Appendix 4

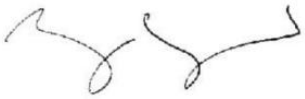
Sewerage Impact Assessment

Prepared by

Ramboll Hong Kong Limited

PROPOSED FLAT WITH PERMITTED EATING PLACE AND SHOP AND SERVICES USES IN "COMMERCIAL (9)" ZONE

SEWERAGE IMPACT ASSESSMENT

Date	23 June 2025
Prepared by	Crystal Lui Assistant Environmental Consultant
Signed	
Approved by	Katie Yu Senior Manager
Signed	
Project Reference	KTASMTRDEI00
Document No.	R9561_v3.0.docx

Ramboll Hong Kong Limited

21/F, BEA Harbour View Centre
56 Gloucester Road, Wan Chai, Hong Kong

Tel: (852) 3465 2888
Fax: (852) 3465 2899
Email: hkinfo@ramboll.com

Q:\Projects\KTASMTRDEI00\04 Deliverables\02 SIA Report\R9561_v3.0.docx

CHAPTERS

Page

1. INTRODUCTION 1-1
   1.1 Background and Objectives 1-1
   1.2 Application Site and its Environ 1-1
   1.3 Application Site and its Environ 1-1
2. SEWERAGE IMPACT ASSESSMENT 2-1
   2.1 Scope of Work 2-1
   2.2 Assessment Criteria and Methodology 2-1
   2.3 Existing and Future Sewerage System 2-1
   2.4 Wastewater Generated by the Proposed Development 2-2
   2.5 Assessment of Sewerage Impact 2-3
   2.6 Discussion 2-3
3. OVERALL CONCLUSION 3-1

TABLES

Table 2.1 Estimated Peak Flow 2-2

FIGURES

Figure 1.1 Location of Application Site and its Environ

Figure 2.1 Existing Sewerage System in the Vicinity of the Application Site

Figure 2.2 Existing Sewerage System and Catchment Area in the Vicinity of the Application Site

APPENDICES

Appendix 2.1 Detailed Sewerage Impact Assessment Calculations

1. INTRODUCTION

1.1 Background and Objectives

1.1.1 Ramboll Hong Kong Limited has been appointed by the Applicant to prepare this Sewerage Impact Assessment (SIA) for the Proposed Development at San Ma Tau Street, Ma Tau Kok, Kowloon (hereafter the “Application Site”).

1.1.2 The purpose of this assessment is to confirm the feasibility of the Application Site in terms of its sewerage impact.

1.2 Application Site and its Environ

1.2.1 According to the Approved Kai Tak Outline Zoning Plan (OZP) No. S/K22/8, the Application Site falls within an area zoned “Commercial (9)” (“C(9)”).

1.2.2 The Application Site has an area of about 2,038 m². It is situated in Kowloon City area and bounded by San Ma Tau Street to its southwest and northeast, To Kwa Wan Road to its northwest with industrial and residential buildings nearby. Figure 1.1 shows the location of the Application Site and its environ.

1.3 Application Site and its Environ

1.3.1 The Proposed Development comprises a 27-storey building (including a 6-storey podium) above 1 level of basement, for residential, F&B and retail use, with a maximum building height of 100 mPD. The tentative population intake year is year 2030.

2. SEWERAGE IMPACT ASSESSMENT

2.1 Scope of Work

2.1.1 The aim of this SIA is to assess whether the capacity of the existing sewerage network serving the Application Site is sufficient to cope with the sewage flow from the proposed development.

2.2 Assessment Criteria and Methodology

2.2.1 The Commercial and Industrial Floor Space Utilization Survey (CIFSUS) conducted by the Planning Department has been used to determine the worker density for various economic activities and planned usage types.

2.2.2 Environmental Protection Department's (EPD's) Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, Version 1 (GESF) has been referred to for the purposes of estimating the quantity of the sewage generated from the Proposed Development and the existing catchment area. Sewage flow parameters and global peaking factors in this document have been adopted for this SIA.

2.2.3 According to the GESF, the overall unit flow is composed of flows due to employees and the associated activities. The following unit flow factors have been adopted in the SIA calculation in accordance with Tables T-1 and T-2 of the GESF:

- Residential housing: 0.27m3/day (Private R2)
- Warehouse: 0.18m3/day (Commercial Employee and J3 – Transport, Storage & Communication)
- Retail/Wholesale Trade: 0.28m3/day (Commercial Employee and J4 – Retail & Wholesale)
- Clubhouse: 0.28 m3/day (Commercial Employee and J11 – Community, Social & Personal Services)
- Business/Office: 0.08m3/day (Commercial Employee and J6 – Finance, Insurance, Real Estate & Business Services)
- Restaurants: 1.58m3/day (Commercial Employee and J10 – Restaurants & Hotels)
- Manufacturing: 0.63m3/day (Industrial Employee and J1 – Central Kowloon)

2.2.4 The catchment inflow factor, PCIF of 1.0 (Central Kowloon), is adopted in catchment calculations.

2.3 Existing and Future Sewerage System

2.3.1 According to the Drainage Record obtained from DSD, there is a Ø1125mm sewer pipe running along San Ma Tau Street, and a Ø1300mm sewer running along To Kwa Wan Road. The existing sewers in the vicinity of the Application Site are shown in Figure 2.1.

2.3.2 A new terminal manhole "S0" will be constructed at the Application Site to collect sewage from the Proposed Development. A new Ø225mm polyethylene pipe will be proposed to connect the Proposed Development and the existing manhole FMH4025687 (S1) downstream of the public sewerage system along San Ma Tau Street.

2.3.3 Invert levels and pipe size of the proposed terminal manhole and existing manholes are shown in Appendix 2.1.

2.4 Wastewater Generated by the Proposed Development

2.4.1 The sewage generated by the Application Site will be contributed by the commercial employee of the office, retail and food and beverage (F&B) areas.

2.4.2 Detailed calculation of sewage generation from the Proposed Development is given in Table 2.1 below.

Table 2.1 Estimated Peak Flow

Calculation for Sewage Generation Rate of the Proposed Development			
Residential Area			
Total number of residential units	=	260	units
Total number of residents	=	702	residents -- (refer to the average household size of 2.7 in Kowloon City District in 2023 provided by C&SD)
Design flow	=	270	m^3/person/day -- (Private R2 in Table T-1 of GESF)
Sewage generation rate	=	189.5	m^3/day
Retail Area			
Assumed Area	=	2830	m^2
Assumed floor area per employee	=	28.6	m^2 per employee – (refer to Table 8 of CIFSUS – Retail Trade)
Total number of employees	=	99	employees
Design flow	=	280	m^3/employee/day – (refer to Table T-2 of GESF – J4 Retail & Wholesale)
Sewage generation rate	=	27.7	m^3/day
F&B Area			
Assumed Area	=	2830	m^2
Assumed floor area per employee	=	19.6	m^2 per employee – (refer to Table 8 of CIFSUS – Restaurants)
Total number of employees	=	144	employees
Design flow	=	1580	m^3/employee/day – (refer to Table T-2 of GESF – J10 Restaurants & Hotels)
Sewage generation rate	=	228.0	m^3/day
Clubhouse			
Assumed Area	=	73.9	m^2
Assumed floor area per employee	=	30.3	m^2 per employee – (refer to Table 8 of CIFSUS – Community, Social & Personal Services)
Total number of employees	=	2	employees
Design flow	=	280	m^3/employee/day – (refer to Table T-2 of GESF – J11 Community, Social & Personal Services)
Sewage generation rate	=	0.7	m^3/day
Total Flow at Proposed Terminal Manhole S0			
Flow rate	=	446.0	m^3/day
Total Flow from the Proposed Development			
Flow rate	=	446.0	m^3/day
Flow rate with P_{CIF} (Central Kowloon - 1.0)	=	446.0	m^3/day (refer to Table T-4 of GESF – Central Kowloon - 1.0)
Contributing population	=	1652	people
Peaking factor	=	6	(refer to Table T-5 of GESF for a population of 1,000-5,000 incl. stormwater allowance)
Peak flow	=	31.0	litre/sec

2.5 Assessment of Sewerage Impact

2.5.1 Sewage generated from the Application Site will be discharged via the proposed terminal manhole (S0) via a polyethene (PE) pipe to the existing manhole FMH4025687 (S1) downstream of the public sewerage system as shown in Figure 2.1. Catchments in the vicinity of the Application Site are shown in Figure 2.2.

2.5.2 The estimated sewage flow from the Application Site and the existing catchments have been compared with the capacity of the existing sewerage system as shown in Appendix 2.1. Wastewater discharged from upstream “Catchment E” is assumed based on fullbore condition of upstream pipeline for the worst-case scenario.

2.5.3 In accordance with Section 5.11 of the Sewerage Manual, should the existing sewage system be under-capacity, the following shall be satisfied to demonstrate that no adverse sewerage impact will arise as a result of the proposed development:

- minimum freeboard of 1m at peak flow;
- A minimum factor of safety against overflowing of 1.15, i.e. overflow will not occur at a flow rate of (1.15 times peak flow)

2.6 Discussion

2.6.1 According to the calculation results presented in Table 4 of Appendix 2.1, the sewage generated from the Application Site exceeds the capacity of the existing sewerage network at segment S2-S3. Therefore, backwater analysis has been conducted and shown in Tables 5a – 5b of Appendix 2.1.

2.6.2 The results indicate that there are sufficient freeboards for all concerned manholes, i.e. over 1m. Taking into account the safety factor requirement, the peak flow rates are multiplied by 1.15 and no overflow is identified. With sufficient freeboards for the surcharged sewers, no unacceptable sewerage impact resulting from the Proposed Development is anticipated.

3. OVERALL CONCLUSION

3.1.1 The potential sewerage impact arising from the Application Site has been quantitatively assessed by comparing the estimated sewage flow from the Proposed Development and the capacity of the existing sewerage system in the vicinity.

3.1.2 Based on the findings of sewerage impact assessment, the sewage generated from the Application Site exceeds the capacity of the existing sewerage network at segment S2-S3. A backwater analysis was conducted and revealed that there are sufficient freeboards for all concerned manholes and no overflow during peak flow rates. Therefore, with sufficient freeboards for the surcharged sewer, no unacceptable sewerage impact resulting from the Proposed Development is anticipated.

3.1.3 This SIA confirms the feasibility of the Proposed Development in terms of its sewerage impact.

Figures

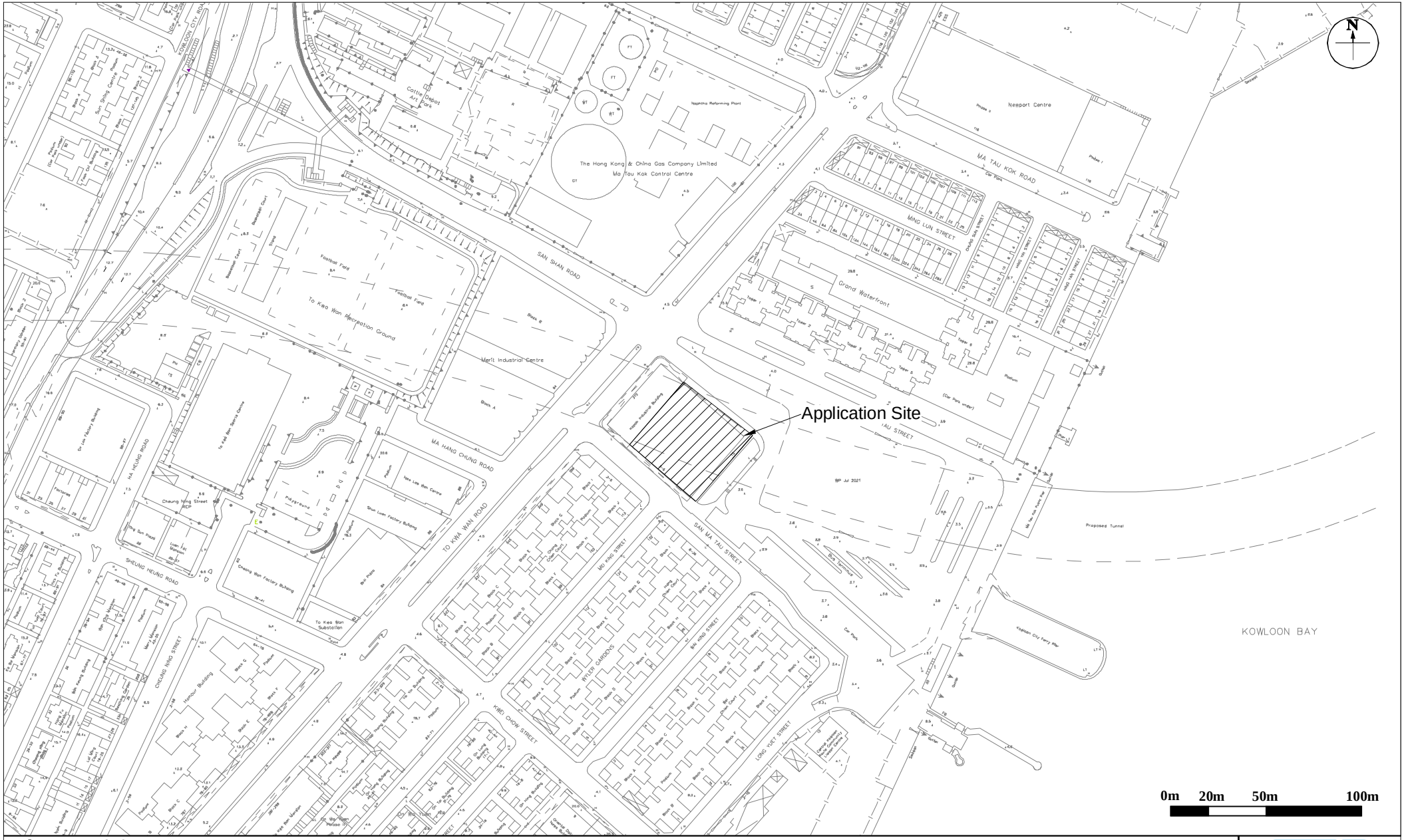


Figure: 1.1	RAMBOLL
Title: Location of Application Site and Its Environ	Drawn by: CL
	Checked by: KY
Project: Proposed Flat with Permitted Eating Place and Shop and Services Uses in "Commercial (9)" Zone	Rev.: 1.1
	Date: Nov 2024

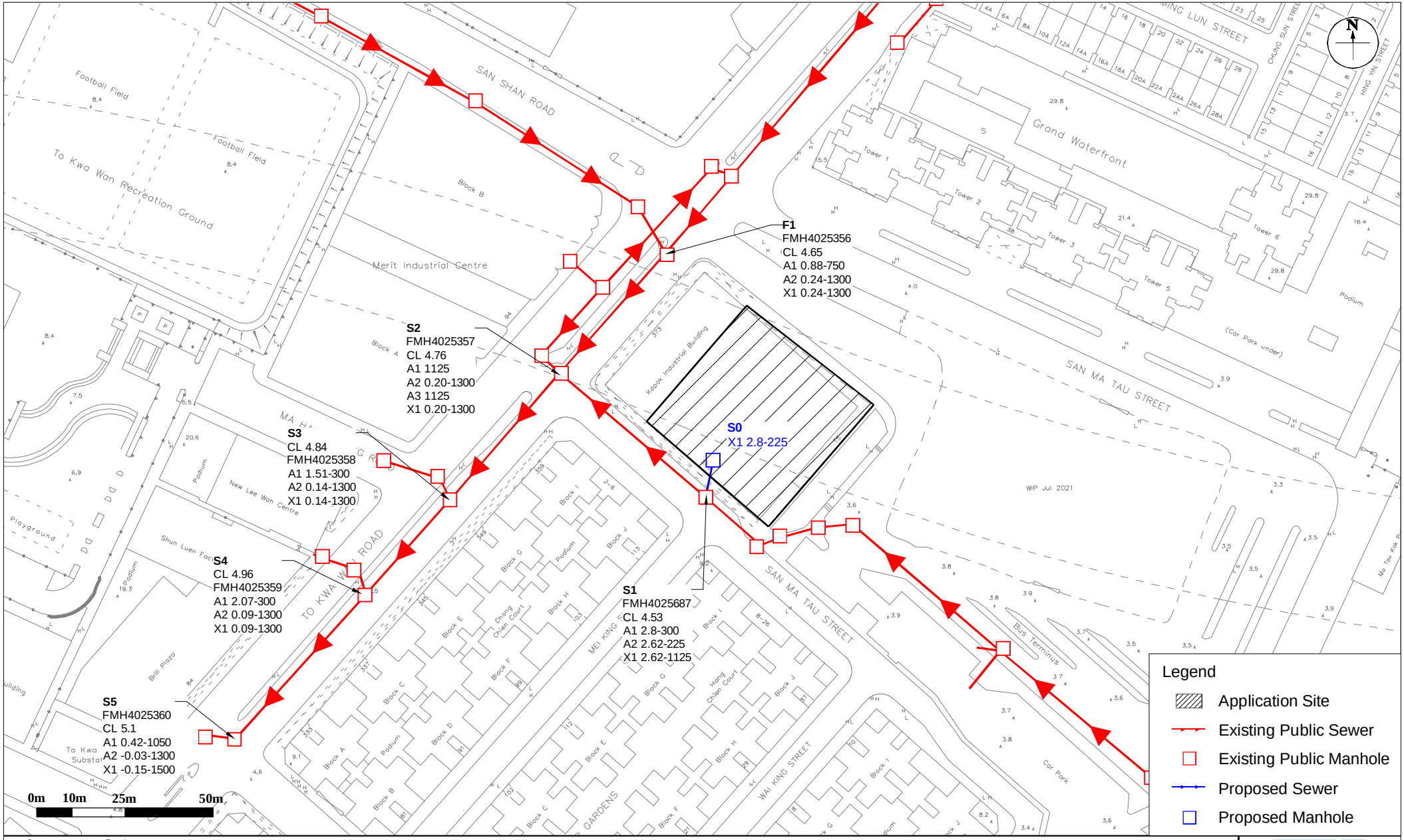


Figure: 2.1

Title: Existing Sewerage System in the Vicinity of the Application Site

Project: Proposed Flat with Permitted Eating Place and Shop and Services Uses in "Commercial (9)" Zone

RAMBOLL

Drawn by: CL

Checked by: KY

Rev.: 1.1

Date: Nov 2024

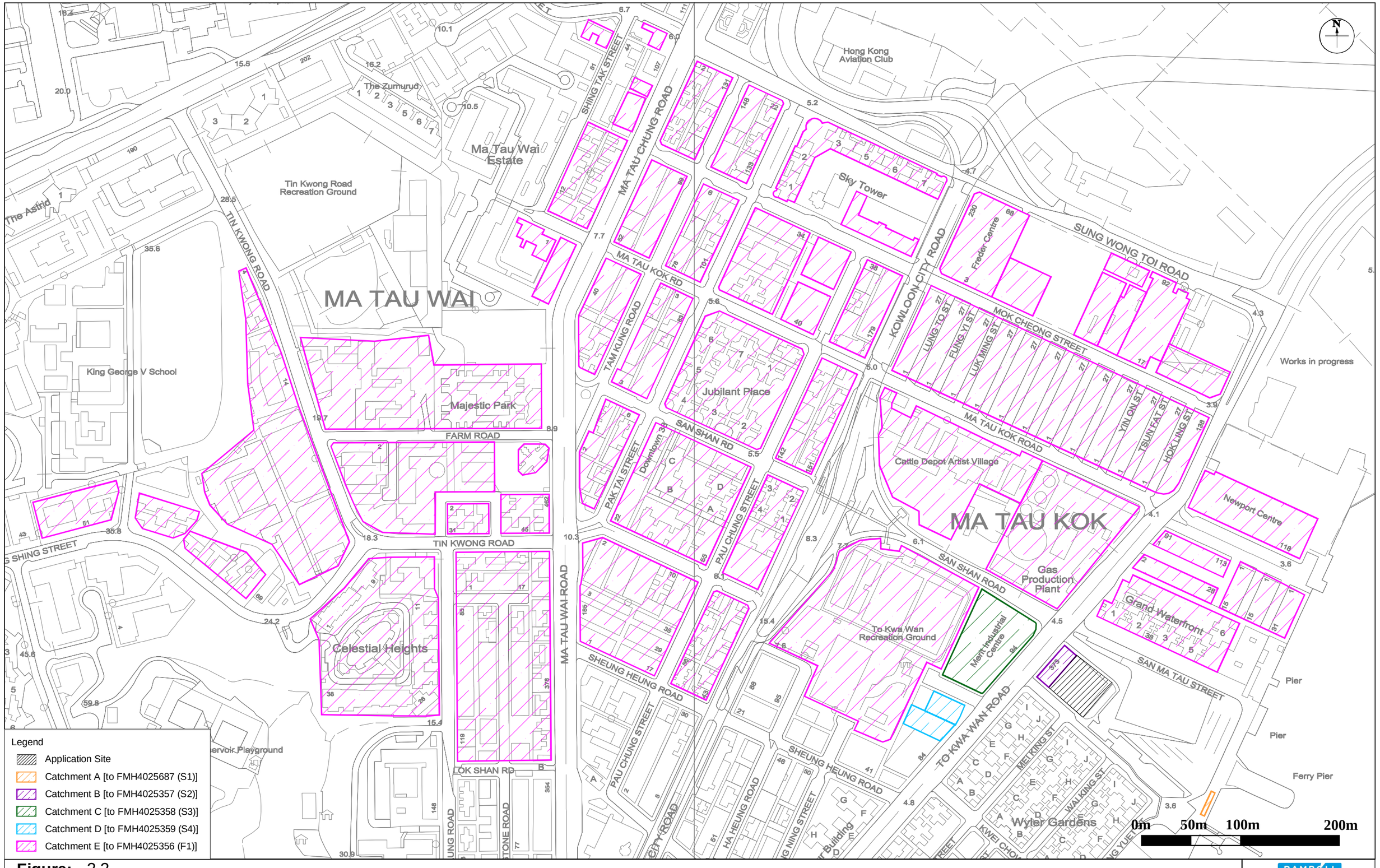


Figure: 2.2

Title: Existing Sewerage System and Catchment Area in the Vicinity of the Application Site

Project: Proposed Flat with Permitted Eating Place and Shop and Services Uses in "Commercial (9)" Zone

RAMBOLL

Drawn by:	CL
Checked by:	KY
Rev.:	2.0
Date:	Feb 2025

Appendix

Appendix 2.1

Detailed Sewerage Impact Assessment Calculations

Table 1a Hydraulic Capacity of Existing Sewers at San Ma Tau Street / To Kwa Wan Road, To Kwa Wan

Segment	Manhole Reference	Manhole Reference	Pipe Diameter	Pipe Length	Invert Level 1	Invert Level 2	g	k_s	s	v	V	Area	Q	Estimated Capacity
			mm	m	mPD	mPD	m/s^2	m		m^2/s	m/s	m^2	m^3/s	L/s
S0-S1	Terminal Manhole	FMH4025687	225	8.4	2.8	2.62	9.81	0.00030	0.021	0.000001	2.09	0.04	0.08	83
S1-S2	FMH4025687	FMH4025357	1125	52.8	2.62	0.20	9.81	0.00300	0.046	0.000001	6.32	0.99	6.28	6280
S2-S3	FMH4025357	FMH4025358	1300	49.2	0.20	0.14	9.81	0.00600	0.001	0.000001	1.02	1.33	1.36	1358
S3-S4	FMH4025358	FMH4025359	1300	33.3	0.14	0.09	9.81	0.00300	0.001	0.000001	1.25	1.33	1.66	1660
S4-S5	FMH4025359	FMH4025360	1300	54.1	0.09	-0.03	9.81	0.00300	0.002	0.000001	1.52	1.33	2.02	2020

Table 1b Hydraulic Capacity of Existing Sewers at To Kwa Wan Road, To Kwa Wan (Assume Full Bore Flow)

Segment	Manhole Reference	Manhole Reference	Pipe Diameter	Pipe Length	Invert Level 1	Invert Level 2	g	k_s	s	v	V	Area	Q	Estimated Capacity
			mm	m	mPD	mPD	m/s^2	m		m^2/s	m/s	m^2	m^3/s	L/s
F1-S2	FMH4025356	FMH4025357	1300	47.4	0.24	0.20	9.81	0.00600	0.001	0.000001	0.85	1.33	1.13	1130

Notes: (1) According to DSD Drainage Records, the incoming invert level of Manhole S2 (FMH4025357) is missing. Therefore, the outgoing invert level of 0.20mPD is used. A manhole survey will be conducted during construction phase to confirm the manhole settings and the corresponding pipe capacity.

Remarks: (1) g=gravitational acceleration; k_s=equivalent sand roughness; s=gradient; v=kinematic viscosity of water; V=mean velocity

(2) The values of ks = 3mm and ks = 6mm are used for the calculation of slimed concrete sewer, poor condition @mean velocity = 1.2m/s and 0.75m/s respectively (based on Table 5: Recommended Roughness Values in Sewerage Manual)

(3) The values of ks = 0.3mm is used for the calculation of slimed PE sewer, poor condition @mean velocity = approximately 1.2m/s (based on Table 5: Recommended Roughness Values in Sewerage Manual)

(4) The value of velocity (V) is referred to the Tables for the hydraulic design of pipes, sewers and channels (8th edition)

(5) Equation used: $$V = -\sqrt{(8gDs)}\log\left(\frac{k_s}{3.7D} + \frac{2.51v}{D\sqrt{(2gDs)}}\right)$$

Table 2 Calculation for Sewage Generation Rate of the Proposed Development at the Subject Site

1. Residential Area			
Total number of residential units	=	260	units
Total number of residents	=	702	residents -- (refer to the average household size of 2.7 in Kowloon City District in 2023 provided by C&SD)
Design flow	=	270	m^3/person/day -- (Private R2 in Table T-1 of GESF)
Sewage generation rate	=	**189.5**	m^3/day
2. Retail Area			
Assumed Area	=	2830	m^2
Assumed floor area per employee	=	28.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Retail Trade)
Total number of employees	=	99	employees
Design flow for commercial activities	=	280	m^3/employee/day -- (refer to Table T-2 of GESF - J4 Retail & Wholesale)
Sewage Generation rate	=	**27.7**	m^3/day
3. F&B Area			
Assumed Area	=	2830	m^2
Assumed floor area per employee	=	19.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Restaurants)
Total number of employees	=	144	employees
Design flow for commercial activities	=	1580	m^3/employee/day -- (refer to Table T-2 of GESF - J10 Restaurants & Hotels)
Sewage Generation rate	=	**228.0**	m^3/day
4. Clubhouse			
Assumed Area	=	73.9	m^2
Assumed floor area per employee	=	30.3	m^2 per employee -- (refer to Table 8 of CIFSUS - Community, Social & Personal Services)
Total number of employees	=	2	employees
Design flow for commercial activities	=	280	m^3/employee/day -- (refer to Table T-2 of GESF - J11 Community, Social & Personal Services)
Sewage Generation rate	=	**0.7**	m^3/day
Total Flow from Proposed Development			
Flow Rate	=	446.0	m^3/day
Flow Rate with P_{CIF} (Central Kowloon - 1.0)	=	446.0	m^3/day (refer to Table T-4 of GESF - Central Kowloon - 1.0)
Contributing Population	=	1652	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance
Peak Flow	=	**31.0**	litre/sec

Table 3a Calculation for Sewage Generation Rate of the Existing Surrounding Building (Catchment A)

Catchment A

1. Public Lavatory (near Ferry Pier)

1a. Discharge from WC (Qty * DU)	=	21.6	L/s
1b. Discharge from Basin (Qty * DU)	=	2.1	L/s
1c. Discharge from Single Urinal with Cistern (Qty * DU)	=	2	L/s
1d. Sum of DUs	=	25.7	L/s
1e. Wastewater Flow Rate ($K\sqrt{\sum DU}$)	=	**5.07**	L/s

Frequency of use, K = 1, extracted from Table 6 of Plumbing Engineering Services Design Guide (PESDG)
Discharge Unit (DU) of WC = 1.8 L/s; DU of Basin = 0.3 L/s, DU of Single Urinal with Cistern = 0.4L/s, extracted from Table 5 of PESDG
Total number of WC = 12; Total number of Basin = 7; Total number of Single Urinal with Cistern = 5 (Site observation)

Total Flow at Manhole S1 (FMH4025687), including Proposed Development and Catchment A

Flow Rate	=	446.0	m^3/day
Flow Rate with P_{CIF} (Central Kowloon - 1.0)	=	446.0	m^3/day (refer to Table T-4 of GESF - Central Kowloon - 1.0)
Contributing Population	=	1652	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance
Peak Flow	=	**31.0**	litre/sec
Peak Flow including Public Lavatory	=	**36.0**	litre/sec

Table 3b Calculation for Sewage Generation Rate of the Existing Surrounding Building (Catchment B)

Catchment B

1. Kapok Industrial Building (373 To Kwa Wan Road)

1a. Assumed Warehouse Area	=	2449	m^2 -- (GFA reference: BRAVO File no.: 2/4073/64, Drawing no. B01)
1b. Assumed floor area per employee of warehouse area	=	250	m^2 per employee -- (refer to Table 8 of CIFSUS - Storage)
1c. Total number of employees of warehouse area	=	10	employees
1d. Design flow for commercial employee of warehouse area	=	180	litre/employee/day -- (refer to Table T-2 of GESF - J3)
1e. Sewage Generation rate of warehouse area	=	**1.8**	m^3/day
1f. Assumed Commercial Area	=	3248.8	m^2 -- (GFA reference: BRAVO File no.: 2/4073/64, Drawing no. B01)
1g. Assumed floor area per employee of commercial area	=	18.2	m^2 per employee -- (refer to Table 8 of CIFSUS - Business Services)
1h. Total number of employees of commercial area	=	179	employees
1i. Design flow for commercial employee of commercial area	=	80	litre/employee/day -- (refer to Table T-2 of GESF - J6)
1j. Sewage Generation rate of commercial area	=	**14.3**	m^3/day
1k. Assumed Manufacturing Area	=	258.7	m2 -- (GFA reference: BRAVO File no.: 2/4073/64, Drawing no. B01)
1l. Assumed floor area per employee of manufacturing area	=	43.5	m2 per employee -- (refer to Table 8 of CIFSUS - Manufacturing)
1m. Total number of employees of manufacturing area	=	6	employees
1n. Design flow for industrial employee of manufacturing area	=	630.0	litre/employee/day -- (refer to Table T-2 of GESF - J1: Central Kowloon)
1o. Sewage Generation rate of manufacturing area	=	**3.7**	m3/day
Sub-total Sewage Generation Rate	=	**19.8**	m^3/day

Total Flow at Manhole S2 (FMH4025357), Proposed Development and Catchment A-B

Flow Rate	=	465.8	m^3/day
Flow Rate with P_{CIF} (Central Kowloon - 1.0)	=	465.8	m^3/day (refer to Table T-4 of GESF - Central Kowloon - 1.0)
Contributing Population	=	1725	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance
Peak Flow	=	**32.3**	litre/sec
Peak Flow including Lavatory	=	**37.4**	litre/sec

Table 3c Calculation for Sewage Generation Rate of the Existing Surrounding Building (Catchment C)

Catchment C

1. Merit Industrial Centre (94 To Kwa Wan Road)

1a. Assumed Warehouse Area	=	30401	m^2 -- (Assume 50% of GFA) (GFA reference: BRAVO File no.: 2/4086/79, Drawing no. 217(E))
1b. Assumed floor area per employee of warehouse area	=	250.0	m^2 per employee -- (refer to Table 8 of CIFSUS - Storage)
1c. Total number of employees of warehouse area	=	122	employees
1d. Design flow for commercial employee of warehouse area	=	180	litre/employee/day -- (refer to Table T-2 of GESF - J3)
1e. Sewage Generation rate of warehouse area	=	**21.9**	m^3/day
1f. Assumed Manufacturing Area	=	30401	m^2 -- (Assume 50% of GFA) (GFA reference: BRAVO File no.: 2/4086/79, Drawing no. 217(E))
1g. Assumed floor area per employee of manufacturing area	=	43.5	m2 per employee -- (refer to Table 8 of CIFSUS - Manufacturing)
1h. Total number of employees of manufacturing area	=	699	employees
1i. Design flow for industrial employee of manufacturing area	=	630	litre/employee/day -- (refer to Table T-2 of GESF - J1: Central Kowloon)
1j. Sewage Generation rate of manufacturing area	=	**440.5**	m^3/day
Sub-total Sewage Generation Rate	=	**462.4**	m^3/day

Total Flow at Manhole S3 (FMH4025358), Proposed Development and Catchment A-C

Flow Rate	=	928.2	m^3/day
Flow Rate with P_{CIF} (Central Kowloon - 1.0)	=	928.2	m^3/day (refer to Table T-4 of GESF - Central Kowloon - 1.0)
Contributing Population	=	3438	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance
Peak Flow	=	**64.5**	litre/sec
Peak Flow including Lavatory	=	**69.5**	litre/sec

Table 3d Calculation for Sewage Generation Rate of the Existing Surrounding Building (Catchment D)

Catchment D

1. New Lee Wah Centre (88 To Kwa Wan Road)

1a. Assumed Commercial area	=	10912.4	m^2 -- (GFA reference: BRAVO File no.: 2/4114/94, Drawing no. A22)
1b. Assumed floor area per employee of commercial area	=	18.2	m^2 per employee -- (refer to Table 8 of CIFSUS - Business Services)
1c. Total number of employees of commercial area	=	600	employees
1d. Design flow for commercial employee of commercial area	=	80	litre/employee/day -- (refer to Table T-2 of GESF - J6)
1e. Sewage Generation rate of commercial area	=	**48.0**	m^3/day
1f. Assumed Retail area	=	3637.5	m^2 -- (GFA reference: BRAVO File no.: 2/4114/94, Drawing no. A22)
1g. Assumed floor area per employee of retail area	=	28.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Retail Trade)
1h. Total number of employees of retail area	=	127	employees
1d. Design flow for commercial employee of retail area	=	280	litre/employee/day -- (refer to Table T-2 of GESF - J4)
1j. Sewage Generation rate of retail area	=	**35.6**	m^3/day
Sub-total Sewage Generation Rate	=	**83.7**	m^3/day

2. Shun Luen Factory Building (86 To Kwa Wan Road)

2a. Assumed Commercial Area	=	5384.3	m^2 -- (GFA reference: BRAVO File no.: 2/4529/59, Drawing no.: 1504A(6/6))
2b. Assumed floor area per employee of commercial area	=	18.2	m^2 per employee -- (refer to Table 8 of CIFSUS - Business Services)
2c. Total number of employees of commercial area	=	296	employees
2d. Design flow for commercial employee of commercial area	=	80	litre/employee/day -- (refer to Table T-2 of GESF - J6)
2e. Sewage Generation rate of commercial area	=	**23.7**	m^3/day
2f. Assumed Retail Area	=	1794.8	m^2 -- (GFA reference: BRAVO File no.: 2/4529/59, Drawing no.: 1504A(6/6))
2g. Assumed floor area per employee of retail area	=	28.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Retail Trade)
2h. Total number of employees of retail area	=	63	employees
2i. Design flow for commercial employee of retail area	=	280	litre/employee/day -- (refer to Table T-2 of GESF - J4)
2j. Sewage Generation rate of retail area	=	**17.6**	m^3/day
2k. Assumed Warehouse Area	=	897.4	m^2 -- (GFA reference: BRAVO File no.: 2/4529/59, Drawing no.: 1504A(6/6))
2l. Assumed floor area per employee of warehouse area	=	250.0	m^2 per employee -- (refer to Table 8 of CIFSUS - Storage)
2m. Total number of employees of warehouse area	=	4	employees
1d. Design flow for commercial employee of warehouse area	=	180	litre/employee/day -- (refer to Table T-2 of GESF - J3)
2o. Sewage Generation rate of warehouse area	=	**0.6**	m^3/day
2p. Assumed Manufacturing Area	=	2692.2	m2 -- (GFA reference: BRAVO File no.: 2/4073/64, Drawing no. B01)
2q. Assumed floor area per employee of manufacturing area	=	43.5	m2 per employee -- (refer to Table 8 of CIFSUS - Manufacturing)
2r. Total number of employees of manufacturing area	=	62	employees
2s. Design flow for industrial employee of manufacturing area	=	630	litre/employee/day -- (refer to Table T-2 of GESF - J1: Central Kowloon)
2t. Sewage Generation rate of manufacturing area	=	**39.0**	m3/day
Sub-total Sewage Generation Rate	=	**41.9**	m^3/day

Sub-total Catchment D

Flow Rate	=	125.6	m^3/day
Contributing Population	=	465	people
Peaking factor	=	8	Refer to Table T-5 of GESF for population <1,000 including stormwater allowance
Peak Flow	=	**11.6**	litre/sec

Total Flow at Manhole S4 (FMH4025359), Proposed Development and Catchment A-D

Flow Rate	=	1053.8	m^3/day
Flow Rate with P_{CIF} (Central Kowloon - 1.0)	=	1053.8	m^3/day (refer to Table T-4 of GESF - Central Kowloon - 1.0)
Contributing Population	=	3903	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 5,000-10,000 incl. stormwater allowance
Peak Flow	=	**73.2**	litre/sec
Peak Flow including Lavatory	=	**78.2**	litre/sec

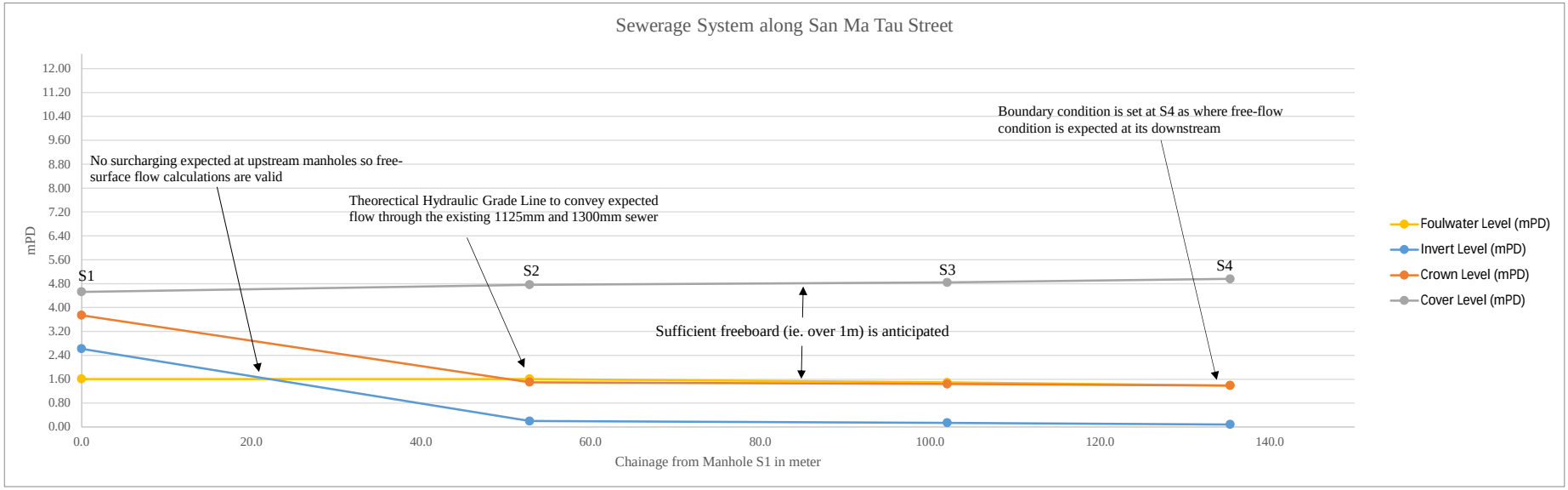
Table 4 Comparision of the Hydraulic Capacity of Existing Sewers for Sewerage generated from the Proposed Development and Surrounding Catchment Areas

Segment	Pipe Diameter (mm)	Pipe Length (m)	Gradient	Estimated Capacity (L/s)	Estimated Flow from the Proposed Development only (L/s)	Contributed by the Proposed Development only (%)	Status	Included Catchment	Daily Flow (m3/day)	Contributing Population	Peaking Factor	Public Lavatory (L/s)	Estimated Flow including the Proposed Development and Catchment Areas (L/s)	Contributed by the Proposed Development and the Surrounding Catchment Areas (%)	Status
S0-S1	225	8.4	0.021	83	31.0	37.2%	OK	Proposed Development	446.0	1652	6	-	31.0	37.2%	OK
S1-S2	1125	52.8	0.046	6280	31.0	0.5%	OK	Proposed Development and Catchment A	446.0	1652	6	5.1	36.0	0.6%	OK
S2-S3	1300	49.2	0.001	1358	31.0	2.3%	OK	Proposed Development and Catchment A+B+E	1595.4	5909	5	5.1	1226.6	90.3%	Spill
S3-S4	1300	33.3	0.001	1660	31.0	1.9%	OK	Proposed Development and Catchment A+B+C+E	2057.8	7621	5	5.1	1253.4	75.5%	OK
S4-S5	1300	54.1	0.002	2020	31.0	1.5%	OK	Proposed Development and Catchment A+B+C+D+E	2183.4	8087	5	5.1	1260.7	62.4%	OK

Remarks:
1. The estimated flow (including development and catchment areas) for segments S2-S5 assumes full bore flow from segment F1-S2 (FMH4025356 to FMH4025357) of 1245L/s. (Refer to Table 1b)

Table 5a Hydraulic Capacity of Existing Sewers S1-S5 - surcharge condition with 1m freeboard

Segmemt	Manhole Reference	Manhole Reference	Pipe Dia.	Pipe Length	Chainage	Invert Level 1	Invert Level 2	Foulwater Level 1	Foulwater Level 2	Cover Level 1	Cover Level 2	Freeboard 1	Freeboard 2	Friction Loss	Entry and Exit Loss	g	k_s	Required $s_{hydraulic}$	v	V	Area	Q	Required Peak Flow
			mm	m	m	mPD	mPD	mPD	mPD	mPD	mPD	m	m	m	m	m/s^2	m		m^2/s	m/s	m^2	m^3/s	L/s
S1-S2	FMH4025687	FMH4025357	1125	52.81	0.0	2.62	0.20	1.61	1.61	4.53	4.76	2.92	3.15	0.00	0.00	9.81	0.00600	0.000002	0.000001	0.04	0.99	0.04	36.0
S2-S3	FMH4025357	FMH4025358	1300	49.19	52.8	0.20	0.14	1.61	1.49	4.76	4.84	3.15	3.35	0.05	0.07	9.81	0.00600	0.000995	0.000001	0.92	1.33	1.23	1226.6
S3-S4	FMH4025358	FMH4025359	1300	33.34	102.0	0.14	0.09	1.49	1.39	4.84	4.96	3.35	3.57	0.03	0.07	9.81	0.00600	0.001039	0.000001	0.94	1.33	1.25	1253.4
S4-S5	FMH4025359	FMH4025360	1300	54.10	135.3	0.09	-0.03	1.39	-	4.96	5.10	3.57	-	0.06	0.07	9.81	0.00600	0.001051	0.000001	0.95	1.33	1.26	1260.7



Note:

1. Foulwater level at S4 is assumed to be: 0.09 (IL) + 1.300 (pipe dia.) = 1.39 mPD as a conservative approach.
2. For this assessment, the Colebrook-White Equation has been used to calculate the friction loss. (Sewerage Mannual Section 5.2.1)
3. According to DSD'sSewerage Manual (Part 1) section 5.2.2, Local losses are usually small in realtion to the pipeline head losses and are not normally considered. However, as a conservative approach, further allowances have been included for local losses at pipe entry (K=0.5) and exit (K = 1), with a total local loss coefficient of 1.5.
4. Comparing the cover level and foulwater levels at each of the manholes, the freeboards are found sufficient (>1m). Therefore, no adverse sewerage impact is anticipated.
5. Friction loss is deduced by required hydraulic gradient x pipe length, while the local loss is deduced by the equation:

$$h_f = K\frac{V^2}{2g}$$

Remarks:

(1) g=gravitational acceleration; k_s=equivalent sand roughness; s=gradient; v=kinematic viscosity of water; V=mean velocity

(2) The values of ks = 3mm and ks = 6mm are used for the calculation of slimed concrete sewer, poor condition @mean velocity = 1.2m/s and 0.75m/s respectively (based on Table 5: Recommended Roughness Values in Sewerage Manual)

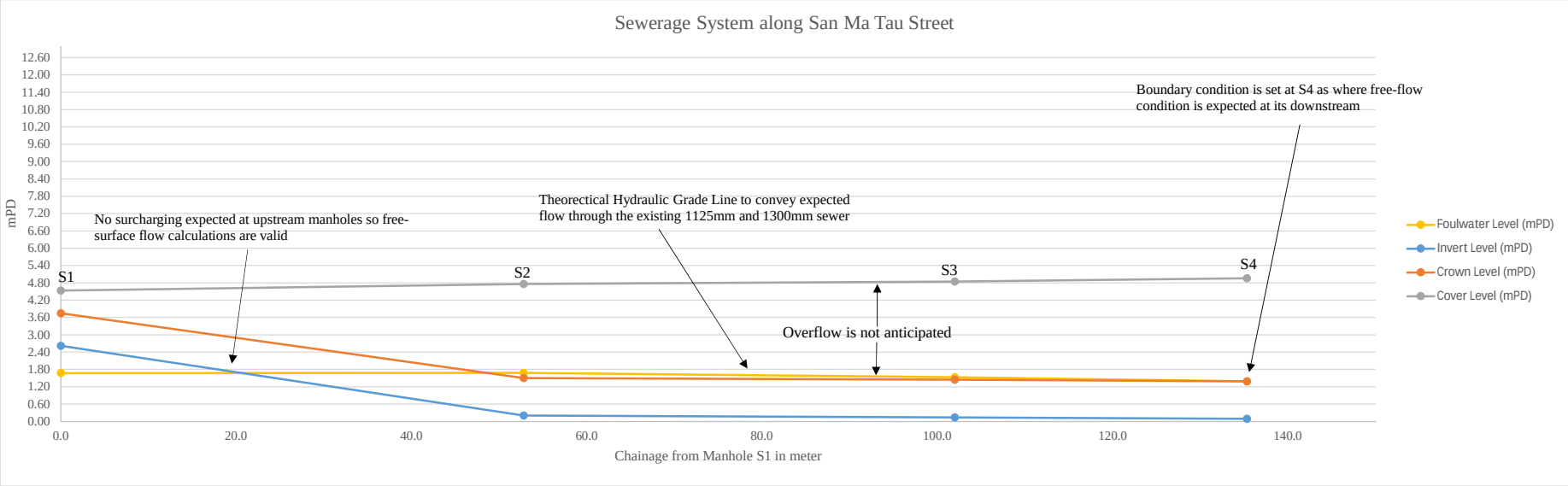
(3) The value of velocity (V) is referred to the Tables for the hydraulic design of pipes, sewers and channels (8th edition)

(4) Equation used:

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

Table 5b Hydraulic Capacity of Existing Sewers S1-S5 at San Ma Tau Street - surcharge condition with 1.15 safety factor

Segment	Manhole Reference	Manhole Reference	Pipe Dia.	Pipe Length	Chainage	Invert Level 1	Invert Level 2	Foulwater Level 1	Foulwater Level 2	Cover Level 1	Cover Level 2	Freeboard 1	Freeboard 2	Friction Loss	Entry and Exit Loss	g	k_s	Required $s_{hydraulic}$	v	V	Area	Q	Required Peak Flow
			mm	m	m	mPD	mPD	mPD	mPD	mPD	mPD	m	m	m	m	m/s^2	m		m^2/s	m/s	m^2	m^3/s	L/s
S1-S2	FMH4025687	FMH4025357	1125	52.8	0.0	2.62	0.20	1.68	1.68	4.53	4.76	2.85	3.08	0.00	0.00	9.81	0.00600	0.000003	0.000001	0.04	0.99	0.04	41.4
S2-S3	FMH4025357	FMH4025358	1300	49.2	52.8	0.20	0.14	1.68	1.53	4.76	4.84	3.08	3.31	0.06	0.09	9.81	0.00600	0.001316	0.000001	1.06	1.33	1.41	1410.6
S3-S4	FMH4025358	FMH4025359	1300	33.3	102.0	0.14	0.09	1.53	1.39	4.84	4.96	3.31	3.57	0.05	0.09	9.81	0.00600	0.001374	0.000001	1.09	1.33	1.44	1441.4
S4-S5	FMH4025359	FMH4025360	1300	54.1	135.3	0.09	-0.03	1.39	-	4.96	5.10	3.57	-	0.08	0.09	9.81	0.00600	0.001390	0.000001	1.09	1.33	1.45	1449.7



Note:
1. Foulwater level at S4 is assumed to be: 0.09 (IL) + 1.300 (pipe dia.) = 1.39 mPD as a conservative approach.
2. For this assessment, the Colebrook-White Equation has been used to calculate the friction loss. (Sewerage Mannual Section 5.2.1)
3. According to DSD'sSewerage Manual (Part 1) section 5.2.2, Local losses are usually small in realtion to the pipeline head losses and are not normally considered. However, as a conservative approach, further allowances have been included for local losses at pipe entry (K=0.5) and exit (K = 1), with a total local loss coefficient of 1.5.
4. Comparing the cover level and foulwater levels at each of the manholes, the freeboards are found sufficient (>1m). Therefore, no adverse sewerage impact is anticipated.
5. Friction loss is deduced by required hydraulic gradient x pipe length, while the local loss is deduced by the equation:

$$h_f = K\frac{V^2}{2g}$$

Remarks:
(1) g=gravitational acceleration; k_s=equivalent sand roughness; s=gradient; v=kinematic viscosity of water; V=mean velocity
(2) The values of ks = 3mm and ks = 6mm are used for the calculation of slimed concrete sewer, poor condition @mean velocity = 1.2m/s and 0.75m/s respectively (based on Table 5: Recommended Roughness Values in Sewerage Manual)
(3) The value of velocity (V) is referred to the Tables for the hydraulic design of pipes, sewers and channels (8th edition)
(4) Equation used:

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