

Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Flat and Proposed Shop and Services Uses at Lots 4614 and 4615 RP in D.D. 116, Lots 1753 S.B ss.3 (Part), 1753 S.B RP (Part), 1756 S.A (Part), 1756 RP (Part), 1757, 1758 RP and 1760 RP in D.D. 120, and Adjoining Government Land, Tai Kei Leng, Yuen Long, New Territories

Sewerage Impact Assessment (Revision D)

January 2024

This page left intentionally blank for pagination.

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	Aug 2023	Edith CHOW	May TSE	May TSE	For Submission
B	Oct 2023	Edith CHOW	May TSE	May TSE	For Submission
C	Dec 2023	Edith CHOW	May TSE	May TSE	For Submission
D	Jan 2024	Edith CHOW	May TSE	May TSE	For Submission

Document reference: 601364736 | 072 | D |

Information class: Standard

This document is issued for the party which commissioned it and for specific purposes connected with the above-captioned project only. It should not be relied upon by any other party or used for any other purpose.

We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purpose, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

This document contains confidential information and proprietary intellectual property. It should not be shown to other parties without consent from us and from the party which commissioned it.

Contents

1	Introduction	1
1.1	Background	1
1.2	Key Development Parameters	1
1.3	Objectives of Report	1
1.4	Structure of the Report	2
2	Methodology and Design Parameters for Sewerage Impact Assessment	3
2.1	General Approach	3
2.2	Methodology	3
2.3	Design Parameters and Assumptions	4
2.4	Planned Population and Employee Data of the Proposed Development	6
3	Existing Sewerage and Estimation of Sewage Flow for the Existing Condition	7
3.1	Existing Sewerage System	7
3.2	Estimated Sewage Flow from the Existing Site Area	7
4	Estimation of Sewage Flow for the Proposed Development	8
4.1	Estimated Sewage Flow for the Proposed Development	8
5	Sewerage Impact Assessment and Sewage Discharge Arrangement	9
5.1	Sewage Discharge Arrangement	9
5.2	Sewerage Impact Assessment	9
6	Conclusion	11
	Appendices	12

1 Introduction

1.1 Background

1.1.1 Mott MacDonald Hong Kong Limited (hereinafter as “MMHK”) was commissioned by the Applicant to prepare a Sewerage Impact Assessment (SIA) in support of the proposed minor relaxation of statutory planning control of plot rate of PR3.5 up to PR4.287 for additional residential development and small retail service application abutting Tai Tong Road and Tai Shu Ha Road East, Yuen Long. The location of the development is shown in **Appendix A**.

1.1.2 This report will demonstrate that the additional flats of 55 together with the planned residential development is feasible in terms of its impact on the sewerage system.

1.2 Key Development Parameters

1.2.1 The location and layout of the proposed development is provided in **Appendices A and B** and the Development data is given in **Table 1.1** and **Table 1.2** below:-

Table 1.1: Data of the Proposed Residential Development

Items	Details
Area	Approximately 2,540 m ²
Proposed Domestic GFA	10,668 m ²
Proposed Plot Ratio	4.287 (minor relaxation of DPR0.6 and NDPR0.087 above permitted 3.5)
No. of Blocks	1
Nos. of Units	Approximately 345 (including 55 additional flats)
Anticipated Intake Year	2028

Table 1.2: Data of the Proposed Retail Building

Items	Details
Area	Approximately 220 m ²
No. of Blocks	1
No. of storey	1
Anticipated Completion Year	2028

1.3 Objectives of Report

1.3.1 This SIA report aims to identify the existing and planned sewerage systems in vicinity of the proposed development, to assess the sewerage impacts arising from the proposed

development and to identify the required sewerage works, if required, to support the development.

1.4 Structure of the Report

1.4.1 This SIA report contains the following sections in addition to this introduction (Section 1):-

Section 2 – Methodology and Design Parameters for Sewerage Impact Assessment

Covers the approach of the SIA and the parameters used in the assessment.

Section 3 – Existing Sewerage and Estimation of Sewage Flow for the Existing Condition

Discuss the sewage flow under the existing condition and the existing sewerage system.

Section 4 – Estimation of Sewage Flow for the Proposed Development

Discuss the sewage flow generated from the Development.

Section 5 – Sewerage Impact Assessment and Sewage Discharge Arrangement

Discuss the sewerage impact arising from the Development and the potential sewage disposal option for the Development.

Section 6 – Conclusion

Summarise the findings and conclude the sewerage impact arising from the Development.

2 Methodology and Design Parameters for Sewerage Impact Assessment

2.1 General Approach

- 2.1.1 The SIA is carried out to identify and assess if there are any potential adverse sewerage impacts arising from the proposed development.

2.2 Methodology

Assessment Approach

- 2.2.1 The following approach and methodology have been adopted in this sewerage impact assessment:-

- Carry out desktop study to collect the relevant information for the assessment. Relevant information for the assessment collected included drainage record plans from Drainage Services Department (DSD) and information as listed in Section 2.2.3;
- Estimate the sewage flow generated from the existing site and the proposed development; and
- Assess the sewerage impacts arising from the proposed development and formulate option to mitigate the sewerage impacts identified. Sewage disposal arrangement for the proposed development will also be proposed.

- 2.2.2 For the existing and proposed sewerage in vicinity of the proposed development, Colebrook-White equation has been used to assess the hydraulic conditions of the sewerage network.

Design Standards, Guidelines and Reference

- 2.2.3 The sewage flow generated from the proposed development is estimated based on the following standards, guidelines and references for the sewerage design:-

- Sewerage Manual published by Drainage Services Department (DSD);
- Guidelines for Estimating Sewage Flows (GESF) for Sewerage Infrastructure published by Environmental Protection Department (EPD); and
- Commercial and Industrial Floor Space Utilisation Survey conducted by Planning Department (PlanD).

2.3 Design Parameters and Assumptions

Unit Flow Factors

2.3.1 The category of the components of the Unit Flow Factors adopted in the assessment are indicated in **Table 2.1**.

Table 2.1: Unit Flow Factors

Scenario	Category / Use	Unit	Unit Flow Factor
For existing developments and proposed development	Domestic Flow for Private Housing (R2)	m ³ /d per resident	0.27 (i)
	J4 Wholesale & Retail	m ³ /d per employee	0.28 (ii)
	J10 Restaurants & Hotels	m ³ /d per employee	1.58 (iii)
	J11 Community, Social & Personal Services	m ³ /d per employee	0.28 (iv)
Remark:-			

- (i) According to the Guidelines for Estimating Sewage Flows (GESF) issued by EPD, unit flow factor for private housing unit (R2) are 0.27 m³/d.
- (ii) According to the Guidelines for Estimating Sewage Flows (GESF) issued by EPD, unit flow factor for Wholesale & Retail (J4) is 0.28 m³/h/d.
- (iii) According to the Guidelines for Estimating Sewage Flows (GESF) issued by EPD, unit flow factor for Restaurants & Hotels (J10) is 1.58 m³/h/d.
- (iv) According to the Guidelines for Estimating Sewage Flows (GESF) issued by EPD, unit flow factor for Community, Social & Personal Services (J11) is 0.28 m³/h/d.

Catchment Inflow Factors

2.3.2 The Catchment Inflow Factors (P_{CIF}) cater for the net overall ingress of water or wastewater to the sewerage system. They are catchment-dependent and applicable to major sewerage facilities of a catchment. It is not applicable to new catchments which have no connection from existing sewerage system which are deemed to be free from misconnections and pipe defects. Therefore, the P_{CIF} is not applicable in estimating the total flows from the new development project.

2.3.3 With reference to EPD Technical Paper - Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF) - Table T-4, for the existing sewerage system in Yuen Long, the P_{CIF} of 1.0 for catchments will be adopted.

Peaking Factors

2.3.4 Peaking factors cater for seasonal / diurnal fluctuation and normal amount of infiltration and inflow. The peaking factors shall be in accordance with Table T-5 of the GESF and are shown in **Table 2.2**.

Table 2.2: Peaking Factors for Various Population Ranges

Population Range	Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage	Peaking Factor (excluding stormwater allowance) for facility with new upstream sewerage
(a) Sewers		
< 1,000	8	6
1,000 – 5,000	6	5
5,000 – 10,000	5	4
10,000 – 50,000	4	3
> 50,000	Max (7.3/N ^{0.15} , 2.4)	Max (6/N ^{0.0175} , 1.6)
(b) Sewage Treatment Works, Preliminary Treatment Works and Pumping Stations		
< 10,000	4	3
10,000 – 25,000	3.5	2.5
25,000 – 50,000	3	2
> 50,000	Max (3.9/N ^{0.065} , 2.4)	Max (2.6/N ^{0.065} , 1.6)

Note:

N = Contributing population in thousands

$$\text{Contributing Population} = \frac{\text{Calculated total average flow (m}^3\text{/day)}}{0.27 \text{ (m}^3\text{/person/day)}}$$

2.3.5 Peaking factors (excluding stormwater allowance) are applicable to planning sewerage facilities flow from new upstream sewerage systems which essentially have no misconnections and defects for infiltration. Thus, peaking factor excluding stormwater allowance has been used for the proposed sewers. For existing sewers, peaking factor including stormwater allowance has been adopted.

Roughness

2.3.6 For the proposed sewerage network, polyethylene pipe will be used. A roughness value of 1.5 mm, similar to uPVC material pipe under poor slimed condition in accordance with Sewerage Manual – Table 5, has been adopted for polyethylene pipe. For existing clayware sewer, a roughness value of 3mm for slimed sewer in poor condition has been adopted.

2.4 Planned Population and Employee Data of the Proposed Development

2.4.1 The development parameters and design population of the proposed development are shown in **Table 2.3** and **Table 2.4** below. The layout plan of the proposed development could be referred to **Appendix A1**.

Table 2.3: Design Parameters for the Proposed Development

Development Parameters	
Site Area (m ²)	About 2,540
Proposed Domestic Plot Ratio	4.2
Proposed No. of Units	About 345
Estimated Population ⁽ⁱ⁾	966
Non-Domestic Facilities (m ²)	About 220 (Retail and Restaurant)
Remarks:	
(i) The population is estimated with the average number of occupants, 2.8 occupants per unit for Yuen Long according to 2021 Population Census.	

Table 2.4: Estimated Employee Number and Serving Population for the Development

Type	Category / Use	Population / No. of Staff
Proposed Residential Development		
Residential	R2	966
Residential - Employee	J11	18 ^{(i) (ii)}
Proposed Retail Building		
Retail - Employee ^(v)	J4	4 ⁽ⁱⁱⁱ⁾
Restaurant - Employee ^(v)	J10	6 ^(iv)
Remarks:-		
(i) It is assumed there would be 2 security guards and 2 managing staffs for housing block.		
(ii) For the club house, it is assumed there would be 3.3 workers per GFA (in 100 m ²) for Community, Social & Personal Services according to Figure 9: Worker Density by Industry Group of "Commercial and Industrial Floor Space Utilization Survey" published by Plannings Department.		
(iii) It is assumed there would be 3.5 workers per GFA (in 100 m ²) for Retail Trade according to Figure 9: Worker Density by Industry Group of "Commercial and Industrial Floor Space Utilization Survey" published by Plannings Department.		
(iv) It is assumed there would be 5.1 workers per GFA (in 100 m ²) for Restaurants according to Figure 9: Worker Density by Industry Group of "Commercial and Industrial Floor Space Utilization Survey" published by Plannings Department.		
(v) It is assumed that 50% of the GFA of the Retail Building is retail and 50% of the GFA of the Retail Building is restaurant.		

3 Existing Sewerage and Estimation of Sewage Flow for the Existing Condition

3.1 Existing Sewerage System

- 3.1.1** There is no existing public sewerage system serving the Site. Based on sewerage record from DSD, there is a 200mm to 450mm diameter sewage pipeline located along Tai Tong Road at the north of the proposed site. The existing sewage pipeline along Tai Tong Road collects sewage from The Brand (via Existing Manhole FMH1035400) and joins with another set of 200mm to 300mm diameter sewage pipeline along Shap Pat Heung Road at existing manhole FMH1036051. The sewage collected by two sets of sewage pipeline along Tai Tong Road and along Shap Pat Heung Road will be discharged to 750mm diameter sewers along Shap Pat Heung Road via a 300mm diameter sewer (ID: FWD1043910) and a 450mm diameter sewer (ID: FWD1043909).
- 3.1.2** According to drawings from Building Department, there is a sewage treatment plant within Sereno Verde to handle and treat the sewage generated from Sereno Verde. The treated effluent from Sereno Verde is then discharged to the existing channel next to Tai Shu Ha Road East. It is also observed that the sewage generated from Reach Summit is discharged to existing manhole FMH1064703 for discharge based on drawings from Building Department.
- 3.1.3** The existing sewerage system near to the proposed development is shown in **Appendix B**. The catchments of existing sewerage system are presented in **Appendix B1**.

3.2 Estimated Sewage Flow from the Existing Site Area

- 3.2.1** At present, the site area is a paved car park with no sewerage facilities. Thus, no sewage flow generation is expected under existing condition within the site area.

4 Estimation of Sewage Flow for the Proposed Development

4.1 Estimated Sewage Flow for the Proposed Development

4.1.1 Based on the Development parameters and sewage unit flow factors as mentioned in Section 2, the estimated Average Dry Weather Flow (ADWF) for the proposed development with associated facilities is approximately 276.5 m³/day. Details of the sewage flow estimation are given in **Table 4.1** below.

Table 4.1: Sewage Flow Estimation for Proposed Development

Type	Population / No. of Staff (nos.)	Unit Flow Factor (m ³ /h/d)	Average Dry Weather Flow (m ³ /d)
Proposed Residential Development			
Residential (R2)	966	0.27	260.82
Residential - Employee (J11)	18	0.28	5.04
Sub-total =			265.86
Proposed Retail Building			
Retail - Employee (J4)	4	0.28	1.12
Restaurant – Employee (J10)	6	1.58	9.48
Sub-total =			10.60
Total =			276.46

5 Sewerage Impact Assessment and Sewage Discharge Arrangement

5.1 Sewage Discharge Arrangement

- 5.1.1** As discussed in Section 3, there is a 200mm to 450mm diameter sewage pipeline located along Tai Tong Road at the north of the proposed site.
- 5.1.2** Also, as mentioned in Section 4, the ADWF generated from the proposed development is 276.46 m³/d. The sewage generated from the proposed residential development is proposed to be discharged to the proposed manhole FMH-01 and the sewage generated from the retail building will be discharged to the proposed manhole FMH-02.
- 5.1.3** For conveying the sewage flow from the Development to the existing manhole FMH1035400, new polyethylene sewers of **280mm outside diameter (OD) (i.e. 250 mm internal diameter)** are proposed to collect sewage from the proposed development to the existing manhole FMH1035400 via proposed pipes FMD-P1, FMD-P2 and FMD-P3. The proposed sewage discharge arrangement refers to **Appendix C**.

5.2 Sewerage Impact Assessment

- 5.2.1** The hydraulic capacities of the proposed sewers for the proposed development have been assessed using Colebrook-White equation. The results are summarised in **Table 5.1** below and details of the calculation are attached in **Appendix D**.

Table 5.1: Hydraulic Capacities of Existing Sewers along Tai Tong Road under Existing and Proposed Flow Condition

Upstream Manhole	Downstream Manhole	Internal Pipe Size (mm)	Utilization under Existing Condition	Utilization under Proposed Condition	Utilization under Proposed Condition with upgrading works
Sewerage Network along Tai Tong Road (Sub-catchment 1)					
FMH1035400*	FMH1064703	200	9%	90% [^]	44% [^]
FMH1064703	FMH1035401	450	24%	37%	37%
FMH1035401	FMH1036053	450	7%	11%	11%
FMH1036053	FMH1036051	450	27%	42%	42%
Sewerage Network along Shap Pat Heung Road (Sub-catchment 2)					
FMH1060002	FMH1060022	250	10%	10%	10%
FMH1060022	FMH1060023	250	12%	12%	12%
FMH1060023	FMH1060024	250	11%	11%	11%
FMH1060024	FMH1060062	250	9%	9%	9%
FMH1060062	FMH1060063	250	7%	7%	7%
FMH1060063	FMH1036052	200	10%	10%	10%
FMH1036052	FMH1036051	300	7%	7%	7%
300mm and 450mm diameter sewers (ID: FWD1043910 & FWD1043909) along Shap Pat Heung Road (Sub-catchments 1 & 2)					
FMH1036051	FMH1036050	300	26%	41%	41%
FMH1036051	FMH1036049	450	12%	18%	18%

Upstream Manhole	Downstream Manhole	Internal Pipe Size (mm)	Utilization under Existing Condition	Utilization under Proposed Condition	Utilization under Proposed Condition with upgrading works
Remark: - 1. * The downstream existing manhole connected to the proposed pipe (i.e. FMD-P1, FMD-P2 and FMD-P3). 2. @ For FMD1002480, it consists of two 200mm pipes. it is assumed that the cumulative peak sewage flow is equally divided between 2 pipes. 3. ^ In light of the high utilization under the proposed condition for the sewer between manholes FMH1035400 and FMH1064703, it is proposed that to upgrade that existing sewer from 200mm to 250mm in internal diameter (i.e. 280mm OD PE pipe).					

5.2.2 Based on the hydraulic calculation, the existing sewers along Tai Tong Road and Shap Pat Heung Road are below 50% except the 200mm sewer between manholes FMH1035400 and FMH1064703 which is about 90% and the sewers are capable of discharging sewage flow generated from the proposed Development. In light of the high utilization under the proposed condition for the 200mm diameter sewer between manholes FMH1035400 and FMH1064703, it is proposed to upgrade the existing sewer from 200mm to 250mm in internal diameter (i.e. 280mm OD PE pipe). After the proposed upgrading works, the utilization of the existing sewer between manholes FMH1035400 and FMH1064703 will be decreased from 90% to 44%.

5.2.3 For the proposed sewers (PE pipes) connecting the proposed Development to the existing sewers along Tai Tong Road, the hydraulic result is summarised in **Table 5.2** below and details of the calculation are attached in **Appendix D**. A reduction in flow area has also been added to check for the proposed sewers for future rehabilitation if necessary.

Table 5.2: Hydraulic Capacities of Proposed Sewers to Sewers along Tai Tong Road under Proposed Flow Condition

Upstream Manhole	Downstream Node	Internal Pipe Size (mm)	Utilization under Proposed Flow Condition	Utilization under Proposed Flow Condition with Flow Area Reduced for Rehabilitation
FMH-01*	FMH-02	250	50%	57%
FMH-02@	FMH-03	250	48%	55%
FMH-03	FMH1035400	250	48%	55%

Remark: -
 1. * The discharge manhole for the proposed residential development.
 2. @ The discharge manhole for the proposed retail building.

5.2.4 Based on the hydraulic calculation, the sewage flow from the proposed development is well within the capacity of the existing and proposed sewage pipelines with utilisation below or equal to 57% even taking account of reduced size for proposed sewers taking account of future rehabilitation. Thus, it is considered that there is no adverse sewerage impact arising from the Development. The construction of the proposed sewers (i.e. FMD-P1, FMD-P2 and FMD-P3) and proposed upgraded pipe between manholes FMH1035400 and FMH1064703 will be carried out by the project proponent.

6 Conclusion

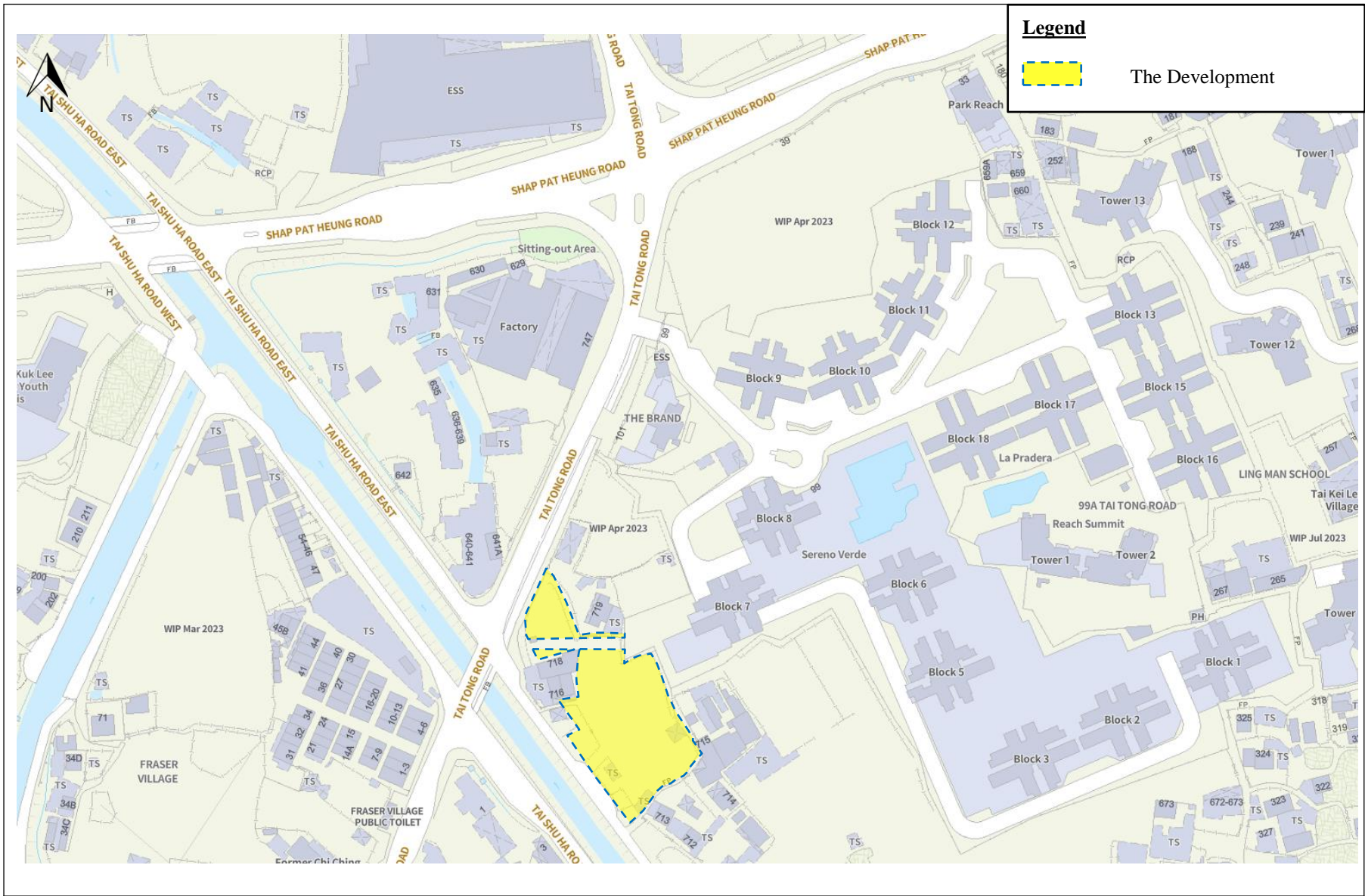
- 6.1.1** The estimated Average Dry Weather Flow (ADWF) for the proposed whole development is approximately 276.5 m³/day. The sewage generated will be discharged at a proposed manhole FMH-01. Sewage flow is then conveyed by three proposed 250mm internal diameter PE pipes (i.e. 280mm outside diameter) connecting the existing manhole FMH1035400, and then to 200mm to 450mm diameter sewage pipeline along Tai Tong Road and Shap Pat Heung Road. In light of the high utilization under the proposed condition for the 200mm diameter sewer between manholes FMH1035400 and FMH1064703, it is proposed to upgrade the existing sewer from 200mm to 250mm in internal diameter (i.e. 280mm OD PE pipe). After the proposed upgrading works, the utilization of the existing sewer FWD1042941 will be decreased from 90% to 44%.
- 6.1.2** The construction of three proposed 250mm internal diameter PE pipe (i.e. 280mm outside diameter) and the proposed upgrading works of the existing sewer between FMH1035400 and FMH1064703 will be constructed on the cost of the Applicant and the completed works will be handed back to DSD for maintenance.
- 6.1.3** Based on the hydraulic calculation, the sewage flow from the proposed development is within the capacity of the existing and proposed sewage pipelines. However, it should be noted that the additional impact for the 55 flats and 220m² retail building generate sewage flow of 52.2 m³/d only which is 19% of the whole planned development. In view of the nearby development, possible upgrade is anticipated. The minor increase in the sewerage flow of 52.2m³/d is very minor and thus, it is considered that there is no adverse sewerage impact arising from the Development site.

Appendices

- Appendix A Location Plan of the Development
- Appendix A1 Layout Plan of the Development
- Appendix B Existing Sewerage System
 - Appendix B1 Existing Catchment Plan
 - Appendix B2 Proposed Catchment Plan
- Appendix C Proposed Sewerage System
- Appendix D Hydraulic Calculation
- Appendix E Distribution of Flow from Existing Manhole FMH1036051 To Existing Sewers FWD1043910 and FWD1043909 Under Existing and Proposed Conditions

Appendix A

Location Plan of the Development



Project Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Flat and Proposed Shop and Services Uses at Lots 4614 and 4615 RP in D.D. 116, Lots 1753 S.B ss.3 (Part), 1753 S.B RP (Part), 1756 S.A (Part), 1756 RP (Part), 1757, 1758 RP and 1760 RP in D.D. 120, and Adjoining Government Land, Tai Kei Leng, Yuen Long, New Territories



Title Location Plan

Appendix A

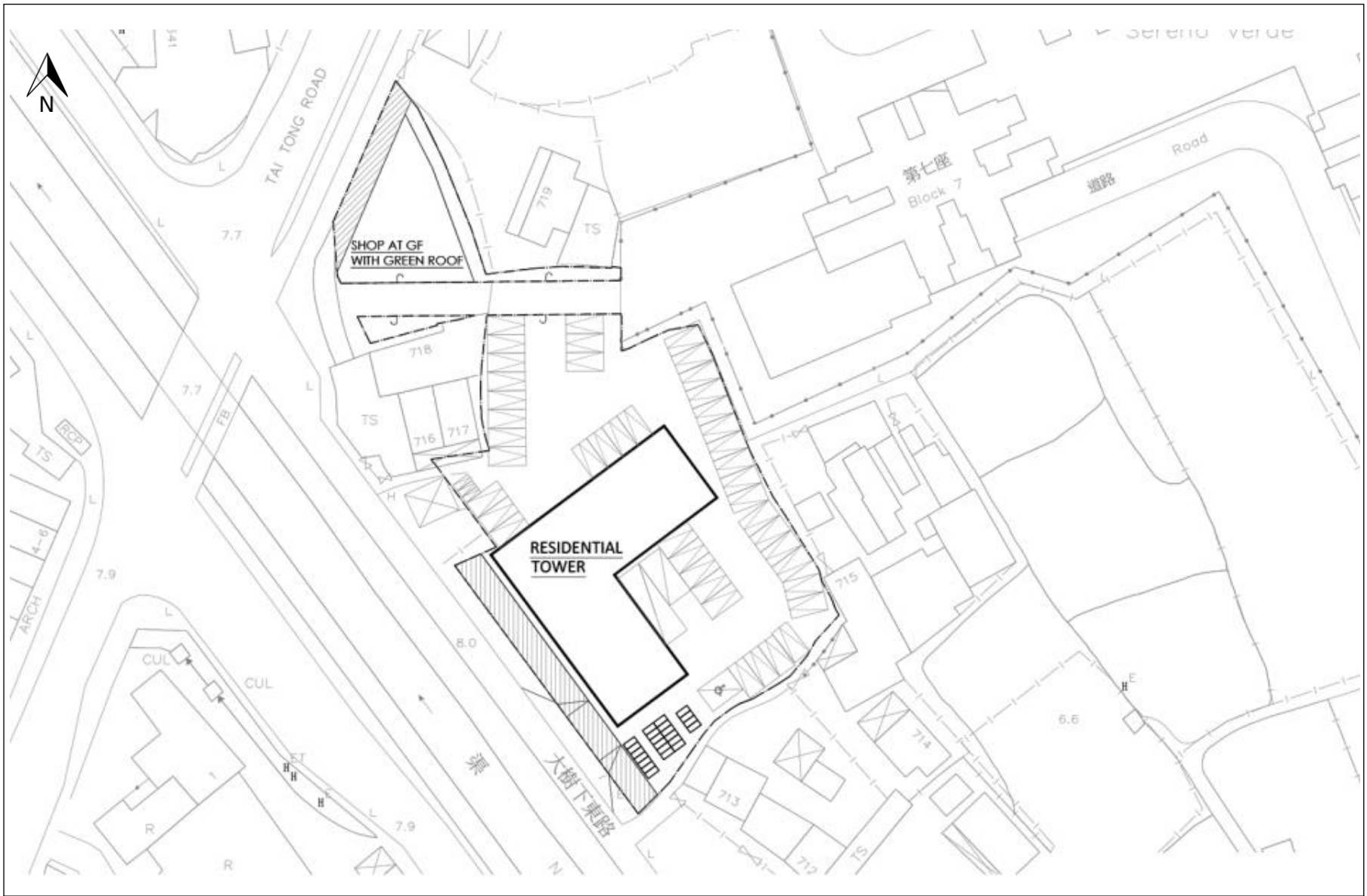
Date Aug 2023

Scale N.T.S.

File

Appendix A1

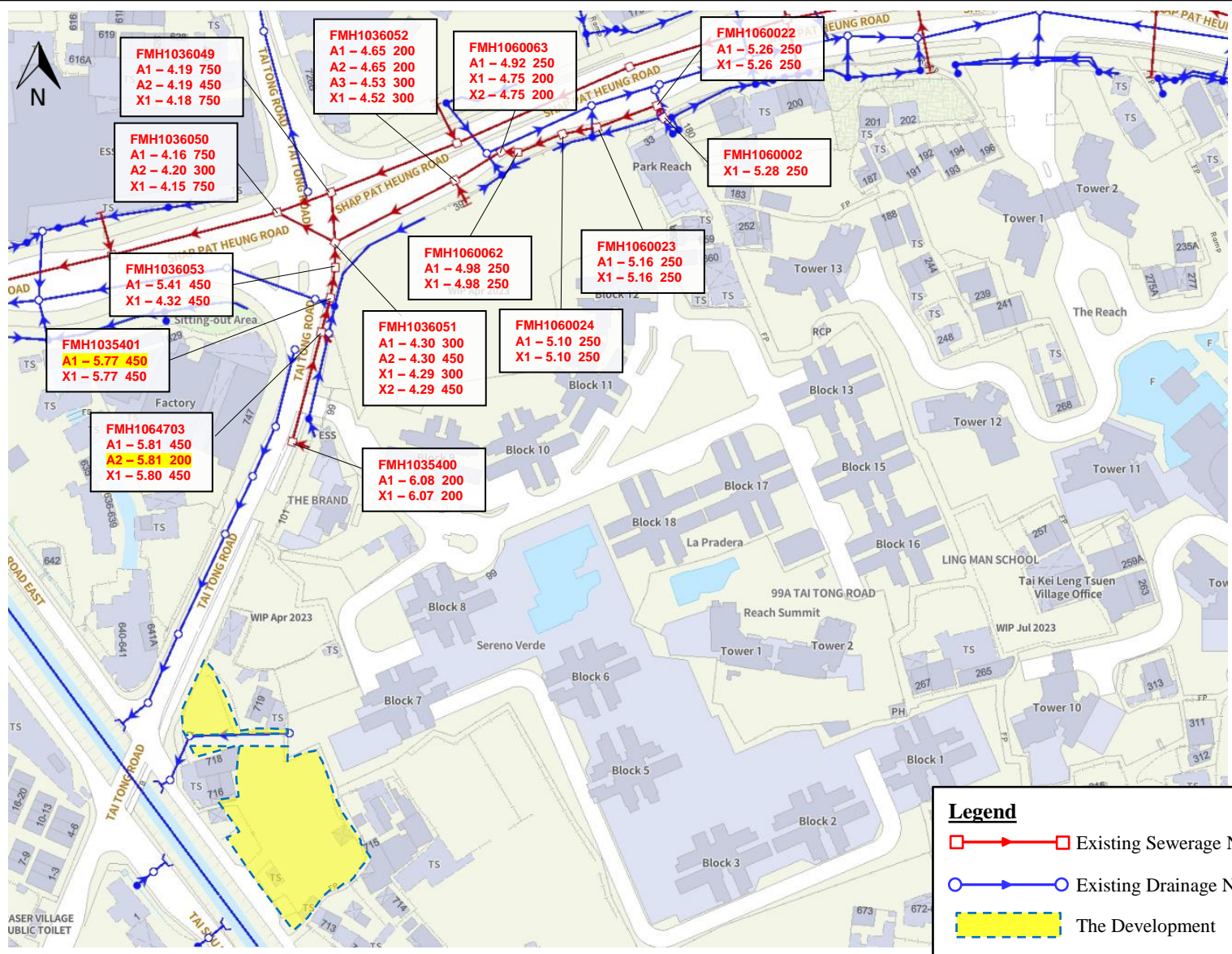
Layout Plan for the Development



Project	Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Flat and Proposed Shop and Services Uses at Lots 4614 and 4615 RP in D.D. 116, Lots 1753 S.B ss.3 (Part), 1753 S.B RP (Part), 1756 S.A (Part), 1756 RP (Part), 1757, 1758 RP and 1760 RP in D.D. 120, and Adjoining Government Land, Tai Kei Leng, Yuen Long, New Territories	M M <small>MOTT MACDONALD</small>
Title	Layout Plan of the Development	Appendix A1
Date	Aug 2023	Scale
	N.T.S.	File

Appendix B

Existing Sewerage System



FMH1036049
 A1 - 4.19 750
 A2 - 4.19 450
 X1 - 4.18 750

FMH1036052
 A1 - 4.65 200
 A2 - 4.65 200
 A3 - 4.53 300
 X1 - 4.52 300

FMH1060063
 A1 - 4.92 250
 X1 - 4.75 200
 X2 - 4.75 200

FMH1060022
 A1 - 5.26 250
 X1 - 5.26 250

FMH1036050
 A1 - 4.16 750
 A2 - 4.20 300
 X1 - 4.15 750

FMH1060002
 X1 - 5.28 250

FMH1036053
 A1 - 5.41 450
 X1 - 4.32 450

FMH1060062
 A1 - 4.98 250
 X1 - 4.98 250

FMH1060023
 A1 - 5.16 250
 X1 - 5.16 250

FMH1035401
 A1 - 5.77 450
 X1 - 5.77 450




FMH1036051
 A1 - 4.30 300
 A2 - 4.30 450
 X1 - 4.29 300
 X2 - 4.29 450


FMH1060024
 A1 - 5.10 250
 X1 - 5.10 250

FMH1064703
 A1 - 5.81 450
 A2 - 5.81 200
 X1 - 5.80 450

FMH1035400
 A1 - 6.08 200
 X1 - 6.07 200

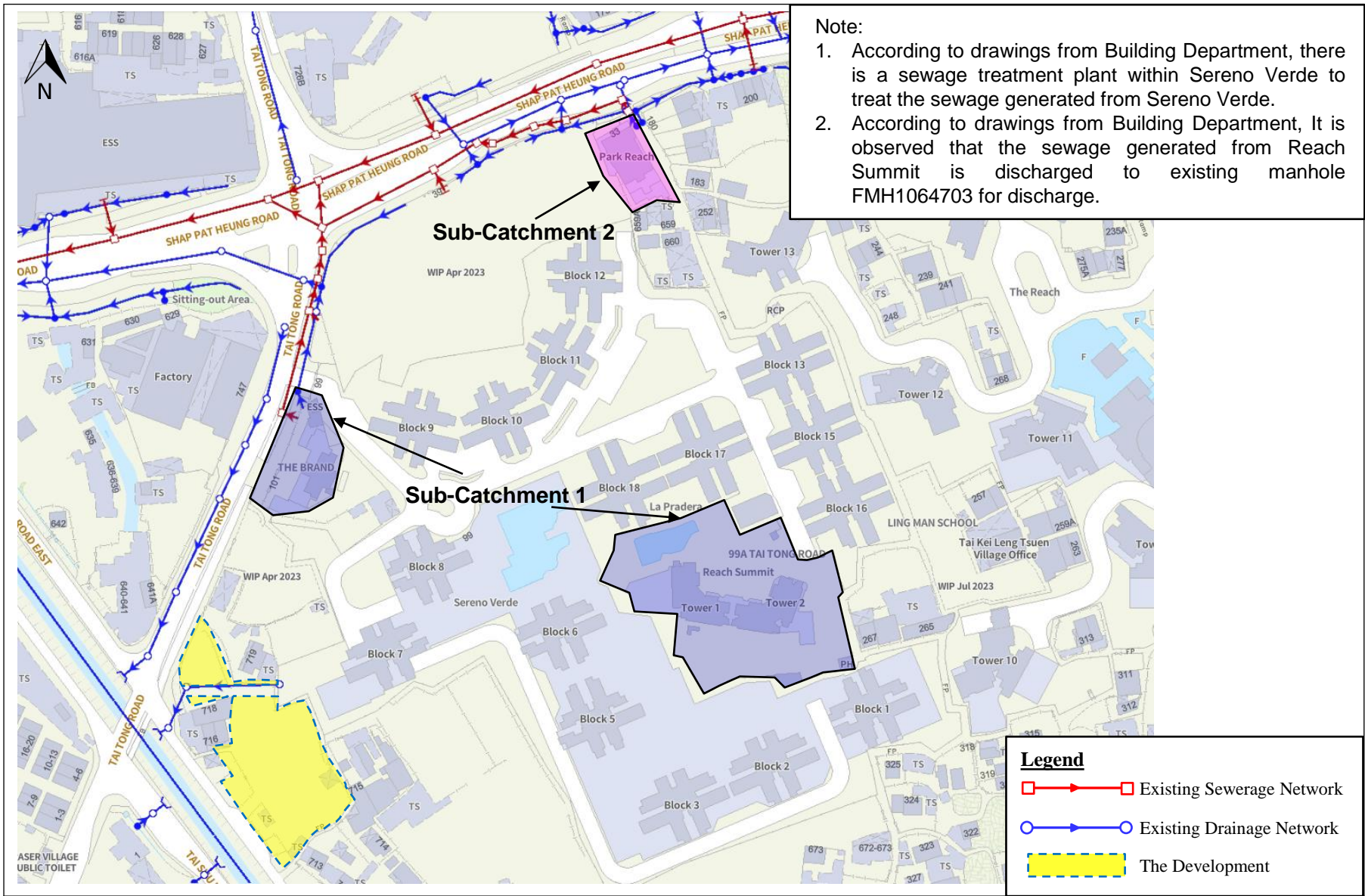
Legend

-  Existing Sewerage Network
-  Existing Drainage Network
-  The Development

Project	Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Flat and Proposed Shop and Services Uses at Lots 4614 and 4615 RP in D.D. 116, Lots 1753 S.B ss.3 (Part), 1753 S.B RP (Part), 1756 S.A (Part), 1756 RP (Part), 1757, 1758 RP and 1760 RP in D.D. 120, and Adjoining Government Land, Tai Kei Leng, Yuen Long, New Territories				
				Title	Existing Sewerage System
Date	January 2024	Scale	N.T.S.		

Appendix B1




Existing Catchment Plan




Note:

1. According to drawings from Building Department, there is a sewage treatment plant within Sereno Verde to treat the sewage generated from Sereno Verde.
2. According to drawings from Building Department, It is observed that the sewage generated from Reach Summit is discharged to existing manhole FMH1064703 for discharge.

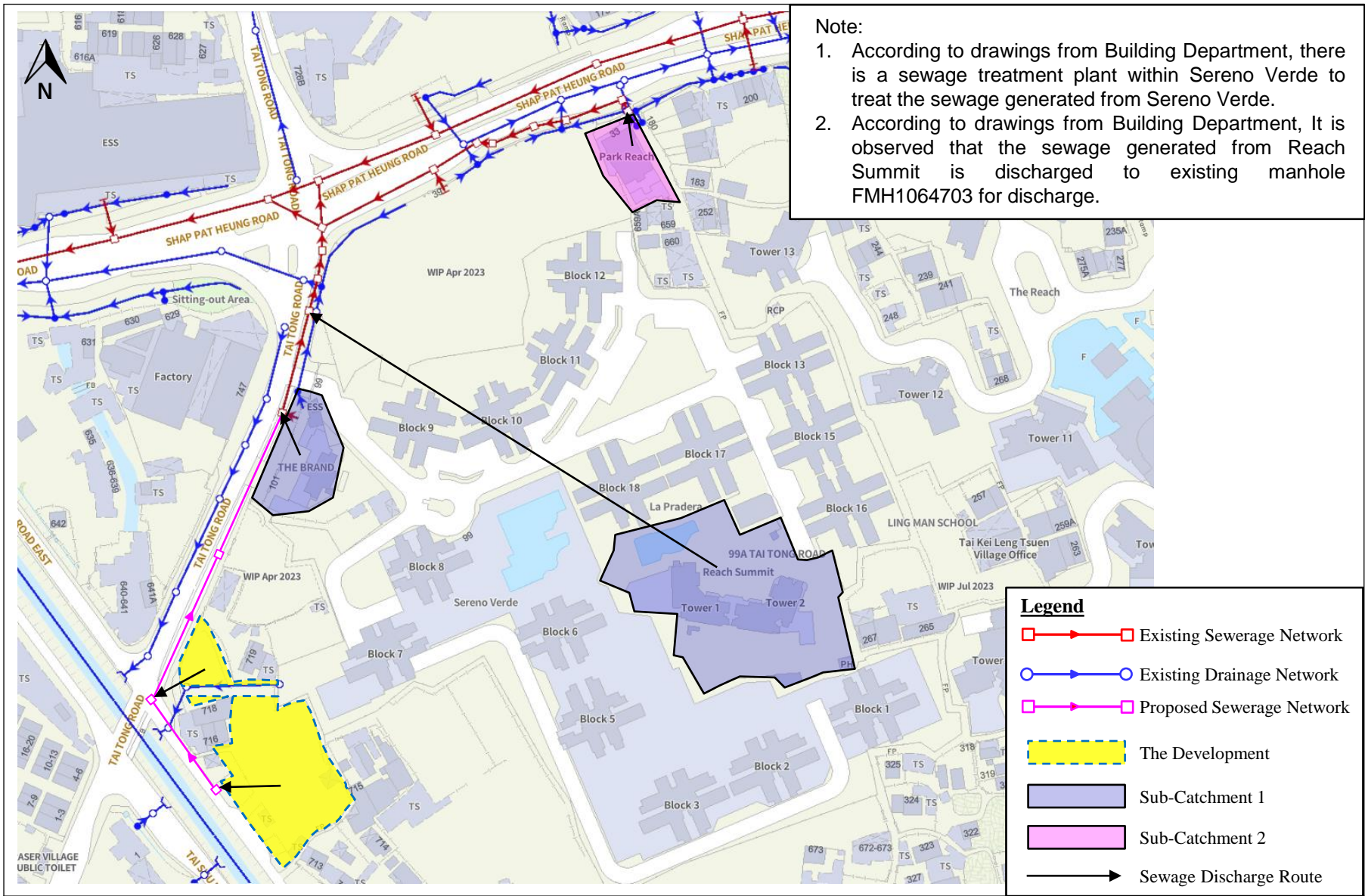
Legend

-  Existing Sewerage Network
-  Existing Drainage Network
-  The Development

Project	Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Flat and Proposed Shop and Services Uses at Lots 4614 and 4615 RP in D.D. 116, Lots 1753 S.B ss.3 (Part), 1753 S.B RP (Part), 1756 S.A (Part), 1756 RP (Part), 1757, 1758 RP and 1760 RP in D.D. 120, and Adjoining Government Land, Tai Kei Leng, Yuen Long, New Territories	
Title	Existing Sewerage Catchment Plan for Assessed Sewers	<h1>Appendix B1</h1>
Date	Aug 2023	Scale
	N.T.S.	File

Appendix B2

Proposed Catchment Plan



Note:

1. According to drawings from Building Department, there is a sewage treatment plant within Sereno Verde to treat the sewage generated from Sereno Verde.
2. According to drawings from Building Department, It is observed that the sewage generated from Reach Summit is discharged to existing manhole FMH1064703 for discharge.

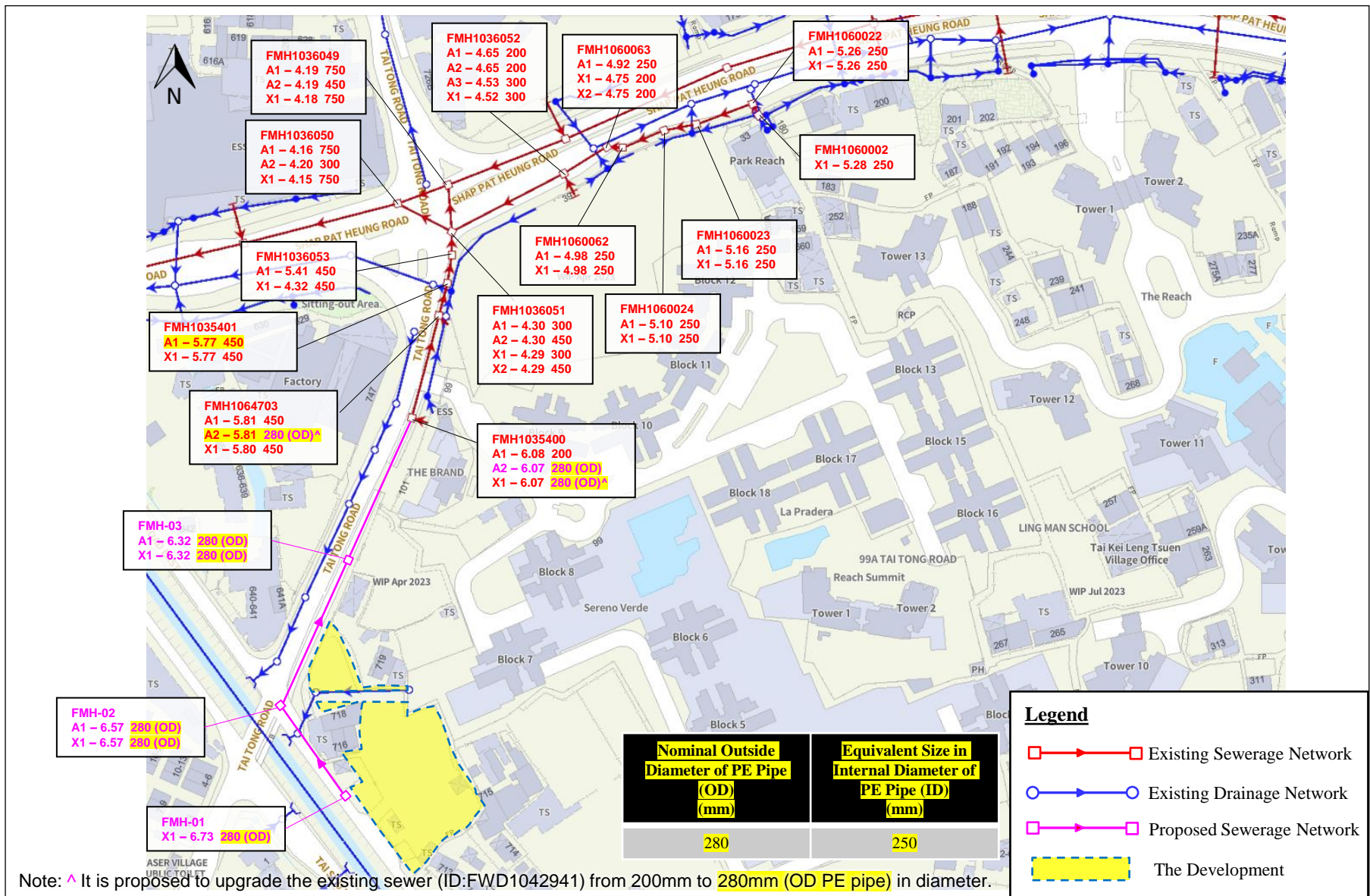
Legend

- ▣ → ▣ Existing Sewerage Network
- → ○ Existing Drainage Network
- ▣ → ▣ Proposed Sewerage Network
- The Development
- Sub-Catchment 1
- Sub-Catchment 2
- Sewage Discharge Route

Project	Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Flat and Proposed Shop and Services Uses at Lots 4614 and 4615 RP in D.D. 116, Lots 1753 S.B ss.3 (Part), 1753 S.B RP (Part), 1756 S.A (Part), 1756 RP (Part), 1757, 1758 RP and 1760 RP in D.D. 120, and Adjoining Government Land, Tai Kei Leng, Yuen Long, New Territories	
Title	Proposed Sewerage Catchment Plan for Assessed Sewers	<h1 style="margin: 0;">Appendix B2</h1>
Date	Dec 2023	
Scale	N.T.S.	
File		

Appendix C

Proposed Sewerage System



Project	Proposed Minor Relaxation of Plot Ratio Restriction for Permitted Flat and Proposed Shop and Services Uses at Lots 4614 and 4615 RP in D.D. 116, Lots 1753 S.B ss.3 (Part), 1753 S.B RP (Part), 1756 S.A (Part), 1756 RP (Part), 1757, 1758 RP and 1760 RP in D.D. 120, and Adjoining Government Land, Tai Kei Leng, Yuen Long, New Territories	M M MOTT MACDONALD
Title	Proposed Sewerage System	Appendix C
Date	January 2024	Scale N.T.S.
File		

Appendix D

Hydraulic Calculation

Appendix D.1 - Sewage Flow for Existing Condition

Sub-Catchment 1

The Brand

	Residential		
Estimated No. of Flats =	28	Flats	
Average Household Size =	2.8	Persons per Flat	According to 2021 Population Census, average household size in Yuen Long is 2.8 persons per flat.
Population =	79	Persons	
Global Unit Flow Factors =	0.27	m ³ /d per person	Domestic Flow Private Housing (R2)
Sewage Flow (ADWF) =	21.33	m³/d	
	0.25	l/s	

Reach Summit

	Residential		
Estimated No. of Flats =	504	Flats	
Average Household Size =	2.8	Persons per Flat	According to 2021 Population Census, average household size in Yuen Long is 2.8 persons per flat.
Population =	1412	Persons	
Global Unit Flow Factors =	0.27	m ³ /d per person	Domestic Flow Private Housing (R2)
Sewage Flow (ADWF) =	381.24	m³/d	
	4.41	l/s	

Reach Summit Swimming Pool

	Swimming Pool		
Pool Volume =	264	m ³	Assumed 1.2m deep
Turnover Rate =	6	hrs	
Surface Loading Rate of Filter =	48	m ³ /m ² /hr	Filtration Rate = 48 m ³ /m ² /h
Filter Areas Required =	0.92	m ²	
Backwash Duration =	3	min/day	
Backwash Flow Rate =	30	m ³ /m ² /hr	
Average Design Flow for swimming pool backwashing =	1.38	m³/day	
	0.02	l/s	
Instant peak flow =	27.50	m ³ /hr	
	7.64	l/s	

Sub-Catchment 2

Park Reach

	Residential		
Estimated No. of Flats =	63	Flats	
Average Household Size =	2.8	Persons per Flat	According to 2021 Population Census, average household size in Yuen Long is 2.8 persons per flat.
Population =	177	Persons	
Global Unit Flow Factors =	0.27	m ³ /d per person	Domestic Flow Private Housing (R2)
Sewage Flow (ADWF) =	47.79	m³/d	
	0.55	l/s	

Appendix D.2 - Sewage Flow for Proposed Condition

Sewage Flow from proposed residential and retail development

	Residential Building		
Estimated No. of Flats =	345	Flats	
Average Household Size =	2.8	Persons per Flat	According to 2021 Population Census, average household size in Yuen Long is 2.8 persons per flat.
Population =	966	Persons	
Global Unit Flow Factors =	0.27	m ³ /d per person	Domestic Flow Private Housing (R2)
Sewage Flow (ADWF) =	260.82	m³/d	
	3.02	l/s	

	Residential Building		
J11 Community, Social & Personal Services- Population =	4	Persons	It is assumed there would be 2 security guards and 2 managing staffs for housing block.
Global Unit Flow Factors =	0.28	m ³ /d per employee	
Sewage flow =	1.12	m³/d	
	0.01	l/s	

	Clubhouse		
J11 Community, Social & Personal Services- Estimated GFA of Building =	420.00	m ²	It is assumed there would be 3.3 workers per GFA (in 100 m2) for Community, Social & Personal Services according to Figure 9: Worker Density by Industry Group of "Commercial and Industrial Floor Space Utilization Survey" published by Plannings Department.
Population =	14	Persons	
Global Unit Flow Factors =	0.28	m ³ /d per employee	
Sewage flow =	3.92	m³/d	
	0.05	l/s	

Sewage Discharge to FMH-01

	Retail Building (Retail)		
J4 Wholesale & Retail - Estimated GFA of Building =	110.00	m ²	50% of the GFA of Retail Building
Population =	4	Persons	It is assumed there would be 3.5 workers per GFA (in 100 m2) for Retail Trade according to Figure 9: Worker Density by Industry Group of "Commercial and Industrial Floor Space Utilization Survey" published by Plannings Department.
Global Unit Flow Factors =	0.28	m ³ /d per employee	
Sewage flow =	1.12	m³/d	
	0.01	l/s	

	Retail Building (Restaurant)		
J10 Restaurants & Hotels - Estimated GFA of Building =	110.00	m ²	50% of the GFA of Retail Building
Population =	6	Persons	It is assumed there would be 5.1 workers per GFA (in 100 m2) for Restaurants according to Figure 9: Worker Density by Industry Group of "Commercial and Industrial Floor Space Utilization Survey" published by Plannings Department.
Global Unit Flow Factors =	1.58	m ³ /d per employee	
Sewage flow =	9.48	m³/d	
	0.11	l/s	

Sewage Discharge to FMH-02

Appendix D.3 - Sewer Pipeline Information and Cumulative Peak Sewage Flow Calculation (Existing Condition)

Peaking Factor based on Factor:

Including Stormwater

Foulwater Drains Capacity Design Check (By Colebrook White Equation)

where V = velocity (m/s)
 g = 9.81 (ms⁻²)
 R = hydraulic radius (m)
 s = Slope of pipe / hydraulic gradient
 v = kinematic viscosity (m²/s)
 Ks = pipe roughness (mm)

For circular pipes flowing full,

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

For partially full pipes or pipes with non-circular cross-sections,

$$V = -\sqrt{(32gRs)} \log\left(\frac{ks}{14.8R} + \frac{1.255v}{R\sqrt{(32gRs)}}\right)$$

Assumptions:

Pipe roughness for Proposed PE Pipeline = 1.5 mm (Similar roughness value of uPVC material pipe under poor slimed condition in accordance with Sewerage Manual - Table 5 has been adopted for polyethylene pipe)
 Pipe roughness for Existing Sewage Pipeline (<=600 dia.) = 3 mm (Refer to Sewerage Manual Part 1 - Table 5: Clayware)

Transitional flow and water at 15 degree celsius, i.e. kinematic viscosity is 1.14 x 10⁻⁶ m²/s

Population Range	Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage	Peaking Factor (excluding stormwater allowance) for facility with new upstream sewerage
(a) For sewers		
<1,000	8	6
1,000 - 5,000	6	5
5,000 - 10,000	5	4
10,000 - 50,000	4	3
>50,000	Max($\frac{7.3}{N^{0.15}}$, 2.4)	Max($\frac{6}{N^{0.15}}$, 1.6)
(b) Sewage Treatment Works, Preliminary Treatment Works and Pumping Stations		
<10,000	4	3
10,000 - 25,000	3.5	2.5
25,000 - 50,000	3	2
>50,000	Max($\frac{3.9}{N^{0.15}}$, 2.4)	Max($\frac{2.6}{N^{0.15}}$, 1.6)

Hydraulic Calculation and Utilisation for 200mm to 450mm Existing Sewers along Tai Tong Road

Pipe Information																	Result			
Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Sewerage Network along Tai Tong Road (Sub-catchment 1)																				
FWD1042941	FMH1035400	FMH1064703	200	43.4	6.07	5.81	167	0.25	1.00	0.25	79	8.00	0.00	1.98	0.0020	23	0.73	9%	OK	
FWD1094193	FMH1064703	FMH1035401	450	9.0	5.80	5.77	300	4.66	1.00	4.66	1491	6.00	7.64	35.60	0.0356	149	0.94	24%	OK	
FWD1043890	FMH1035401	FMH1036053	450	9.8	5.77	5.41	27	4.66	1.00	4.66	1491	6.00	7.64	35.60	0.0356	497	3.12	7%	OK	
FWD1043891	FMH1036053	FMH1036051	450	7.9	4.32	4.30	393	4.66	1.00	4.66	1491	6.00	7.64	35.60	0.0356	130	0.82	27%	OK	

Hydraulic Calculation and Utilisation for 200mm to 300mm Existing Sewers along Shap Pat Heung Road

Pipe Information																	Result			
Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Sewerage Network along Shap Pat Heung Road (Sub-catchment 2)																				
FWD1081043	FMH1060002	FMH1060022	250	3.2	5.28	5.26	159	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	43	0.87	10%	OK	
FWD1081044	FMH1060022	FMH1060023	250	21.5	5.26	5.16	215	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	37	0.75	12%	OK	
FWD1081062	FMH1060023	FMH1060024	250	11.3	5.16	5.10	189	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	39	0.80	11%	OK	
FWD1081063	FMH1060024	FMH1060062	250	15.5	5.10	4.98	129	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	47	0.97	9%	OK	
FWD1081064	FMH1060062	FMH1060063	250	4.8	4.98	4.92	80	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	60	1.23	7%	OK	
FMD1002480	(1)	FMH1060063	200	18.9	4.75	4.65	189	0.55	1.00	0.55	177	8.00	0.00	2.21	0.0022	22	0.69	10%	OK	
FWD1043892	FMH1036052	FMH1036051	300	47.3	4.52	4.30	215	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	60	0.85	7%	OK	

Hydraulic Calculation and Utilisation for downstream 450mm and 300mm pipes of manhole FMH1036051

Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Peak Discharge from FMH1036051 (2) (l/s)	Peak Discharge from FMH1036051 (2) (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check
Sewerage Network along Shap Pat Heung Road (Downstream of Subcatchments 1 & 2)													
FWD1043910	(2)	FMH1036051	300	22.3	4.29	4.20	248	14.49	0.0145	56	0.79	26%	OK
FWD1043909	(2)	FMH1036051	450	17.0	4.29	4.19	170	24.42	0.0244	199	1.25	12%	OK

Remarks:

- For FMD1002480, it consists of two 200mm pipes, it is assumed that the cumulative peak sewage flow is equally divided between 2 pipes.
- The peak discharges from existing manhole FMH1036051 to two existing sewers (i.e. FWD1043910 & FWD1043909) are calculated in Appendix E.

Appendix D.4 - Sewer Pipeline Information and Cumulative Peak Sewage Flow Calculation (Proposed Condition)

Peaking Factor based on Factor:

Including Stormwater for Existing Pipes
Not Including Stormwater for Proposed Pipes

Foulwater Drains Capacity Design Check (By Colebrook White Equation)

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

For circular pipes flowing full,

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

For partially full pipes or pipes with non-circular cross-sections,

$$V' = -\sqrt{(32gRs)} \log\left(\frac{ks}{14.8R} + \frac{1.255\nu}{R\sqrt{(32gRs)}}\right)$$

Assumptions:

Pipe roughness for Proposed PE Pipeline = 1.5 mm (Similar roughness value of uPVC material pipe under poor slimed condition in accordance with Sewerage Manual - Table 5 has been adopted for polyethylene pipe)
 Pipe roughness for Existing Sewage Pipeline (<=600 dia. 3 mm (Refer to Sewerage Manual Part 1 - Table 5. Clayware)

Transitional flow and water at 15 degree celsius, i.e. kinematic viscosity is $1.14 \times 10^{-6} \text{ m}^2/\text{s}$

Population Range	Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage	Peaking Factor (excluding stormwater allowance) for facility with new upstream sewerage
(a) For sewers		
<1,000	8	6
1,000 - 5,000	6	5
5,000 - 10,000	4	4
10,000 - 50,000	4	3
>50,000	$\text{Max}\left(\frac{7.3}{N^{0.387}}, 2.4\right)$	$\text{Max}\left(\frac{6}{N^{0.387}}, 1.6\right)$
(b) Sewage Treatment Works, Preliminary Treatment Works and Pumping Stations		
<10,000	4	3
10,000 - 25,000	3.5	2.5
25,000 - 50,000	3	2
>50,000	$\text{Max}\left(\frac{3.9}{N^{0.387}}, 2.4\right)$	$\text{Max}\left(\frac{2.6}{N^{0.387}}, 1.6\right)$

Proposed Sewer From The Development Site

Pipe Information															Result					
Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Proposed Sewer From The Development Site																				
FMD-P1	(2)	FMH-01	FMH-02	250	42.2	6.73	6.57	263	3.08	1.00	3.08	985	6.00	0.00	18.47	0.02	37	0.76	50%	OK
FMD-P2	(3), (4)	FMH-02	FMH-03	250	60.0	6.57	6.32	243	3.20	1.00	3.20	1024	5.00	0.00	18.47	0.02	39	0.79	48%	OK
FMD-P3	(4)	FMH-03	FMH1035400	250	61.6	6.32	6.07	243	3.20	1.00	3.20	1024	5.00	0.00	18.47	0.02	39	0.79	48%	OK

Hydraulic Calculation and Utilisation for 200mm to 450mm Existing Sewers along Tai Tong Road

Pipe Information															Result					
Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Sewerage Network along Tai Tong Road (Sub-catchment 1)																				
FWD1042941		FMH1035400	FMH1064703	250	43.4	6.07	5.81	167	3.45	1.00	3.45	1103	6.00	0.00	20.67	0.0207	47	0.95	44%	OK
FWD1094193		FMH1064703	FMH1035401	450	9.0	5.80	5.77	300	7.86	1.00	7.86	2515	6.00	7.64	54.79	0.0548	149	0.94	37%	OK
FWD1043890		FMH1035401	FMH1036053	450	9.8	5.77	5.41	27	7.86	1.00	7.86	2515	6.00	7.64	54.79	0.0548	497	3.12	11%	OK
FWD1043891		FMH1036053	FMH1036051	450	7.9	4.32	4.30	393	7.86	1.00	7.86	2515	6.00	7.64	54.79	0.0548	130	0.82	42%	OK

Hydraulic Calculation and Utilisation for 200mm to 300mm Existing Sewers along Shap Pat Heung Road

Pipe Information															Result					
Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Sewerage Network along Shap Pat Heung Road (Sub-catchment 2)																				
FWD1081043		FMH1060002	FMH1060022	250	3.2	5.28	5.26	159	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	43	0.87	10%	OK
FWD1081044		FMH1060022	FMH1060023	250	21.5	5.26	5.16	215	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	37	0.75	12%	OK
FWD1081062		FMH1060023	FMH1060024	250	11.3	5.16	5.10	189	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	39	0.80	11%	OK
FWD1081063		FMH1060024	FMH1060062	250	15.5	5.10	4.98	129	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	47	0.97	9%	OK
FWD1081064		FMH1060062	FMH1060063	250	4.8	4.98	4.92	80	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	60	1.23	7%	OK
FMD1002480	(1)	FMH1060063	FMH1036052	200	18.9	4.75	4.65	189	0.55	1.00	0.55	177	8.00	0.00	2.21	0.0022	22	0.69	10%	OK
FWD1043892		FMH1036052	FMH1036051	300	47.3	4.52	4.30	215	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	60	0.85	7%	OK

Hydraulic Calculation and Utilisation for downstream 450mm and 300mm pipes of manhole FMH1036051

Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Peak Discharge from FMH1036051 (4) (l/s)	Peak Discharge from FMH1036051 (4) (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Sewerage Network along Shap Pat Heung Road (Downstream of Subcatchments 1 & 2)														
FWD1043910	(5)	FMH1036051	FMH1036050	300	22.3	4.29	4.20	248	22.91	0.0229	56	0.79	41%	OK
FWD1043909	(5)	FMH1036051	FMH1036049	450	17.0	4.29	4.19	170	35.20	0.0352	199	1.25	18%	OK

Remarks:

- For FMD1002480, it consists of two 200mm pipes. It is assumed that the cumulative peak sewage flow is equally divided between 2 pipes.
- The sewage generated from the proposed residential development will be discharged into proposed manhole FMH-01.
- The sewage generated from the proposed retail building will be discharged into proposed manhole FMH-02.
- The cumulative peak sewage flows for FMD-P2 and FMD-P3 are 15.99 l/s. In view of this the upstream sewage flow of those two pipes is 18.47 l/s (i.e. cumulative peak sewage flow of FMD-P1) which is greater than that of FMD-P2 and FMD-P3. Cumulative peak sewage flow of 18.47 l/s is adopted for FMD-P2 and FMD-P3.
- The peak discharges from existing manhole FMH1036051 to two existing sewers (i.e. FWD1043910 & FWD1043909) are calculated in Appendix E.

Appendix D.5 - Sewer Pipeline Information and Cumulative Peak Sewage Flow Calculation (Proposed Condition with reduction in pipe area for rehabilitation)

Peaking Factor based on Factor:

Including Stormwater for Existing Pipes
Not Including Stormwater for Proposed Pipes

 Foulwater Drains Capacity Design Check (By Colebrook White Equation)

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

For circular pipes flowing full,

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

For partially full pipes or pipes with non-circular cross-sections,

$$V = -\sqrt{(32gRs)} \log\left(\frac{ks}{14.8R} + \frac{1.255\nu}{R\sqrt{(32gRs)}}\right)$$

Assumptions:

Pipe roughness for Proposed PE Pipeline = 1.5 mm (Similar roughness value of uPVC material pipe under poor slimed condition in accordance with Sewerage Manual - Table 5 has been adopted for polyethylene pipe)
 Pipe roughness for Existing Sewerage Pipeline (<=600 dia.) 3 mm (Refer to Sewerage Manual Part 1 - Table 5: Clayware)

- Assumed the lining thickness for rehabilitation is 6mm for 250mm diameter pipe.
- Transitional flow and water at 15 degree celsius, i.e. kinematic viscosity is $1.14 \times 10^{-6} \text{ m}^2/\text{s}$

Population Range	Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage	Peaking Factor (excluding stormwater allowance) for facility with new upstream sewerage
(a) For sewers		
<1,000	8	6
1,000 - 5,000	6	5
5,000 - 10,000	5	4
10,000 - 50,000	4	3
>50,000	Max($\frac{7.3}{N^{0.77}} - 2.4$)	Max($\frac{6}{N^{0.77}} - 1.6$)
(b) Sewerage Treatment Works, Preliminary Treatment Works and Pumping Stations		
<10,000	4	3
10,000 - 25,000	3.5	2.5
25,000 - 50,000	3	2
>50,000	Max($\frac{3.9}{N^{0.77}} - 2.4$)	Max($\frac{2.6}{N^{0.77}} - 1.6$)

Proposed Sewer From The Development Site

Pipe Information															Result					
Pipe no.	From	To	Size After Rehabilitation (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Proposed Sewer From The Development Site																				
FMD-P1	(2)	FMH-01	FMH-02	238	42.2	6.73	6.57	263	3.08	1.00	3.08	985	6.00	0.00	18.47	0.02	33	0.73	57%	OK
FMD-P2	(3), (4)	FMH-02	FMH-03	238	60.0	6.57	6.32	243	3.20	1.00	3.20	1024	5.00	0.00	18.47	0.02	34	0.76	55%	OK
FMD-P3	(4)	FMH-03	FMH1035400	238	61.6	6.32	6.07	243	3.20	1.00	3.20	1024	5.00	0.00	18.47	0.02	34	0.76	55%	OK

Hydraulic Calculation and Utilisation for 200mm to 450mm Existing Sewers along Tai Tong Road

Pipe Information															Result				
Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check
Sewerage Network along Tai Tong Road (Sub-catchment 1)																			
FWD1042941	FMH1035400	FMH1064703	238	43.4	6.07	5.81	167	3.45	1.00	3.45	1103	6.00	0.00	20.67	0.0207	41	0.92	51%	OK
FWD1094193	FMH1064703	FMH1035401	450	9.0	5.80	5.77	300	7.86	1.00	7.86	2515	6.00	7.64	54.79	0.0548	149	0.94	37%	OK
FWD1043890	FMH1035401	FMH1036053	450	9.8	5.77	5.41	27	7.86	1.00	7.86	2515	6.00	7.64	54.79	0.0548	497	3.12	11%	OK
FWD1043891	FMH1036053	FMH1036051	450	7.9	4.32	4.30	393	7.86	1.00	7.86	2515	6.00	7.64	54.79	0.0548	130	0.82	42%	OK

Hydraulic Calculation and Utilisation for 200mm to 300mm Existing Sewers along Shap Pat Heung Road

Pipe Information															Result					
Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Cumulative Daily Sewage Flow (l/s)	Catchment Inflow Factor	Cumulative Daily Sewage Flow with Catchment Inflow Factor (l/s)	Contributing Population	Peaking Factor	Instant Peak Flow from Swimming Pool (l/s)	Cumulative Peak Sewage Flow (l/s)	Cumulative Peak Sewage Flow (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Sewerage Network along Shap Pat Heung Road (Sub-catchment 2)																				
FWD1081043	FMH1060002	FMH1060022	250	3.2	5.28	5.26	159	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	43	0.87	10%	OK	
FWD1081044	FMH1060022	FMH1060023	250	21.5	5.26	5.16	215	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	37	0.75	12%	OK	
FWD1081062	FMH1060023	FMH1060024	250	11.3	5.16	5.10	189	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	39	0.80	11%	OK	
FWD1081063	FMH1060024	FMH1060062	250	15.5	5.10	4.98	129	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	47	0.97	9%	OK	
FWD1081064	FMH1060062	FMH1060063	250	4.8	4.98	4.92	80	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	60	1.23	7%	OK	
FMD1002480	(1)	FMH1060063	FMH1036052	200	18.9	4.75	4.65	189	0.55	1.00	0.55	177	8.00	0.00	2.21	0.0022	22	0.69	10%	OK
FWD1043892	FMH1036052	FMH1036051	300	47.3	4.52	4.30	215	0.55	1.00	0.55	177	8.00	0.00	4.43	0.0044	60	0.85	7%	OK	

Hydraulic Calculation and Utilisation for downstream 450mm and 300mm pipes of manhole FMH1036051

Pipe no.	From	To	Size (mm)	Length (m)	U.S. Invert Level (mPD)	D.S. Invert Level (mPD)	Gradient 1 in	Peak Discharge from FMH1036051 (4) (l/s)	Peak Discharge from FMH1036051 (4) (m ³ /s)	Pipe Full Flow Capacity (l/s)	Pipe Full Flow Velocity (m/s)	Utilization (%)	Flow Capacity Check	
Sewerage Network along Shap Pat Heung Road (Downstream of Subcatchments 1 & 2)														
FWD1043910	(5)	FMH1036051	FMH1036050	300	22.3	4.29	4.20	248	22.91	0.0229	56	0.79	OK	
FWD1043909	(5)	FMH1036051	FMH1036049	450	17.0	4.29	4.19	170	35.20	0.0352	199	1.25	18%	OK

Remarks:

- For FMD1002480, it consists of two 200mm pipes, it is assumed that the cumulative peak sewage flow is equally divided between 2 pipes.
- The sewage generated from the proposed residential development will be discharged into proposed manhole FMH-01.
- The sewage generated from the proposed retail building will be discharged into proposed manhole FMH-02.
- The cumulative peak sewage flows for FMD-P2 and FMD-P3 are 15.99 l/s. In view of this the upstream sewerage flow of those two pipes is 18.47 l/s (i.e. cumulative peak sewage flow of FMD-P1) which is greater than of FMD-P2 and FMD-P3, cumulative peak sewage flow of 18.47 l/s is adopted for FMD-P2 and FMD-P3.
- The peak discharges from existing manhole FMH1036051 to two existing sewers (i.e. FWD1043910 & FWD1043909) are calculated in Appendix E.

Appendix E

Distribution of Flow from Existing Manhole FMH1036051 To Existing Sewers FWD1043910 and FWD1043909 Under Existing and Proposed Conditions

Appendix E

Peaking Factor based on Factor:

Including Stormwater

1. Determine the distribution of flow from existing manhole FMH1036051 to existing sewers FWD1043910 and FWD1043909 under existing condition

Cumulative Daily Sewage Flow with Catchment Inflow Factor from FWD1043891 and FWD1043892 under Existing Condition = 5.21 l/s (from Appendix D.3)
 Contribution Population = 1668
 Peaking Factor = 6
 Instant Peak Flow from Swimming Pool from FWD1043891 and FWD1043892 = 7.64 l/s (from Appendix D.3)
 Cumulative Peak Flow Discharge to Existing Sewers FWD1043910 and FWD1043909 under Existing Condition = 38.91 l/s

Assumptions:

1. The hydraulic is designed based on Colebrook-White equation and Wallingford charts.
2. Pipe roughness = 3 mm (Refer to Sewerage Manual Part 1 - Table 5: Clayware)
4. Transitional flow and water at 15 degree Celsius

Pipe Information					Discharge		Capacity and Velocity Check			Partial Flow Calculation				
Pipe No.	From	To	Pipe Diameter mm	Gradient 1 in	Design Discharge l/s	Pipe Partial Flow Velocity m/s	Pipe Full Flow Capacity l/s	Pipe Full Flow Velocity m/s	Capacity Check	% utilization	Calculated Proportional Discharge	From Chart Proportional Depth	From Chart Proportional Velocity	Actual Water Depth m
FWD1043910	FMH1036051	FMH1036050	300	247.8	14.49	0.68	56	0.79	OK	26	0.26	0.351	0.86	0.105
FWD1043909	FMH1036051	FMH1036049	450	169.8	24.42	0.85	199	1.25	OK	12	0.12	0.233	0.68	0.105

2. Determine the distribution of flow from existing manhole FMH1036051 to existing sewers FWD1043910 and FWD1043909 under Proposed condition

Cumulative Daily Sewage Flow with Catchment Inflow Factor from FWD1043891 and FWD1043892 under Proposed Condition = 8.41 l/s (from Appendix D.4)
 Contribution Population = 2691.6
 Peaking Factor = 6
 Instant Peak Flow from Swimming Pool from FWD1043891 and FWD1043892 = 7.64 l/s (from Appendix D.4)
 Cumulative Peak Flow Discharge to Existing Sewers FWD1043910 and FWD1043909 under Proposed Condition = 58.11 l/s

Assumptions:

1. The hydraulic is designed based on Colebrook-White equation and Wallingford charts.
2. Pipe roughness = 3 mm (Refer to Sewerage Manual Part 1 - Table 5: Clayware)
4. Transitional flow and water at 15 degree Celsius

Pipe Information					Discharge		Capacity and Velocity Check			Partial Flow Calculation				
Pipe No.	From	To	Pipe Diameter mm	Gradient 1 in	Design Discharge l/s	Pipe Partial Flow Velocity m/s	Pipe Full Flow Capacity l/s	Pipe Full Flow Velocity m/s	Capacity Check	% utilization	Calculated Proportional Discharge	From Chart Proportional Depth	From Chart Proportional Velocity	Actual Water Depth m
FWD1043910	FMH1036051	FMH1036050	300	247.8	22.91	0.75	56	0.79	OK	41	0.41	0.446	0.95	0.134
FWD1043909	FMH1036051	FMH1036049	450	169.8	35.20	0.96	199	1.25	OK	18	0.18	0.297	0.77	0.134

