

Appendix 6-3

Sewage Offsetting Calculation



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D.D. 104 Kam Pok Road Residential Development Sewerage Impact Assessment			
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Design Calculation of Pollution Loads for KPR Development		May-2016	

Reference Document

- (1) Guidelines for Estimating Sewage Flows, published by EPD (GESF)
- (2) Sewerage Manual, published by DSD (SM)
- (3) Wastewater Treatment Plants: Planning, Design and Operation, by Syed R. Qasim (WTP)
- (4) Water Reuse - Issues, Technologies and Applications, Metcalf & Eddy, AECOM, 2007 (WR)
- (5) Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, 2003 (WETR)

Assumptions for Calculation of Design Sewage Flow

- (1) The housing type for the development is R4 and the Unit Flow Factor for R4 type resident shall be 0.370 m³/head/day, which is extracted from Table T-1 of Guidelines for Estimating Sewage Flows (GESF) published by EPD.
- (2) The unit flow factors for commercial flows in the development are extracted from Table T-2 of GESF, based on the unit flow factor of Commercial Employee as 0.080 and Type J4 Commercial Activity (Wholesale & Retail) and J11 Commercial Activity (Social & Personal Services) as 0.200 for estimating the flow generated from the employee. The unit flow factor of 0.280 m³/head/day is adopted.
- (3) Laboratory testing results of water samples at Ngau Tam Mei channel are adopted for assessment.

GESF Table T-1

GESF Table T-2

Water Quality of Ngau Tam Mei Channel

- (1) The following average concentration are taken from the laboratory testing results between September 2012 to September 2013, and between March 2015 to April 2015.

Average Result from Water Quality Sample					
BOD (mg/L)	TN-N (mg/L)	TP (mg/L)	TSS (mg/L)	NH3-N (mg/L)	E. coli (no./100 ml)
4	5.45	0.8	61	2.69	30,100

Water Quality of Treated Effluent from Kam Pok Road Development

Parameters	Target Effluent Quality of STP
BOD (mg/L)	3.0
TN-N (mg/L)	4.0
TP (mg/L)	0.5
TSS (mg/L)	10
NH3-N (mg/L)	2
E. Coli (no./100 ml)	1,000



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1) Design Calculation of Pollution Loads - BOD

1A) Condition of channel and the Site before the Development

Flow:-

Average flow collected from the channel **200 m³/day**

Pollution Load:-

Water sampling results for BOD **4 mg/L**
 BOD loading from channel
 = 4 mg/L x 200 m³/day
 = **0.800 kg/day**

Total pollution loads:-

Total BOD load
 = BOD loading from channel
 = **0.800 kg/day**

1B) Condition of channel and the Site after the Development

Proposed Residential Population:-

Number of people in each house **3.5 heads**
 Total number of house **32 houses**
 Total Residential Population
 = 32 houses x 3.5 heads
 = **112 heads**

Sewage generated by the Resident:-

The unit flow factor of housing **0.37 m³/head/day**
 Sewage generated
 = 0.37 m³/head/day x 112 heads
 = **41 m³/day**

Proposed Employee in the Development **20 heads**

Sewage generated by the employee in the development:-

The unit flow factor of employee **0.08 m³/head/day**
 The unit flow factor of its activities **0.2 m³/head/day**
 The sum of unit flow factor
 = 0.08 m³/head/day + 0.2 m³/head/day
 = **0.28 m³/head/day**
 Sewage generated
 = 0.28 m³/head/day x 20 heads
 = **6 m³/day**

Sewage generated by the swimming pools:- = **4.3 m³/day**

Total Residual Pollution Loads from On-Site Treatment Plant

Average flow collected from the channel **200 m³/day**

Total Sewage generated due to the development
 = 6 m³/day + 41 m³/day + 4.3 m³/day
 = **51.3 m³/day**

Effluent Discharge Quality from the On-Site Treatment Plant:-

Effluent BOD Concentration **3 mg/L**

Pollution Loads in Effluent
 = Volume of Effluent x Effluent Concentration
 = (200+51.3) m³/day x 3 mg/L
 = **0.754 kg/day**

Comparison between Condition before and after the Development

Loading before the Development = **0.80 kg/day**

Loading after the Development = **0.75 kg/day**

Since the Loading after the Development is smaller than the Loading before the Development, the requirement of "No Net Increase in Pollution Loading to Deep Bay" is achieved.



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2) Design Calculation of Pollution Loads - TN-N

2A) Condition of channel and the Site before the Development

Flow:-
Average flow collected from the channel = **200 m³/day**

Pollution Load:-
Water sampling results for TN-N = **5.45 mg/L**
TN-N loading from channel = 5.45 mg/L x 200 m³/day
= **1.090 kg/day**

Total pollution loads:-
Total TN-N load = TN-N loading from channel
= **1.090 kg/day**

2B) Condition of channel and the Site after the Development

Proposed Residential Population:-
Number of people in each house = **3.5 heads**
Total number of house = **32 houses**
Total Residential Population = 32 houses x 3.5 heads
= **112 heads**

Sewage generated by the Resident:-
The unit flow factor of housing = **0.37 m³/head/day**
Sewage generated = 0.37 m³/head/day x 112 heads
= **41 m³/day**

Proposed Employee in the Development = **20 heads**

Sewage generated by the employee in the development:-
The unit flow factor of employee = **0.08 m³/head/day**
The unit flow factor of its activities = **0.2 m³/head/day**
The sum of unit flow factor = 0.08 m³/head/day + 0.2 m³/head/day
= **0.28 m³/head/day**
Sewage generated = 0.28 m³/head/day x 20 heads
= **6 m³/day**

Sewage generated by the swimming pools:- = **4.3 m³/day**

Total Residual Pollution Loads from On-Site Treatment Plant

Average flow collected from the channel = **200 m³/day**

Total Sewage generated due to the development = 6 m³/day + 41 m³/day + 4.3 m³/day
= **51.3 m³/day**

Effluent Discharge Quality from the On-Site Treatment Plant:-
Effluent TN-N Concentration = **4 mg/L**

Pollution Loads in Effluent = Volume of Effluent x Effluent Concentration
= (200+51.3) m³/day x 4 mg/L
= **1.005 kg/day**

Comparison between Condition before and after the Development

Loading before the Development	=	<u>1.09 kg/day</u>
Loading after the Development	=	<u>1.01 kg/day</u>

Since the Loading after the Development is smaller than the Loading before the Development, the requirement of "No Net Increase in Pollution Loading to Deep Bay" is achieved.



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3) Design Calculation of Pollution Loads - TP

3A) Condition of channel and the Site before the Development

Flow:-
Average flow collected from the channel = **200 m³/day**

Pollution Load:-
Water sampling results for TP = **0.8 mg/L**
TP loading from channel = 0.8 mg/L x 200 m³/day
= **0.160 kg/day**

Total pollution loads:-
Total TP load = TP loading from channel
= **0.160 kg/day**

3B) Condition of channel and the Site after the Development

Proposed Residential Population:-
Number of people in each house = **3.5 heads**
Total number of house = **32 houses**
Total Residential Population = 32 houses x 3.5 heads
= **112 heads**

Sewage generated by the Resident:-
The unit flow factor of housing = **0.37 m³/head/day**
Sewage generated = 0.37 m³/head/day x 112 heads
= **41 m³/day**

Proposed Employee in the Development = **20 heads**

Sewage generated by the employee in the development:-
The unit flow factor of employee = **0.08 m³/head/day**
The unit flow factor of its activities = **0.2 m³/head/day**
The sum of unit flow factor = 0.08 m³/head/day + 0.2 m³/head/day
= **0.28 m³/head/day**
Sewage generated = 0.28 m³/head/day x 20 heads
= **6 m³/day**

Sewage generated by the swimming pools:- = **4.3 m³/day**

Total Residual Pollution Loads from On-Site Treatment Plant

Average flow collected from the channel = **200 m³/day**

Total Sewage generated due to the development = 6 m³/day + 41 m³/day + 4.3 m³/day
= **51.3 m³/day**

Effluent Discharge Quality from the On-Site Treatment Plant:-
Effluent TP Concentration = **0.5 mg/L**

Pollution Loads in Effluent = Volume of Effluent x Effluent Concentration
= (200+51.3) m³/day x 0.5 mg/L
= **0.126 kg/day**

Comparison between Condition before and after the Development

Loading before the Development	=	0.16 kg/day
Loading after the Development	=	0.13 kg/day

Since the Loading after the Development is smaller than the Loading before the Development, the requirement of "No Net Increase in Pollution Loading to Deep Bay" is achieved.



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4) Design Calculation of Pollution Loads - TSS

4A) Condition of channel and the Site before the Development

Flow:-
Average flow collected from the channel = **200 m³/day**

Pollution Load:-
Water sampling results for TSS = **61 mg/L**
TSS loading from channel = 61 mg/L x 200 m³/day
= **12.200 kg/day**

Total pollution loads:-
Total TSS load = TSS loading from channel
= **12.200 kg/day**

4B) Condition of channel and the Site after the Development

Proposed Residential Population:-
Number of people in each house = **3.5 heads**
Total number of house = **32 houses**
Total Residential Population = 32 houses x 3.5 heads
= **112 heads**

Sewage generated by the Resident:-
The unit flow factor of housing = **0.37 m³/head/day**
Sewage generated = 0.37 m³/head/day x 112 heads
= **41 m³/day**

Proposed Employee in the Development = **20 heads**

Sewage generated by the employee in the development:-
The unit flow factor of employee = **0.08 m³/head/day**
The unit flow factor of its activities = **0.2 m³/head/day**
The sum of unit flow factor = 0.08 m³/head/day + 0.2 m³/head/day
= **0.28 m³/head/day**
Sewage generated = 0.28 m³/head/day x 20 heads
= **6 m³/day**

Sewage generated by the swimming pools:- = **4.3 m³/day**

Total Residual Pollution Loads from On-Site Treatment Plant

Average flow collected from the channel = **200 m³/day**

Total Sewage generated due to the development = 6 m³/day + 41 m³/day + 4.3 m³/day
= **51.3 m³/day**

Effluent Discharge Quality from the On-Site Treatment Plant:-
Effluent SS Concentration = **10 mg/L**

Pollution Loads in Effluent = Volume of Effluent x Effluent Concentration
= (200+51.3) m³/day x 10 mg/L
= **2.513 kg/day**

Comparison between Condition before and after the Development

Loading before the Development = **12.20 kg/day**

Loading after the Development = **2.51 kg/day**

Since the Loading after the Development is smaller than the Loading before the Development, the requirement of "No Net Increase in Pollution Loading to Deep Bay" is achieved.



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5) Design Calculation of Pollution Loads - NH3-N

5A) Condition of channel and the Site before the Development

Flow:-

Average flow collected from the channel **200 m³/day**

Pollution Load:-

Water sampling results for NH3-N **2.69 mg/L**
NH3-H loading from channel = 2.69 mg/L x 200 m³/day
= **0.538 kg/day**

Total pollution loads:-

Total NH3-N load = NH3-N loading from channel
= **0.538 kg/day**

5B) Condition of channel and the Site after the Development

Proposed Residential Population:-

Number of people in each house **3.5 heads**
Total number of house **32 houses**
Total Residential Population = 32 houses x 3.5 heads
= **112 heads**

Sewage generated by the Resident:-

The unit flow factor of housing **0.37 m³/head/day**
Sewage generated = 0.37 m³/head/day x 112 heads
= **41 m³/day**

Proposed Employee in the Development **20 heads**

Sewage generated by the employee in the development:-

The unit flow factor of employee **0.08 m³/head/day**
The unit flow factor of its activities **0.2 m³/head/day**
The sum of unit flow factor = 0.08 m³/head/day + 0.2 m³/head/day
= **0.28 m³/head/day**
Sewage generated = 0.28 m³/head/day x 20 heads
= **6 m³/day**

Sewage generated by the swimming pools:- = **4.3 m³/day**

Total Residual Pollution Loads from On-Site Treatment Plant

Average flow collected from the channel **200 m³/day**

Total Sewage generated due to the development = 6 m³/day + 41 m³/day + 4.3 m³/day
= **51.3 m³/day**

Effluent Discharge Quality from the On-Site Treatment Plant:-

Effluent NH3-N Concentration **2 mg/L**

Pollution Loads in Effluent

= Volume of Effluent x Effluent Concentration
= (200+51.3) m³/day x 2 mg/L
= **0.503 kg/day**

Comparison between Condition before and after the Development

Loading before the Development = **0.54 kg/day**

Loading after the Development = **0.50 kg/day**

Since the Loading after the Development is smaller than the Loading before the Development, the requirement of "No Net Increase in Pollution Loading to Deep Bay" is achieved.

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