤ 0.05	✓
Lead	mg/L	< 0.001	0.002	< 0.001	≤ 0.01	✓
Cyanide	mg/L	< 0.01	< 0.01	< 0.01	≤ 0.05	✓
Volatile Phenols	mg/L	< 0.001	< 0.001	< 0.001	≤ 0.002	✓
Petroleum Hydrocarbons	mg/L	< 0.0125	< 0.0125	< 0.0125	≤ 0.05	✓
Anionic Surfactants	mg/L	< 0.1	< 0.1	< 0.1	≤ 0.2	✓
Sulphides	mg/L	< 0.05	< 0.05	< 0.05	≤ 0.1	✓

Parameters	Unit	Monitoring Data (10/2016 - 09/2017)			GB3838-2002 Type II Standard Value	Compliance (Please see general points above)
		Minimum	Maximum	Average		
Faecal Coliforms	no./L	10 (Note 2)	70000 (Note 2)	1100 (Note 2)	≤ 2000	✓
Sulphate (as SO_4^{2-})	mg/L	8	12	10	≤ 250	✓
Chloride (as Cl^-)	mg/L	< 5	10	7	≤ 250	✓
Nitrate (as N)	mg/L	1.0	2.1	1.6	≤ 10	✓
Iron	mg/L	0.02	0.52	0.07	≤ 0.3	✓
Manganese	mg/L	< 0.01	0.19	0.03	≤ 0.1	✓
Benzo[a]pyrene	mg/L	$< 2.0 \times 10^{-6}$	$< 2.0 \times 10^{-6}$	$< 2.0 \times 10^{-6}$	$< 2.8 \times 10^{-6}$	✓

Note:

(1) Analytical result for chromium(III) and chromium(VI).

(2) Analytical result for *E. coli.*

Drinking Water Quality for the Period of October 2016 - September 2017

Part A. Microbiological quality

General Points

- Hong Kong enjoys one of the safest water supplies in the world. Since August 2012, we monitor the quality of our drinking water supply according to the World Health Organization's (WHO) Guidelines for Drinking-water Quality (2011). The WHO recommends a set of Guideline Values (GVs) representing the concentration of constituents in drinking water that will not result in any significant health risk to a consumer weighing 60 kg over a lifetime consumption of 2 litres per day for 70 years.

- In extreme cases of contamination, we will take concerted actions with the Department of Health. The public will be informed to take appropriate measures if necessary.

- Samples were taken at water treatment works, service reservoirs, connection points and publicly accessible consumer taps.

- Based on water samples taken during this period, the testing results revealed that the drinking water quality for this period complied with the World Health Organization's Guidelines for Drinking-water Quality (2011).

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)			WHO 2011 Guideline Value	Compliance
		Minimum	Maximum	Average		
E. coli	cfu* per 100 mL	0	0	0	0	✓
Total Coliforms#	cfu* per 100 mL	0	0	0	-	-
Cryptosporidium@	no. of oocyst per L	0.00	0.00	0.00	-	-
Giardia@	no. of cyst per L	0.00	0.00	0.00	-	-

Note:

(1) This is a summary report on drinking water quality.

(2) All values are compiled in accordance with requirements stipulated by the current quality assurance protocol of the Water Science Division of WSD.

(3) * Colony forming unit (cfu)

WHO 2011 has not established health-related GV for Total Coliforms.

@ Although the WHO has not established any health-related GV for Cryptosporidium or Giardia in drinking water, we also monitor Cryptosporidium and Giardia in our drinking water. The monitoring data of 0.00 per litre represents no oocyst or cyst detected in a volume of not less than 100 litres of treated water sample.

Drinking Water Quality for the Period of October 2016 - September 2017

Part B. Chemicals of health significance as described by World Health Organization's Guidelines for Drinking-water Quality 2011

General Points

- Hong Kong enjoys one of the safest water supplies in the world. Since August 2012, we monitor the quality of our drinking water supply according to the World Health Organization's (WHO) Guidelines for Drinking-water Quality (2011). The WHO recommends a set of Guideline Values (GVs) representing the concentration of constituents in drinking water that will not result in any significant health risk to a consumer weighing 60 kg over a lifetime consumption of 2 litres per day for 70 years.
- Some GVs are recommended by WHO as provisional GVs. (See Note **3**)
- Occasional deviations above the WHO GVs do not mean that the water is unsuitable for consumption. Large safety margins have been allowed for in the derivation of the GVs.
- In extreme cases of contamination, we will take concerted actions with the Department of Health. The public will be informed to take appropriate measures if necessary.
- Samples were taken at water treatment works, service reservoirs, connection points and publicly accessible consumer taps.
- Based on water samples taken during this period, the testing results revealed that the drinking water quality for this period complied with the World Health Organization's Guidelines for Drinking-water Quality (2011).

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)			WHO 2011 Guideline Value	Compliance
		Minimum	Maximum	Average		
Acrylamide	µg/L	< 0.4	< 0.4	< 0.4	0.5	✓
Alachlor	µg/L	< 5.0	< 5.0	< 5.0	20	✓
Aldicarb	µg/L	< 2.5	< 2.5	< 2.5	10	✓
Aldrin and Dieldrin	µg/L	< 0.008	< 0.008	< 0.008	0.03	✓
Antimony	mg/L	< 0.001	< 0.001	< 0.001	0.02	✓
Arsenic	mg/L	< 0.001	< 0.001	< 0.001	0.01 (A,T)	✓
Atrazine and its chloro-s-triazine metabolites	µg/L	< 25	< 25	< 25	100	✓
Barium	mg/L	0.003	0.020	0.013	0.7	✓
Benzene	µg/L	< 2.5	< 2.5	< 2.5	10	✓
Benzo(a)pyrene	µg/L	< 0.0020	< 0.0020	< 0.0020	0.7	✓

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)			WHO 2011 Guideline Value	Compliance
		Minimum	Maximum	Average		
Boron	mg/L	< 0.02	0.04	0.02	2.4	✓
Bromate	µg/L	< 2.5	< 2.5	< 2.5	10 (A,T)	✓
Bromodichloromethane	µg/L	< 15	15	< 15	60	✓
Bromoform	µg/L	< 25	< 25	< 25	100	✓
Cadmium	mg/L	< 0.001	< 0.001	< 0.001	0.003	✓
Carbofuran	µg/L	< 1.2	< 1.2	< 1.2	7	✓
Carbon tetrachloride	µg/L	< 0.50	< 0.50	< 0.50	4	✓
Chlorate	µg/L	< 175	< 175	< 175	700 (D)	✓
Chlordane	µg/L	< 0.050	< 0.050	< 0.050	0.2	✓
Chlorine	mg/L	< 0.1	1.4	0.7	5 (C)	✓
Chlorite	µg/L	< 50	< 50	< 50	700 (D)	✓
Chloroform	µg/L	< 50	< 50	< 50	300	✓
Chlorotoluron	µg/L	< 7.5	< 7.5	< 7.5	30	✓
Chlorpyrifos	µg/L	< 7.5	< 7.5	< 7.5	30	✓
Chromium	mg/L	< 0.001	0.002	< 0.001	0.05 (P)	✓
Copper	mg/L	< 0.003	0.039	< 0.003	2	✓
Cyanazine	µg/L	< 0.15	< 0.15	< 0.15	0.6	✓
2,4-D (or 2,4-dichlorophenoxyacetic acid)	µg/L	< 7.5	< 7.5	< 7.5	30	✓
2,4-DB (or 4-(2,4-dichlorophenoxy) butyric acid)	µg/L	< 22	< 22	< 22	90	✓
DDT and metabolites	µg/L	< 0.50	< 0.50	< 0.50	1	✓
Di(2-ethylhexyl)phthalate	µg/L	< 2	< 2	< 2	8	✓
Dibromoacetonitrile	µg/L	< 25	< 25	< 25	70	✓
Dibromochloromethane	µg/L	< 25	< 25	< 25	100	✓
1,2-Dibromo-3-chloropropane	µg/L	< 0.25	< 0.25	< 0.25	1	✓
1,2-Dibromoethane	µg/L	< 0.10	< 0.10	< 0.10	0.4 (P)	✓
Dichloroacetate	µg/L	< 12	14	< 12	50 (D)	✓

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)			WHO 2011 Guideline Value	Compliance
		Minimum	Maximum	Average		
Dichloroacetonitrile	µg/L	< 5.0	< 5.0	< 5.0	20 (P)	✓
1,2-Dichlorobenzene	µg/L	< 250	< 250	< 250	1000 (C)	✓
1,4-Dichlorobenzene	µg/L	< 75	< 75	< 75	300 (C)	✓
1,2-Dichloroethane	µg/L	< 7.5	< 7.5	< 7.5	30	✓
1,2-Dichloroethene	µg/L	< 12	< 12	< 12	50	✓
Dichloromethane	µg/L	< 5.0	< 5.0	< 5.0	20	✓
1,2-Dichloropropane	µg/L	< 5.0	< 5.0	< 5.0	40 (P)	✓
1,3-Dichloropropene	µg/L	< 5.0	< 5.0	< 5.0	20	✓
Dichlorprop (or 2,4-DP)	µg/L	< 25	< 25	< 25	100	✓
Dimethoate	µg/L	< 1.5	< 1.5	< 1.5	6	✓
1,4-Dioxane	µg/L	< 12.5	< 12.5	< 12.5	50	✓
Edetic acid (EDTA)	µg/L	< 50	< 50	< 50	600	✓
Endrin	µg/L	< 0.15	< 0.15	< 0.15	0.6	✓
Epichlorohydrin	µg/L	< 0.4	< 0.4	< 0.4	0.4 (P)	✓
Ethylbenzene	µg/L	< 75	< 75	< 75	300 (C)	✓
Fenoprop (or 2,4,5-TP)	µg/L	< 2.2	< 2.2	< 2.2	9	✓
Fluoride	mg/L	0.18	0.65	0.48	1.5	✓
Hexachlorobutadiene	µg/L	< 0.15	< 0.15	< 0.15	0.6	✓
Hydroxyatrazine	µg/L	< 50	< 50	< 50	200	✓
Isoproturon	µg/L	< 2.2	< 2.2	< 2.2	9	✓
Lead	mg/L	< 0.001	0.002	< 0.001	0.01 (A,T)	✓
Lindane	µg/L	< 0.50	< 0.50	< 0.50	2	✓
MCPA (or 4-(2-methyl-4-chlorophenoxy) acetic acid)	µg/L	< 2.0	< 2.0	< 2.0	2	✓
Mecoprop (or MCPP)	µg/L	< 2.5	< 2.5	< 2.5	10	✓
Mercury	mg/L	< 0.00005	< 0.00005	< 0.00005	0.006	✓
Methoxychlor	µg/L	< 5.0	< 5.0	< 5.0	20	✓

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)			WHO 2011 Guideline Value	Compliance
		Minimum	Maximum	Average		
Metolachlor	µg/L	< 2.5	< 2.5	< 2.5	10	✓
Microcystin-LR (total)	µg/L	< 0.5	< 0.5	< 0.5	1 (P)	✓
Molinate	µg/L	< 1.5	< 1.5	< 1.5	6	✓
Monochloramine	mg/L	< 1.0	< 1.0	< 1.0	3	✓
Monochloroacetate	µg/L	< 10	< 10	< 10	20	✓
Nickel	mg/L	< 0.001	0.009	0.004	0.07	✓
Nitrate (as NO_3^-)	mg/L	< 2.5	15	4.5	50	✓
Nitrilotriacetic acid	µg/L	< 50	< 50	< 50	200	✓
Nitrite (as NO_2^-)	mg/L	< 0.004	0.011	< 0.004	3	✓
N-Nitrosodimethylamine	µg/L	< 0.025	< 0.025	< 0.025	0.1	✓
Pendimethalin	µg/L	< 5.0	< 5.0	< 5.0	20	✓
Pentachlorophenol	µg/L	< 2.2	< 2.2	< 2.2	9 (P)	✓
Selenium	mg/L	< 0.003	< 0.003	< 0.003	0.04 (P)	✓
Simazine	µg/L	< 0.50	< 0.50	< 0.50	2	✓
Sodium dichloroisocyanurate (as cyanuric acid)	mg/L	< 10	< 10	< 10	40	✓
Styrene	µg/L	< 5.0	< 5.0	< 5.0	20 (C)	✓
2,4,5-T (or 2,4,5-trichlorophenoxy acetic acid)	µg/L	< 2.2	< 2.2	< 2.2	9	✓
Terbuthylazine	µg/L	< 1.8	< 1.8	< 1.8	7	✓
Tetrachloroethene	µg/L	< 10	< 10	< 10	40	✓
Toluene	µg/L	< 175	< 175	< 175	700 (C)	✓
Trichloroacetate	µg/L	< 25	< 25	< 25	200	✓
Trichloroethene	µg/L	< 18	< 18	< 18	20 (P)	✓
2,4,6-Trichlorophenol	µg/L	< 50	< 50	< 50	200 (C)	✓
Trifluralin	µg/L	< 5.0	< 5.0	< 5.0	20	✓
Uranium	mg/L	< 0.0002	0.0005	< 0.0002	0.03 (P)	✓
Vinyl chloride	µg/L	< 0.2	< 0.2	< 0.2	0.3	✓

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)			WHO 2011 Guideline Value	Compliance
		Minimum	Maximum	Average		
Xylenes	µg/L	< 125	< 125	< 125	500 (C)	✓

Note:

(1) This is a summary report on drinking water quality.

(2) All values are compiled in accordance with requirements stipulated by the current quality assurance protocol of the Water Science Division of WSD.

(3) According to WHO 2011:

P = provisional guideline value because of uncertainties in the health database.

T = provisional guideline value as calculated guideline value is below the level that can be achieved through practical treatment methods, source protection, etc.

A = provisional guideline value as calculated guideline value is below the achievable quantification level.

D = provisional guideline value as disinfection may result in the guideline value being exceeded.

C = concentrations of the substance at or below the health-based guideline value may affect the appearance, taste or odour of the water, leading to consumer complaints.

Part C Radiological quality

General Points

- Hong Kong enjoys one of the safest water supplies in the world. Since August 2012, we monitor the quality of our drinking water supply according to the World Health Organization's (WHO) Guidelines for Drinking-water Quality (2011).
- According to the recommendation of the WHO, the screening levels for radiation in drinking water are 0.5 Bq/L for gross alpha activity and 1.0 Bq/L for gross beta activity respectively, below which no further investigation or detailed analysis for specific radionuclides is required.
- In extreme cases of contamination, we will take concerted actions with the Department of Health. The public will be informed to take appropriate measures if necessary.
- Samples were taken at water treatment works, connection points and publicly accessible consumer taps.
- Based on water samples taken during this period, the radioactivity level of drinking water was well below the screening levels for gross alpha and gross beta activities recommended by the WHO 2011 and was safe for consumption.

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)			WHO 2011 Screening Level	Below Screening Level
		Minimum	Maximum	Average		
Gross alpha activity	Bq/L	< 0.1	< 0.1	< 0.1	0.5	✓
Gross beta activity	Bq/L	< 0.2	< 0.2	< 0.2	1.0	✓

Note:

(1) This is a summary report on drinking water quality.

(2) All values are compiled in accordance with requirements stipulated by the current quality assurance protocol of the Water Science Division of WSD.

(3) Reporting values for gross alpha and gross beta activities are set at 20% of their respective WHO screening levels.

Drinking Water Quality for the Period of October 2016 - September 2017

Part D. Other parameters

Parameter	Unit	Monitoring Data (10/2016 - 09/2017)		
		Minimum	**Maximum**	**Average**
pH at 25 ^{o}C	pH	7.3	9.3	8.5
Colour	Hazen unit	< 5	< 5	< 5
Turbidity	NTU	< 0.1	3.0	0.3
Conductivity at 25 ^{o}C	µS/cm	40	212	118
Temperature	^{o}C	13.0	33.0	24.3
Total alkalinity (as $CaCO_3$)	mg/L	7	84	22
Total hardness (as $CaCO_3$)	mg/L	< 5	59	32
Calcium	mg/L	0.9	19	11
Magnesium	mg/L	0.37	2.3	1.3
Chloride	mg/L	< 5	16	8
Sulphate	mg/L	4	20	12
Ortho-phosphates (as PO_4)	mg/L	< 0.01	0.02	< 0.01
Iron	mg/L	< 0.01	0.07	< 0.01
Aluminium	mg/L	< 0.01	0.10	0.02
Silica (as SiO_2)	mg/L	2.2	20	10
Manganese	mg/L	< 0.01	0.02	< 0.01

Note:

(1) This is a summary report on drinking water quality.

(2) All values are compiled in accordance with requirements stipulated by the current quality assurance protocol of the Water Science Division of WSD.

Water Supplies Department

DWQMS Annex 4a
July 2017
Version No. 1

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
1(i). Deterioration of raw water quality due to meteorological and hydrological conditions - Thermal stratification	- Seasonal water temperature changes - Hot and sunny periods	Moderately likely (3)	Minor (2)	6	- Alerting downstream WTWs **Ch/RM or Ch/T(1)**	- Reservoir water quality at abstraction level or surface water level: - Turbidity < criteria set out in the guidelines to SDOIC of relevant WTWs - pH 6.0 to 9.0 - Ammoniacal nitrogen ≤ 0.50 mg/L - Manganese ≤0.10 mg/L	- Turbidity criteria as set out in relevant SDOIC guidelines are exceeded - pH <6.0 or >9.0 - Ammoniacal nitrogen > 0.50 mg/L - Manganese >0.10 mg/L	- Ammoniacal nitrogen - Manganese - pH - Dissolved oxygen - Turbidity - Water temperature	- Daily to Quarterly	**Ch/RM or Ch/T(1)**	- Step up water quality test frequency - Inform relevant Ch/T and E/HW to take appropriate remedial measures All the above by **Ch/RM or Ch/T(1)** - Select other appropriate draw-off level - Install or switch on aeration system as appropriate - Adjust chemical dosing at water treatment works - Blending of raw water at WTW - All the above by **E/HW**

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
1(ii). Deterioration of raw water quality due to meteorological and hydrological conditions - Algal blooms	- Hot and sunny periods - Ingress of nutrients from polluted inflows	Plover Cove reservoir Likely (4)	Moderate (3)	12	- Protect water source and prevent contamination in accordance with DI810 - Minimize the ingress of nutrients to the reservoir in accordance with DI810 and DI1039 - All the above by **E/HW** - Restrict or regulate industrial, agricultural or housing development in the catchment of reservoir in accordance with DI810 **[WSD & DLO]** - Maintain public toilets near reservoirs in clean and hygienic conditions **[AFCD**] - All effluents from village houses and septic tank soakaway system are required to connect to the sewage networks if available **[DSD**] - Alerting downstream WTWs **Ch/RM or Ch/T(1)** - Fish stocking **Ch/RM(1)**	- Reservoir water quality at abstraction level or surface water level: - No proliferation of algae in reservoir - No abnormal increase in number of dead fish - No odour detected - pH 6.0 to 9.0 - Total phosphate ≤0.3 mg/L	- Large quantity of algae in reservoir and signs of prolific algal activities or algal scum - Abnormal increase in number of dead fish - Odour (fishy/earthy /musty) due to algae - pH >9.0 - Total phosphate >0.3 mg/L	- Odour - Algal count -Chlorophyll-a - Ammoniacal nitrogen - Total phosphate - pH - Water temperature - Nitrate nitrogen - Silica - Turbidity - Regular site inspection and patrolling - On-line monitoring DJ water quality at Muk Wu P/S	- Daily to Quarterly - Daily to Quarterly - Continuous	**Ch/RM or Ch/T(1)** **E/HW**	- Step up water quality test frequency - Inform relevant Ch/T and E/HW to take appropriate remedial measures - All the above by **Ch/RM or Ch/T(1)** - Dosing of PAC at WTW and review the need for pre-chlorination **[Ch/T]** - Harvesting of algae - Clear dead fish (if present) - Increase inspection and patrolling frequency - Blending of raw water at WTW - Select other appropriate draw-off level - All the above by **E/HW**- Check septic tanks or soakaway systems at public toilets and increase desludging frequency **[AFCD], [FEHD]**
		Other reservoirs Moderately Likely (2)	Minor (3)	6							

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
1(iii). Deterioration of raw water quality due to meteorological and hydrological conditions - Low reservoir storage level	- Drought - Drawing down of water level due to operational requirements	Unlikely (2)	Moderate (3)	6	- Monitor water levels of impounding reservoirs - Take minimum water levels into account during the planning of draw-off patterns with reference to previous records/experience/study as well as advice from Chemist All the above by **[E/HW** - Alerting downstream WTWs **Ch/RM or Ch/T(1)**	- Water level maintained above the minimum level (50% of full capacity or based on statistics of the lowest storage level of the past 5 years whichever is the higher) - Reservoir water quality reference values: pH 6.0 to 9.0 Ammoniacal nitrogen ≤0.50 mg/L Total phosphate ≤0.30 mg/L Manganese ≤0.10 mg/L Iron ≤0.50 mg/L Turbidity < criteria set out in guidelines to SDOIC of relevant WTWs. -Water level maintained above the value reviewed and endorsed by SCh(2) in the monthly Reservoir Draw-off Pattern of HI, PC,SP & TLC	- Water level lower than the minimum level - Water quality parameters exceed reference values - Water levels at HI, PC, SP and TLC lower than the endorsed values	- pH - Ammoniacal nitrogen - Total phosphate - Manganese - Iron - Turbidity - Water level - Regular site inspection and patrolling	- Weekly to Monthly - Daily - Weekly to Quarterly	- **Ch/RM or Ch/T(1)** **E/HW**	- Select other appropriate draw-off levels if necessary - Clear dead fish (if present) - Increase inspection and patrolling frequency - Blending of raw water at WTW - Inform respective Ch/RM and Ch/T(1) - Step up raw water quality test frequency at relevant WTWs as advised by Ch/T - All the above by **E/HW** - Inform the relevant Ch/T and E/HW to take appropriate remedial measures **Ch/RM or Ch/T(1)**

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
1(iv). Deterioration of raw water quality due to meteorological and hydrological conditions - Occurrence of objectionable taste and odour in reservoir water	- Microbial activities (cyanobacteria, actinomycetes, fungi, etc.) - Ingress of contaminants from surface run-off during heavy rainfall	Moderately likely (3)	Moderate (3)	9	- Protect water source and prevent contamination in accordance with DI810 - Minimize the ingress of nutrients to the reservoir in accordance with DI810 and DI1039 - All the above by **E/HW** - Alerting downstream WTWs **Ch/RM** - Fish stocking **Ch/RM(1)**	- Reservoir water quality at abstraction level or surface water level: - No proliferation of algae in reservoir - No odour detected - MIB conc ≤ 20ng/L - pH 6.0 to 9.0	- Large quantity of algae in reservoir and sings of prolific algal activities or algal scum - Odour (fishy/earthy/musty) due to algae - MIB conc >20ng/L - pH >9.0	- Odour - Algal count - MIB -Chlorophyll-a - Ammoniacal nitrogen - Total phosphate - pH - Water temperature - Nitrate nitrogen - Silica - Turbidity - Regular site inspection and patrolling	- Daily to Quarterly - Daily to Quarterly	**Ch/RM** **E/HW**	- Step up water quality test frequency - Inform SCh(2) and/or relevant Ch/T and E/HW to take appropriate remedial measures - All the above by Ch/RM - Step up T&O monitoring at WTWs - Dosing of PAC at WTW and review the need for pre-chlorination **[Ch/T]** - Select other appropriate draw-off level - Install or switch on aeration system as appropriate - Harvesting of algae - Increase inspection and patrolling frequency - Blending of raw water at WTW - All the above by **E/HW**

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
2(i). Pollution of raw water from human activities - Oil or chemical spills	- Improper management/ maintenance of works sites - Traffic accidents	Unlikely (2)	Moderate (3)	6	- Prohibit the storage or use of hazardous chemical at or near reservoir - Improve security fencing - Inspection and Patrolling of the establishment/ point source - All of the above by **E/HW** - Alerting downstream WTWs **Ch/RM or Ch/T(1)**	- No fuel contamination or oil slicks in reservoir - No hazardous chemical contamination in reservoir - No abnormal increase in number of dead fish - No sign of gross pollution	- Appearance or suspicion of fuel contamination - Appearance or suspicion of chemical contamination - Abnormal increase of number of dead fish - Sign of gross pollution - Detection of contaminations by water quality monitoring	- Regular inspection of reservoir - As set out in sectional sampling and testing programmes	- Weekly to Quarterly - As set out in sectional sampling and testing programmes	**E/HW** - **Ch/RM or Ch/T(1)**	- Conduct sampling and analysis immediately - Inform relevant Ch/T and E/HW to take appropriate remedial measures - All the above by **Ch/RM or Ch/T(1)** - Inform the Fire Services Department and the Police as appropriate - Select other appropriate draw-off level - Clear dead fish (if present) - Use appropriate methods or material to contain, control, clear and prevent the spreading of contamination - Blending of raw water at WTW - Increase inspection and patrolling frequency - All the above by **E/HW**

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
2(ii). Pollution of raw water from human activities - Surface run-off from construction sites/ maintenance activities	Improper management/ maintenance of works sites	Unlikely (2)	Moderate (3)	6	- Alerting downstream WTWs **Ch/RM or Ch/T(1)** - Patrolling of the establishment/point source **E/HW**	- No fuel contamination or oil slicks in reservoir - No hazardous chemical contamination in reservoir - No abnormal increase in number of dead fish - Turbidity <criteria set out in guidelines to SDOIC of relevant WTWs - Manganese ≤0.10 mg/L	- The appearance or suspicion of fuel contamination - The appearance or suspicion of chemical contamination - Abnormal increase of number of dead fish - Turbidity criteria in relevant SDOIC guidelines are exceeded - Manganese >0.10 mg/L	- Manganese - Turbidity - Regular inspection and patrolling	- Daily to Quarterly - Daily to Quarterly	**Ch/RM or Ch/T(1)** **E/HW**	- Conduct sampling and analysis immediately - Inform relevant Ch/T and E/HW to take appropriate remedial measures - All the above by **Ch/RM or Ch/T(1)** - Select other appropriate draw-off level - Clear dead fish (if present) - Increase inspection and patrolling frequency - Blending of raw water at WTW - All the above by **E/HW**

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
2(iii). Pollution of raw water from human activities - Illegal activities	- Littering - Waste dumping - Fish poaching - Swimming - Ritual release of animals - Cycling	Unlikely (2)	Moderate (3)	6	- Public education - Enforcement of WWO - Improve security fencing - Erection of warning signposts - Inspection and Patrolling of the establishment/ point source - All of the above by **E/HW** - Alerting downstream WTWs **Ch/RM or Ch/T(1)**	- No littering, swimming or release of animals - No fuel contamination or oil slicks in reservoir - No hazardous chemical contamination in reservoir - No abnormal increase in number of dead fish - No sign of gross pollution -No cycling activities	- Appearance or suspicion of fuel contamination - Appearance or suspicion of chemical contamination - Abnormal increase of number of dead fish - Sign of gross pollution - Detection of contaminations by water quality monitoring - Detection of cycling activities	- Regular inspection and patrolling - As set out in sectional sampling and testing programmes	- Weekly to Quarterly - As set out in sectional sampling and testing programmes	**E/HW** **- Ch/RM or Ch/T(1)**	- Conduct sampling and analysis immediately - Inform relevant Ch/T and E/HW to take appropriate remedial measures - All the above by **Ch/RM or Ch/T(1)** - Inform the Police as appropriate - Select other appropriate draw-off level - Clear dead fish (if present) - Use appropriate methods or material to contain, control, clear and prevent the spreading of contamination - Blending of raw water at WTW - Increase inspection and patrolling frequency - All the above by **E/HW**

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	
2(iv). Pollution of raw water from human activities - Sabotage	- Vandalism - Terrorist attack	Rare (1)	Catastrophic (5)	5	- Improve security fencing - Inspection and Patrolling of the establishment/ point source - All of the above by **E/HW** - Alerting downstream WTWs **Ch/RM or Ch/T(1)**	- No fuel contamination or oil slicks in reservoir - No hazardous chemical contamination in reservoir - No abnormal increase in number of dead fish - No sign of gross pollution	- Appearance or suspicion of fuel contamination - Appearance or suspicion of chemical contamination - Abnormal increase of number of dead fish - Sign of gross pollution - Detection of contaminations by water quality monitoring	- Regular inspection and patrolling - As set out in sectional sampling and testing programmes	- Quarterly - As set out in sectional sampling and testing programmes	**E/HW** - **Ch/RM or Ch/T(1)**	- Conduct sampling and analysis immediately - Inform relevant Ch/T and E/HW to take appropriate remedial measures - All the above by **Ch/RM or Ch/T(1)** - Inform the Fire Services Department and the Police as appropriate - Select other appropriate draw-off level - Clear dead fish (if present) - Use appropriate methods or material to contain, control, clear and prevent the spreading of contamination - Blending of raw water at WTW - Increase inspection and patrolling frequency - All the above by **E/HW**

Water Safety Plan - Risk Summary Table for Impounding Reservoirs

Hazard/ Hazardous event	Cause	Risk			Control measure	Critical limits		Operational monitoring			Corrective action
		Likelihood (Rating)	Severity (Rating)	Score		Target	Signs for action	Parameter	Frequency	Action by	

3. Ingress of sea water into submarine raw water mains
 	
a) From Harbour Island RWPS to Sai O
 	
b) From Tai Lam Chung Reservoir to Siu Ho Wan
	- Burst/ leakage of submarine mains	Rare(1)	Minor(2)	2	For (a) only
					
					- Monitor delivery pressure at the relevant RWPS **EE/O**
					- Monitor quantity of water pumped and that received at the respective WTWs **EE/O** and **E/HW**
					
					For (a) and (b)
					
					- Alerting downstream WTWs
					Ch/T(5) & Ch/T(11)
						For (a) only
						
						- No abnormally low delivery pressure at the relevant RWPS
						
						For (a) and (b)
						
						- No major discrepancy in water quantity record
						
						- Raw water within the range of acceptable quality
							For (a) only
							
							- Abnormally low delivery pressure at the relevant RWPS
							
							For (a) and (b)
							
							- Major discrepancy in water quantity record- Raw water is outside the range of acceptable quality
								- Delivery pressure at the relevant RWPS
								- Quantity of water pumped and that received at the respective WTWs
								-Conductivity and chloride of raw water received at the relevant WTWs
									- Daily
									
									- Weekly
										- **EE/O** and **E/HW**
										
										Ch/T(5) & Ch/T(11)
											- Inspect and repair the burst/ leak submarine mains **[E/HW]**
											- Reduce pumping at the relevant RWPS (for (a) only) and arrange blending by raw water or switch completely to supply from another source as appropriate (for (a) and (b)) EE/O and/or E/HW as appropriate
											
											For (a) and (b) **E/HW**- Step up frequency of water quality tests and adjust water treatment process **[E/HW and Ch/T(5)&Ch/T(11)]**

Annex 4

Final Treated Water Quality Targets

(A) Water treatment works shall be capable of producing a reliable and continuous supply of wholesome potable water. The final water quality after treatment shall comply with the following standards :

Parameters	WSD's Final Treated Water Quality Targets	WHO 2011 Guideline Value
pH at 25^{o}C	8.2 - 8.8	-
Colour	not exceeding 5 Hazen units	-
Turbidity	not exceeding 1.5 NTU	-
Iron as Fe	not exceeding 0.1 mg/L	-
Manganese as Mn	not exceeding 0.05 mg/L	-
Aluminium as Al	not exceeding 0.10 mg/L	-
Free residual chlorine	0.5 - 1.5 mg/L	5 mg/L
Fluorides as F	$\pm$ 10% of nominal level (current 0.5 mg/L)	1.5 mg/L
Taste and odour	unobjectionable	-
Total Coliforms(no./100mL)	absent	-
E. coli (no./100mL)	absent	absent

(B) For individual water quality parameters not referred to above, they shall meet the guideline values / provisional guideline values in the World Health Organization's "Guidelines for Drinking-water Quality", 4th edition (WHO 2011).