Annex 7E

Result Table for Construction Phase Conservative Tracer Dispersion and Nutrient Release

7E TRACER DISPERSION MODEL

7E.1 TOTAL PCBS

According to the results of the elutriate test conducted under this Study, total PCBs showed the highest number of dilution required for compliance to the proposed assessment criterion among all contaminants analyzed in the elutriate test. If assuming the maximum contaminant concentration of total PCBs to be the same as the reporting limit (0.18 µg L^{-1}), it is then 6 times of the corresponding assessment criteria (0.03 µg L^{-1}), which is higher than that required for Arsenic (2 dilutions required) and Mercury (3 dilutions required) based on reviewed elutriate data from past EIAs.

The potential elevation of total PCBs at WSRs is calculated based on modelled tracer concentration at WSRs as well as PCBs contribution per unit sediment loss from the dredging/jetting works according to the following:

Total PCBs at WSRs (µg L^{-1})= Tracer at WSRs (mg L^{-1}) [from model] ×Tracer released per unit Sediment Loss [set to 1 in model] × Total PCBs released per unit Sediment Loss (µg kg^{-1}) [from elutriate test results]

Similar method for calculating level of released sediment-bounded contaminants based on modelled sediment concentration / tracer concentration has been adopted in a number of past approved EIAs, such as EIA for Wanchai Development phase II (AEIAR-042/2001), Shatin to Central Link - Hung Hom to Admiralty Section (AEIAR-166/2012) and Expansion of Sha Tau Kok Sewage Treatment Works (AEIAR-207/2017). Total PCBs released per unit sediment loss is calculated assuming total PCBs levels in elutriate is at its reporting limit (0.18 µg L^{-1}) while that in the blank sampling is 0.00 µg L^{-1}. Based on the procedures for sediment elutriate test stated in the approved MSSTP (***Annex 8A***), 1 L of sediment would be mixed and agitated in 4 L of marine water to allow the release of sediment-bounded contaminants. The sediment dry density is assumed to be 0.7 kg L^{-1} while the density of water is assumed to 1 kg L^{-1}. The amount of total PCBs released per unit mass of sediment is calculated as follow:

Total PCBs released per unit mass of sediment (µg kg^{-1})
= Increase in PCB Concentration in Elutriate × Volume of Elutriate × Density of Seawater / Elutriate ÷ Mass of Sediment
= (0.18µg L^{-1} - 0.00 µg L^{-1}) × 4 L × 1 kg L^{-1} ÷ 0.7 kg
= 1.0286 µg kg^{-1}

According to the results of tracer dispersion model as presented in ***Table 7E1***, the representative WSRs and observation points (in term of contaminant release) among all construction phase modelling scenarios would be the observation point MPA-3 at the southwest corner of the Sha Chau and Lung Kwu Chau Marine Park in both seasons. As presented in ***Table 7E1***, the maximum tracer concentrations predicted at MPA-3 in are 10.4 mg L^{-1} and 149.0

mg L^{-1} respectively in dry and wet seasons. These would result in 1.07×10^{-5} µg L^{-1} and 1.53×10^{-4} µg L^{-1} of total PCBs at MPA-3 in dry and wet seasons respectively. The predictions are both significantly below the corresponding assessment criteria of 0.03 µg L^{-1}. No unacceptable elevation of total PCBs is therefore anticipated at all WSRs in both dry and wet seasons.

The potential elevation of total TIN and UIA at the WSRs is calculated based on modelled tracer concentration at WSRs as well as the results of the elutriate test according to the following calculations.

For TIN:

Total TIN at WSRs (mg L^{-1})= *Tracer at WSRs (mg L^{-1}) [from model]*
×Tracer released per unit Sediment Loss [set to 1 in model]
×TN released per unit Sediment Loss (mg kg^{-1}) [from elutriate test results]

TN released per unit mass of sediment (mg kg^{-1})
= Increase in TN Concentration in Elutriate × Volume of Elutriate × Density of Seawater / Elutriate ÷ Mass of Sediment
= (4.27 mg L^{-1} – 1.10 mg L^{-1}) × 4 L × 1 kg L^{-1} ÷ 0.7 kg
= 18.1143 mg kg^{-1}

For UIA:

Total UIA at WSRs (mg L^{-1})= *Total TIN at WSRs (mg L^{-1})*
× UIA/NH_3-N ratio in marine water

It is conservatively assumed all released TN would be turned into TIN in the water column. All the TN released is also assumed to exist in form of NH_3-N, which gives conservative estimation for UIA. Based on the data from the EPD Marine Water Quality Monitoring Programme, UIA contributes to at most 7.8% of NH_3-N within the Study Area. The same ratio has been adopted as the UIA/NH_3-N ratio for nutrient release estimation under this Study. Furthermore, for conservative worst-case estimation, the maximum concentration of conservative tracer among all dredging/jetting scenarios and the maximum contribution of TN and NH_3-N from the elutriate test results were adopted.

Results shown in ***Table E1*** indicated predicted elevation in TIN would generally be a small fraction of the corresponding WQO as well as the ambient level. Among all WSRs and observation points, the predicted levels of TIN have generally small contribution and only up to about 0.6% of the WQO criteria and about 0.5% of the ambient level (0.60 mg L^{-1}) at MPA-3. Given only small contribution in the elevation of TIN to the criteria and ambient level due to marine dredging/jetting works, no unacceptable water quality impact on the WSRs would be expected.

For the release of NH_3-N into the water column, the predicted increase in UIA levels were considered to be negligible. As shown in ***Table E1***, the maximum predicted increase in UIA was below 0.001 mg L^{-1} in both seasons, which is below the corresponding WQO criteria at all WSRs and observation points. It is therefore concluded no unacceptable water quality impact from increase in UIA level from marine dredging/jetting works on the WSRs would be expected.

Table 7E.1 ***Predicted Maximum Nutrient Elevations (mg L^{-1}) based on Maximum Conservative Tracer Concentration at Water Quality Sensitive Receivers***

Sensitive Receivers	Model Output Location	MAX Conservative Tracer Concentration		TIN Elevation		WQO Criteria for TIN	UIA		UIA WQO Allowable Elevation	
		Dry	Wet	Dry	Wet		Dry	Wet	Dry	Wet
Spawning/Nursery Grounds (Depth-averaged)										
Fisheries Spawning Ground in North Lantau	MPA-5	7.1	16.6	0.000	0.000	0.5	0.000	0.000	0.016	0.015
	AR1	7.7	22.1	0.000	0.000	0.5	0.000	0.000	0.018	0.016
	CR3	7.2	21.1	0.000	0.000	0.5	0.000	0.000	0.016	0.015
Fisheries Spawning/Nursery Grounds in South Lantau	MPC-8	1.9	3.6	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-8	4.3	3.1	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-9	2.8	4.2	0.000	0.000	0.1	0.000	0.000	0.020	0.019
	CR4	2.9	4.3	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	CR5	4.0	3.1	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	NB9	2.5	2.7	0.000	0.000	0.1	0.000	0.000	0.019	0.017
	NB10	0.2	1.3	0.000	0.000	0.1	0.000	0.000	0.019	0.018
	B8	3.8	2.6	0.000	0.000	0.1	0.000	0.000	0.019	0.018
	B9	3.9	2.9	0.000	0.000	0.1	0.000	0.000	0.019	0.018
	MPE	4.2	2.9	0.000	0.000	0.1	0.000	0.000	0.019	0.018
Artificial Reef Deployment Area (Depth-averaged)										
Sha Chau and Lung Kwu Chau	AR1	7.8	27.8	0.000	0.001	0.5	0.000	0.000	0.018	0.017
Fish Culture Zone (Depth-averaged)										
Cheung Sha Wan FCZ	FCZ1	0.7	2.1	0.000	0.000	0.1	0.000	0.000	0.019	0.017
Lo Tik Wan FCZ	FCZ2	1.1	1.6	0.000	0.000	0.1	0.000	0.000	0.019	0.018
Sok Kwu Wan FCZ	FCZ3	0.8	1.4	0.000	0.000	0.1	0.000	0.000	0.019	0.018
Oyster Production Area (Depth-averaged)										
Sheung Pak Nai	O1	4.4	2.2	0.000	0.000	0.5	0.000	0.000	0.012	0.012
Seagrass Beds (Bottom)										
Ha Pak Nai	H1	7.4	4.6	0.000	0.000	0.5	0.000	0.000	0.012	0.013
Tung Chung Bay	C8	3.1	12.0	0.000	0.000	0.5	0.000	0.000	0.019	0.018
Marine Park (Depth-averaged)										

Sensitive Receivers	Model Output Location	MAX Conservative Tracer Concentration		TIN Elevation		WQO Criteria for TIN	UIA		UIA WQO Allowable Elevation	
		Dry	Wet	Dry	Wet		Dry	Wet	Dry	Wet
Sha Chau and Lung Kwu Chau MP	MPA-5	7.1	16.6	0.000	0.000	0.5	0.000	0.000	0.016	0.015
Proposed AAHK 3RS MP	MPB	7.4	44.5	0.000	0.001	0.5	0.000	0.000	0.019	0.017
Proposed Southwest Lantau MP	MPC-7	4.1	14.4	0.000	0.000	0.5	0.000	0.000	0.019	0.017
	MPC-8	1.9	3.6	0.000	0.000	0.1	0.000	0.000	0.020	0.018
Proposed South Lantau MP	MPD-8	4.3	3.1	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-9	4.7	3.3	0.000	0.000	0.1	0.000	0.000	0.020	0.019
Proposed South Lamma MP	MPE	4.2	2.9	0.000	0.000	0.1	0.000	0.000	0.019	0.018
Intertidal Mudflats / Mangroves / Horseshoe Crab Nursery Grounds (Depth-averaged)										
Sheung Pak Nai	H9	4.3	1.8	0.000	0.000	0.5	0.000	0.000	0.012	0.012
Ha Pak Nai	H1	7.0	3.6	0.000	0.000	0.5	0.000	0.000	0.012	0.012
Ngau Hom Shek	H8	3.3	1.5	0.000	0.000	0.5	0.000	0.000	0.002	0.003
Lung Kwu Sheung Tan	NB1	1.5	1.2	0.000	0.000	0.5	0.000	0.000	0.016	0.015
Tung Chung Bay	C8	3.1	11.0	0.000	0.000	0.5	0.000	0.000	0.019	0.017
Sha Lo Wan	H2	6.8	21.7	0.000	0.000	0.5	0.000	0.000	0.019	0.017
Sham Wat Wan	H6	5.3	16.7	0.000	0.000	0.5	0.000	0.000	0.019	0.017
Tai O	H3	5.8	33.7	0.000	0.001	0.5	0.000	0.000	0.019	0.017
Yi O	H4	6.3	30.7	0.000	0.001	0.5	0.000	0.000	0.019	0.017
Fan Lau Tung Wan	MPC-5	2.1	6.5	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	NB4	1.7	4.7	0.000	0.000	0.1	0.000	0.000	0.020	0.018
Tong Fuk Miu Wan / Shui Hau	H5	1.6	3.0	0.000	0.000	0.1	0.000	0.000	0.019	0.017
Pui O	B4	1.1	3.2	0.000	0.000	0.1	0.000	0.000	0.019	0.017
Shek Kwu Chau North	H7	2.8	3.7	0.000	0.000	0.1	0.000	0.000	0.019	0.017
Corals (Bottom)										
Artificial Seawall at BPPS	CR1	9.7	4.8	0.000	0.000	0.5	0.000	0.000	0.015	0.016
	CR2	10.8	2.9	0.000	0.000	0.5	0.000	0.000	0.015	0.016

Sensitive Receivers	Model Output Location	MAX Conservative Tracer Concentration		TIN Elevation		WQO Criteria for TIN	UIA		UIA WQO Allowable Elevation	
		Dry	Wet	Dry	Wet		Dry	Wet	Dry	Wet
Pak Chau	CR3	7.2	30.3	0.000	0.001	0.5	0.000	0.000	0.017	0.016
Shek Kwu Chau	CR4	3.3	5.7	0.000	0.000	0.1	0.000	0.000	0.020	0.019
Siu A Chau	CR5	4.0	3.1	0.000	0.000	0.1	0.000	0.000	0.020	0.018
Tai A Chau	CR6	3.6	7.1	0.000	0.000	0.1	0.000	0.000	0.020	0.018
Cheung Chau	CR7	0.8	2.0	0.000	0.000	0.1	0.000	0.000	0.018	0.018
	CR8	0.9	2.0	0.000	0.000	0.1	0.000	0.000	0.018	0.018
Hei Ling Chau	CR9	0.9	1.9	0.000	0.000	0.1	0.000	0.000	0.018	0.018
	CR10	0.9	1.9	0.000	0.000	0.1	0.000	0.000	0.018	0.018
Sunshine Island	CR11	0.8	1.9	0.000	0.000	0.1	0.000	0.000	0.018	0.018
Shek Kok Tsui	CR12	5.8	6.7	0.000	0.000	0.1	0.000	0.000	0.018	0.018
Pak Kok	CR13	2.7	2.4	0.000	0.000	0.4	0.000	0.000	0.018	0.019
Sha Wan	CR14	0.4	1.3	0.000	0.000	0.4	0.000	0.000	0.018	0.019
Ap Lei Chau	CR15	0.3	1.3	0.000	0.000	0.1	0.000	0.000	0.019	0.019
Wong Chuk Kok	CR16	0.3	1.1	0.000	0.000	0.1	0.000	0.000	0.019	0.019
	CR17	0.8	1.0	0.000	0.000	0.1	0.000	0.000	0.019	0.019
Sham Wan	CR18	0.3	1.4	0.000	0.000	0.1	0.000	0.000	0.020	0.019
Luk Chau	CR19	1.5	1.3	0.000	0.000	0.1	0.000	0.000	0.019	0.019
Hung Shing Yeh	CR20	3.7	2.5	0.000	0.000	0.1	0.000	0.000	0.020	0.019
Ha Mei Wan	CR21	4.4	3.2	0.000	0.000	0.1	0.000	0.000	0.020	0.019
Chi Ma Wan Peninsula	CR22	0.7	2.0	0.000	0.000	0.1	0.000	0.000	0.019	0.017
Seawater Intakes (Bottom)										
Tai Kwai Wan	NB8	0.0	0.0	0.000	0.000	0.83 (dry) / 0.75 (wet)	-	-	-	-
Ap Lei Chau	C12	0.0	0.0	0.000	0.000	0.88 (dry) / 0.89 (wet)	-	-	-	-
Observation Points (Depth-averaged) (for reference)										
Boundary of Proposed Marine Parks	MPA-1	2.1	2.1	0.000	0.000	0.5	0.000	0.000	0.016	0.015
	MPA-2	8.0	7.2	0.000	0.000	0.5	0.000	0.000	0.016	0.015
	MPA-3	10.4	149.0	0.000	0.003	0.5	0.000	0.000	0.018	0.016
	MPA-4	6.0	6.9	0.000	0.000	0.5	0.000	0.000	0.018	0.016
	MPC-1	4.9	23.7	0.000	0.000	0.5	0.000	0.000	0.019	0.017
	MPC-2	5.9	33.5	0.000	0.001	0.5	0.000	0.000	0.019	0.017

Sensitive Receivers	Model Output Location	MAX Conservative Tracer Concentration		TIN Elevation		WQO Criteria for TIN	UIA		UIA WQO Allowable Elevation	
		Dry	Wet	Dry	Wet		Dry	Wet	Dry	Wet
	MPC-3	3.5	13.5	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPC-4	2.1	10.0	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPC-5	2.1	6.5	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPC-6	2.1	4.5	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-1	3.6	5.3	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-2	3.6	4.3	0.000	0.000	0.1	0.000	0.000	0.020	0.018
	MPD-3	4.1	3.1	0.000	0.000	0.1	0.000	0.000	0.020	0.019
	MPD-4	4.4	2.7	0.000	0.000	0.1	0.000	0.000	0.020	0.019
	MPD-5	4.0	7.5	0.000	0.000	0.1	0.000	0.000	0.020	0.019
	MPD-6	1.5	3.4	0.000	0.000	0.1	0.000	0.000	0.020	0.019
	MPD-7	4.2	3.1	0.000	0.000	0.1	0.000	0.000	0.020	0.019