Appendix E

Sewerage Impact Assessment

Prepared by

Ramboll Hong Kong Limited

SECTION 12A PLANNING APPLICATION FOR PROPOSED AMENDMENTS TO THE TSUEN WAN OUTLINE ZONING PLAN TO REZONE "INDUSTRIAL" ZONE TO "OTHER SPECIFIED USES (HOTEL DEVELOPMENT)" ZONE IN SUPPORT OF PROPOSED HOTEL DEVELOPMENT AT LOT 486 IN D.D. 443 AND TSUEN WAN TOWN LOT 85, TSUEN WAN, NEW TERRITORIES

SEWERAGE IMPACT ASSESSMENT

Date	**June 2026**
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Project Reference	**PPIFKYSTEI00**
Document No.	**R10132_v1.0_260601.docx**

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CHAPTERS

TABLES

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1. INTRODUCTION

1.1 Background

1.1.1 The Application Site is located at lot no. 486 in D.D. 443 and Tsuen Wan Town Lot 85 (46&48 Fui Yiu Kok Street), Tsuen Wan. It falls within an area zoned "Industrial" ("I") on the draft Tsuen Wan Outline Zoning Plan (OZP) No. S/TW/40.

1.1.2 The subject S12A planning application is submitted to seek permission from the Town Planning Board (the Board) in support of rezoning the Application Site from "I" to "Other Specified Uses" annotated "Hotel Development" ("OU (Hotel Development)") on the draft Tsuen Wan OZP No. S/TW/40.

1.1.3 To support this planning application, Ramboll Hong Kong Limited has been commissioned by the Applicant to conduct the Sewerage Impact Assessment to evaluate potential impact of proposed sewage discharge routing and identify any mitigation measures required such as upgrading of existing of sewer, if required. If any mitigation measures are required, the Project Proponent will be responsible for the relevant upgrading works.

1.2 Application Site and its Environs

1.2.1 The Application Site is currently zoned "I" under draft Tsuen Wan OZP No. S/TW/40. According to the OZP, the area surrounding the Subject Site is mostly zoned "I" to the east, south and west. To the north of the Application Site, Fui Yiu Kok Street is immediate abutting with the existing residential use, Indi Home located further north. **Figure 1.1** shows the location of the Application Site and its environs.

1.3 Proposed Development

1.3.1 The Proposed Development consists of a three-storey podium accommodating hotel's ancillary uses, E&M and an above-ground car park, with a roughly square footprint aligning with the Application Site boundary. Above the podium are one floor of refuge floor / podium landscape garden and 25 floors of hotel rooms. The master layout plan and sections of the Proposed Development are shown in **Appendix 1.1**.

1.3.2 The tentative completion year of the Proposed Development is 2032.

1.4 Appraisal of Impact

1.4.1 The aim of this SIA is to assess whether the capacity of sewerage network serving the Project is sufficient to cope with the sewage flow from the Application Site.

1.4.2 The impact sewerage system serving the Project is discussed in **Section 2**.

2. SEWERAGE IMPACT ASSESSMENT

2.1 Introduction

2.1.1 The aim of this section is to assess whether the capacity of the sewerage network serving the Project is sufficient to cope with the sewage flow arise from the S12A Planning Application for Application Site. Practicable sewerage mitigation measures would be recommended, where necessary.

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 planed 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 estimating the quantity of the sewage generated from the Notional Design of the Project and the existing catchment area. Sewage flow parameters and global peaking factors in this document have been adopted in the sewerage impact assessment.

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, T-2 and T-3 of the GESF:

- Domestic Private R1: 0.19 m^3/person/day
- J1 – Manufacturing – Tsuen Wan: 0.73 m^3/employee/day
- J4 – Wholesale & Retail: 0.28 m^3/employee/day
- J10 – Restaurants & Hotels: 1.58 m^3/employee/day
- J11 Community, Social & Personal Services: 0.28 m^3/employee/day

2.2.4 The catchment inflow factor, PCIF of 1.1 (Kwai Tsing), is adopted in the catchment calculations.

2.3 Existing and Future Sewerage System

2.3.1 According to the Geoinfo Map, there is an existing public sewer network running along Fui Yiu Kok Street, then southward to alley, Wang Lung Street (westward), Ma Kok Lane (southward), Texaco Road (eastward), and subsequently connects to Tsuen Wan Sewage Pumping Station at the south.

2.3.2 The location of existing sewers in the vicinity of the Application Site is shown in **Figure 2.1**.

2.3.3 To collect sewage from the Proposed Development, a new terminal manhole will be constructed - STMH-01 (A0) with approximate ground level of 4.73 mPD. A new Ø225mm pipe are proposed to connect to the existing manhole FMH4023055 (A1).

2.3.4 The invert levels and pipe sizes of the proposed terminal manholes and sewers are shown in **Figure 2.2**.

2.4 Assessment of the Sewerage Impact

2.4.1 Detailed Calculation of sewage generation from the Application Site is given in **Table 2.1** and Table 1 of **Appendix 2.1.** Estimated sewage generation and area breakdown

of surrounding catchments is given in Table 2 to 10 of **Appendix 2.1.** The hydraulic capacity for sewerage system is located in **Appendix 2.2**.

Table 2.1 Estimated Peak Flow for the Application Site

Calculation for Sewage Generation Rate for the Application Site			
1. Hotel			
1a. Assumed Area	=	4980	m^2 (provided by Project Proponent)
1b. Assumed floor area per employee	=	31.3	m^2 per worker -- (refer to Table 8 of CIFSUS – Restaurants & Hotel)
1c. Total number of employees [1]	=	159	employees
1d. Design flow for commercial activities and employee	=	1.58	m^3/employee/day -- (refer to Table T-2 of GESF - J10)
1e. Sewage Generation rate	=	**251.8**	m^3/day
2. F&B			
2a. Assumed Area	=	131	m^2 (20% of the non-Domestic GFA after deduction of Hotel GFA)
2b. Assumed floor area per employee	=	19.6	m^2 per worker -- (refer to Table 8 of CIFSUS – Restaurants & Hotel)
2c. Total number of employees [1]	=	7	employees
2d. Design flow for commercial activities and employee	=	1.58	m^3/employee/day -- (refer to Table T-2 of GESF - J10)
2e. Sewage Generation rate	=	**10.5**	m^3/day
3. Retail			
3a. Assumed Area	=	522	m^2 (80% of the non-Domestic GFA after deduction of Hotel
3b. Assumed floor area per employee	=	28.6	m^2 per worker -- (refer to Table 8 of CIFSUS - Community, Social & Personal Services)
3c. Total number of employees [1]	=	18	employees
3d. Design flow for commercial activities	=	0.28	m^3/employee/day -- (refer to Table T-2 of GESF – J4)
3e. Sewage Generation rate	=	**5.1**	m^3/day
Total Flow from Application Site, connected to Manhole A0 (STMH-01)			
Flow Rate	=	267.4	m^3/day
Flow Rate with Catchment Inflow Factor	=	294.2	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	1090	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance

Peak Flow	=	**18.6**	litre/sec

Remark:

[1] Total number of employees = Assume Area / Assumed floor area per employee

2.4.2 Sewage generation rate from the Application Site is estimated to be 294.2 m^3/day and 18.6 litre/sec.

2.4.3 As shown in **Figure 2.2**, the sewage generated from the Application Site will be discharged into a designated terminal manhole (STMH-01). From the terminal manhole, the collected sewage will then be connected to the existing sewer manhole FMH4023055 (A1) along the Fui Yiu Kok Street (southwest), then southward to alley between Yuet Kwong Industrial Building and Tsuen Hing Factory Building and westward to Wang Lung Street.

2.4.4 There are two terminal manholes for Indi Home (one at east and one at west facing Fui Yiu Kok Street), thus the calculated sewage flow of Indi Home is being allocated evenly to manholes FMH4023056 (A1) and FMH400798 (A2) (i.e. 50% for each discharge point). For the sewage generation of swimming pool of Indi Home, it is assumed the sewage are discharged to FMH400798 (A2) (at the east) for shorter distance and worst case assumption.

2.4.5 For sewer A0-A1, A1-A2, A2-A3 and A4-A5, as no available information on downstream invert level of the manhole, thus the downstream invert level is assumed with upstream invert level of the same manhole.

2.4.6 As reference to previous approved SIA report for the Application Site (TPB ref.: A/TW/514) in **Appendix 2.3**, 360 m^3/day are added in manhole FMH4007098 (A3) to assess the worst case scenario as per EPD's request. Same approach is adopted in current sewage calculation of Application Site.

2.4.7 For A6-A7, the backwater profile of the sewer under surcharge condition is included as part of sewage calculations. By comparing the cover levels and foul water levels at the concerned manholes, the freeboards are >1m under surcharge conditions and >0m under surcharge condition with 1.15 safety factor.

2.4.8 The results of the backwater profile for Peak Flow conditions are set out in **Table 3a** of **Appendix 2.2.** At all manholes, the freeboard between cover/ground level and the expected water level is greater than 1.76m, i.e. substantially more than the minimum requirement of 1m.

2.4.9 The results of the backwater profile for Peak Flow x 1.15 conditions are set out in **Table 3b** of **Appendix 2.2**. It is evident that, even with the 1.15 safety factor, there would still be substantial freeboard (minimum freeboard of 1.72m), so there would be no risk of overflow under the Peak Flow x 1.15 conditions.

2.4.10 Based on the assessment, the sewage generated from the Application Site would only contribute to around 5% of the downstream of Ø525mm sewer.

2.5 Conclusion

2.5.1 The potential sewerage impact due to the Application Site has been quantitatively addressed. Base on the sewage generation rate estimated from the Application Site (Table 1 of **Appendix 2.1**), the average sewage flow from the Application Site will be approximately 294.2 m^3/day and 18.6 litre/sec.

2.5.2 One terminal manhole A0 (STMH-01) and sewer (A0-A1) is proposed at the north of the Application Site to connect with existing sewerage system at Fui Yiu Kok Street.

2.5.3 With proposed new terminal manhole, sewer and backwater calculation, the sewerage system will have adequate capacity to cater for Application Site and nearby catchments.

3. CONCLUSION

3.1.1 This planning application is submitted to the Town Planning Board in support of rezoning the Application Site from "I" to "OU (Hotel Development)" on the draft Tsuen Wan OZP No. S/TW/40 in support of the proposed hotel development. The Application Site is located at lot no. 486 in D.D. 443 and Tsuen Wan Town Lot 85 (46&48 Fui Yiu Kok Street).

3.1.2 Based on the sewerage impact assessment result, with proposed new sewer and terminal manhole, the capacity of the existing sewers serving the area would be sufficient to cater for the sewage generation from the Application Site and other related catchment area with backwater calculation for one sewer section (A6-A7).

3.1.3 Thus, the Application Site will have no adverse impact on the existing sewerage system.

Figures

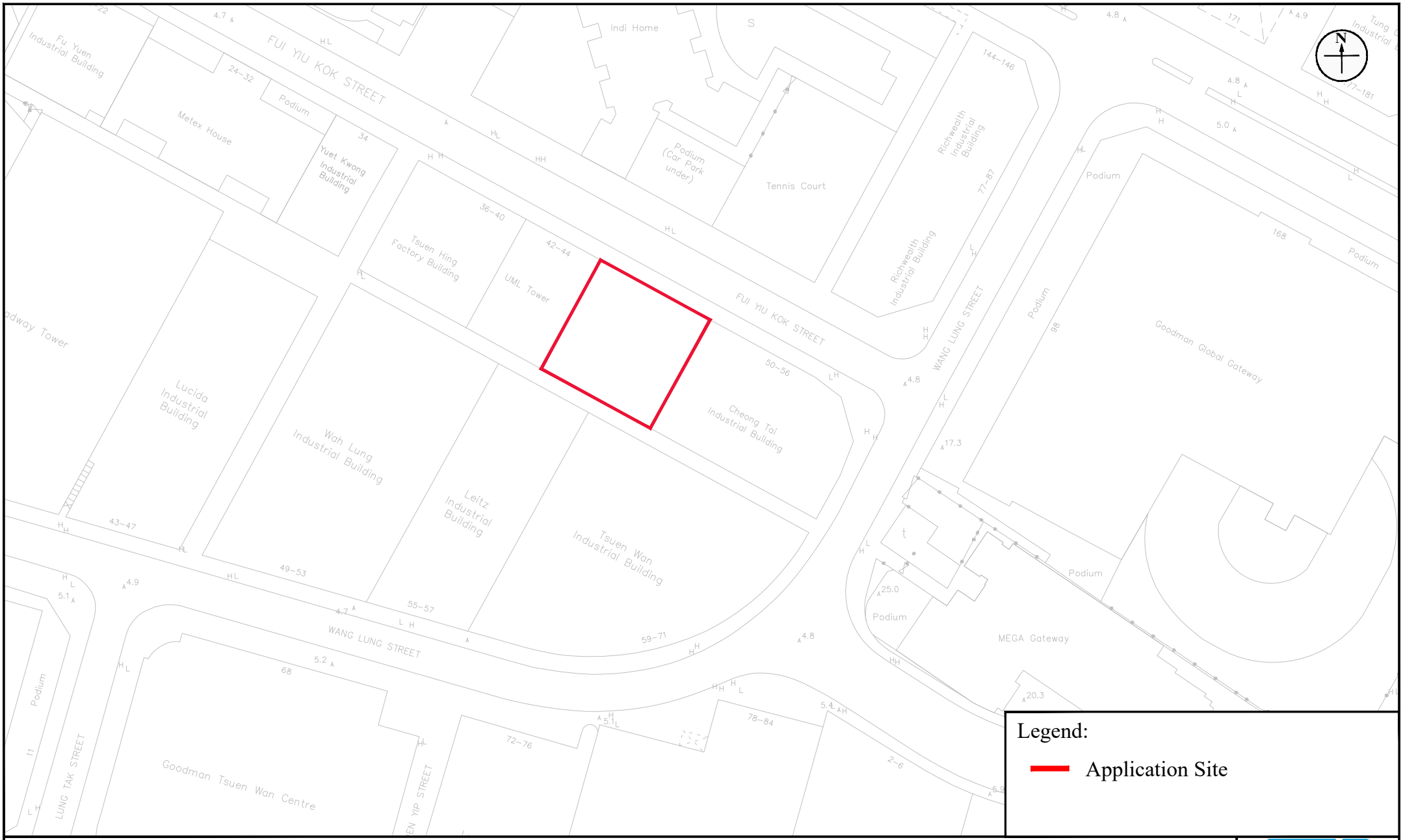

Figure: 1.1

Title: Location of Application Site and Its Environ

Project: Section 12A Planning Application for Proposed Amendments to the Tsuen Wan Outline Zoning Plan to Rezone "Industrial" Zone to "Other Specified Uses (Hotel Development)" Zone in Support of Proposed Hotel Development at Lot 486 in D.D.443 and Tsuen Wan Town Lot 85, Tsuen Wan, New Territories

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Date:	May 2026

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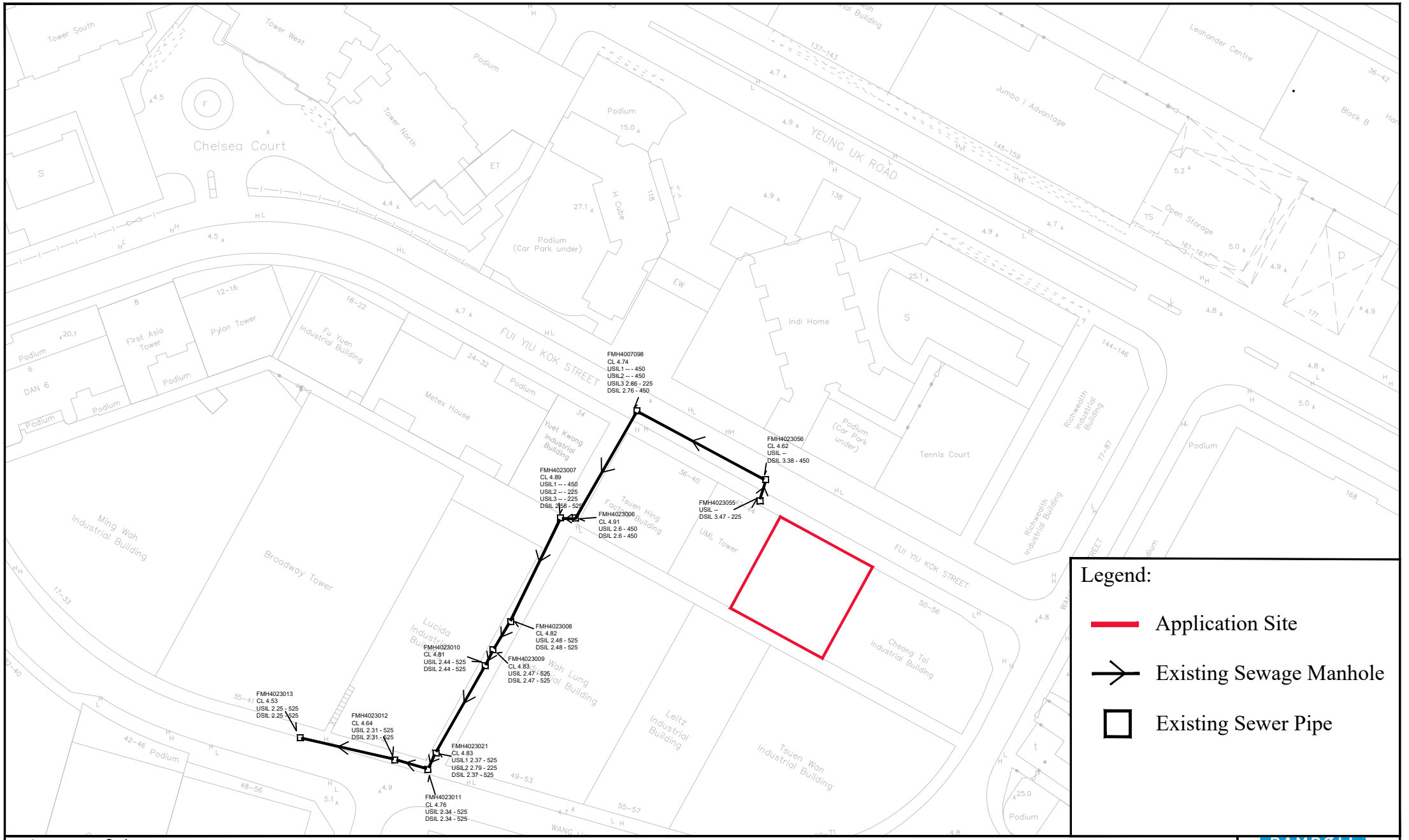

Figure: 2.1

Title: Existing Sewerage System in Vicinity of the Project

Project: Section 12A Planning Application for Proposed Amendments to the Tsuen Wan Outline Zoning Plan to Rezone "Industrial" Zone to "Other Specified Uses (Hotel Development)" Zone in Support of Proposed Hotel Development at Lot 486 in D.D.443 and Tsuen Wan Town Lot 85, Tsuen Wan, New Territories

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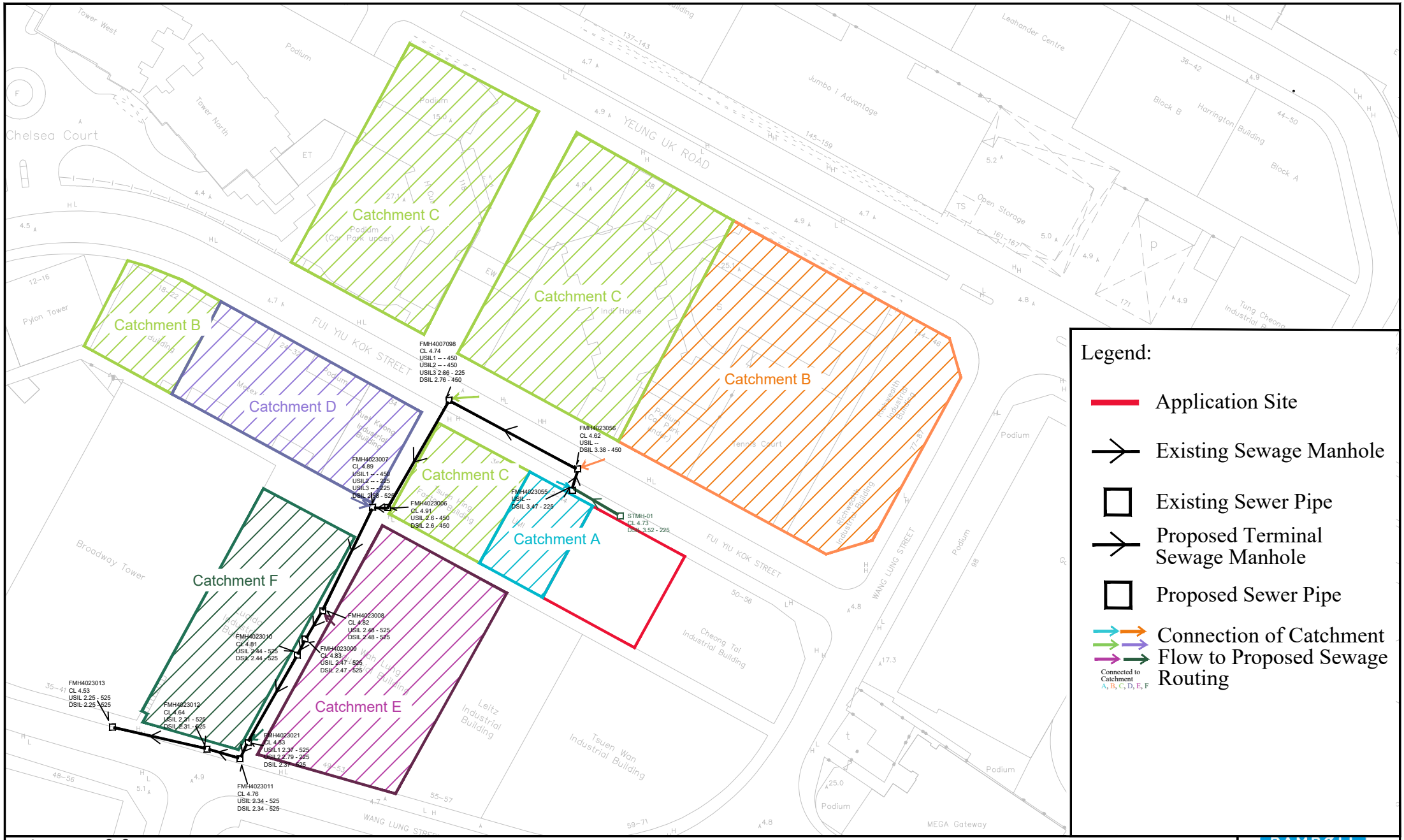

Figure: 2.2

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

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Appendix 1.1 Master Layout Plan and Section of the Development Site

1 2 3 4 5

TSUEN WAN INDUSTRIAL BUILDING

LEITZ INDUSTRIAL BUILDING

SERVICE LANE (3.00m wide)

D

C

B

A

E&M

E&M

LIFT LOBBY

CARPARK

HGV

TOUR BUS LAY-BY

ADJACENT BUILDING

ADJACENT BUILDING

M.C.

TAXI LAY-BY

HOTEL LOBBY

TAXI LAY-BY

CARPARK

HOTEL'S ANCILLARY USES INCLUDING F&B / SHOP & SERVICES ETC.

E&M

E&M

E&M

0.6m SETBACK AREA

PROPOSED UPGRADING OF PAVEMENT WITH CONCRETE PAVING BLOCK PER HYD'S STANDARD (SUBJECT TO HYD APPROVAL)

GLASS CANOPY ABOVE

Application Site

GROUND FLOOR PLAN OF HOTEL SCALE 1:125

FUI YIU KOK STREET (15.75m)

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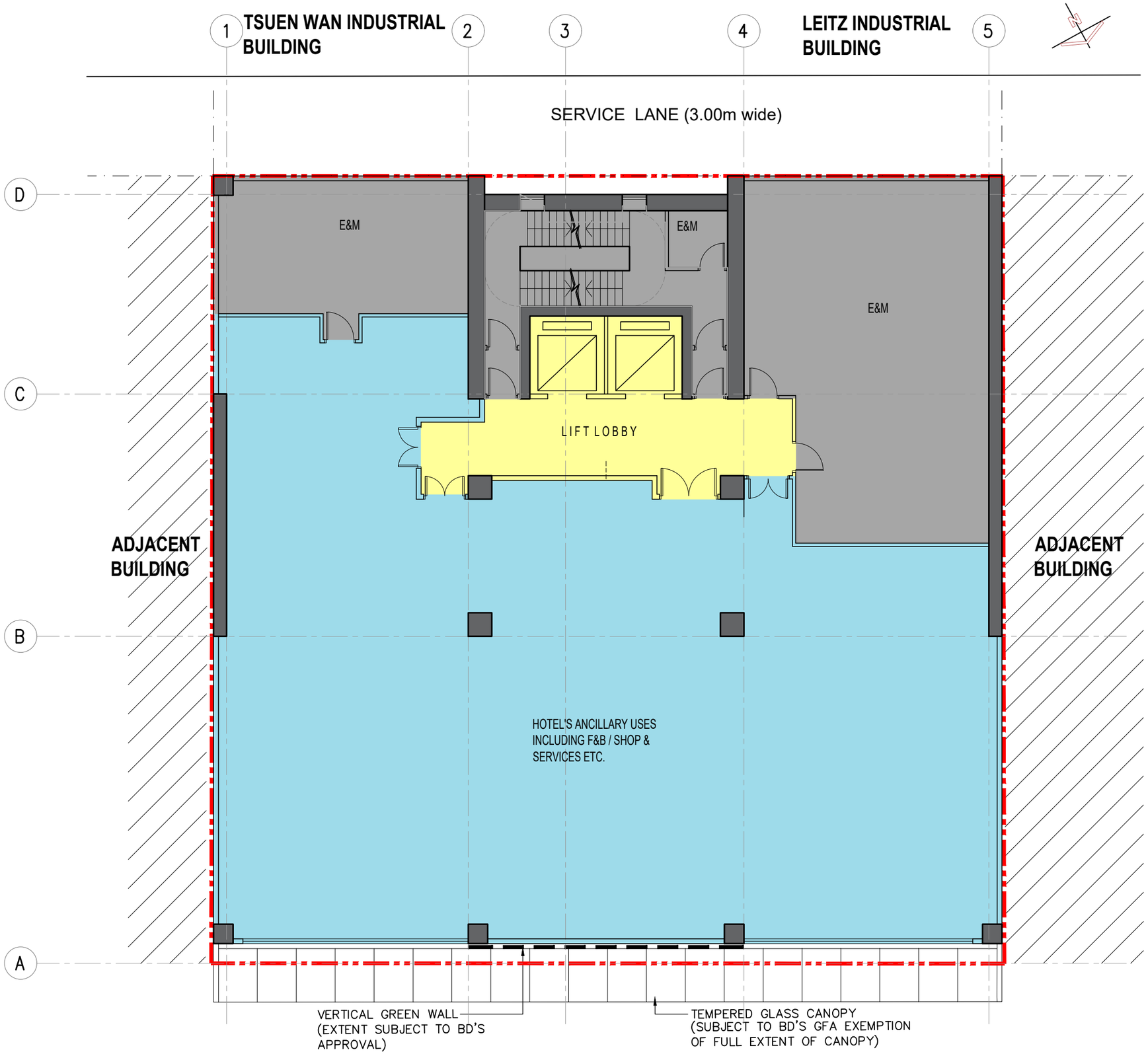

Application Site

1/F PLAN OF HOTEL SCALE 1:125

FUI YIU KOK STREET (15.75m)

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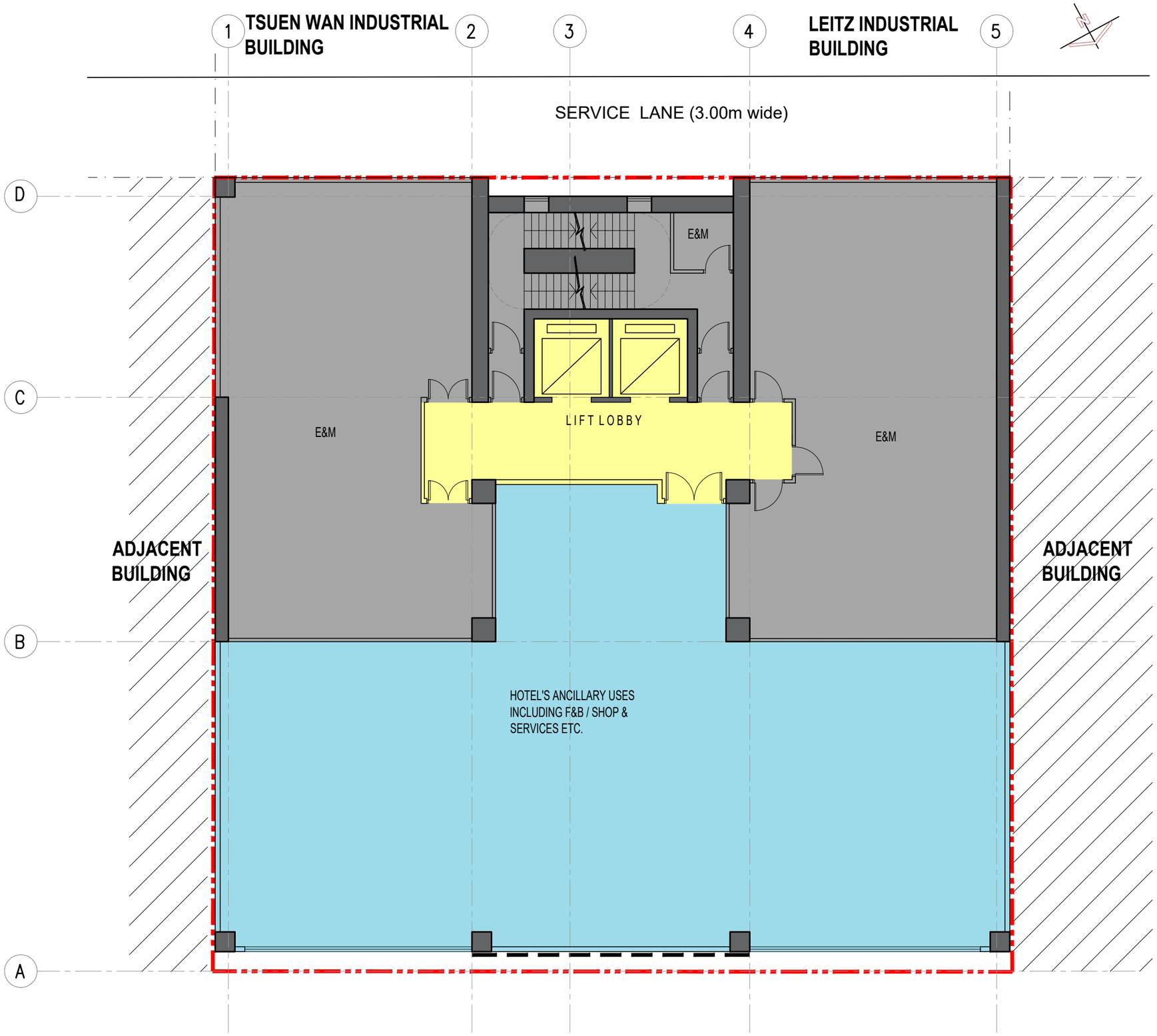

Application Site

2/F PLAN OF HOTEL SCALE 1:125

FUI YIU KOK STREET (15.75m)

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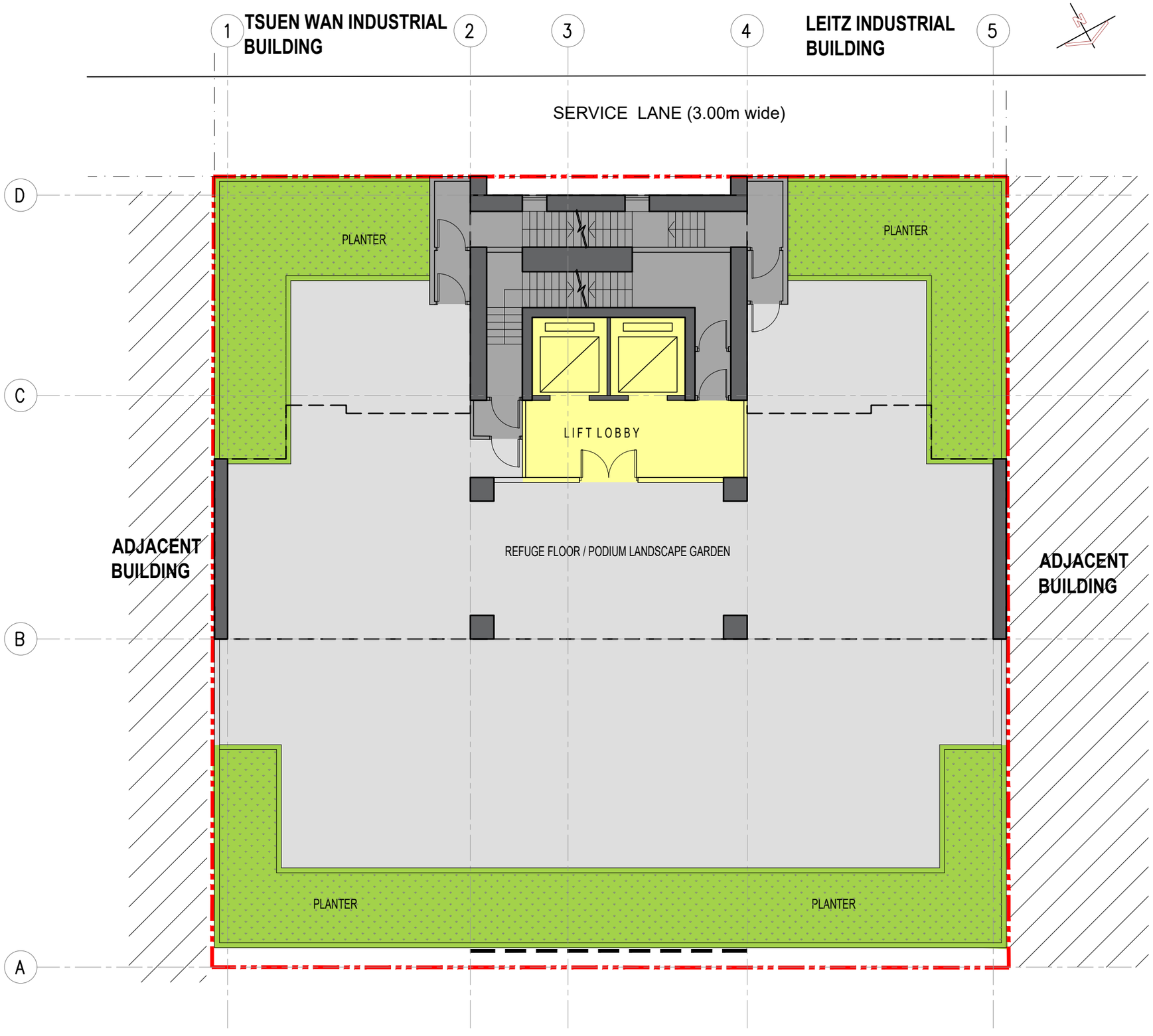

Application Site

3/F PLAN OF HOTEL SCALE 1:125

FUI YIU KOK STREET (15.75m)

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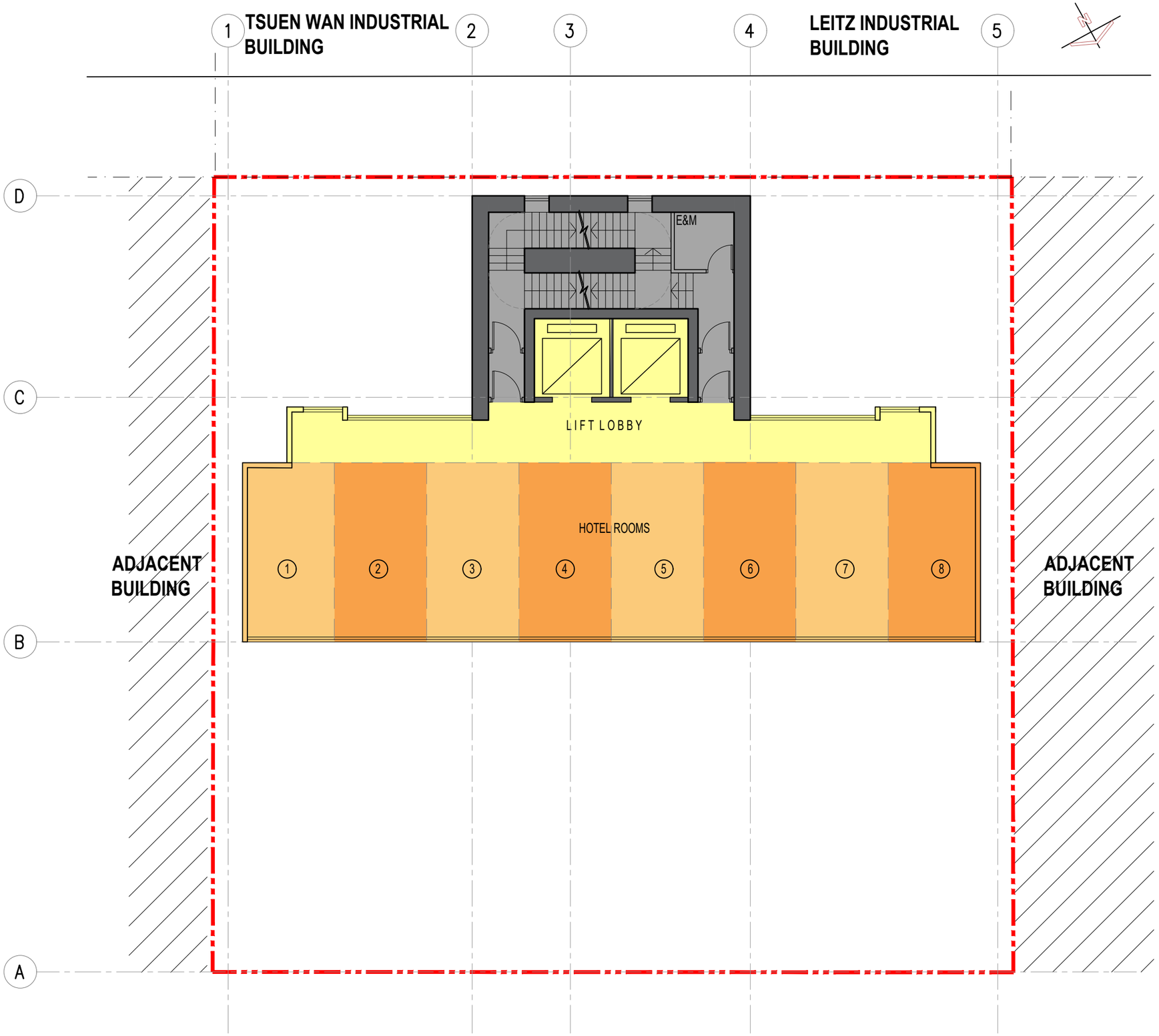

Application Site

TYPICAL FLOOR PLAN (4 - 28/F) OF HOTEL SCALE 1:125

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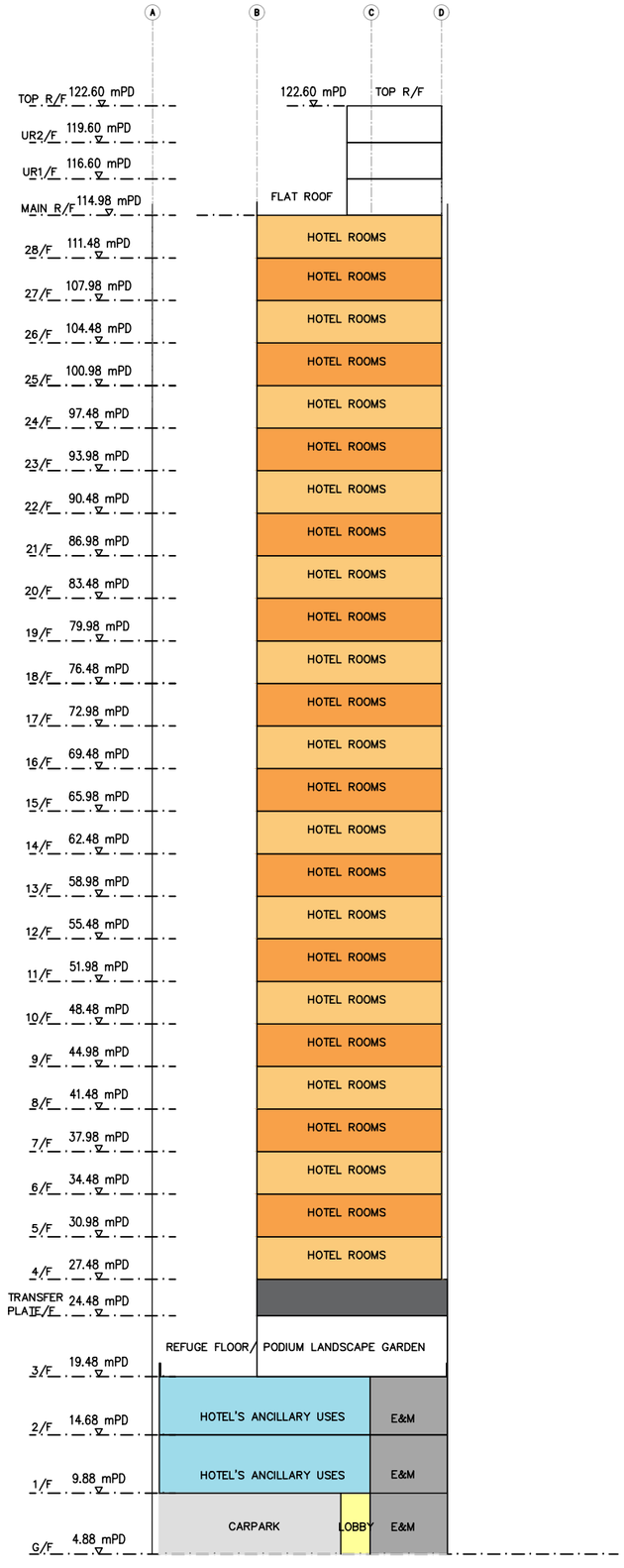

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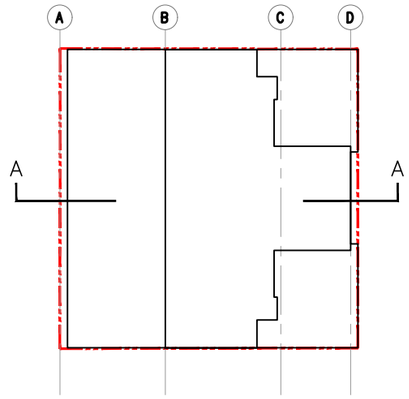

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Appendix 2.1 Detailed Sewage Generation for the Application Site and surrounding Catchments

Table 1 Calculation for Sewage Generation Rate of the Application Site

1. Hotel

Assumed area	=	4980	m^2
Assumed floor area per employee	=	31.3	m^2 per employee -- (refer to Table 8 of CIFSUS - Hotels and Boarding Houses)
Total number of employees	=	159	employees
Design flow for commercial employees	=	1.58	m^3/employee/day -- (refer to Table T-2 of GESF - J10 Restaurant & Hotels)
Sewage generation rate	=	**251.8**	m^3/day

2. F&B

Assumed Floor Area	=	131	m^2
Assumed floor area per employee	=	19.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Restaurant)
Total number of employees	=	7	employees
Design flow for commercial employees	=	1.58	m^3/employee/day -- (refer to Table T-2 of GESF - J10 Restaurant & Hotels)
Sewage generation rate	=	**10.5**	m^3/day

3. Retail

Assumed Floor Area	=	522	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	=	18	employees
Design flow for commercial employees	=	0.28	m^3/employee/day -- (refer to Table T-2 of GESF - J4 Wholesale & Retail)
Sewage generation rate	=	**5.1**	m^3/day

Total Flow from the Proposed Development , connected to Manhole STMH-01

Flow Rate	=	267.4	m^3/day
Flow Rate with Catchment Inflow Factor	=	294.2	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	1090	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance
Peak Flow	=	**18.6**	litre/sec

Table 2 Calculation for Sewage Generation Rate of Surrounding Catchment (Indi Home)

Indi Home

1. Residential

Number of units	=	980	units
Number of residents	=	2744	residents (refer to Census and Statistics Department 2021 data - average household size of 2.8 in (K03) Tsuen Wan South)
Design flow	=	0.19	m^3/day (Private R1 in Table T-1 of GESF)
Sewage generation rate	=	**521.4**	m^3/day
Total Non-Domestic GFA	=	4451	m^2
Non-Domestic GFA of G/F and 1/F (shops)	=	4016	m^2
Non-Domestic GFA of Recreational Facilities	=	435	m^2 (Total Non-Domestic GFA - sum of G/F and 1/F non-domestic GFA)

2. Retail

Assumed Floor Area	=	2811.2	m^2 (70% of G/F and 1/F GFA)
Assumed floor area per employee	=	28.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Retail Trade)
Total number of employees	=	98	employees
Design flow for commercial employees	=	0.28	m^3/employee/day -- (refer to Table T-2 of GESF - J4 Wholesale & Retail)
Sewage generation rate	=	**27.5**	m^3/day

3. F&B

Assumed Floor Area	=	1204.8	m^2 (30% of G/F and 1/F GFA)
Assumed floor area per employee	=	19.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Restaurant)
Total number of employees	=	61	employees
Design flow for commercial employees	=	1.58	m^3/employee/day -- (refer to Table T-2 of GESF - J10 Restaurant & Hotels)
Sewage generation rate	=	**97.1**	m^3/day

4. Recreational Facilities

Assumed Area	=	435	m^2 (Total Non-Domestic GFA - sum of G/F and 1/F non-domestic GFA)
Assumed floor area per employee	=	30.3	m^2 per worker -- (refer to Table 8 of CIFSUS - Community, Social & Personal Services)
Total number of employees	=	14	employees
Design flow for commercial activities	=	0.28	m^3/employee/day -- (refer to Table T-2 of GESF - J11)
Sewage Generation rate	=	**4.0**	m^3/day
Total Sewage Flow	=	650.0	m^3/day

Remark: As Indi Home has two terminal manholes, the calculated sewage flow is being allocated evenly to manholes.

50% Sewage Flow	=	325.0	m^3/day (to Catchment B)
50% Sewage Flow	=	325.0	m^3/day (to Catchment C)

5. Swimming Pool of Indi Home

Assumed area	=	437	m^2
Assumed depth of water	=	1.5	m
Volume of water	=	655.5	m^3
Turnover Rate	=	6.0	hr (CAP132CA, Section 9 Swimming Pools Regulation (open air pool))
Surface loading rate of filter	=	50.0	$m^3/m^2/hr$
Filter areas required	=	2.2	m^2
Backwashing flow rate	=	30.0	$m^3/m^2/hr$
Design flow for backwashing	=	65.6	m^3/hr
Backwash duration	=	3.0	min/day
Backwash generation rate	=	3.28	m^3/day
Backwash generation rate	=	**18.2**	litre/sec (To Catchment B)

Table 3 Calculation for Sewage Generation Rate of Surrounding Catchment (H Cube)

H Cube

1. Resdiential			
Number of units	=	440	units
Number of residents	=	1232	residents (refer to Census and Statistics Department 2021 data - average household size of 2.8 in (K03) Tsuen Wan South)
Design flow	=	0.27	m^3/day (Private R2 in Table T-1 of GESF)
Sewage generation rate	=	**332.6**	m^3/day
Non-Domestic GFA of G/F and 1/F (shops)	=	2800	m^2 (80% of Area measured in basemap)
Non-Domestic GFA of Recreational Facilities	=	435	m^2 (Assumed same as Indi Home due to similar scale)
2. Retail			
Assumed Floor Area	=	1960	m^2 (70% of G/F and 1/F GFA)
Assumed floor area per employee	=	28.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Retail Trade)
Total number of employees	=	69	employees
Design flow for commercial employees	=	0.28	m^3/employee/day -- (refer to Table T-2 of GESF - J4 Wholesale & Retail)
Sewage generation rate	=	**19.2**	m^3/day
3. F&B			
Assumed Floor Area	=	840	m^2 (30% of G/F and 1/F GFA)
Assumed floor area per employee	=	19.6	m^2 per employee -- (refer to Table 8 of CIFSUS - Restaurant)
Total number of employees	=	43	employees
Design flow for commercial employees	=	1.58	m^3/employee/day -- (refer to Table T-2 of GESF - J10 Restaurant & Hotels)
Sewage generation rate	=	**67.7**	m^3/day
4. Recreational Facilities			
Assumed Area	=	435	m^2 (Total Non-Domestic GFA - sum of G/F and 1/F non-domestic GFA)
Assumed floor area per employee	=	30.3	m^2 per worker -- (refer to Table 8 of CIFSUS - Community, Social & Personal Services)
Total number of employees	=	14	employees
Design flow for commercial activities	=	0.28	m^3/employee/day -- (refer to Table T-2 of GESF - J11)
Sewage Generation rate	=	**4.0**	m^3/day
5. Swimming Pool			
Assumed area	=	250	m^2
Assumed depth of water	=	1.5	m
Volume of water	=	375.0	m^3
Turnover Rate	=	6.0	hr (CAP132CA, Section 9 Swimming Pools Regulation (open air pool))
Surface loading rate of filter	=	50.0	$m^3/m^2/hr$
Filter areas required	=	1.3	m^2
Backwashing flow rate	=	30.0	$m^3/m^2/hr$
Design flow for backwashing	=	37.5	m^3/hr
Backwash duration	=	3.0	min/day
Backwash generation rate	=	1.88	m^3/day
Backwash generation rate	=	**10.4**	litre/sec (to Catchment C)
Total Sewgae Generation Rate (Without Swimming Pool)	=	423.6	m^3/day (to Catchment C)

Table 4 Calculation for Sewage Generation Rate of Surrounding Catchment (Catchment A)

1. UML Tower

1a. Assumed used area	=	3080	m^2
1b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - I/O Building)
1c. Total number of employees	=	71	employees
1d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
1e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
1f. Sewage generation rate	=	**51.8**	m^3/day

Total Flow from the Proposed Development + Catchment A, connected to Manhole A1 (FMH4023055)

Flow Rate	=	319.3	m^3/day
Flow Rate with Catchment Inflow Factor	=	351.2	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	1301	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance
Peak Flow	=	**22.2**	litre/sec

Table 5 Calculation for Sewage Generation Rate of Surrounding Catchment (Catchment B)

1. Richwealth Industrial Building			
1a. Assumed used area	=	20930	m^2
1b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - I/O Building)
1c. Total number of employees	=	481	employees
1d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
1e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
1f. Sewage generation rate	=	**351.1**	m^3/day
2. 50% of Sewage Flow from Indi Home	=	325	m^3/day
3. Swimming Pool from Indi Home	=	18.2	litre /sec
Total Flow from the Proposed Development + Catchments (A + B), connected to Manhole A2 (FMH4023056)			
Flow Rate	=	995.4	m^3/day
Flow Rate with Catchment Inflow Factor	=	1094.9	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	4055	people
Peaking factor	=	6	Refer to Table T-5 of GESF for population 1,000-5,000 incl. stormwater allowance
Peak Flow (without Swimming Pool)	=	**69.1**	litre/sec
Peak Flow (with Swimming Pool)	=	**87.3**	litre/sec

Table 6 Calculation for Sewage Generation Rate of Surrounding Catchment (Catchment C)

1. Tsuen Hing Factory Building			
1a. Assumed used area	=	4720	m^2
1b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - I/O Building)
1c. Total number of employees	=	109	employees
1d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
1e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
1f. Sewage generation rate	=	**79.6**	m^3/day
2. Fu Yuen Industrial Building			
2a. Assumed used area	=	4365	m^2
2b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - Manufacturing)
2c. Total number of employees	=	100	employees
2d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
2e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
2f. Sewage generation rate	=	**73.0**	m^3/day
3. 50% of Sewage Flow from Indi Home	=	325	m^3/day
4. Sewage Flow from H Cube	=	424	m^3/day
5. Swimming Pool from H Cube	=	10.4	litre /sec
6. Additional Sewage Flow [1]	=	360.0	m^3/day
Total Flow from the Proposed Development + Catchments (A + B + C), connected to Manhole A3 (FMH4007098)			
Flow Rate	=	2256.5	m^3/day
Flow Rate with Catchment Inflow Factor	=	2482.2	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	9193	people
Peaking factor	=	5	Refer to Table T-5 of GESF for population 5,000-10,000 incl. stormwater allowance
Peak Flow (without Swimming Pool)	=	**130.6**	litre/sec
Peak Flow (with Swimming Pool)	=	**159.2**	litre/sec

[1]: With referenced to previous approved SIA report of Application Site (TPB ref: A/TW/514), 360m3/day is being added to manhole FMH2007098 (A3) under the request of EPD for assessing worst case scenario.

Table 7 Calculation for Sewage Generation Rate of Surrounding Catchment (Catchment D)

1. Metex House			
1a. Assumed used area	=	9185	m^2
1b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - I/O Building)
1c. Total number of employees	=	211	employees
1d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
1e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
1f. Sewage generation rate	=	**154.0**	m^3/day
2. Yuet Kwong Industrial Building			
2a. Assumed used area	=	3150	m^2
2b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - Manufacturing)
2c. Total number of employees	=	72	employees
2d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
2e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
2f. Sewage generation rate	=	**52.6**	m^3/day

Total Flow from the Proposed Development + Catchments (A + B + C + D), connected to Manhole A5 (FMH4023007)

Flow Rate	=	2463.1	m^3/day
Flow Rate with Catchment Inflow Factor	=	2709.4	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	10035	people
Peaking factor	=	4	Refer to Table T-5 of GESF for population 5,000-10,000 incl. stormwater allowance
Peak Flow (without Swimming Pool)	=	**114.0**	litre/sec
Peak Flow (with Swimming Pool)	=	**142.7**	litre/sec

Table 8 Calculation for Sewage Generation Rate of Surrounding Catchment (Catchment E)

1. Wah Lung Industrial Building

1a. Assumed used area	=	19690	m^2
1b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - I/O Building)
1c. Total number of employees	=	453	employees
1d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
1e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
1f. Sewage generation rate	=	**330.7**	m^3/day

Total Flow from the Proposed Development + Catchments (A + B + C + D + E), connected to Manhole A6 (FMH4023008)

Flow Rate	=	2793.8	m^3/day
Flow Rate with Catchment Inflow Factor	=	3073.2	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	11382	people
Peaking factor	=	4	Refer to Table T-5 of GESF for population 5,000-10,000 incl. stormwater allowance
Peak Flow (without Swimming Pool)	=	**129.3**	litre/sec
Peak Flow (with Swimming Pool)	=	**158.0**	litre/sec

Table 9 Calculation for Sewage Generation Rate of Surrounding Catchment (Catchment F)

1. Lucida Industrial Building

1a. Assumed used area	=	28375	m^2
1b. Assumed floor area per employee	=	43.5	m^2 per employee -- (refer to CIFSUS Table 8 - I/O Building)
1c. Total number of employees	=	653	employees
1d. Design flow for commercial employee	=	80	litre/employee/day -- (refer to Table T-3 of GESF Industrial employee)
1e. Design flow for commercial activities	=	650	litre/employee/day -- (refer to Table T-2 of GESF Job Type J1 Manufacturing - Tsuen Wan)
1f. Sewage generation rate	=	**476.7**	m^3/day

Total Flow from the Proposed Development + Catchments (A + B + C + D + E + F), connected to Manhole A9 (FMH4023021)

Flow Rate	=	3270.5	m^3/day
Flow Rate with Catchment Inflow Factor	=	3597.5	m^3/day (Refer to Table T-4, Catchment Inflow Factor: Kwai Chung, 1.1 is adopted)
Contributing Population	=	13324	people
Peaking factor	=	4	Refer to Table T-5 of GESF for population 10,000-50,000 incl. stormwater allowance
Peak Flow (without Swimming Pool)	=	**151.4**	litre/sec
Peak Flow (with Swimming Pool)	=	**180.0**	litre/sec

Table 10 Breakdown for the estimation of Area of Industrial Buildings

Catchment	Industrial Buidling	Estimated Gross Floor Area (m2) / Storey	Storey	GFA (sqm)
A	UML Tower	385	8	3080
B	Richwealth Industrial Building	910	23	20930
C	Tsuen Hing Factory Building	590	8	4720
C	Fu Yuen Industrial Building	485	9	4365
D	Metex House	835	11	9185
D	Yuet Kwong Industrial Building	315	10	3150
E	Wah Lung Industrial Building	1790	11	19690
F	Lucida Industrial Building	1135	25	28375

Appendix 2.2 Hydraulic Capacity Calculations for Sewerage System

Table 1 Hydraulic Capacity of Existing Sewers

Segment	Manhole Reference	Manhole Reference	Pipe Dia.	Pipe Length	Upstream Invert Level	Downstream Invert Level	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
A0-A1	STMH-01	FMH4023055	225	12.00	3.52	3.47	9.81	0.00060	0.004	0.000001	0.84	0.04	0.03	33.4
A1-A2	FMH4023055	FMH4023056	225	4.85	3.47	3.38	9.81	0.00060	0.019	0.000001	1.79	0.04	0.07	71.0
A2-A3	FMH4023056	FMH4007098	450	34.08	3.38	2.76	9.81	0.00060	0.018	0.000001	2.75	0.16	0.44	436.9
A3-A4	FMH4007098	FMH4023006	450	28.76	2.76	2.6	9.81	0.00060	0.006	0.000001	1.51	0.16	0.24	240.7
A4-A5	FMH4023006	FMH4023007	450	3.79	2.6	2.58	9.81	0.00060	0.005	0.000001	1.47	0.16	0.23	234.5
A5-A6	FMH4023007	FMH4023008	525	26.89	2.58	2.48	9.81	0.00060	0.004	0.000001	1.36	0.22	0.29	294.6
A6-A7	FMH4023008	FMH4023009	525	7.56	2.48	2.47	9.81	0.00300	0.001	0.000001	0.65	0.22	0.14	141.5
A7-A8	FMH4023009	FMH4023010	525	4.27	2.47	2.44	9.81	0.00060	0.007	0.000001	1.88	0.22	0.41	406.1
A8-A9	FMH4023010	FMH4023021	525	23.30	2.44	2.37	9.81	0.00060	0.003	0.000001	1.22	0.22	0.26	264.6
A9-A10	FMH4023021	FMH4023011	525	4.09	2.37	2.34	9.81	0.00060	0.007	0.000001	1.92	0.22	0.41	414.9
A10-A11	FMH4023011	FMH4023012	525	8.03	2.34	2.31	9.81	0.00060	0.004	0.000001	1.36	0.22	0.30	295.3
A11-A12	FMH4023012	FMH4023013	525	22.72	2.31	2.25	9.81	0.00060	0.003	0.000001	1.15	0.22	0.25	247.9

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

(2a) The value of ks = 0.6mm is adopted for slimed clayware sewer with V of approximately 1.2m/s, poor condition (based on Table 3: Recommended roughness values in Sewerage Manual)

(2b) The value of ks = 3.0mm is adopted for slimed clayware sewer with V of approximately 0.75m/s, poor condition (based on Table 3: 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: $$V=-\sqrt{(8gDs)}\log\left(\frac{k_s}{3.7D}+\frac{2.51v}{D\sqrt{(2gDs)}}\right)$$

For sewer A0-A1, A1-A2, A2-A3 and A4-A5, as no available information on downstream invert level of the manhole, thus the downstream invert level is assumed with upstream invert level of the same manhole.

For sewer A0-A1, proposed upstream invert level is adopted for STMH-01.

Table 2 Hydraulic Capacity of Existing Sewers for Sewerage generated from the Proposed Development and Surrounding Catchment Areas

Segment	Pipe Dia. (mm)	Pipe Length (m)	Gradient	Estimated Capacity (L/s)	Flow from Proposed Development (m3/day)	Included Catchment Area	Total Flow Rate from the Proposed Development and Catchment Areas (m3/day)	Contribution Population [1]	Peaking Factor [2]	Peak Flow from the Existing Buildings with the Site Boundary and Catchment Areas (L/s) [3]	Contribution of Proposed Development (%)	Contribution of Catchments (%)	Contribution of Proposed Development and Catchments (%)	
A0-A1	225	12.0	0.004	33.4	294.2	-	294.2	1090	6	20.43	61.2%	0.0%	61.2%	
A1-A2	225	4.9	0.019	71.0	294.2	A	351.2	1301	6	24.39	28.8%	5.6%	34.4%	
A2-A3	450	34.1	0.018	436.9	294.2	A,B	1094.9	4055	6	94.25	4.7%	12.7%	21.6%	
A3-A4	450	28.8	0.006	240.7	294.2	A,B,C	2482.2	9193	5	172.27	7.1%	52.6%	71.6%	[1]
A4-A5	450	3.8	0.005	234.5	294.2	A,B,C	2482.2	9193	5	172.27	7.3%	54.0%	73.5%	
A5-A6	525	26.9	0.004	294.6	294.2	A,B,C,D	2709.4	10035	4	154.06	4.6%	38.0%	52.3%	
A6-A7	525	7.6	0.001	141.5	294.2	A,B,C,D,E	3073.2	11382	4	170.90	9.6%	90.9%	120.8%	[2]
A7-A8	525	4.3	0.007	406.1	294.2	A,B,C,D,E	3073.2	11382	4	170.90	3.4%	31.7%	42.1%	
A8-A9	525	23.3	0.003	264.6	294.2	A,B,C,D,E	3073.2	11382	4	170.90	5.1%	48.6%	64.6%	
A9-A10	525	4.1	0.007	414.9	294.2	A,B,C,D,E,F	3597.5	13324	4	195.18	3.3%	36.9%	47.0%	
A10-A11	525	8.0	0.004	295.3	294.2	A,B,C,D,E,F	3597.5	13324	4	195.18	4.6%	51.8%	66.1%	
A11-A12	525	22.7	0.003	247.9	294.2	A,B,C,D,E,F	3597.5	13324	4	195.18	5.5%	61.7%	78.7%	

[1]: With referenced to previous approved SIA report of Application Site (TPB ref: A/TW/514), 360m3/day is being added to manhole FMH2007098 (A3) under the request of EPD for assessing worst case scenario.
[2]; Due to Peak Flow to Segment A6-A7 exceed 93% of the sewer capacity, backwater profile of the sewer under surcharge condition is calculated and shown in Table 3.

Table 3a Hydraulic Capacity of Existing Sewers along Alley between Fui Yiu Kok Street and Wang Lung Street - Surcharged Condition

Segment	Manhole Reference	Manhole Reference	Pipe Dia.	Pipe Length	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	Delivered Flow rate
			mm	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
A5-A6	FMH4023007	FMH4023008	525	26.894	2.58	2.48	3.12	3.06	4.89	4.82	1.77	1.76	0.03	0.04	9.81	0.0006	0.0010	0.000001	0.71	0.22	0.15	154.1
A6-A7	FMH4023008	FMH4023009	525	7.5628	2.48	2.47	3.06	3.00	4.82	4.83	1.76	1.84	0.01	0.05	9.81	0.0030	0.0019	0.000001	0.79	0.22	0.17	170.9
A7-A8	FMH4023009	FMH4023010	525	4.2685	2.47		3.00															

Note:

1. For this assessment, the Colebrook-White Equation has been used to calculate the friction loss. (Sewerage Mannual section 5.2.1)
2. According to DSD's Sewerage Manual (Part 1) section 5.2.2, Local losses are usually small in relation 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
3. Comparing the Cover levels and foulwater levels at each manhole, the freeboards are found sufficient (>1m). Therefore, no unacceptable adverse sewerage impacts are identified.
4. Friction loss is deduced by required hydraulic gradient x pipe length, while the local loss is deduced by the equation: $h_f = K\frac{V^2}{2g}$

Table 3b Hydraulic Capacity of Existing Sewers along Alley between Fui Yiu Kok Street and Wang Lung Street - Surcharged Condition with 1.15 Safety Factor

Segment	Manhole Reference	Manhole Reference	Pipe Dia.	Pipe Length	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	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
A5-A6	FMH4023007	FMH4023008	525	26.89	2.58	2.48	3.17	3.077	4.89	4.82	1.72	1.74	0.04	0.05	9.81	0.0006	0.0014	0.000001	0.82	0.22	0.18	177.2
A6-A7	FMH4023008	FMH4023009	525	7.56	2.48	2.47	3.08	2.995	4.82	4.83	1.74	1.84	0.02	0.06	9.81	0.0030	0.0025	0.000001	0.91	0.22	0.20	196.5
A7-A8	FMH4023009	FMH4023010	525	4.27	2.47		3.00															

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

(2) Table 1a: The value of ks = 0.6mm is used for the calculation of slimed clayware sewer, poor condition (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: $V=-\sqrt{(8gDs)}\log\left(\frac{k_s}{3.7D}+\frac{2.51v}{D\sqrt{(2gDs)}}\right)$

(5) Friction loss is deduced by required hydraulic gradient x pipe length, while the local loss is deduced by the equation: $h_f = K\frac{V^2}{2g}$

(6) Comparing the Cover levels and foulwater levels at each manhole, the freeboards are found sufficient (>0m) even with 1.15 Safety Factor. Therefore, no unacceptable adverse sewerage impacts are identified.

Appendix 2.3 Extracted Pages of Approved SIA Report for Application Site (TPB ref.: A/TW/514)

Appendix D - Sewer Pipeline Design Check (Proposed Condition)

Foulwater Drains Capacity Design Check (By Colebrook White Equation)

Peaking Factor based on Factor: Including Stormwater

where V = velocity (m/s)
g = 9.81 (ms^{-2})
R = hydraulic radius (m)
s = Slope of pipe / hydraulic gradient
v = kinematic viscosity (m^2/s)
Ks = pipe roughness (mm)

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

Assumptions:
1. Pipe roughness (Existing Condition)= 3 mm
2. Pipe roughness (Proposed condition)= 3 mm

(refer to Sewerage Manual Part 1 - Table 5: Clayware in Poor Conditio

2. Transitional flow and water at 15 degree celcius, i.e. kinematic viscosity is 1.14×10^{-6} m^2/s

			Pipe Information							
Pipe no.	From	To	Pipe Diameter mm	Pipe Length m	Ground Level (US) mPD	Invert Level (US) mPD	Ground Level (DS) mPD	Invert Level (DS) mPD	Gradient 1in	Flow AD
NMH01.1	New manhole G3	FMH4023055	225	9	4.81	3.57	4.73	3.47	90	2.6
FMH4023055.1	FMH4023055	FMH4023056	225	4	4.73	3.47	4.62	3.38	44	0.1
FMH4023056.1	FMH4023056	FMH4007098	450	34	4.62	3.38	4.74	2.76	55	6.0
FMH4007098.1	FMH4007098	FMH4023006	450	29	4.74	2.76	4.91	2.60	181	12.
FMH4023006.1	FMH4023006	FMH4023007	450	4	4.91	2.60	4.89	2.58	200	0.1
FMH4023007.1	FMH4023007	FMH4023008	525	26	4.89	2.58	4.82	2.48	261	0.3
FMH4023008.1	FMH4023008	FMH4023009	525	7	4.82	2.48	4.83	2.47	681	0.4
FMH4023009.1	FMH4023009	FMH4023010	525	4	4.83	2.47	4.81	2.44	117	0.(
FMH4023010.1	FMH4023010	FMH4023021	525	23	4.81	2.44	4.83	2.37	322	0.(
FMH4023021.1	FMH4023021	FMH4023011	525	3	4.83	2.37	4.76	2.34	111	3.(
FMH4023011.1	FMH4023011	FMH4023012	525	7	4.76	2.34	4.64	2.31	243	0.(

Remark:
1. It has assumed the pipe under a free flow condition, thus, water level boundary at the downstream pipe is considered not required.
2. Some of the invert level records are not available from records, for carrying out the hydraulic assessment, it is assumed that the invert levels of the inlet pipes at manhole FMH4023056
3. Discharge manhole for the site is highlighted in green colour.
4. Additional Flow of 360 m3/day is being added to manhole ID: FMH4007098 under the request of EPD for assessing the impact under worst case scenario.

Freeboard Check for Surcharged 525mm Sewer between manholes FMH4023008 and FMH 4023009

Condition 1 - Under Peak Sewage Flow

Condition

Pipe size D =	525	mm		
Pipe roughness ks =	3	mm		
Design flow Q =	151.82	l/s		
Flow area A =	0.216	m^2		
Flow velocity v =	0.70	m/s		
Energy gradient s =	1	in	656	(By Colebrook White Equation)
Pipe length L =	7	m		
Frication head hf =	0.010	m		(= L x s)
Downstream water level H_d =	2.995	mPD		(assumed full flow at downstream end of the pipe)
Upstream water level H_{up} =	3.005	mPD		[H_d + hf]
Downstream end ground level =	4.82	mPD		
Upstream end ground level =	4.83	mPD		
Freeboard at downstream end =	1.825	mPD	>1m	
Freeboard at upstream end =	1.825	mPD	>1m	

Do

Fre

According to the freeboard check of the surchaged 525mm pipe, the pipe has freeboard more than 1m under both peak flow and 1.15x peak flow condtion.