Drainage Services Department

Agreement No. HATS 05/2017 Study on Water Quality Impact arising from Temporary Bypass of Screened Sewage for Modification/Maintenance Works at the Main Pumping Station No. 1 of Stonecutters Island Sewage Treatment Works

Executive Summary of Water Quality Assessment Report

REP-002-02

Final | February 2018

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 258092

Ove Arup & Partners Hong Kong Ltd Level 5 Festival Walk 80 Tat Chee Avenue Kowloon Tong Kowloon Hong Kong www.arup.com

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1 Introduction

- **1.1.1** Arup was commissioned by Drainage Services Department (DSD) of the Hong Kong Special Administrative Region to carry out the Consultancy Services of the Agreement No. HATS 05/2017 Study on Water Quality Impact arising from Temporary Bypass of Screened Sewage for Modification/Maintenance Works at the Main Pumping Station No. 1 of Stonecutters Island Sewage Treatment Works.
- 1.1.2 Currently, there are scheduled maintenance works at Main Pumping Station No. 1 (MPS1) in Stonecutters Island Sewage Treatment Works (SCISTW) and replacement works of 2 large penstocks at the bottom of MPS1. Such works would necessitate the temporary shutdown of MPS1 and hence the bypass of 1.2 million m³/day of screened sewage from the 7 preliminary treatment works (PTWs) within the Harbour Area Treatment Scheme (HATS) Stage 1 catchment which include Chai Wan PTW (CWPTW), Kwun Tong PTW (KTPTW), Shau Kei Wan PTW (SKWPTW), To Kwa Wan PTW (TKWPTW), Tseung Kwan O PTW (TKOPTW), Tsing Yi PTW (TYPTW) and Kwai Chung PTW (KCPTW) into the Victoria Harbour on 5 occasions, each for 2 weeks, in the dry seasons of 2017/18, 2018/19 and 2019/20 (hereafter referred to as "the bypass discharge of HATS").
- **1.1.3** This report is prepared to summarize the results from the quantitative assessment on the water quality impact arising from the bypass discharge of HATS.

2 Water Quality Assessment Criteria

- **2.1.1** The relevant legislations, standards and guidelines applicable to the present study for the assessment of water quality impacts include:
 - Water Quality Objectives (WQO) specified under the Water Pollution Control Ordinance (WPCO) (Cap. 358)
 - Water quality criteria (WQC) established under the "Environmental and Engineering Feasibility Assessment Studies in relation to the Way Forward of the HATS (EEFS)" and "Harbour Area Treatment Scheme Stage 2A Environmental Impact Assessment (HATS 2A EIA)"
- **2.1.2** A summary of the assessment criteria under WPCO, EEFS and HATS 2A EIA is given in **Table 2.1**.

Parameter	Value	Type/ Period	Applicable Zone/ Use	Source
E. coli ^[1]	≪ 610 no./100ml	Geometric mean criteria for beach closure (Non-bathing season:	Bathing waters	Reference to the operational practice that a beach will be closed if it is ranked "Very Poor" (i.e. E. coli >610 for 5 most recent samples or

 Table 2.1
 Summary of the assessment criteria for water quality impact assessment

Parameter	Value	Type/ Period	Applicable Zone/ Use	Source			
		November to February)		1600 for the last record) repeatedly.			
	≤ 610 no./100ml	Annual geometric mean	Secondary contact recreation zones and mariculture zones	WPCO & EEFS/ HATS 2A EIA			
Dissolved oxygen (DO)	≥ 4 mg/l (water column average)	≥ 90% of occasions	Western Buffer, Eastern Buffer, Junk Bay and Victoria Harbour WCZ (except mariculture zones and fish spawning ground)	WPCO & EEFS/ HATS 2A EIA			
	≥ 2 mg/l (bottom DO within 2m from the seabed)	At all times	All WCZ (except mariculture zones)	EEFS/ HATS 2A EIA			
	≥ 5 mg/l (water column average)	Monthly average	Southern WCZ and fish spawning ground	EEFS/ HATS 2A EIA			
	≥ 5 mg/l (water column average)	≥ 90% of occasions	Mariculture zones only	WPCO & EEFS/ HATS 2A EIA			
	≥ 2 mg/l (bottom DO within 2m from the seabed)	≥ 90% of occasions	Mariculture zones only	WPCO & EEFS/ HATS 2A EIA			
Depth- averaged Unionized Ammonia (UIA)	≤ 0.021 mg(N)/l	Annual mean	All WCZ	WPCO & EEFS/ HATS 2A EIA			
Suspended solids (SS)	Not to raise the ambient level by 30%	Annual mean	All WCZ	WPCO			
Sedimentation Rate	≤100 g/m²/day	At all times	Coral sites	EEFS/ HATS 2A EIA			

Notes:

[1] The WQO for bathing beach subzones is that the level of *E.coli* should not exceed 180 per 100 ml, calculated as the geometric mean of all samples collected from March to October inclusive.

3 Water Sensitive Receivers

3.1.1 The major Water Sensitive Receivers (WSRs) in the vicinity of the Project area include gazetted beaches, Fish Culture Zones (FCZs), coral sites, etc.

Table 3.1 tabulates the major WSRs, and **Figure 3.1** shows the locations of these WSRs.

Table 3.1:	List of major WSRs	
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ID	Description
Gazetted B	eaches
B7	Anglers'
B8	Gemini
B9	Hoi Mei Wan
B10	Casam
B11	Lido
B12	Ting Kau
B13	Approach
B14	Ma Wan Tung Wan
B24	Big Wave Bay
B26	Shek O
Fish Cultur	re Zones
F1	Tung Lung Chau
F5	Ma Wan
Coral Sites	
CR25	Junk Bay – South East
CR26	Junk Bay
CR27	Junk Bay
CR28	Junk Bay - Junk Island
CR29	Joss House Bay
CR31	Tung Lung Chau West
CR44	Cape Collinson
CR46	Tung Lung Chau North
CR52	Green Island
CR54	Sandy Bay

4 Assessment Methodology and Model Scenarios

- **4.1.1** The hydrodynamic and water quality model developed with Delft3D model suite was adopted to simulate the hydrodynamic and water quality conditions in this study. The model has been well calibrated and validated. The modelling water quality parameters include *E. coli*, SS, DO, UIA, sedimentation rate, etc.
- **4.1.2** Due to the maintenance works and replacement works of SCISTW, 2-week bypass discharge of 1.2 Mm³/day of screened sewage from the 7 PTWs

within HATS Stage 1 catchment in 3 consecutive dry seasons from 2018 is anticipated. A typical 2-week bypass discharge in dry season has been assessed by the model to evaluate the water quality conditions during the bypass discharge. Two scenarios (Baseline Scenario and Bypass Scenario) have been developed to assess the water quality impacts. Details of the configuration including the discharge locations are discussed in **Table 4.1**.

Table 4.1: Water quality modelling scenarios

Scenario	Configuration
Baseline	 No bypass discharge. Flow rate of SCISTW: 2.21 M m³/day.
Bypass	 Discharge from submarine outfall locations for KTPTW, SKWPTW and TKOPTW. Seawall bypass for KCPTW. Discharge from the submarine outfall location of TYPTW with occasional discharge from the seawall bypass. For the purpose of modelling, the discharge from TYPTW is allocated to both submarine outfall and seawall bypass based on the average proportion being discharged via each. Discharge from both leakage locations and submarine outfall locations for TKWPTW and CWPTW. Flow rate of SCISTW: 0.91 M m³/day for the period of 2-week bypass discharge.

5 Assessment Results

5.1.1 The water quality modelling results for the baseline and bypass discharge scenarios at all water sensitive receivers are tabulated in **Appendix 5.1.** A discussion of the results is given below.

Beaches

- **5.1.2** All 10 bathing beaches identified in this report would comply with the *E*. *coli* criteria of geometric mean of 610 no. per 100ml. The impact due to the bypass would not cause criteria exceedance. Short-term elevation of *E. coli* levels is predicted at Anglers', Gemini, Hoi Mei Wan, Casam, Lido, Ting Kau and Approach Beaches. The water quality conditions were predicted to recover within 2 days after the end of the bypass discharge period.
- **5.1.3** Moreover, the predicted DO and UIA levels at all beaches during the 2-week bypass discharge under Bypass Scenario would comply with the respective criteria.

Fish culture zones

5.1.4 All two FCZs identified in this report would comply with the criteria for DO and *E. coli*. The bypass would not have significant impact on FCZs. Short-term elevation of *E. coli* level are predicted at the two FCZs, despite that, all

the predicted peak *E. coli* values at the FCZ are well below the assessment criteria of not exceeding 610 no. per 100 ml.

5.1.5 Moreover, the predicted SS elevation and UIA levels at all FCZs during the 2-week bypass discharge under Bypass Scenario would comply with the respective criteria.

Coral Sites

5.1.6 The predicted sedimentation rates, SS elevation, DO and UIA levels at all the coral sites would comply with the respective criteria.

Overall Water Quality Assessment Results

5.1.7 The modelling results reveal that the predicted water quality impact of the proposed HATS bypass is acceptable. The predicted impact would be confined mainly in Victoria Harbour and Rambler Channel, and would not cause non-compliance with the relevant water quality assessment criteria at major sensitive receivers such as gazetted beaches, FCZs, coral sites etc. The predicted overall water quality impact would be minor, transient and reversible with recovery of normal water quality within a few days after the bypass.

Figure 3.1

Locations of Water Sensitive Receivers and Discharge Locations



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Appendix 5.1

Summary of Water Quality Modelling Results for Baseline and Bypass Scenarios Project: Agreement No. HATS 05/2017 Study on Water Quality Impact arising from Temporary Bypass of Screened Sewage for Modification/Maintenance Works at the Main Pumping Station No. 1 of Stonecutters Island Sewage Treatment Works

Project No: 258092

 Title:
 Table A5.1a-1
 2-week model results for gazetted beaches

ID			Bottom [1]		Depth Averaged ^[1]													
	Description	10%ile DO (溶解氧) (mg/L)			10%ile DO (溶解氧) (mg/L)			Geometric Mean E.coli (大腸桿菌) (no./100mL)			Mean	UIA (非離子 (mg/L)	子氨氨)	Mean SS (懸浮固體) (mg/L)				
		Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario		
Gazetted Bea	aches																	
B7	Anglers'	>2	6.49	6.22	>4	6.50	6.24	<610	133	216	< 0.021	0.0103	0.0100	N/A	5.6	5.8		
B8	Gemini	>2	6.48	6.20	>4	6.50	6.22	<610	128	242	< 0.021	0.0103	0.0100	N/A	5.5	5.7		
B9	Hoi Mei Wan	>2	6.48	6.19	>4	6.51	6.23	<610	101	213	< 0.021	0.0103	0.0100	N/A	5.4	5.6		
B10	Casam	>2	6.57	6.33	>4	6.60	6.36	<610	151	240	< 0.021	0.0101	0.0099	N/A	5.4	5.6		
B11	Lido	>2	6.55	6.32	>4	6.56	6.30	<610	128	219	< 0.021	0.0102	0.0100	N/A	5.6	5.8		
B12	Ting Kau	>2	6.55	6.35	>4	6.58	6.35	<610	179	283	< 0.021	0.0100	0.0099	N/A	5.7	5.9		
B13	Approach	>2	6.50	6.13	>4	6.52	6.13	<610	293	591	< 0.021	0.0103	0.0105	N/A	5.6	5.9		
B14	Tung Wan, Ma Wan	>2	6.60	6.43	>4	6.62	6.44	<610	19	50	< 0.021	0.0099	0.0095	N/A	5.2	5.4		
B24	Big Wave Bay	>2	7.02	7.01	>5	7.02	7.01	<610	2	22	< 0.021	0.0021	0.0026	N/A	4.0	4.4		
B26	Shek O	>2	6.62	6.62	>5	6.65	6.64	<610	35	35	< 0.021	0.0032	0.0033	N/A	3.6	3.6		

Project: Agreement No. HATS 05/2017 Study on Water Quality Impact arising from Temporary Bypass of Screened Sewage for Modification/Maintenance Works

at the Main Pumping Station No. 1 of Stonecutters Island Sewage Treatment Works

Project No: 258092

Title: Table A5.1a-2 2-week model results for fish culture zones and coral sites

	Description	Bottom ^[1] 10%ile DO (溶解氧) (mg/L)			Maximum Sedimentation Rate (沉降速度) (g/m ² /d)			Depth Averaged ^[1]										
ID								10%ile DO (溶解氧) (mg/L)			Geometric Mean <i>E.coli</i> (大陽桿菌) (no./100mL)			Mean UIA (非離子氨氨) (mg/L)			Max. SS Elevation (懸浮固體) (mg/L)	
		Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario	Criteria	Baseline	Bypass Scenario	Criteria	Bypass Scenario
Fish Culture	Zones																	
F1	Tung Lung Chau	>2	6.7	6.6	N/A	2.05	2.13	>5	6.7	6.6	<610	12	27	< 0.021	0.0033	0.0036	<2.3 [1]	0.1
F5	Ma Wan	>2	6.5	6.3	N/A	6.17	6.33	>5	6.5	6.4	<610	47	81	< 0.021	0.0100	0.0097	<1.2 [1]	0.4
Coral Sites														-				
CR25	Junk Bay - SE	>2	6.7	6.1	<100	2.94	3.91	>4	6.7	6.1	N/A	52	1720	< 0.021	0.0041	0.0072	<1.3 [1]	1.1
CR26	Junk Bay	>2	6.7	6.2	<100	2.98	3.68	>4	6.7	6.2	N/A	19	756	< 0.021	0.0039	0.0066	<1.0 ^[1]	0.9
CR27	Junk Bay	>2	6.5	6.0	<100	2.88	3.31	>4	6.5	6.1	N/A	1793	2042	< 0.021	0.0057	0.0084	<1.0 ^[1]	0.7
CR28	Junk Bay - Junk Island	>2	6.7	6.3	<100	3.02	3.39	>4	6.7	6.2	N/A	14	783	< 0.021	0.0038	0.0062	<1.3 [1]	1.2
CR29	Joss House Bay	>2	6.7	6.7	<100	0.17	0.17	>5	6.7	6.7	N/A	8	10	< 0.021	0.0031	0.0032	<1.2 [1]	0.1
CR31	Tung Lung Chau	>2	6.6	6.5	<100	1.49	1.48	>4	6.6	6.5	N/A	24	84	< 0.021	0.0033	0.0038	<1.2 [1]	0.3
CR44	Cape Collinson	>2	6.7	6.3	<100	2.92	3.72	>4	6.7	6.3	N/A	124	2524	< 0.021	0.0036	0.0061	<1.2 [1]	1.0
CR46	Tung Lung Chau	>2	6.7	6.6	<100	0.83	0.81	>5	6.7	6.7	N/A	17	28	< 0.021	0.0032	0.0034	<1.2 [1]	0.1
CR52	Green Island	>2	6.5	6.3	<100	4.00	4.34	>4	6.5	6.2	N/A	151	168	< 0.021	0.0083	0.0077	<1.4 [1]	0.8
CR54	Sandy Bay	>2	6.5	6.5	<100	2.97	3.05	>4	6.5	6.4	N/A	234	243	< 0.021	0.0065	0.0059	<1.4 [1]	0.3

Notes

[1] Calculated based on 0.3 times of SS levels at the nearest water quality monitoring station in the baseline of the HATS2A EIA report.