Appendix V

Revised Sewerage Impact Assessment

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Section 16 Planning Application for Proposed Concrete Batching Plant at 13-17 Wah Sing Street, Kwai Chung
Sewerage Impact Assessment

Prepared for:
Wah Sing Manager Company Ltd

January 2025

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For and on behalf of
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Group COO

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1 INTRODUCTION

1.1 Project Background

1.1.1 It is planned to demolish the existing building at 13-17 Wah Sing Street, Kwai Chung ("the Site") redevelop it into a Concrete Batching Plant ("the Proposed CBP" or "the Proposed Development").

1.1.2 The Site is zoned Industrial ("I") under the Approved Kwai Chung Outline Zoning Plan ("OZP") No. S/KC/32. In accordance with schedule of "I" Zone on the OZP, the use of concrete batching plant falls into Column 2, which may be permitted with or without conditions on application to the Town Planning Board ("TPB"). Therefore, a planning application under Section 16 of the *Town Planning Ordinance* ("TPO") is required.

1.1.3 In order to support the planning application for the Proposed Development, EnviroSolutions & Consulting Ltd ("ESC") has been appointed to prepare this Sewerage Impact Assessment ("SIA") Report.

1.2 Site Description

1.2.1 The Site is situated at 13-17 Wah Sing Street in Kwai Chung. As shown on **Figure 1-1**, its environs are summarised below:

- To the North: Vanta Industrial Centre
- To the East: Wah Sing Street, Boldwin Industrial Building
- To the South: Wah Sing Street, The Venus Industrial Building
- To the West: Gold King Industrial Building

1.3 Project Description

1.3.1 The site area will be approx. 1,780m^2. The indicative layout of the Proposed CBP can be referred to the Planning Statement.

1.3.2 The maximum hourly concrete production rate of the Proposed CBP will be approx. 400 m^3/hour.

1.4 Objectives of the Report

1.4.1 The objectives of this SIA Report are to:

- Estimate the quantity of wastewater arising from the Proposed CBP and the nearby uses
- Recommend the necessary mitigation measures to handle the associated wastewater.

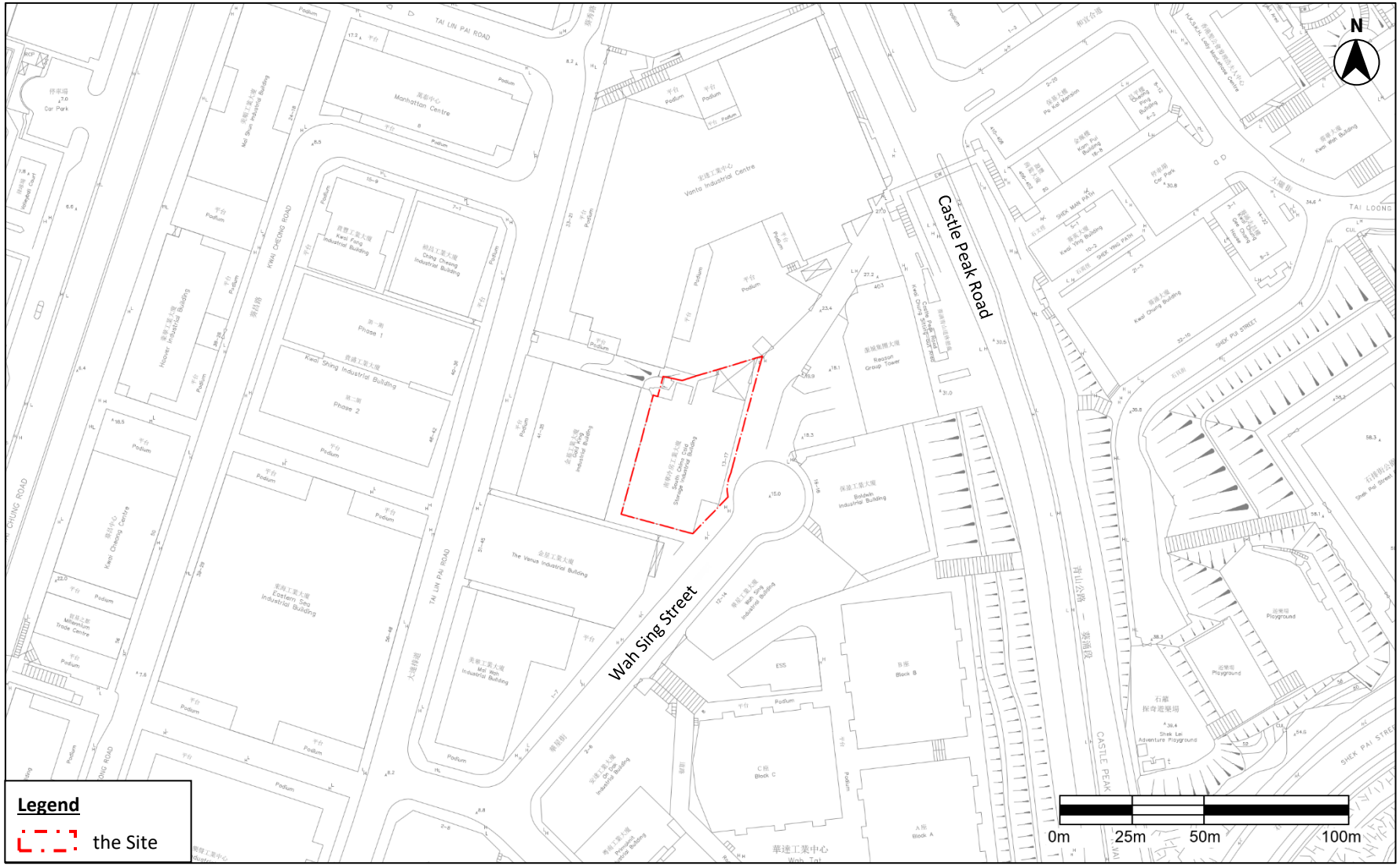
1.5 Reference Materials

1.5.1 In evaluating the sewerage impacts arising from the Proposed CBP, the following sources have been referred to:

- Drainage Services Department ("DSD") publication *Sewerage Manual (with Eurocodes incorporated) (Part 1) Key Planning Issues and Gravity Collection System, 3rd Edition, May 2013*

- DSD publication *Sewerage Manual (Part 1) - Corrigendum No. 1/2024*, 28 March 2024
- Environmental Protection Department ("EPD") publication *Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0, March 2005* ("GESF")
- Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations (Cap.123I)
- Practice Note for Professional Persons Drainage Plans subject to Comment by the Environmental Protection Department -Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations (ProPECC PN1/23)
- Sewerage data of GeoInfo Map checked on 17 October 2024

Figure 1-1 Site Location and its Environs



2 EVALUATION OF SEWERAGE IMAPCT

2.1 Existing Baseline Conditions

2.1.1 According to the sewerage data from GeoInfo Map checked on 17 October 2024, there are existing municipal sewers in the vicinity of the Site along Wah Sing Street at the east and south of the Site. The nearest foul manhole is Manhole FMH4021330 which is located to the southeast of the Site. The existing municipal sewerage system near the Site is shown on **Figure 2-1**.

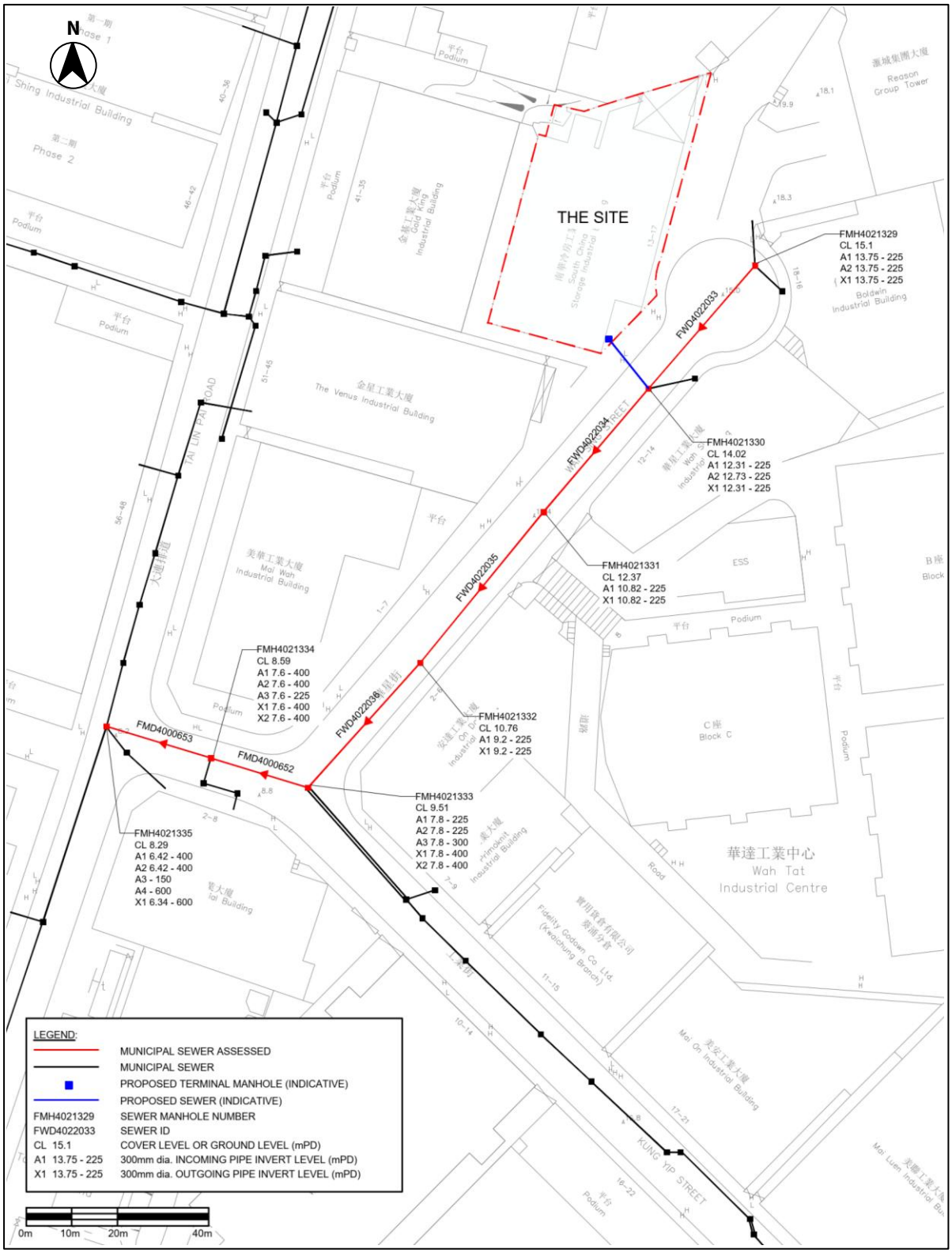
2.1.2 Wastewater currently flows from the terminal manhole of the Site via a connection into the nearby sewerage system at Manhole FMH4021330. From there it flows along the 225mm diameter sewer to the southeast (underneath Wah Sing Street), which connects to the two 400mm diameter sewers (underneath Kung Yip Street) before joining a 600mm sewer underneath Tai Lin Pai Road. From there, wastewater will flow into the downstream sewerage system.

2.2 Sewage Impact During the Operation Phase

2.2.1 During the operation of the Proposed CBP, the major source of wastewater will be industrial wastewater generated by wheel washing facilities and from concrete production, as well as sewage from toilets generated by the on-site staff and truck drivers.

2.2.2 Industrial wastewater generated from the operation of the Proposed CBP will be 100% be recycled, as advised by the Applicant. Sewage from toilets will be discharged into the public sewerage system underneath Wah Sing Street via the proposed sewer to the south of the Site, as shown on **Figure 2-1**.

Figure 2-1 Sewerage Pipe Manhole Facilities in the Vicinity of the Site



3 SEWERAGE ANALYSIS

3.1 Review of Sewage Handling

3.1.1 As mentioned in **Section 2.2**, sewage generated by the on-site staff and truck drivers, i.e. wastewater generated from the washrooms e.g. flushing, handwashing and micturition, will be the only wastewater source to be discharged into the municipal sewerage system underneath Wah Shing Street. For the other sources of wastewater including concrete production and vehicle washing, such industrial wastewater will be treated and recycled/reused, and will not be discharged.

3.2 Assumptions

3.2.1 In order to assess the acceptability of the sewage impact arising from the Proposed CBP, the maximum sewage generated has been estimated based on the assumptions listed in **Table 3-1**, below. The Average Dry Weather Flows ("ADWFs") of the upstream, Proposed CBP and downstream catchments were estimated based on the Unit Flow Factors ("UFFs") recommended in the GESF and in *Commercial and Industrial Floor Space Utilization Survey* ("CIFSUS") published by the Planning Department ("PlanD").

Table 3-1 Parameters for Estimating Wastewater Generation from the Proposed CBP

PARAMETER	VALUE	REMARK
GENERATION FROM ON-SITE STAFF		
No. of staff	20	Assumed based on the scale and nature of the Proposed CBP
UFF of staff	0.23 m^3/day/staff	UFF for "Commercial Employee + J9 Construction" in Table T-2 of GESF
GENERATION FROM TRUCK DRIVERS		
Total no. of toilet visit	40 visits/ day	Assumed based on the scale and nature of the Proposed CBP
UFF of drivers	0.0091 m^3/day/driver	Assumed 200ml micturition[Note 1] + 7.5L flushing[Note 2] + 1.4L hand washing[Note 2]
CATCHMENT INFLOW FACTOR AND PEAKING FACTOR		
Catchment Inflow Factor	1.10	Catchment inflow factor for Kwai Chung is adopted as stated in Table T-4 of GESF
Peaking Factor	8 for <1,000 6 for 1,000 – 5,000 5 for 5,000 – 10,000	Peaking factor (including stormwater allowance) for facility with existing upstream sewerage is adopted as stated in Table T-5 of GESF

Notes:
1. Human's micturition is assumed to be 200mL in accordance with p. 3081 of "Magill's Medical Guide", 6th ed.
2. BEAM Plus New Buildings Version 1.2 in July 2012.

3.3 Methodology

3.3.1 To evaluate the capacities of sewers, the wastewater generation from the upstream and downstream catchments of the receiving sewers are estimated. This allows the acceptability of the sewerage impact arising from operation of the Proposed CBP to be determined.

3.3.2 Flow capacities for pipe segments between Manhole FMH4021329 and FMH4021335 along Wah Sing Street and Kung Yip Street were calculated using the Colebrook-White Equation for circular pipes, assuming full bore flow with no surcharge, as shown below:

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

where V = mean velocity (m/s)
g = gravitational acceleration (m/s^2)
D = internal pipe diameter (m)
ks = hydraulic pipeline roughness (m)
n = kinematic viscosity of fluid (m^2/s)
s = hydraulic gradient (energy loss per unit length due to friction)

3.3.3 Sewerage systems are designed and sized to ensure that (when examined from any point) the downstream sections have sufficient capacity for the sewage flowing from all the sections upstream, provided that the capacity of the upstream sections is not exceeded. Thus, if the sewerage system can provide sufficient receiving capacity for the cumulative sewage quantities generated from the Proposed CBP and from the upstream catchments, there should be no unacceptable impact on the downstream sewerage system.

3.3.4 To evaluate the flow rate from on-site staff and truck drivers in the Proposed CBP, the UFFs recommended in GESF have been used.

3.3.5 Locations of the upstream and downstream catchments of the Site are shown in **Appendix A**. Sewage generation from the Site and the upstream and downstream catchments have been calculated and is detailed in **Appendix B**. Flow capacities for pipe segments of the receiving sewerage system are estimated via the Colebrook-White Equation under two scenarios, i.e., the existing condition and after the operation of the Proposed Development. Details are provided in **Appendix C**.

3.4 Results and Discussion

3.4.1 Detailed sewage generation calculations are provided in **Appendix B**. The total estimated ADWF from the Proposed CBP is calculated to be 5.46m^3/day (Catchment Inflow Factor of 1.1 for Kwai Chung inclusive), which will be discharged into Manhole FMH4021330.

3.4.2 To determine what impact this flow has on the existing sewerage system, the capacity of the downstream sewerage system has been evaluated. The utilisations when taking into consideration the sewage contributed by the Site as well as upstream/ downstream catchments between Manholes FMH4021329 and FMH4021335 are provided in **Appendix C**.

3.4.3 Flow capacity for the scenario without the Proposed CBP has been assessed. As the existing building at the Site has been abandoned, no sewage is expected to be discharged from the Site into the downstream sewerage system. The pipe capacity utilization between Manholes FMH4021329 and FMH4021335 ranges from 19% to 82%.

3.4.4 With the Proposed CBP, the capacity utilization of the proposed Ø100 sewer is 6%. The pipe capacity utilization between Manholes FMH4021329 and FMH4021335 ranges from 19% to 83%. This shows that less than 100% of the available capacity will be used under the worst-case scenario and the contribution of sewerage generation from the Proposed CBP to the downstream sewerage system is considered negligible.

3.4.5 Therefore, the sewerage analysis indicates there will be no unacceptable impact on the existing municipal sewerage system under the worst-case scenario with the existing flows and the peak sewage discharge from the Site. As such, no upgrading work for the existing network is required.

4 CONCLUSION AND RECOMMENDATIONS

4.1.1 Potential sewerage impacts arising from the Site has been assessed. Sewage generated from the Site will be collected and conveyed to the municipal sewerage system beneath Wah Sing Street at the southeast of the Site.

4.1.2 The detailed sewage generation calculation shows that total estimated ADWF from the Site is calculated to be 5.46m^3/day, which will be discharged into Manhole FMH4021330.

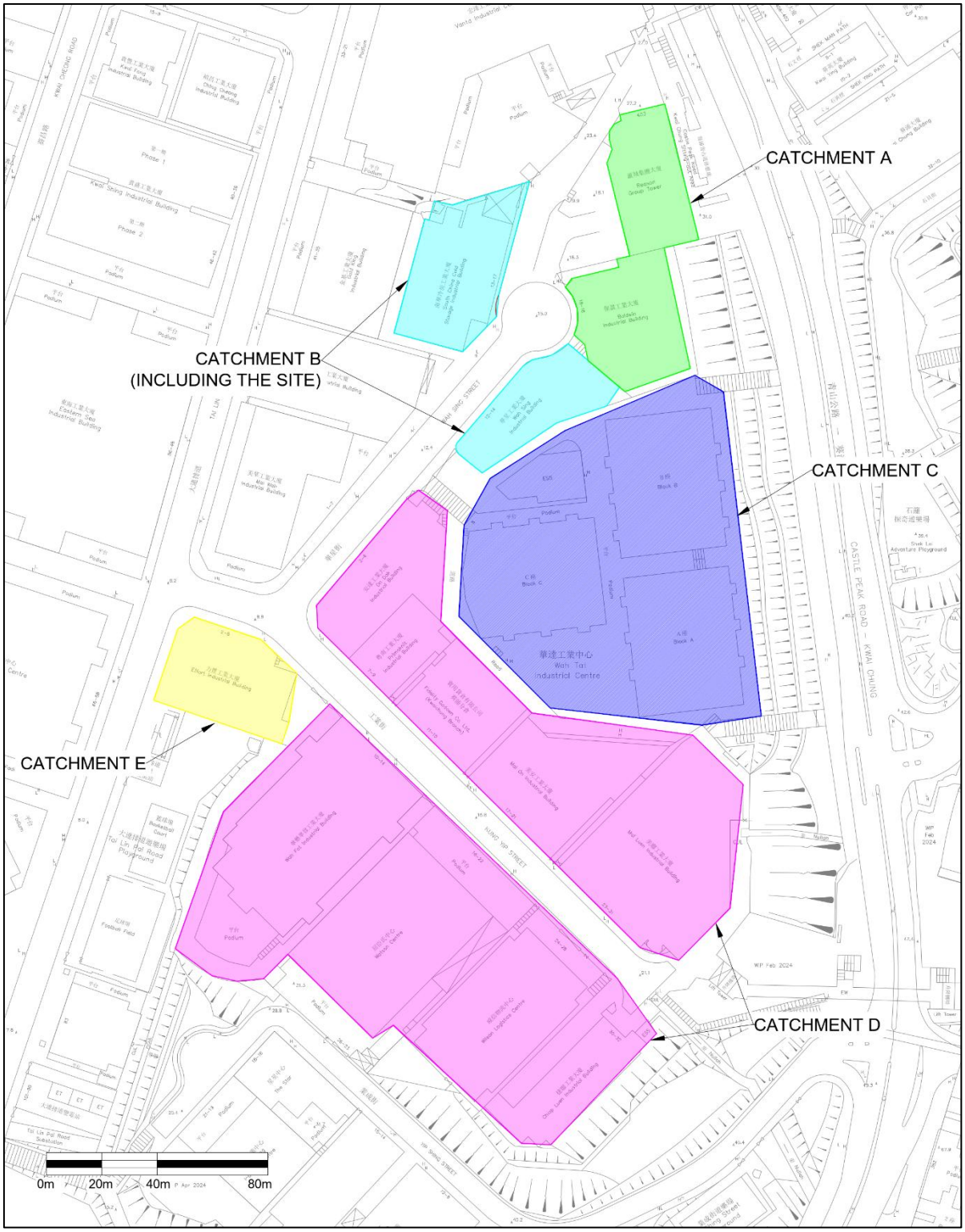
4.1.3 The capacity of the sewerage system has been evaluated under two scenarios, before and after the operation of the Proposed CBP, while sewage from other properties/uses upstream and downstream discharged to the sewerage system between the Manhole FMH4021329 and FMH4021335 have been taken into account in the evaluation.

4.1.4 Flow capacity for the scenario without the Proposed CBP has been assessed. The pipe capacity utilization between Manholes FMH4021329 and FMH4021335 ranges from 19% to 82%.

4.1.5 The capacity utilization of the proposed sewer is 6%. The utilisation of existing sewer from FMH4021329 and FMH4021335 will be 19% to 83%. This shows that less than 100% of the available capacity will be used under the worst-case scenario and the contribution of sewerage generation from the Proposed CBP to the downstream sewerage system is considered negligible.

4.1.6 Therefore, the sewerage analysis indicates there will be no unacceptable impact on the existing municipal sewerage system under the worst-case scenario with the existing flows and the peak sewage discharge from the Site. No upgrading works for the municipal sewerage system will be required for the Proposed Development.

Appendix A Location Plan of Catchment Areas


CATCHMENT A
CATCHMENT B
(INCLUDING THE SITE)
CATCHMENT C
CATCHMENT D
CATCHMENT E
WAH SING STREET
KUNG YIP STREET
CASTLE PEAK ROAD – KWAI CHUNG
華達工業中心
Wah Tat
Industrial Centre
0m
20m
40m
80m

Details of Catchments

Buildings	Location	Class	Estimated Area (m^2)
Catchment A			
Reason Group Tower	5F-12F, 15F-23F, 25F	Financial	20831.5
	5F-12F, 15F-23F, 25F	Community	1225.4
Boldwin Industrial Building	GF	Retail Trade	451.3
	1F-24F	Financial	28881.2
	1F-24F	Manufactoring	3610.1
	1F-24F	Community	3610.1
Catchment B			
Wah Sing Industrial Building	1F	Restaurant	362.8
	GF, 2F-14F, 16F-25F	Financial	29023.9
Catchment C			
Wah Tat Industrial Centre			
Block A	1F-21F	Storage	20168.0
	1F-21F	Manufactoring	2016.8
	1F-21F	Financial	16134.4
	1F-21F	Community	2016.8
Block B	1F-21F	Financial	16189.5
	1F-21F	Community	4047.4
	1F-21F	Storage	20236.9
Block C	GF	Restaurant	372.8
	1F-21F	Storage	19571.0
	1F-21F	Community	3914.2
	1F-21F	Financial	15656.8
Catchment D			
On Dak Industrial Building	1F-24F	Manufactoring	2954.3
	1F-24F	Storage	5908.6
	1F-24F	Financial	20680.1
Primoknit Industrial Building	GF	Manufactoring	333.3
	1F-11F	Financial	5132.3
	1F-11F	Storage	2199.6
Fidelity Godown Co. Ltd. (Kwaichung Branch)	1F-13F	Financial	1457.3
	1F-13F	Storage	13115.7
Mai On Industrial Building	1F	Restaurant	348.6
	GF	Wholesale Trade	1220.2
	2F-9F, 11F-23F	Manufactoring	3660.7
	2F-9F, 11F-23F	Community	7321.4
	2F-9F, 11F-23F	Financial	25625.0
Mai Luen Industrial Building	GF	Wholesale Trade	2043.9
	GF	Restaurant	615.4
	2F-9F, 11F-24F	Manufactoring	6769.2
	2F-9F, 11F-24F	Storage	13538.5
	2F-9F, 11F-24F	Community	6769.2
	2F-9F, 11F-24F	Financial	40615.4
Chiap Luen Industrial Building	GF	Wholesale Trade	975.5
	1F-18F	Manufactoring	1871.6
	1F-18F	Financial	9358.0
	1F-18F	Storage	5614.8
Wilson Logistics Centre	1F-14F	Storage	17409.0
	1F-14F	Financial	7461.0
Watson Centre	1F-20F	Financial	37115.1
	1F-20F	Storage	15906.5
Wah Fat Industrial Building	GF	Storage - Recycling Centre	2293.9
	2F-28F	Storage	23225.5
	2F-28F	Manufactoring	3870.9
	2F-28F	Financial	50322.0
	2F-28F	Restaurant	573.5

Catchment E			
Effort Industrial Building	GF	Wholesale Trade - Metalware Company	291.3
	GF	Retail Trade - Convenient Store	145.7
	GF	Financial - Foreign Exchange Stores/ Real Estate Agencies/ Bank	437.0
	1F-12F	Retail Trade	873.9
	1F-12F	Financial	13109.1
	1F-12F	Restaurant	873.9
	1F-12F	Storage	873.9
	1F-12F	Community	1747.9

Note: Building information including number of storeys, type of business activities and floor area were obtained and assumed from building directories during site visit and desktop study.

Appendix B Calculation of Sewage Flow Generation

Calculation of Sewage Generation from the Proposed CBP, Upstream and Downstream Catchments				Remarks / Justification
Catchment A				
A1) Office				
Estimated Floor Area	=	49712.7	m^2	
Staff Occupancy Density	=	29.4	m^2/staff	Worker density by Industry Group (All Type) for "All Economic Activities" is 3.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	1,691	staff	
Unit flow Factor (UFF) per resident	=	0.080	m^3/day/person	UFF for "Commercial Employee" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	135.3	m^3/day	
A2) Community				
Estimated Floor Area	=	4835.5	m^2	
Staff Occupancy Density	=	30.3	m^2/staff	Worker density by Industry Group (All Type) for "Community, Social & Personal Services" is 3.3 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	160	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J11 Community, Social & Personal Services" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	44.8	m^3/day	
A3) Shop				
Estimated Floor Area	=	451.3	m^2	
Staff Occupancy Density	=	28.6	m^2/staff	Worker density by Industry Group (All Type) for "Retail Trade" is 3.5 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	16	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J4 Wholesale & Retail" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	4.5	m^3/day	
A4) Factory/ Workshop Use				
Estimated Floor Area	=	3610.1	m^2	
Staff Occupancy Density	=	43.5	m^2/staff	Worker density by Industry Group (All Type) for "Manufacturing" is 2.3 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	84	staff	
Unit flow Factor (UFF) per resident	=	0.730	m^3/day/person	UFF for "Industrial Employee + Industrial Activities of Kwai Chung" in Table T-3 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	61.3	m^3/day	
Total Estimated Flow	=	**245.9**	**m^3/day**	
Catchment Inflow Factor	=	**1.1**		Catchement Inflow Factor for Kwai Chung in Table T-4 of Ref. 2 is adopted
Total Average Daily Dry Weather Flow of Catchment A	=	**270.5**	**m^3/day**	
Catchment B				
B1) Proposed CBP				
No. of On-site Staff	=	20	persons	Assumed based on the scale and nature of the Proposed CBP.
Unit Flow Factor (UFF) per Staff	=	0.23	m^3/day/person	UFF for "Commercial Employee + J9 Construction" in Table T-2 of Ref. 1.
No. of Toilet Visit for Truck Drivers	=	40	visits	Assumed based on the scale and nature of the Proposed CBP.
Unit Flow Factor (UFF) per Drivers	=	0.0091	m^3/day/person	Assumed 200ml micturition + 7.5L flushing + 1.4L hand washing.
Estimated Total Average Daily Dry Weather Flow Rate	=	5.0	m^3/day	
B2) Office				
Estimated Floor Area	=	29023.9	m^2	
Staff Occupancy Density	=	29.4	m^2/staff	Worker density by Industry Group (All Type) for "All Economic Activities" is 3.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	987	staff	
Unit flow Factor (UFF) per resident	=	0.080	m^3/day/person	UFF for "Commercial Employee" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	79.0	m^3/day	
B3) Food & Beverage				
Estimated Floor Area	=	362.8	m^2	
Staff Occupancy Density	=	19.6	m^2/staff	Worker density by Industry Group (All Type) for "Restaurants" is 5.1 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	19	staff	
Unit flow Factor (UFF) per resident	=	1.580	m^3/day/person	UFF for "Commercial Employee + J10 Restaurants & Hotels" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	30.0	m^3/day	
Total Estimated Flow	=	**113.9**	**m^3/day**	
Catchment Inflow Factor	=	**1.1**		Catchement Inflow Factor for Kwai Chung in Table T-4 of Ref. 2 is adopted.
Total Average Daily Dry Weather Flow of Catchment B	=	**125.3**	**m^3/day**	

Catchment C				
C1) Logistics/ Storage				
Estimated Floor Area	=	59976.0	m^2	
Staff Occupancy Density	=	250.0	m^2/staff	Worker density by Industry Group (All Type) for "Storage" is 0.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	240	staff	
Unit flow Factor (UFF) per resident	=	0.180	m^3/day/person	UFF for "Commercial Employee + J3 Transport, Storage & Communications" in Table T-3 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	43.2	m^3/day	
C2) Factory/ Workshop Use				
Estimated Floor Area	=	2016.8	m^2	
Staff Occupancy Density	=	43.5	m^2/staff	Worker density by Industry Group (All Type) for "Manufacturing" is 2.3 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	47	staff	
Unit flow Factor (UFF) per resident	=	0.730	m^3/day/person	UFF for "Industrial Employee + Industrial Activities of Kwai Chung" in Table T-3 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	34.3	m^3/day	
C3) Office				
Estimated Floor Area	=	47980.8	m^2	
Staff Occupancy Density	=	29.4	m^2/staff	Worker density by Industry Group (All Type) for "All Economic Activities" is 3.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	1,632	staff	
Unit flow Factor (UFF) per resident	=	0.080	m^3/day/person	UFF for "Commercial Employee" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	130.6	m^3/day	
C4) Community				
Estimated Floor Area	=	9978.4	m^2	
Staff Occupancy Density	=	30.3	m^2/staff	Worker density by Industry Group (All Type) for "Community, Social & Personal Services" is 3.3 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	330	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J11 Community, Social & Personal Services" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	92.4	m^3/day	
C5) Food & Beverage				
Estimated Floor Area	=	372.8	m^2	
Staff Occupancy Density	=	19.6	m^2/staff	Worker density by Industry Group (All Type) for "Restaurants" is 5.1 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	20	staff	
Unit flow Factor (UFF) per resident	=	1.580	m^3/day/person	UFF for "Commercial Employee + J10 Restaurants & Hotels" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	31.6	m^3/day	
Total Estimated Flow	=	**332.1**	**m^3/day**	
Catchment Inflow Factor	=	**1.1**		Catchement Inflow Factor for Kwai Chung in Table T-4 of Ref. 2 is adopted.
Total Average Daily Dry Weather Flow of Catchment C	=	**365.3**	**m^3/day**	
Catchment D				
D1) Factory/ Workshop Use				
Estimated Floor Area	=	19460.1	m^2	
Staff Occupancy Density	=	43.5	m^2/staff	Worker density by Industry Group (All Type) for "Manufacturing" is 2.3 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	448	staff	
Unit flow Factor (UFF) per resident	=	0.730	m^3/day/person	UFF for "Industrial Employee + Industrial Activities of Kwai Chung" in Table T-3 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	327.0	m^3/day	
D2) Logistics/ Storage				
Estimated Floor Area	=	99212.1	m^2	
Staff Occupancy Density	=	250.0	m^2/staff	Worker density by Industry Group (All Type) for "Storage" is 0.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	397	staff	
Unit flow Factor (UFF) per resident	=	0.180	m^3/day/person	UFF for "Commercial Employee + J3 Transport, Storage & Communications" in Table T-3 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	71.5	m^3/day	

D3) Office				
Estimated Floor Area	=	197766.3	m^2	
Staff Occupancy Density	=	29.4	m^2/staff	Worker density by Industry Group (All Type) for "All Economic Activities" is 3.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	6,725	staff	
Unit flow Factor (UFF) per resident	=	0.080	m^3/day/person	UFF for "Commercial Employee" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	538.0	m^3/day	
D4) Community				
Estimated Floor Area	=	14090.7	m^2	
Staff Occupancy Density	=	30.3	m^2/staff	Worker density by Industry Group (All Type) for "Community, Social & Personal Services" is 3.3 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	465	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J11 Community, Social & Personal Services" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	130.2	m^3/day	
D5) Food & Beverage				
Estimated Floor Area	=	1537.5	m^2	
Staff Occupancy Density	=	19.6	m^2/staff	Worker density by Industry Group (All Type) for "Restaurants" is 5.1 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	79	staff	
Unit flow Factor (UFF) per resident	=	1.580	m^3/day/person	UFF for "Commercial Employee + J10 Restaurants & Hotels" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	124.8	m^3/day	
D6) Wholesale				
Estimated Floor Area	=	4239.6	m^2	
Staff Occupancy Density	=	19.6	m^2/staff	Worker density by Industry Group (All Type) for "Wholesale Trade" is 2.2 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	217	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J4 Wholesale & Retail" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	60.8	m^3/day	
Total Estimated Flow	=	**1,252.3**	**m^3/day**	
Catchment Inflow Factor	=	**1.1**		Catchement Inflow Factor for Kwai Chung in Table T-4 of Ref. 2 is adopted.
Total Average Daily Dry Weather Flow of Catchment D	=	**1,377.5**	**m^3/day**	
Catchment E				
E1) Wholesale				
Estimated Floor Area	=	291.3	m^2	
Staff Occupancy Density	=	19.6	m^2/staff	Worker density by Industry Group (All Type) for "Wholesale Trade" is 2.2 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	15	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J4 Wholesale & Retail" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	4.2	m^3/day	
E2) Shop				
Estimated Floor Area	=	1019.6	m^2	
Staff Occupancy Density	=	28.6	m^2/staff	Worker density by Industry Group (All Type) for "Retail Trade" is 3.5 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	36	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J4 Wholesale & Retail" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	10.1	m^3/day	
E3) Office				
Estimated Floor Area	=	13546.1	m^2	
Staff Occupancy Density	=	29.4	m^2/staff	Worker density by Industry Group (All Type) for "All Economic Activities" is 3.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	461	staff	
Unit flow Factor (UFF) per resident	=	0.080	m^3/day/person	UFF for "Commercial Employee" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	36.9	m^3/day	

E4) Food & Beverage				
Estimated Floor Area	=	873.9	m^2	
Staff Occupancy Density	=	19.6	m^2/staff	Worker density by Industry Group (All Type) for "Restaurants" is 5.1 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	45	staff	
Unit flow Factor (UFF) per resident	=	1.580	m^3/day/person	UFF for "Commercial Employee + J10 Restaurants & Hotels" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	71.1	m^3/day	
E5) Logistics/ Storage				
Estimated Floor Area	=	873.9	m^2	
Staff Occupancy Density	=	250.0	m^2/staff	Worker density by Industry Group (All Type) for "Storage" is 0.4 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	4	staff	
Unit flow Factor (UFF) per resident	=	0.180	m^3/day/person	UFF for "Commercial Employee + J3 Transport, Storage & Communications" in Table T-3 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	0.7	m^3/day	
E6) Community				
Estimated Floor Area	=	1747.9	m^2	
Staff Occupancy Density	=	30.3	m^2/staff	Worker density by Industry Group (All Type) for "Community, Social & Personal Services" is 3.3 Staff in 100m^2 as stated in Table 8 of Ref.1.
No. of Staff	=	58	staff	
Unit flow Factor (UFF) per resident	=	0.280	m^3/day/person	UFF for "Commercial Employee + J11 Community, Social & Personal Services" in Table T-2 of Ref. 2 is adopted.
Estimated Total Average Daily Dry Weather Flow Rate	=	16.2	m^3/day	
Total Estimated Flow	=	**139.2**	**m^3/day**	
Catchment Inflow Factor	=	**1.1**		Catchement Inflow Factor for Kwai Chung in Table T-4 of Ref. 2 is adopted.
Total Average Daily Dry Weather Flow of Catchment E	=	**153.1**	**m^3/day**	

Reference:

1 Commercial and Industrial Floor Space Utilization Survey, Planning Department, 2005
2 Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0, Environmental Protection Department of HK Government, March 2005

Appendix C Calculation of Flow Capacity

"Before" Scenario

Pipe Segment ID	Pipe Segment between Manholes		Length	Level (In)	Level (Out)	d	r	A_w	P_w	R	s	k_s [1]	V	Q_C	ADWF	P_c	P	Q_p	Catchment	Is $Q_C > Q_p$?	% of capacity [2]
			m	mPD	mPD	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/day			m^3/s		Y/N	%
FWD4022033	FMH4021329	FMH4021330	34.8	13.75	12.31	0.225	0.113	0.040	0.707	0.057	0.041	6	1.829	0.066	270.47	1002	6	0.019	Catchment A	Y	29%
FWD4022034	FMH4021330	FMH4021331	34.7	12.31	10.82	0.225	0.113	0.040	0.707	0.057	0.043	6	1.864	0.067	390.35	1446	6	0.027	Catchments A to B	Y	40%
FWD4022035	FMH4021331	FMH4021332	41.9	10.82	9.20	0.225	0.113	0.040	0.707	0.057	0.039	6	1.769	0.064	755.62	2799	6	0.052	Catchments A to C	Y	82%
FWD4022036	FMH4021332	FMH4021333	35.9	9.20	7.80	0.225	0.113	0.040	0.707	0.057	0.039	6	1.776	0.064	755.62	2799	6	0.052		Y	82%
FMD4000652 [3]	FMH4021333	FMH4021334	21.4	7.80	7.60	0.400	0.200	0.126	1.257	0.100	0.009	6	1.294	0.293	2133.13	7900	5	0.123	Catchments A to D	Y	42%
FMD4000653 [3]	FMH4021334	FMH4021335	23.1	7.60	6.42	0.400	0.200	0.126	1.257	0.100	0.051	6	3.027	0.686	2286.27	8468	5	0.132	Catchments A to E	Y	19%

Legend

d = pipe diameter, m

r = pipe radius (m) = 0.5d

A_w = wetted area (m^2) = (r^2/2) (b + sinq)

P_w = wetted perimeter (m) = br

s = Slope of the total energy line

R = Hydraulic radius (m) = A_w/P_w

s = Slope of the total energy line

k_s = hydraulic pipeline roughness, mm

V = Velocity of flow calculated based on Colebrook-White Equation, m/s

Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s

Q_p = Estimated total peak flow from the Site during peak season, m^3/s

P_c = Contributing Population = ADWF/0.27

P = Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage

ADWF = Total average dry weather flow, m^3/day

Note

1. Whilst sewage generation from the Site is estimated based on the *"Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0"* (published by the Environmental Protection Department (EPD), 2005) using the best available information, the flow capacities of pipe segments are calculated based on Colebrook-White Equation.
2. The roughness value is referred to Table 5 of the *"Sewerage Manual, Key Planning Issues and Gravity Collection System"* published by the Drainage Services Department (DSD). For conservative approach, the roughness value 6 is adopted, assuming with concrete pipe material under poor condition with a velocity approximately 0.75m/s when flowing half full.
3. Pipe segments FMD4000652 and FMD4000653 contain two multiple parallel pipes. The flow capacity (Q_C) is therefore doubled.

"After" Scenario

Pipe Segment ID	Pipe Segment between Manholes		Length	Level (In)	Level (Out)	d	r	A_w	P_w	R	s	k_s [1]	V	Q_C	ADWF	P_c	P	Q_p	Catchment	Is $Q_C > Q_p$?	% of capacity [2]
			m	mPD	mPD	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/day			m^3/s		Y/N	%
Proposed sewer [4]	Terminal Manhole	FMH4021330	14.0	13.0	12.31	0.100	0.050	0.008	0.314	0.025	0.049	6	1.112	0.008	5.46	20	8	0.001	Proposed CBP	Y	6%
FWD4022033	FMH4021329	FMH4021330	34.8	13.75	12.31	0.225	0.113	0.040	0.707	0.057	0.041	6	1.829	0.066	270.47	1002	6	0.019	Catchment A	Y	29%
FWD4022034	FMH4021330	FMH4021331	34.7	12.31	10.82	0.225	0.113	0.040	0.707	0.057	0.043	6	1.864	0.067	395.81	1466	6	0.027	Catchments A to B	Y	41%
FWD4022035	FMH4021331	FMH4021332	41.9	10.82	9.20	0.225	0.113	0.040	0.707	0.057	0.039	6	1.769	0.064	761.08	2819	6	0.053	Catchments A to C	Y	83%
FWD4022036	FMH4021332	FMH4021333	35.9	9.20	7.80	0.225	0.113	0.040	0.707	0.057	0.039	6	1.776	0.064	761.08	2819	6	0.053		Y	83%
FMD4000652 [3]	FMH4021333	FMH4021334	21.4	7.80	7.60	0.400	0.200	0.126	1.257	0.100	0.009	6	1.294	0.293	2138.59	7921	5	0.124	Catchments A to D	Y	42%
FMD4000653 [3]	FMH4021334	FMH4021335	23.1	7.60	6.42	0.400	0.200	0.126	1.257	0.100	0.051	6	3.027	0.686	2291.73	8488	5	0.133	Catchments A to E	Y	19%

Legend

d = pipe diameter, m

r = pipe radius (m) = 0.5d

A_w = wetted area (m^2) = (r^2/2) (b + sinq)

P_w = wetted perimeter (m) = br

s = Slope of the total energy line

R = Hydraulic radius (m) = A_w/P_w

s = Slope of the total energy line

k_s = hydraulic pipeline roughness, mm

V = Velocity of flow calculated based on Colebrook-White Equation, m/s

Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s

Q_p = Estimated total peak flow from the Site during peak season, m^3/s

P_c = Contributing Population = ADWF/0.27

P = Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage

ADWF = Total average dry weather flow, m^3/day

Note

1. The roughness value is referred to Table 5 of the "Sewerage Manual, Key Planning Issues and Gravity Collection System" published by the Drainage Services Department (DSD). For conservative approach, the roughness value 6 is adopted, assuming with concrete pipe material under poor condition with a velocity approximately 0.75m/s when flowing half full.
2. Whilst sewage generation from the Site is estimated based on the "Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0" (published by the Environmental Protection Department (EPD), 2005) using the best available information, the flow capacities of pipe segments are calculated based on Colebrook-White Equation.
3. Pipe segments FMD4000652 and FMD4000653 contain two multiple parallel pipes. The flow capacity (QC) is therefore doubled.
4. The invert levels and length of the proposed sewer are indicative only, subject to change during the detailed design stage.

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