Annex C

Replacement Pages of the Revised Drainage Impact Assessment

Prepared for

Wing Mau Tea House Limited

Prepared by

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PROPOSED REZONING FROM "RESIDENTIAL (GROUP B)1" ZONE TO "RESIDENTIAL (GROUP B)4" ZONE FOR MEDIUM-DENSITY HOUSING DEVELOPMENT TO INCLUDE A FOOTPATH FOR PUBLIC USE AT VARIOUS LOTS AND ADJACENT GOVERNMENT LAND IN DD130, LAM TEI, TUEN MUN

DRAINAGE IMPACT ASSESSMENT

Date	**14 March 2024**
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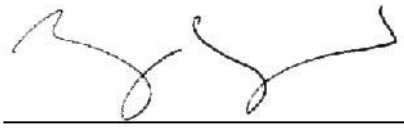
Signed	
Project Reference	**FECLTS12EI00**
Document No.	**R9118_v3.0.docx**

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Appendix 2.3 Pipe Capacity Checking for Proposed Stormwater Tank

1. INTRODUCTION

1.1 Project Background

1.1.1 The project proponent proposed to develop a medium density residential development at D.D.130, Lam Tei in Tuen Mun (the "Application Site").

1.1.2 In order to confirm the environmental feasibility of the Proposed Development, Ramboll Hong Kong Limited is commissioned by the project proponent to prepare a Drainage Impact Assessment (DIA) for the Proposed Development.

1.2 Project Location

1.2.1 With a development area of 8,896m^2 and zoned as Residential (Group B) 1" (R(B)1) zone, the Application Site is proposed to develop a medium density residential development. The Application Site is bounded by Castle Peak Road – Lam Tei Section and the Tuen Ma Line and Light Rail tracks to the east and Ng Lau Road and a nullah to the west. To the north of the Application Site is an existing residential development – Lingrade Garden. Village houses and some car repairing workshops are situated on the west of the Application Site separated by Ng Lau Road and a nullah.

1.2.2 The location of the Application Site is presented in **Figure 1.1**.

1.3 Proposed Development

1.3.1 The Proposed Development consists of 5 residential towers ranging from 14 storeys to 27 storeys. The number of storeys and building height information of the residential towers are as follow:

- Tower 1: 27 storeys (+107.8 mPD)
- Tower 2: 27 storeys (+107.8 mPD)
- Tower 3: 16 storeys (+66.8 mPD)
- Tower 4: 14 storeys (+59.8 mPD)
- Tower 5: 24 storeys (+94.8 mPD)

1.3.2 The total numbers of units are 1,385 units and the tentative population intake year is 2030. Detailed plans of the Proposed Development are presented in **Appendix 1.1**.

2. DRAINAGE IMPACT ASSESSMENT

2.1 Scope of Work

2.1.1 The aim of this study is to assess the changes of the runoff from the Application Site as a result of the Proposed Development and the potential impact on the existing drainage system and surrounding area.

2.1.2 The source of surface runoff is mainly from rainwater and would be directed to existing public storm drains. Based on the previous DIA report for land exchange purpose for the same development site which DSD has no objection (Ramboll (2019) Drainage Impact Assessment for the Proposed Residential Development at D.D.130, Lam Tei (report reference: R5889_v1.1), hereinafter "the 2019 DIA report"), a series of u-channels is proposed along the site boundary to convey the surface runoff from the site and finally discharge to the nullah through a proposed 600mm diameter outlet.

2.1.3 Based on the 2019 DIA report, the unpaved area was 20%. As the Proposed Development has an unpaved area of not less than 20%, with the possible increase in the unpaved area, the amount of surface runoff from the Application Site would decrease.

2.1.4 This DIA Report assesses the drainage impact to the existing and proposed drainage system.

2.2 Assessment Criteria and Methodology

2.2.1 The assessment is conducted in accordance with the DSD SDM (2018 Edition) and SDM Corrigendum No. 1/2022. The Application Site is at the upstream of a major urban drainage system, therefore a 1 in 200-year return storm has been adopted in the assessment. Moreover, a 1 in 50-year return storm has also been considered for the drainage nature of the Application Site.

2.2.2 The catchment runoff has been calculated using the "Rational Method", as outlined in the DSD SDM: Q = 0.278 C i A, where

- Q = peak runoff in m^3/s
- C = runoff coefficient (dimensionless)
- i = rainfall intensity in mm/hr
- A = catchment area in km

2.2.3 The rainfall intensity parameter "i" is dependent on the return period, rainfall duration and the time of concentration of the catchment under consideration. Runoff calculations are presented in **Appendix 2.1**.

2.2.4 With reference to Table 28 of the SDM and (k) of SDM - Corrigendum No. 1/2022 and a tentative population intake year of 2030, rainfall increase due to climate change for mid-21st century has been considered in the calculations. As 1 in 50 years return storm is adopted for the assessment, the (2041 – 2060) value of 11.1% rainfall increase has been considered.

2.3 Existing Site Condition

2.3.1 The Application Site is situated in a flat paved area at existing ground level ranging from +6.8mPD to +8.0mPD. The site area is about 8,896m^2.

2.3.2 Most area of the existing Application Site and upstream catchments are steep and unpaved (assume 70% of the area is unpaved), therefore a runoff coefficient of 0.35

(grassland, heavy soil, steep) has been adopted for the unpaved area, while 0.95 (concrete) has been adopted for the paved area within the Application Site.

2.4 Existing Drainage System

2.4.1 An existing nullah with more than 10m width is located along the western site boundary, where the surface runoff from the Application Site can be discharged to.

2.4.2 According to drainage record plans from DSD, the Application Site is currently served by pipes (diameter size ranging from 450mm to 900mm) running along the cycle track to the east of the Application Site. Based on site inspections and drainage record plans, there is no proper drainage system within the Application Site except for two catchpits (SCH1009270 and SCH1009251) and one drainage manhole (SMH1024623) outside the Application Site.

2.4.3 Catchpit no. SCH1009270 connects to an existing 300mm diameter drainage pipe. The existing 300mm diameter drainage pipe is then connected to the 750mm diameter drainage pipes which run along the cycle track to the south of the Application Site and eventually leading into the nullah.

2.4.4 Catchpit no. SCH1009251 connects with the existing 300mm diameter drainage pipe. The existing 300mm diameter drainage pipe is then connected to the 900mm diameter drainage pipes and eventually leading into the nullah.

2.4.5 The existing drainage system in the area is shown in **Figure 2.1**.

2.5 Existing Catchment

2.5.1 Existing catchments in the Application Site are shown in **Figure 2.2**. The existing surface runoff is summarised in **Table 2.1** below.

Table 2.1 Summary of Surface Runoff under Existing Condition

Catchment	Area (m^2)	Existing Runoff (m^3/s) under 1 in 50 Years Scenario
EX1 (30% paved, 70% unpaved)	6,088	0.21
EX2 (30% paved, 70% unpaved)	2,809	0.10

2.5.2 The existing runoff from the Application Site is about $0.3m^3/s$ under the 1 in 50-year storm event. The calculated runoff from the Application Site to the nullah for storm period of 1 in 50-year and 1 in 200-year are shown in **Appendix 2.1**.

2.6 Hydraulic Performance of the Existing Drainage System

2.6.1 With reference to the 2019 DIA report, the nullah has sufficient flow capacity to cater for the 1 in 20-year storm event without overflow. The Application Site is situated on the existing ground with ground levels ranging from +6.8 to +8.0 mPD. The ground level of the Application Site is about 500mm higher than the predicted water level along the nullah under 1 in 50-year storm event. Hence, it is considered that the Application Site has 50-year flood protection level under existing condition with sufficient freeboard and the Application Site will not be subject to flooding under a 1 in 50-year storm event.

2.7 Proposed Development and Proposed Drainage System

2.7.1 The Proposed Development includes residential towers, a clubhouse, access roads, as well as hard and soft landscaping. An overall runoff coefficient of 0.95 (concrete) has been adopted for the future paved area, while the coefficient of 0.15 (grassland, sandy soil, flat) is adopted for the proposed soft landscaping.

2.7.2 U-channels are proposed along the site boundary and underground carpark to collect the surface runoff from the Application Site. The runoff will be collected and stored temporarily in a stormwater storage tank. The stormwater will be discharged to the nullah with a pump at a rate that does not exceed the maximum discharge rate of the Application under existing condition in a 1 in 50-year storm event (see **Section 2.9** for further discussion). As a new drainage system will be provided for the Proposed Development, the existing catchpits (Catchpit nos. SCH1009270 and SCH1009251) and the two 300mm diameter pipes currently serving the Application Site are proposed to be demolished.

2.7.3 The proposed drainage layout is shown in **Figure 2.3** and the future surface runoff is summarised in **Table 2.2** below. In consideration of the rainfall increase due to climate change for mid-21st century, the 1 in 50-year runoff will increase from 0.45 m^3/s to 0.50 m^3/s.

Table 2.2 Summary of Surface Runoff under Proposed Condition

Catchment	Area (m^2)	Future Runoff (m^3/s) under 1 in 50 Years Scenario	
		Base Case	With Rainfall Increase due to Climate Change for Mid-21st Century
Application Site	8,896	0.45	0.50

2.8 Drainage Impact Assessment and Mitigation Measures

2.8.1 As mentioned in **Section 2.1**, the unpaved area of the Proposed Development will not be less than 20% (comparing to 20% unpaved area assumed in 2019 DIA Report). With the possible increase in unpaved area, the amount of surface runoff from the Application Site would decrease.

2.8.2 After the implementation of the proposed drainage works, the total runoff to the 450mm to 900mm diameter pipes running along the cycle track to the east of the Application Site will be reduced as the surface runoff within the Application Site will be collected by the on-site stormwater storage tank. As the total runoff to the pipes is reduced while the flow capacity of the pipes is maintained, the drainage condition of the pipes is considered as an improvement. Therefore, the Proposed Development shall not induce any adverse drainage impact to the 450mm to 900mm diameter pipes.

2.8.3 The design proposed drainage system within the Application Site will be confirmed in the detailed design stage to ensure it can accommodate 1 in 50-year storm events (refer to **Appendix 2.1**). Hence, the Proposed Development will not induce any local flooding within the Application Site and to the surrounding area after the implementation of the proposed drainage works.

2.8.4 As discussed in **Section 2.6**, the Application Site has ground levels ranging from +6.8mPD to +8.0mPD which are higher than the predicted water level along the nullah under the 1 in 50-year storm by about 500mm, i.e. the Application Site will not be subject to flooding under 1 in 50-year storm events. The Application Site will have

about 50-year flood protection level under proposed condition with sufficient freeboard.

2.9 Proposed Stormwater Storage Tank

2.9.1 A stormwater storage tank is proposed for attenuating the peak flow from the Application Site. The location of the proposed stormwater storage tank is presented in **Figure 2.3**.

2.9.2 As presented in **Appendix 2.2**, a hydrographic assessment for both existing and proposed conditions is conducted to determine the existing peak flow rate and the required stormwater tank volume for the Proposed Development. **Figure 2.4** and **Figure 2.5** show the existing and future storm profile plans within the Application Site.

2.9.3 As mentioned in the Sewage Impact Assessment (SIA) report under this planning application, the treated effluent from the proposed on-site STP would be temporary stored in the proposed stormwater storage tank before discharging into the existing nullah to the west of the Application Site. The sewage peak flow including the backwash of all swimming pools is 57.6 L/s which is equivalent to 0.0576 m^3/s. Simultaneous discharge of treated effluent to the proposed stormwater tank and the collection of surface runoff during a rainfall event are assumed in determining the size of the tank, as a conservative approach.

2.9.4 The calculated required storage capacity of the stormwater storage tank under 1 in 50-year storm event is estimated to be about 100m^3. Considering a safety factor of 1.5, it is proposed to provide a storage tank with a storage capacity of 150m^3. This storage tank will also be able to cater for a 1 in 200-year storm event with a safety factor of 1.2.

2.9.5 The stormwater storage tank is proposed to be located at the most downstream of the new u-channel system. The maximum discharge rate from the stormwater storage tank would be designed not to exceed the maximum discharge rate of 0.281m^3/s (i.e. a flow rate not larger than the existing peak runoff of 1 in 50-year storm event as calculated in **Appendix 2.2**). The capacity checking of the pipe discharging from the proposed stormwater tank into the nullah is presented in **Appendix 2.3**. The exact discharge location and pipe design will be subject to further study and agreed with DSD during detailed design stage.

2.9.6 A control device with a fixed pump rate is proposed for the storage tank to ensure the runoff discharge rate of 0.281m^3/s. The details of the control method will be further confirmed in the detailed design stage and the relevant design will be submitted for approval prior to the construction of storage tank.

2.9.7 With the provision of the stormwater storage tank, the maximum flow from the Application Site to the existing nullah will be controlled not to exceed the peak flow under existing condition, there will be no additional runoff to the existing nullah. Therefore, no adverse drainage impact to the existing nullah is anticipated with the provision of stormwater storage tank.

2.10 Design, Construction and Maintenance Responsibility of the Proposed Drainage System

2.10.1 The Applicant will bear the design, construction and future maintenance of the proposed drainage system within the Application Site at his own cost. The demolishing works to catchpits nos. SCH1009270 and SCH1009251 and the pipeline connecting to these catchpits will also be carried out by the Applicant.

2.10.2 The existing 450mm to 900mm diameter pipes and the existing nullah will be maintained by DSD, same as the current arrangement.

2.10.3 The detailed design of the proposed drainage works will be circulated to DSD for comment and approval in the detailed design stage.

3. CONCLUSION

3.1.1 A Drainage Impact Assessment has been conducted to evaluate the potential drainage impact due to the Proposed Development.

3.1.2 The Drainage Impact Assessment has demonstrated that subject to the implementation of the proposed drainage system, the Proposed Development would not cause adverse drainage impact or an increase in the flooding susceptibility of the adjacent areas.

3.1.3 It is concluded that the Proposed Development will not result in any adverse drainage impact to the existing drainage system.

Figures

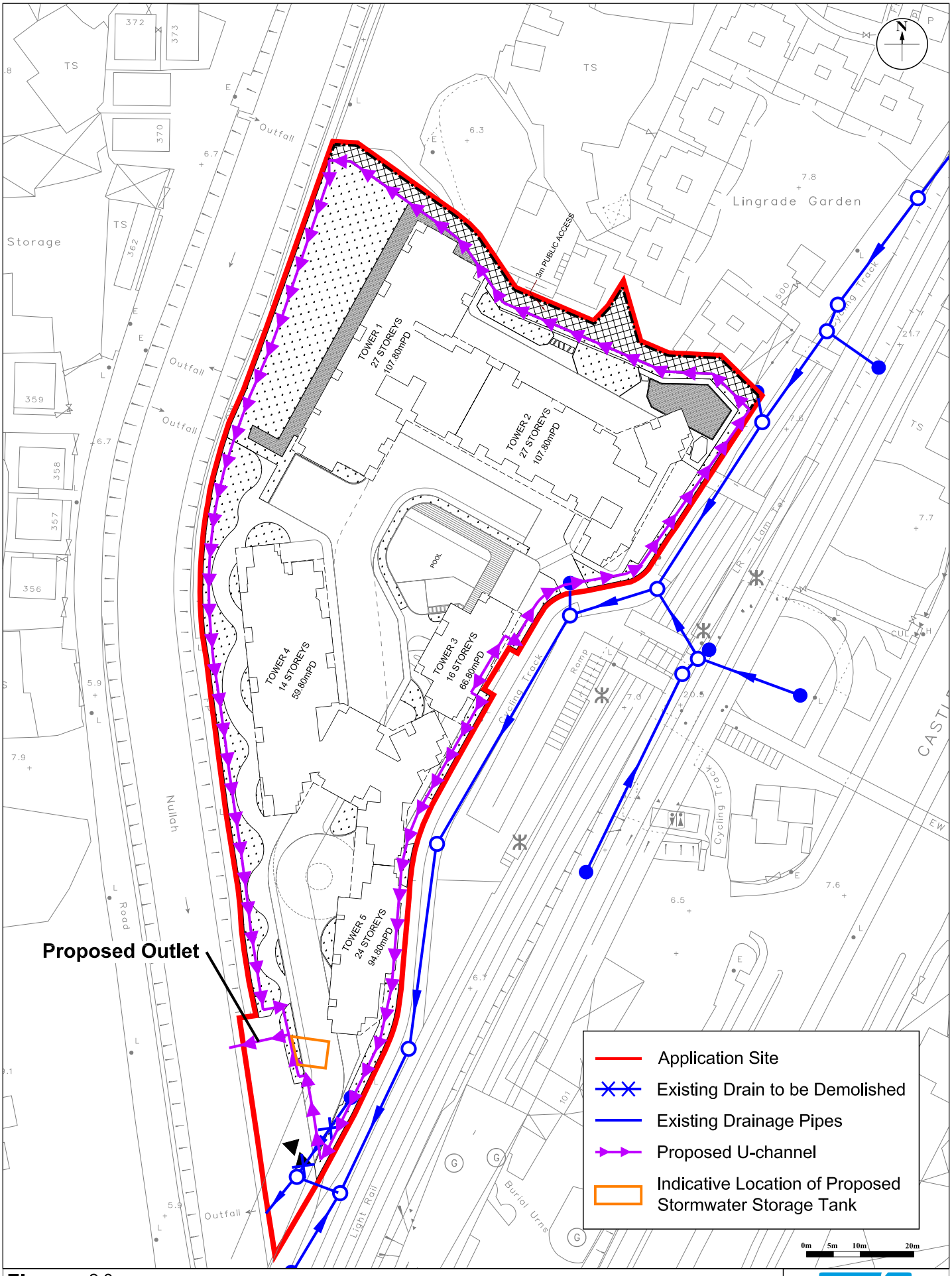

Figure: 2.3

Title: Proposed Drainage Layout

Project: Proposed Rezoning from "Residential (Group B)1" Zone to "Residential (Group B)4" Zone for Medium-Density Housing Development to Include a Footpath for Public use at Various Lots and Adjacent Government Land in DD130, Lam Tei, Tuen Mun

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Checked by: KY

Rev.: 3.0

Date: Mar 2024

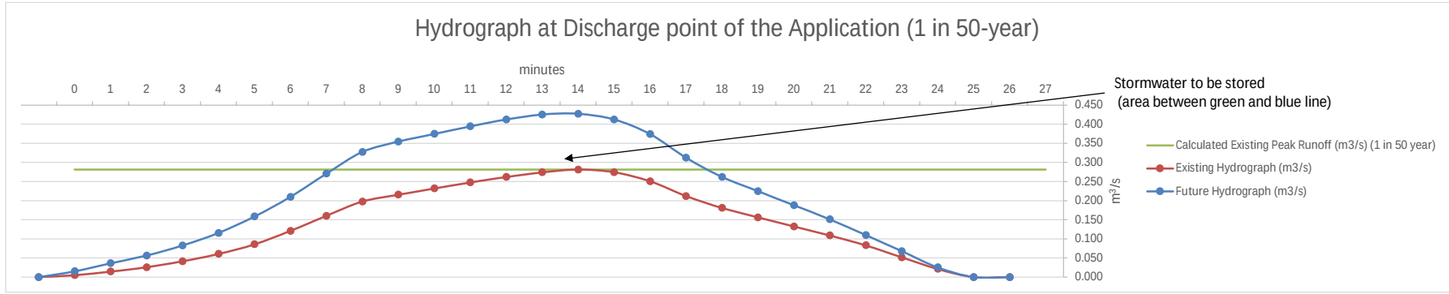
Appendix 2.2

Detailed Hydrographic Assessment for the Estimation of Stormwater Storage Tank Size

Proposed Rezoning from "Residential (Group B)1" Zone to "Residential (Group B)4" Zone for Medium-Density Housing Development to Include a Footpath for Public use at Various Lots and Adjacent Government Land in DD130, Lam Tei, Tuen Mun

Appendix 2.2 Detailed Hydrographic Assessment for the Estimation of Stormwater Storage Tank Size

Hydrographs - 1 in 50-year

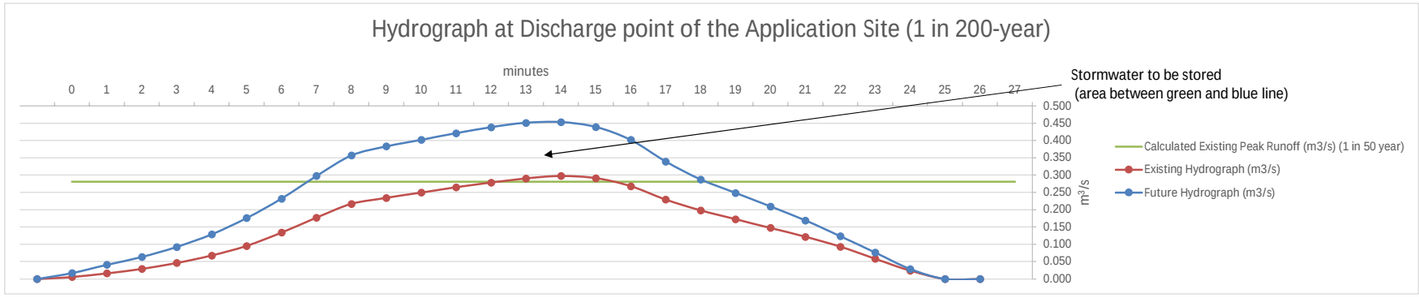


Catchment	t_c (min)	Sub-Catchment	Area (m^2)	Paved	Unpaved	Weighted Run-off Coefficient	Times (minutes) 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
							Rainfall Intensity (mm/hr) - From DSD Stormwater Manual, Table 5a																													
							0	120	125	132	141	152	168	191	234	297	234	191	168	152	141	132	125	120	0	0	0	0	0	0	0	0	0	0
Existing Site	9		8,896																															
		Sub-1	286.6	30%	70%	0.530		0.304	0.317	0.334	0.357	0.385	0.426	0.484	0.593	0.752	0.593	0.484	0.426	0.385	0.357	0.334	0.317	0.304										
		Sub-2	522.2	30%	70%	0.530			0.554	0.577	0.609	0.651	0.702	0.776	0.882	1.080	1.371	1.080	0.882	0.776	0.702	0.651	0.609	0.577	0.554										
		Sub-3	612.0	30%	70%	0.530				0.649	0.676	0.714	0.763	0.822	0.909	1.033	1.266	1.607	1.266	1.033	0.909	0.822	0.763	0.714	0.676	0.649										
		Sub-4	800.8	30%	70%	0.530					0.850	0.885	0.935	0.998	1.076	1.189	1.352	1.657	2.103	1.657	1.352	1.189	1.076	0.998	0.935	0.885	0.850								
		Sub-5	956.8	30%	70%	0.530						1.015	1.057	1.117	1.193	1.286	1.421	1.616	1.979	2.512	1.979	1.616	1.421	1.286	1.193	1.117	1.057	1.015							
		Sub-6	1204.7	30%	70%	0.530							1.278	1.331	1.406	1.502	1.619	1.789	2.034	2.492	3.163	2.492	2.034	1.789	1.619	1.502	1.406	1.331	1.278						
		Sub-7	1631.6	30%	70%	0.530								1.731	1.803	1.904	2.034	2.192	2.423	2.755	3.375	4.284	3.375	2.755	2.423	2.192	2.034	1.904	1.803	1.731					
		Sub-8	1671.2	30%	70%	0.530									1.773	1.847	1.950	2.083	2.246	2.482	2.822	3.457	4.388	3.457	2.822	2.482	2.246	2.083	1.950	1.847	1.773			
		Sub-9	1210.0	30%	70%	0.530										1.284	1.337	1.412	1.508	1.626	1.797	2.043	2.503	3.177	2.503	2.043	1.797	1.626	1.508	1.412	1.337	1.284		
Existing Hydrograph (m^3/min)							0.000	0.304	0.871	1.561	2.492	3.650	5.160	7.259	9.634	11.877	12.943	13.920	14.867	15.718	16.457	16.889	16.487	15.058	12.724	10.870	9.389	7.959	6.539	4.990	3.110	1.284	0.000	0.000
Existing Hydrograph (m^3/s)							0.000	0.005	0.015	0.026	0.042	0.061	0.086	0.121	0.161	0.198	0.216	0.232	0.248	0.262	0.274	0.281	0.275	0.251	0.212	0.181	0.156	0.133	0.109	0.083	0.052	0.021	0.000	0.000
Proposed Development	9		8,896																															
		Sub-1	549.9	80%	20%	0.830		0.913	0.952	1.005	1.073	1.157	1.279	1.454	1.781	2.261	1.781	1.454	1.279	1.157	1.073	1.005	0.952	0.913										
		Sub-2	744.2	80%	20%	0.830			1.236	1.288	1.360	1.453	1.566	1.731	1.968	2.411	3.060	2.411	1.968	1.731	1.566	1.453	1.360	1.288	1.236										
		Sub-3	662.4	80%	20%	0.830				1.101	1.146	1.211	1.293	1.394	1.541	1.752	2.146	2.724	2.146	1.752	1.541	1.394	1.293	1.211	1.146	1.101										
		Sub-4	838.3	80%	20%	0.830					1.393	1.451	1.532	1.636	1.764	1.950	2.217	2.716	3.447	2.716	2.217	1.950	1.764	1.636	1.532	1.451	1.393								
		Sub-5	1008.3	80%	20%	0.830						1.675	1.745	1.843	1.968	2.122	2.345	2.666	3.266	4.146	3.266	2.666	2.345	2.122	1.968	1.843	1.745	1.675							
		Sub-6	1269.7	80%	20%	0.830							2.109	2.197	2.320	2.478	2.672	2.953	3.357	4.113	5.221	4.113	3.357	2.953	2.672	2.478	2.320	2.197	2.109						
		Sub-7	1410.7	80%	20%	0.830								2.344	2.441	2.578	2.754	2.969	3.281	3.730	4.570	5.801	4.570	3.730	3.281	2.969	2.754	2.578	2.441	2.344					
		Sub-8	1491.6	80%	20%	0.830									2.478	2.581	2.726	2.912	3.139	3.469	3.944	4.832	6.133	4.832	3.944	3.469	3.139	2.912	2.726	2.581	2.478			
		Sub-9	920.9	80%	20%	0.830										1.530	1.594	1.683	1.798	1.938	2.142	2.435	2.983	3.786	2.983	2.435	2.142	1.938	1.798	1.683	1.594	1.530		
Future Hydrograph (m^3/min)							0.000	0.913	2.188	3.393	4.972	6.946	9.524	12.599	16.262	19.663	21.294	22.487	23.681	24.752	25.540	25.649	24.758	22.472	18.763	15.745	13.492	11.300	9.074	6.608	4.072	1.530	0.000	0.000
Future Hydrograph (m^3/s)							0.000	0.015	0.036	0.057	0.083	0.116	0.159	0.210	0.271	0.328	0.355	0.375	0.395	0.413	0.426	0.427	0.413	0.375	0.313	0.262	0.225	0.188	0.151	0.110	0.068	0.025	0.000	0.000
Calculated Sewage Peak Flow Including the Backwash of All Swimming Pools							0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576
Calculated Existing Peak Runoff (m^3/s) (1 in 50 year)							0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281
Excess for Storage (m^3/s)							0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.104	0.131	0.151	0.171	0.189	0.202	0.204	0.189	0.151	0.089	0.039	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
																																		Total Storage
Storage (m^3/min)							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83	6.23	7.86	9.05	10.25	11.32	12.11	12.21	11.32	9.04	5.33	2.31	0.06	0.00	0.00	0.00	0.00	0.00	0.00	99.90 m^3
Culmulative Storage (m^3)							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83	9.05	16.91	25.97	36.21	47.53	59.63	71.85	83.17	92.21	97.54	96.39	93.00	87.41	79.59	69.31	56.49	0.00	0.00	0.00

Proposed Rezoning from "Residential (Group B)1" Zone to "Residential (Group B)4" Zone for Medium-Density Housing Development to Include a Footpath for Public use at Various Lots and Adjacent Government Land in DD130, Lam Tei, Tuen Mun

Appendix 2.2 Detailed Hydrographic Assessment for the Estimation of Stormwater Storage Tank Size

Hydrographs - 1 in 200-year



							Times (minutes)																									
							0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Catchment	t_c	Sub-Catchment	Area	Paved	Unpaved	Weighted Run-off Coefficient	Rainfall Intensity (mm/hr) - From DSD Stormwater Manual, Table 5a																											
	(min)		(m^2)				0	135	141	147	156	167	181	204	245	309	245	204	181	167	156	147	141	135	0	0	0	0	0	0	0	0	0	0
Existing Site	9		8,896																													
		Sub-1	286.6	30%	70%	0.530		0.342	0.357	0.372	0.395	0.423	0.459	0.517	0.621	0.783	0.621	0.517	0.459	0.423	0.395	0.372	0.357	0.342										
		Sub-2	522.2	30%	70%	0.530			0.623	0.651	0.679	0.720	0.771	0.836	0.942	1.131	1.427	1.131	0.942	0.836	0.771	0.720	0.679	0.651	0.623									
		Sub-3	612.0	30%	70%	0.530				0.730	0.763	0.795	0.844	0.904	0.979	1.104	1.326	1.672	1.326	1.104	0.979	0.904	0.844	0.795	0.763	0.730								
		Sub-4	800.8	30%	70%	0.530					0.956	0.998	1.041	1.104	1.182	1.281	1.444	1.735	2.188	1.735	1.444	1.281	1.182	1.104	1.041	0.998	0.956							
		Sub-5	956.8	30%	70%	0.530						1.142	1.193	1.243	1.320	1.413	1.531	1.726	2.072	2.614	2.072	1.726	1.531	1.413	1.320	1.243	1.193	1.142						
		Sub-6	1204.7	30%	70%	0.530							1.438	1.502	1.566	1.661	1.779	1.928	2.173	2.609	3.291	2.609	2.173	1.928	1.779	1.661	1.566	1.502	1.438					
		Sub-7	1631.6	30%	70%	0.530								1.947	2.034	2.120	2.250	2.409	2.611	2.942	3.534	4.457	3.534	2.942	2.611	2.409	2.250	2.120	2.034	1.947				
		Sub-8	1671.2	30%	70%	0.530									1.995	2.083	2.172	2.305	2.467	2.674	3.014	3.620	4.565	3.620	3.014	2.674	2.467	2.305	2.172	2.083	1.995			
		Sub-9	1210.0	30%	70%	0.530										1.444	1.508	1.572	1.669	1.786	1.936	2.182	2.621	3.305	2.621	2.182	1.936	1.786	1.669	1.572	1.508	1.444		
Existing Hydrograph (m^3/min)							0.000	0.342	0.980	1.754	2.792	4.079	5.745	8.053	10.638	13.021	14.057	14.994	15.905	16.723	17.437	17.871	17.486	16.100	13.770	11.899	10.368	8.855	7.312	5.603	3.503	1.444	0.000	0.000
Existing Hydrograph (m^3/s)							0.000	0.006	0.016	0.029	0.047	0.068	0.096	0.134	0.177	0.217	0.234	0.250	0.265	0.279	0.291	0.298	0.291	0.268	0.230	0.198	0.173	0.148	0.122	0.093	0.058	0.024	0.000	0.000
Proposed Development	9		8,896																													
		Sub-1	549.9	80%	20%	0.830		1.028	1.073	1.119	1.188	1.271	1.378	1.553	1.865	2.352	1.865	1.553	1.378	1.271	1.188	1.119	1.073	1.028										
		Sub-2	744.2	80%	20%	0.830			1.391	1.453	1.515	1.607	1.721	1.865	2.102	2.524	3.184	2.524	2.102	1.865	1.721	1.607	1.515	1.453	1.391									
		Sub-3	662.4	80%	20%	0.830				1.238	1.293	1.348	1.431	1.532	1.660	1.871	2.247	2.834	2.247	1.871	1.660	1.532	1.431	1.348	1.293	1.238								
		Sub-4	838.3	80%	20%	0.830					1.567	1.636	1.706	1.810	1.938	2.101	2.368	2.843	3.586	2.843	2.368	2.101	1.938	1.810	1.706	1.636	1.567							
		Sub-5	1008.3	80%	20%	0.830						1.884	1.968	2.052	2.178	2.331	2.527	2.848	3.420	4.313	3.420	2.848	2.527	2.331	2.178	2.052	1.968	1.884						
		Sub-6	1269.7	80%	20%	0.830							2.373	2.478	2.584	2.742	2.936	3.182	3.586	4.307	5.432	4.307	3.586	3.182	2.936	2.742	2.584	2.478	2.373					
		Sub-7	1410.7	80%	20%	0.830								2.637	2.754	2.871	3.047	3.262	3.535	3.984	4.785	6.035	4.785	3.984	3.535	3.262	3.047	2.871	2.754	2.637				
		Sub-8	1491.6	80%	20%	0.830									2.788	2.912	3.036	3.222	3.449	3.738	4.213	5.059	6.381	5.059	4.213	3.738	3.449	3.222	3.036	2.912	2.788			
		Sub-9	920.9	80%	20%	0.830										1.721	1.798	1.874	1.989	2.129	2.308	2.601	3.124	3.939	3.124	2.601	2.308	2.129	1.989	1.874	1.798	1.721		
Future Hydrograph (m^3/min)							0.000	1.028	2.464	3.810	5.562	7.748	10.576	13.927	17.868	21.425	23.005	24.141	25.291	26.322	27.093	27.208	26.359	24.135	20.375	17.269	14.922	12.585	10.151	7.422	4.585	1.721	0.000	0.000
Future Hydrograph (m^3/s)							0.000	0.017	0.041	0.063	0.093	0.129	0.176	0.232	0.298	0.357	0.383	0.402	0.422	0.439	0.452	0.453	0.439	0.402	0.340	0.288	0.249	0.210	0.169	0.124	0.076	0.029	0.000	0.000
Calculated Sewage Peak Flow Including the Backwash of All Swimming Pools							0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576	0.0576
Calculated Existing Peak Runoff (m^3/s) (1 in 50 year)							0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281
Excess for Storage (m^3/s)							0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.074	0.133	0.160	0.178	0.198	0.215	0.228	0.230	0.215	0.178	0.116	0.064	0.025	0.000	0.000	0.000	0.000	0.000	0.000	0.000
																																		Total Storage
Storage (m^3/min)							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	4.43	7.99	9.57	10.71	11.86	12.89	13.66	13.77	12.92	10.70	6.94	3.83	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	121.25 m^3
Culmulative Storage (m^3)							0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	4.93	12.92	22.49	33.19	45.05	57.93	71.59	85.36	98.29	108.99	115.93	116.31	114.34	110.04	103.30	93.83	81.53	66.36	0.00	0.00	

Appendix 2.3

Pipe Capacity Checking for Proposed Stormwater Tank

Proposed Rezoning from "Residential (Group B)1" Zone to "Residential (Group B)4" Zone for Medium-Density Housing Development to Include a Footpath for Public use at Various Lots and Adjacent Government Land in DD130, Lam Tei, Tuen Mun

Appendix 2.3 Pipe Capacity Checking for Proposed Stormwater Tank

Colebrook-White Equation
(for circular pipes flowing full)

$$V = -\sqrt{(8gDs)}\log\left(\frac{k_s}{3.7D} + \frac{2.51\nu}{D\sqrt{(2gDs)}}\right)$$

where
V = mean velocity (m/s)
g = gravitational acceleration (m/s2)
D = internal pipe diameter (m)
ks = hydraulic pipeline roughness (m)
v = kinematic viscosity of fluid (m2/s)
s = hydraulic gradient (energy loss per unit length due to friction)

Hydraulic Capacity of Proposed Drainage Pipe for the Proposed Stormwater Tank

Segment	Manhole Reference	Manhole Reference	Pipe Dia.	Pipe Length	g	k_s [1]	s	Gradient	v	V	Area	Q	Q_{silt} [2]
			mm	m	m/s^2	m		1 in	m^2/s	m/s	m^2	m^3/s	m^3/s
A	Stormwater Tank	Nullah	400	11.4	9.81	0.0030	0.039	25	1E-06	2.99	0.13	0.38	0.34

Remarks:
[1] Based on Table 14 - Recommended Roughness Values in DSD's Stormwater Drainage Manual (SDM),
k_s =3.0 mm for slimed concrete, spun or vertically cast sewer under poor condition is adopted for the pipe with V ≥ 1.2 m/s.
[2] To allow sedimentation, 5% reduction in flow area if the gradient is greater than 1 in 25; or 10% reduction in flow area in other cases.

Capacity Checking for the Proposed Drainage Pipe for the Proposed Stormwater Tank

Segment	Pipe Dia. (mm)	Pipe Length (m)	Gradient	Estimated Capacity (m^3/s)	Calculated Existing Peak Runoff (m^3/s)	Percentage of Capacity	Status
A	400	11.4	0.039	0.34	0.281	83.2%	OK