Hong Kong Housing Authority

Public Housing Development at Wang Chau, Yuen Long

Final Sewerage Impact Assessment

REP-032-01

Final | Nov 2014

IMPORTANT – CONFIDENTIALITY

This project and study shall be kept confidential and any information contained in and/or related to the project/study shall not be disclosed to any person not involved in the project/study.

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1 INTRODUCTION

1.1 Project Background

1.1.1.1 Ove Arup & Partners Hong Kong Limited (Arup) was appointed by Hong Kong Housing Authority (HKHA) to conduct a sewerage impact assessment (SIA) for a proposed public housing (PH) development at a potential site at Wang Chau, Yuen Long. The location of the project site and its environs in the vicinity are shown in **Drawing 226464/OAP/P/011**.

1.1.1.2 This SIA is to assess the likely impacts of the proposed development on the existing sewerage system, formulate the sewerage connection points and recommend the necessary improvement/upgrading/ diversion works.

1.1.1.3 The site currently falls within an area zoned "Green Belt" (GB) according to the Approved Ping Shan Outline Zoning Plan (OZP) No. S/YL-PS/14. Rezoning is required for the proposed PH site.

1.2 Objectives of the Report

1.2.1.1 This report is to present the SIA due to the proposed PH development at Wang Chau, Yuen Long. It includes formulation of proposed sewerage systems and improvement measures with an aim to minimize the impact on the downstream sewerage system, including pipeline system, pumping station and sewage treatment works.

1.2.1.2 The report substantiates the feasibility of the Project in terms of adequacy of sewerage facilities and should be satisfactory to Drainage Services Department (DSD) and Environmental Protection Department (EPD).

1.2.1.3 Specifically, the objectives of this report are set out as follows:

- to take cognisance of the existing, committed and planned developments which may have bearing on the development;
- to assess the sewage generated from the developments;
- to assess the likely impacts of the proposed developments on the existing sewerage system including sewage treatment plant, public sewer system and disposal facilities and the requirements for capacity improvements and the extent of impact;
- to carry out schematic design of the sewer arising from the development including carrying out all necessary hydraulic analysis to substantiate the proposed sewer scheme;
- to formulate sewerage connection points and details for the proposed developments to illustrate the hydraulic feasibility of the proposed connection points;

- to formulate and recommend suitable mitigation measures including necessary improvement/upgrading/diversion works to existing and planned sewerage systems for the proposed developments;
- to enable an agreement in principle to be reached with DSD and EPD in respect of mitigation and protection schemes, diversion schemes, re-provisioning works and/or modifications of facilities for incorporation in design and during construction of the development.

1.3 Structure of this Report

1.3.1.1 The structure of this Report is as follows:

Section 1 Introduces the background of the study, as well as the purpose of this report.

Section 2 Presents the key data of the proposed development on which the impact assessments are based.

Section 3 Assesses the impacts on existing and planned sewerage systems due to the development and recommends the corresponding mitigation measures.

Section 4 Conclusion.

1.4 Nomenclature and Abbreviations

1.4.1.1 The following **Table 1.4.1** lists out the meaning of abbreviation for expressions adopted in this report:

Table 1.4.1: Abbreviations

Abbreviations	Term
ADWF	Average Dry Weather Flow
DN	Nominal Diameter
DSD	Drainage Services Department
EIA	Environmental Impact Assessment
EPD	Environmental Protection Department
EPS	Effluent Polishing Scheme
EVA	Emergency Vehicle Access
GB	Green Belt
GFA	Gross Floor Area
G/IC	Government/ Institution/ Community
HKHA	Hong Kong Housing Authority
HKSTP	Hong Kong Science and Technology Parks Corporation
LOS	Local Open Space
OS	Open Storage
OZP	Outline Zoning Plan
PH	Public Housing Site (This Project)
PR	Plot Ratio
PTI	Public Transport Interchange
PVS	Planning Vision and Strategy Zones

Abbreviations	Term
SIA	Drainage Impact Assessment
SPS	Sewage Pumping Station
TPEDM	Territorial Population and Employment Data Matrices (2011)
TR-2	Technical Report No. 2
TR-3	Technical Report No. 3
UFF	Unit flow factor
VE	Village Environs
YLSTW	Yuen Long Sewage Treatment Works

2 PROJECT DESCRIPTION

2.1 Site Location

2.1.1.1 The Project site is bounded by Long Ping Road and Long Ping Estate to the east, Chun Hing San Tsuen, Shui Tin Tsuen and Fung Chi Tsuen to the south, Wing Ning Tsuen and Long Tin Road to the west, as well as Kai Shan to the north as indicated in **Drawing 226464/OAP/P/011**. The site area is about 5.6ha.

2.2 Existing Conditions

2.2.1.1 According to the Approved Ping Shan Outline Zoning Plan (OZP) No. S/YL-PS/14, the PH site is zoned as "Green Belt" (GB). It is currently occupied by farmland, fallow land, rural residential dwellings, temporary structures and few open storages.

2.2.1.2 The surrounding areas of the Project site are characterized by a mixture of various land uses. These include high-rise residential development, villages and low-rise residential developments, natural landscapes, burial grounds and graves, open storage uses, major roads and railway tracks.

2.3 Proposed Public Housing Site

Development Proposal

2.3.1.1 The PH site consists of residential buildings for Home Ownership Scheme (HOS) and Public Rental Housing (PRH), car parks, retails, social welfare block, one 24-classroom primary school, and complementary recreational facilities. In addition, a kindergarten and an Estate Management Office (EMO) have also been planned within the PH site.

2.3.1.2 Retail facilities are planned strategically along Long Ping Road to allow street-front shops to serve the future residents. The social welfare block at the south-western tip would accommodate various welfare facilities.

2.3.1.3 **Drawing 226464/OAP/P/022** shows the latest layout plan of the proposed PH development.

Development Parameters

2.3.1.4 The planning parameters are yet to be confirmed at the stage of the study. For purpose of this SIA, technical assessment is based on the tentative planning parameters for the latest layout plan of the proposed development which are summarized in **Table 2.3.1** below.

Table 2.3.1: Summary of Development Parameters

Development	Parameter
Residential	4,019 flats (with estimated population of 12,338 [1])
Non-domestic uses (including refuse collection point (RCP), covered walkway, etc)	4,000 GFA [2] (m^2)
Retail	3,209 GFA [2] (m^2) 2,118 IFA [2] (m^2)
Primary School	24 Classrooms
Social Welfare Facilities	4,450 NOFA [3] (m^2)

Note:
[1] It is assumed that the person per flat is 3.07.
[2] GFA denotes Gross Floor Area and IFA denotes Internal Floor Area
[3] NOFA denotes Net Operating Floor Area

2.3.1.5 Based on the tentative implementation programme, the PH site would be developed in a single phase, and the planned population intake would be in year 2025.

3 SEWERAGE IMPACT ASSESSMENT

3.1 Introduction

3.1.1.1 Liaison with DSD / EPD has been made to obtain relevant information and discuss the potential sewerage impacts due to the proposed development. A list of data/ information obtained is provided in **Table 3.1.1** below.

Table 3.1.1: Information Obtained from DSD / EPD

Item No.	Information	Source of Information	Date
1	Current and planned YLSTW treatment capacity	DSD/SP	18 Sep 2012
2	DSD drainage record plan	DSD/MN	18 Sep 2012
3	Reserve treatment flow at YLSTW and planned sewage flow from YLIE	HKSTP	16 Oct 2012
4	Agreement no. CE88/2002 (DS) - Feasibility Study for provision of sewerage to unsewered area / villages in northwest new territories, Final Report, September 2008	EPD	5 Oct 2012
5	Meeting with DSD and EPD – Discuss on swage discharge capacity of YLSTW	N/A	6 Nov 2012
6	Existing sewage flow data of YLIE	HKSTP	16 Oct 2012
7	Existing sewage flow data of Long Ping SPS	DSD/ST	11 Nov 2014

3.2 Methodology and Design Criteria

3.2.1.1 The following approach is adopted in carrying out this SIA:

- Identify existing and planned sewerage works within the study area;
- Estimate the sewage generated from the development and take into account / estimate sewage discharge into the same sewerage systems under consideration from all existing sources, committed and planned developments to be implemented within the same time frame of the proposed developments;
- Examine the impact arising from the estimated sewage from the development on existing sewerage and treatment works capacities; and;
- Propose improvement, upgrading and diversion works.

3.2.1.2 The proposed sewerage systems are designed with an aim to minimize the impacts on existing sewers and sewage treatment works.

3.3 Existing Sewage System

3.3.1 Existing Sewage Treatment Works

3.3.1.1 The Project site is located within Yuen Long Sewerage Catchment. The existing sewage flow within Yuen Long Sewerage Catchment is treated at the existing Yuen Long Sewage Treatment Works (YLSTW). A record of the existing sewerage system in the vicinity of the Project site is attached as **Drawing No. 226464/OAP/C/021**.

3.3.1.2 The existing Average Dry Weather Flow (ADWF) treatment capacity of YLSTW is 70,000m^3/day. At the time of preparing this report, the proposed Effluent Polishing Scheme (EPS) at YLSTW is under planning with tentative commissioning date in September 2017. According to the information provided by DSD/SP dated 18 September 2012, the scope of EPS is to upgrade the effluent standards while reducing the design capacity to 46,000m^3/day (ADWF), which was designed to cope with the planned sewage flow in Year 2030. The proposed development at Wang Chau was not originally considered in the EPS planned sewage flow.

3.3.1.3 However, study on upgrading of YLSTW has commenced in mid-2013 to review the contributing population and corresponding sewage flows to YLSTW. The latest planned upgrading capacity of YLSTW will be increased to 100,000 m^3/day at year 2020 (first phase) and ultimately upgraded to 150,000 m^3/day.

3.3.1.4 It was agreed between EPD, DSD, HD and HKSTP in a meeting on 6 Nov 2012 that sewage flows from the proposed development at Wang Chau shall be conveyed to YLSTW, and the proposed EPS upgrading works at YLSTW will be designed to cater for the additional sewage flow from the proposed developments.

3.3.1.5 The YLSTW falls within the Deep Bay Water Control Zone where the requirement of "No net increase in pollution load to Deep Bay" shall be met. The proposed EPS will cater to the increased effluent loading from the proposed development such that no additional pollution will be discharged to Deep Bay.

3.3.2 Existing Sewerage Systems

3.3.2.1 With reference to the DSD drainage record plan and the Feasibility Study for provision of sewerage to unsewered area/villages in northwest new territories under Agreement no. CE88/2002 (DS), **Table 3.3.1** represents an inventory of sewerage pipes between the project site and the YLSTW serving the Project site. The layout of these existing systems is shown in **Drawing No. 226464/OAP/C/021**.

Table 3.3.1: Inventory of Existing and Planned Sewerage Systems Serving the Project Site

Item No.	Location	Size	Existing and Planned Projects Being Served	PVS Zone No. [1]
1	Gravity pipelines along Long Ping Road and Fung Chi Road discharging to Long Ping Sewage Pumping Station (SPS)	225Ø to 750Ø	Yuen Long Town	177
2	Rising (force) main from Long Ping SPS to YLSTW	600Ø Rising Main	Long Ping SPS Sewage Catchment	177; 232
3	Gravity pipelines from Long Ping SPS to YLSTW	1350Ø to 1800Ø	Long Ping SPS Catchment Kau Hui SPS Catchment New Housing Site at YL South	177; 232 372 368; 181; 373

[1] – Taken from TPEDM 2011

3.3.2.2 With reference to the Feasibility Study for provision of sewerage to unsewered area/villages in northwest new territories under Agreement no. CE88/2002 (DS) and according to the operational data for the period from Oct 2012 to Oct 2014 provided by DSD, the existing design capacity of the Long Ping SPS is shown in **Table 3.3.2** below. There is no daily record and only monthly records are available for the Long Ping pumping station. The monthly peak flow recorded in 2014 is about 210,114 m^3 (Jul).

3.3.2.3 According to the "Interim Version of the HK2030 Planning Data," the population contributing of PVS zone 177 is expected to increase from 46,236 (year 2006) to 46,768 (year 2030). The existing design capacity of Long Ping SPS is 17,288m^3/d.

Table 3.3.2: Long Ping Sewage Pumping Stations Study Data

SPS	Design Capacity - ADWF (m^3/d)	Service Catchment (PVS Zone No.) [1]	Service Catchment Description	Discharge
Long Ping SPS	21,600	177	Long Ping	YLSTW

[1] – Taken from TPEDM 2011

3.3.3 Planned Sewerage Systems and Projects

3.3.3.1 Based on the available information at the time of preparing this report, the following planned sewerage systems / projects may interface with the proposed developments, including but not limited to the followings.

Provision of public sewerage for unsewered villages in Yuen Long areas

3.3.3.2 Several DSD sewerage construction works are on-going / completed in Yuen Long area, including Yuen Long and Kam Tin Sewerage and Village Sewerage at Wang Chau of Yuen Long. The scope of works comprises the construction of gravity sewers, rising mains and sewage pumping stations to serve the existing and the proposed developments, and unsewered areas within Yuen Long areas. These sewer systems will be discharged to YLSTW.

3.3.3.3 It is assumed that the above-mentioned works will be completed and the sewage of these areas will be discharged to YLSTW before the commissioning of this proposed development. The YLSTW service sewerage catchment area will include these zones upon completion of the above works, and the corresponding PDZ 454 Zones are included in **Table 3.4.3**.

Improvement of Yuen Long Town Nullah (Town Centre Section) - Dry Weather Flow Interception System

3.3.3.4 A Dry Weather Flow Interception (DWFI) system will be constructed to intercept all polluted dry weather flow being discharged to the Town Centre Section of the Yuen Long Town Nullah which will then be conveyed to the YLSTW for treatment. The intercepted/diverted DWF will be pumped by a DWFI pumping station, with a capacity of 18,000 m^3/day, to the existing sewers leading to the YLSTW.

3.3.3.5 According to the information provided by DSD/MN dated 28 September 2012, about 18,000 m^3/day dry weather flow will be conveyed to YLSTW in year 2017, upon the completion of the above works.

New Territories North Development – Preliminary Feasibility Study

3.3.3.6 According to the Broad Technical Assessment Report of the study dated August 2014, Lok Ma Chau and adjoining areas Potential Development Area (PDA) and Ngau Tam Mei PDA will generate additional sewage flows of approximately 50,420 m^3/day.

3.3.3.7 Both Lok Ma Chau PDA and Ngau Tam Mei PDA fall within YLSTW sewerage catchment, it is recommended to investigate further if the capacity of YLSTW could be expanded to cater for the total flows from these PDAs. Alternatively, a cavern site will be identified near Lok Ma Chau and adjoining areas PDA for a new STW. Both need to be further investigated under the study to determine the preferred option.

3.3.3.8 There is no available information regarding the implementation programme of the planned development, however it is reasonably assumed that the development would not be completed before commissioning of this proposed development. Therefore, this potential development is not included in this SIA report.

Land use review of Kam Tin South and Pat Heung (KTS Development)

3.3.3.9 The landuse planned for residential development at Kam Tin South West Rail Line (WRL) Kam Sheung Road Station (KSRS) and Pat Heung Maintenance Centre (PHMC) has an area of about 33 ha. Together with the public and private housing development in the adjoining areas, the total potential development area is about 110 ha.

3.3.3.10 The SIA of KTS Development has been conducted and recommended that sewage generated from the potential developments at KSRS, PHMC and three public housing sites (Sites 1, 6 and 4a) would be

conveyed to YLSTW via Kam Tin Sewage Pumping Station and associated sewerage system. The estimated sewage flow from these development sites is about 11,300 m^3/day (ADWF).

3.3.3.11 Based on discussions with EPD and PlanD, a new local sewage treatment facility of about 50,000m^3/day (ADWF) was being considered to treat the sewage generated from the remaining sites and surrounding areas. The implementation programme is yet to be confirmed and further coordination with PlanD and EPD would continue in due course. At this stage, there was still uncertainty on the feasibility and programme of the proposed Kam Tin STW. EPD has advised that sewage flow from the remaining sites and surrounding areas was intended to temporarily discharge to YLSTW as interim sewage disposal solution until the STW at Kam Tin is confirmed to be implemented. The estimated sewage flow from the remaining sites is about 10,700 m^3/day (ADWF).

3.3.3.12 The total estimated sewage discharge to YLSTW is about 22,000 m^3/day (ADWF), including flow from KSRS, PHMC, three public housing sites (Sites 1, 6 and 4a) and temporary discharge from the remaining sites. This has been taken into account in this SIA report.

Planning and Engineering Study for Housing Sites in Yuen Long South (YLS Development)

3.3.3.13 The Planning and Engineering Study for Housing Sites in Yuen Long South (YLS) was commissioned in November 2012 and the latest SIA report TR6J was issued on June 2014.

3.3.3.14 The planned development areas cover approximately 216 ha with an estimated sewage flow of 20,000 m^3/day (ADWF) in Year 2036. According to the latest SIA report, two options for YLS sewage disposal, namely Options YL2 and YLS2b were considered technically feasible.

3.3.3.15 Under Option YL2, a new STW of 50,000 m^3/day ADWF treatment capacity at Kam Tin is assumed to be fully commissioned to cater for the flow from part of the KTS development and divert sewage flow from YLSTW sewage catchment, while sewage from YLS will be discharged to YLSTW. However, the implementation programme of the new STW is yet to be confirmed and therefore this option is not considered in this SIA.

3.3.3.16 Under Option YLS2b, sewage generated from the YLS will be discharged to a proposed on-site STW for treatment. Option YLS2b has been assumed in this report for assessment purpose.

Effluent Polishing Scheme at Yuen Long Sewage Treatment Works

3.3.3.17 The design flow / treatment capacity and treatment process of YLSTW is being reviewed under the EPS study. The latest planned upgrading capacity of YLSTW will be increased to 100,000 m^3/day at Year 2020 (first phase) and ultimately upgraded to 150,000 m^3/day.

Coordination with EPD and DSD is required to confirm the planned capacity and implementation programme of the upgrading works.

3.4 Sewage Demand Estimation

3.4.1 Design Parameters and Assumptions

3.4.1.1 The sewage flow estimation, assessment and evaluation of impacts are based on the following established principals and guidelines of Hong Kong:

- EPD Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning No.: EPD/TP 1/05 (GESF)
- Hong Kong Planning Standards and Guidelines (HKPSG).
- Drainage Services Department Sewerage Manual, Third Edition, May 2013

3.4.1.2 The estimate of sewage demands for the proposed development is based on the latest development parameters shown in Section 2 above.

3.4.2 Unit Flow Factors

3.4.2.1 For proposed residential development, a unit flow factor (UFF) of 0.19m^3/person/day is used to estimate sewage flow according to Table T-1 of the GESF. An estimated population of 13,572 including 10% increment has been adopted in this assessment.

3.4.2.2 For schools, a UFF of 0.04m^3/person/day is used to estimate sewage flow for students according to Table T-2 of the GESF. The recommended UFF have taken into account the trend of full time education which is appropriate for future planning purposes.

3.4.2.3 For social welfare facilities, a UFF of 0.08m^3/person/day is used to estimate for sewage flow, assuming the same rate as Commercial Employees according to Table T-2 of the GESF.

3.4.2.4 For commercial areas (retail/market/other non-domestic uses including RCP), a UFF of 0.28m^3/person/day comprising 0.05m^3/person/day for flushing and 0.23m^3/person/day for fresh water is used to estimate sewage flows according to Table T-2 of the GESF.

3.4.3 Peaking Factors

3.4.3.1 The peaking factors to cater for seasonal/diurnal flow variations, and infiltration and inflow due to storm events are made reference to EPD's GESF and shown in **Table 3.4.1**.

Table 3.4.1: 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 Existing Upstream Sewerage
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) [1]	Max ($6/N^{0.175}$, 1.6) [1]
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) [1]	Max ($2.6/N^{0.065}$, 1.6) [1]

[1] – N = Contributing population in thousands

3.4.3.2 Under normal condition, peaking factors (excluding stormwater allowance) are applicable to planning sewerage facilities receiving flow from new upstream sewerage systems which essentially have no misconnections and defects for infiltration. In this analysis, peaking factors (excluding stormwater allowance) is adopted since Yuen Long area is well developed and there are essentially no misconnections and defects for infiltration.

3.4.4 Estimated Sewage Flow from the Proposed Development

3.4.4.1 With reference to EPD Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning No.: EPD/TP 1/05, sewage flow estimation for the proposed development is provided in **Table 3.4.2** below.

Table 3.4.2: Estimated Sewage Generated by the Proposed Development

Accommodation Type	Development	Remarks
Residential - PRH & HOS		
Population	13,572	For assessment purpose, 10% increment is applied
Unit Flow Factor (m^3/person/day)	0.190	Table T-1, EPD's GESF
ADWF (m^3/day)	2,579	
Education - Schools		
No. of Primary School	1	
Students per School	765	Table 4, Chapter 3, HKPSG
No. of Kindergarten	1	
Students per School	980	Conservative value from Table 4, Chapter 3, HKPSG
No. of Students	1,745	
Unit Flow Factor (m^3/person/day)	0.040	Table T-2, EPD's GESF

Accommodation Type	Development	Remarks
ADWF (m^3/day)	70	
Social Welfare Facilities		
Type of Facilities	Day Activity Centre, Hostel, Vocational and Rehabilitation Services Centre, Residential Care Home for Elderly, Day Care Centre for Elderly and Family Service Centre	
No. of Employees	553	Estimated from number of places for different types of facilities
Unit Flow Factor (m^3/person/day)	0.080	Assuming the same as Commercial Employee, Table T-2, EPD's GESF
ADWF (m^3/day)	44	
Retail/Market		
IFA (m^2)	2,118	
IFA per Employment (m^2/employee)	26.15	Clause 2.1, Chapter 6, HKPSG
No. of Employees	82	
Unit Flow Factor (m^3/employee/day)	0.280	Table T-2, EPD's GESF
ADWF (m^3/day)	23	
Non-domestic use including Refuse Collection Point		
GFA (m^2)	4000	Assume total GFA of 4000m^2 for conservative assessment
GFA per Employment (m^2/employee)	20	Assume business use
No. of Employees	200	
Unit Flow Factor (m^3/employee/day)	0.280	Table T-2, EPD's GESF Assume same as J11 activity (Community & Social Services).
ADWF (m^3/day)	56	
Total ADWF (m^3/day)	2,771	

3.4.5 Total Combined Sewage Flow

3.4.5.1 Sewage flow for the existing developments with projection to year 2026 is estimated based on the Population and Employment Data of 2011 Base-Year Estimates by PDZ Zones. Additional flow contributing from planned sewerage systems and projects as mentioned in **Section 3.3.3**, including unsewered villages in Yuen Long areas, DWF from Yuen Long Town Nullah and KTS Development, has also been considered. Detailed calculations of the estimated sewage flow within the YLSTW service catchment are given in **Appendix A**.

3.4.5.2 Sewage demands arising from existing demands, planned growth through 2026, and planned developments within YLSTW sewage service catchment have been estimated and are summarized in the **Table 3.4.3** below. Detailed breakdown of population and sewage flow, and corresponding discharge schedule are presented in **Appendix A**.

Table 3.4.3: Combined Sewage Generated within YLSTW Service Area in Year 2026

Service Area	PDZ 454 Zone No.	TPEDM Population Projection in Year 2026				ADWF	
		Residential	School	Employee	Total	Increment (m^3/d)	Total (m^3/d)
Existing YLSTW Service Catchment	232	11,150	1,800	6,150	19,100	3,913	19,984
	177	42,800	5,600	17,449	65,849	14,316	
	372	5,565	-	2,951	8,516	1,755	
Planned Additional YLSTW Service Catchment (including unseweraged villages in Yuen Long)	182	Replaced by Kam Tin South Development				0	27,792
	183	7,350	1,150	2,200	10,700	2,353	
	184	18,050	3,150	3,800	25,000	5,342	
	316	13,300	2,300	3,700	19,300	4,187	
	331	550	100	500	1,150	271	
	333	500	100	400	1,000	231	
	334	2,350	400	800	3,550	781	
	374	5,250	900	1,100	7,250	1,552	
	375	16,100	2,700	2,900	21,700	4,623	
	376	3,650	600	950	5,200	1,130	
	401	800	100	300	1,200	272	
	402	5,500	900	3,950	10,350	2,407	
	405	0	0	0	0	0	
	447	8,950	1,350	1,600	11,900	2,561	
	448	2,700	450	550	3,700	793	
	449	1,200	200	3,600	5,000	1,292	
Sewage Flow from Other Planned Projects	-	Kam Tin South Development				22,000	40,000
	-	DWF interceptor system - Yuen Long Nullah Improvement Works				18,000	

Service Area	PDZ 454 Zone No.	TPEDM Population Projection in Year 2026				ADWF	
		Residential	School	Employee	Total	Increment (m^3/d)	Total (m^3/d)
Estimated Sewage from Proposed Development	PH Site	13,572	1,745	835	16,152	2,771	2,771
Total							90,547

3.5 Proposed Sewerage Scheme

3.5.1.1 Approximately 550m of sewers from size 300Ø to 750Ø are needed within the proposed development and along Fung Chi Road to convey sewage flows to connection points on the existing sewerage system. **Drawing No. 226464/OAP/C/201** illustrates the proposed sewerage scheme. The distribution of sewage catchment from the proposed development to connection points along the existing system is shown in **Table 3.5.1**.

Table 3.5.1: Distribution of Service Catchments from Project Site to the Existing Sewerage System

Item No.	Existing Sewerage System	Size	Existing and Planned Catchments Being Served (PVS Zone No.) [1]	Proposed Additional Catchments	Connection Point to Existing System
1	Gravity pipelines along Long Ping Road and Fung Chi Road discharging to Long Ping Sewage Pumping Station (SPS)	225Ø to 750Ø	Yuen Long Town (177)	Proposed Development	Intersection of Long Ping Road and Fung Chi Road
2	Rising (force) main from Long Ping SPS to YLSTW	600Ø Rising Main	Long Ping SPS Sewage Catchment (177;232)	Proposed Development	Intersection of Long Ping Road and Fung Chi Road
3	Gravity pipelines from Long Ping SPS to YLSTW	1350Ø to 1800Ø	Long Ping SPS Catchment (177;232) Kau Hui SPS Catchment (372) New Housing Site at YL South (368; 181; 373)	Proposed Development	Intersection of Long Ping Road and Fung Chi Road

[1] – Taken from TPEDM 2011

3.5.1.2 It is proposed that sewerage mains will be concrete, vitrified clay, ductile iron or cast iron. Adherence to DSD standards should be maintained during detailed design and construction.

3.6 Potential Impact to Sewerage Facilities

3.6.1 Impacts to Sewage Treatment Works

3.6.1.1 It was agreed between EPD, DSD, HKHA and HKSTP in the meeting on 6 Nov 2012 that the sewage flows from the proposed development shall be conveyed to YLSTW and the proposed EPS upgrading works at YLSTW would be designed to cater for the additional sewage flow from the proposed developments.

3.6.1.2 The total ADWF from the proposed development is estimated to be 2,771m^3/day. The combined sewage flow from within the YLSTW service area is estimated to be 90,547 m^3/day at year 2026. The proposed EPS upgrading works at YLSTW shall be designed to cater for the additional sewage flow from the proposed development and the planned design capacity of 100,000 m^3/day is adequate to meet the demands within its service area at year 2026.

3.6.1.3 Pollutants generated by the proposed development will be treated at YLSTW under the proposed EPS. The YLSTW falls within the Deep Bay Water Control Zone where the requirement of "No net increase in pollution load to Deep Bay" shall be met. The proposed EPS will cater to the increased effluent loading from the proposed development such that no additional pollution will be discharged to Deep Bay. Therefore the increased sewage flow from the proposed development will have no adverse impact on Deep Bay.

3.6.2 Impacts to Existing Sewerage System

3.6.2.1 Detailed hydraulic assessment on the existing sewerage pipeline systems are presented in pages 5 to 7 of **Appendix A**.

3.6.2.2 The estimate of flows contributing to the sewerage connection point at Long Ping Road and Fung Chi Road shows that the existing 450Ø sewer main along Fung Chi Road is insufficient to cater for additional sewage flow arising from the proposed development. The sewer main along Fung Chi Road is also too high in elevation to accommodate the connection of sewer main by gravity from the proposed development due to the platform grading in the proposed development.

3.6.2.3 The ADWF flow and peak flow (including stormwater allowance) discharged to the Long Ping SPS for the existing service area, taking into account of the planned growth up to year 2026 are estimated to be 3,027 m^3/day and 10,595 m^3/day respectively.

3.6.2.4 With additional sewage discharge from the Project under the planned scenario, the ADWF flow and peak design flow discharged to the Long Ping SPS will be increased to 5,798 m^3/d and 20,294 m^3/d respectively. The design peak flow is below the SPS design capacity of 21,600 m^3/d (ADWF). **Table 3.6.1** summarizes the estimated flows to Long Ping SPS.

Table 3.6.1: Long Ping Sewage Pumping Station Estimated Flows in Year 2026

Scenario	ADWF (m^3/d)	Peaking Factor	Design Flow (m^3/d)	Service Catchment (PVS Zone No.) [1]	Service Catchment Description	Discharge
Existing	3,027	3.50	10,595	177	Long Ping	YLSTW
Planned	5,798	3.50	20,294	177 + proposed PH Site residing in Zone 232	Long Ping + Proposed Wang Chau Development	YLSTW

[1] – Taken from TPEDM 2011

3.6.2.5 The estimated velocity of flow within the existing 600Ø rising main from Long Ping SPS is acceptable to cater for additional sewage from the proposed development.

3.6.2.6 The capacity of the existing 1350Ø to 1800Ø gravity sewer main between the Long Ping SPS 600Ø rising main and YLSTW is also sufficient to cater for additional flows from the proposed development. Therefore, there would be no adverse impact on the Long Ping SPS or associated pipe works between the SPS and YLSTW.

3.7 Recommended Mitigation Measures

3.7.1.1 To serve the proposed development, public sewer mains ranging from 300Ø to 600Ø are proposed along the new public roadway connecting to the existing sewer main at Fung Chi Road.

3.7.1.2 To accommodate the additional flow arising from the proposed development, it is proposed to upgrade the existing 450Ø sewer main along Fung Chi Road to 750Ø sewer main between the point of connection at Long Ping Road and Fung Chi Road and the Long Ping SPS. In order to meet the necessary invert levels from the proposed development due to platform grading, the upgrading works in Fung Chi Road will need to be lowered in elevation. The existing invert elevation at Long Ping SPS will remain the same so as not to impact the operation of the pumping works. There is sufficient space immediately adjacent to the upgrading works to allow temporary diversion of existing sewage flows by gravity during construction. It is anticipated that on-line replacement method will be adopted, i.e. existing DN450 sewer pipe will be permanently replaced by a DN750 pipe and temporary sewage flow diversion will be provided (either by temporary gravity sewer or by pump). The exact temporary diversion scheme will be proposed by the future Contractor to ensure the flow is maintained during construction.

3.7.1.3 **Drawing Nos. 226464/OAP/C/201** and **210** show the layout of these proposed and upgrading works and corresponding details including invert levels and gradients. CEDD will be responsible for the implementation of all these proposed works. The sewers as shown in the drawings are public and will be maintained by DSD. The maintenance responsibility, including recurrent funding, of the

proposed sewerage mitigation measures will be determined during the detailed design stage.

3.7.1.4 Buildings which are not immediately adjacent to the proposed sewer mains at the public roadways will be served by internal private sewer mains and maintained by HKHA. For residential blocks and associated retail facilities at public rental housing site, it is anticipated that the private sewage will be running along the internal EVA and connect to the proposed sewer at public roadway.

4 CONCLUSION

4.1.1.1 The total estimated ADWF from the proposed development is 2,771m^3/day. The combined sewage flow from all existing demands and planned growth, planned developments and proposed development within the YLSTW service area is estimated to be 90,547 m^3/day at year 2026. The planned design capacity of the EPS upgrading works at YLSTW is 100,000 m^3/day at year 2020 which is adequate to meet demands within its service area and able to cater for the additional sewage flow from the proposed development. No additional pollution will be discharged to Deep Bay. Therefore the increased sewage flow from the proposed development will have no adverse impact on Deep Bay.

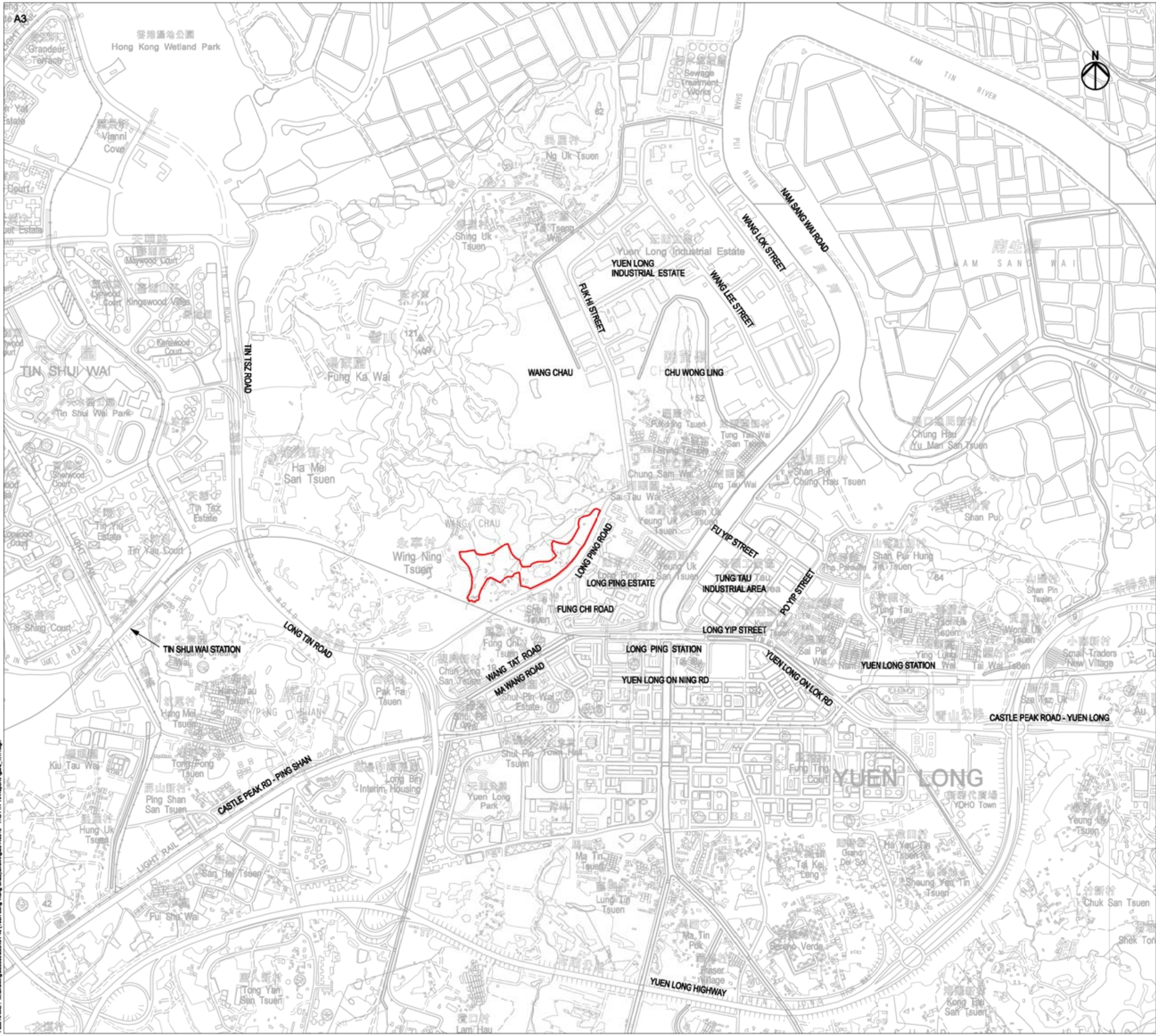
4.1.1.2 The estimated flows within the Long Ping SPS catchment from existing and planned developments and the proposed development are well below the SPS design capacity.

4.1.1.3 Construction of approximately 550m of new public sewers (include upgrading works) ranging from size 300mm to 750mm within the Project Site and along Fung Chi Road are proposed to cater for the additional sewage flow arising from the proposed development.

5 REFERENCES

- Drainage Services Department Sewerage Manual, May 2013.
- EPD Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning No.: EPD/TP 1/05.
- Hong Kong Planning Standards and Guidelines, August 2011.
- Hong Kong Planning Department Territorial Population Employment Data Matrices, 2011

Drawings



LEGEND:

PUBLIC HOUSING SITE

Rev	Description	By	Date
A	FIRST ISSUE	KHC	09/13

Consultant

ARUP

Project title

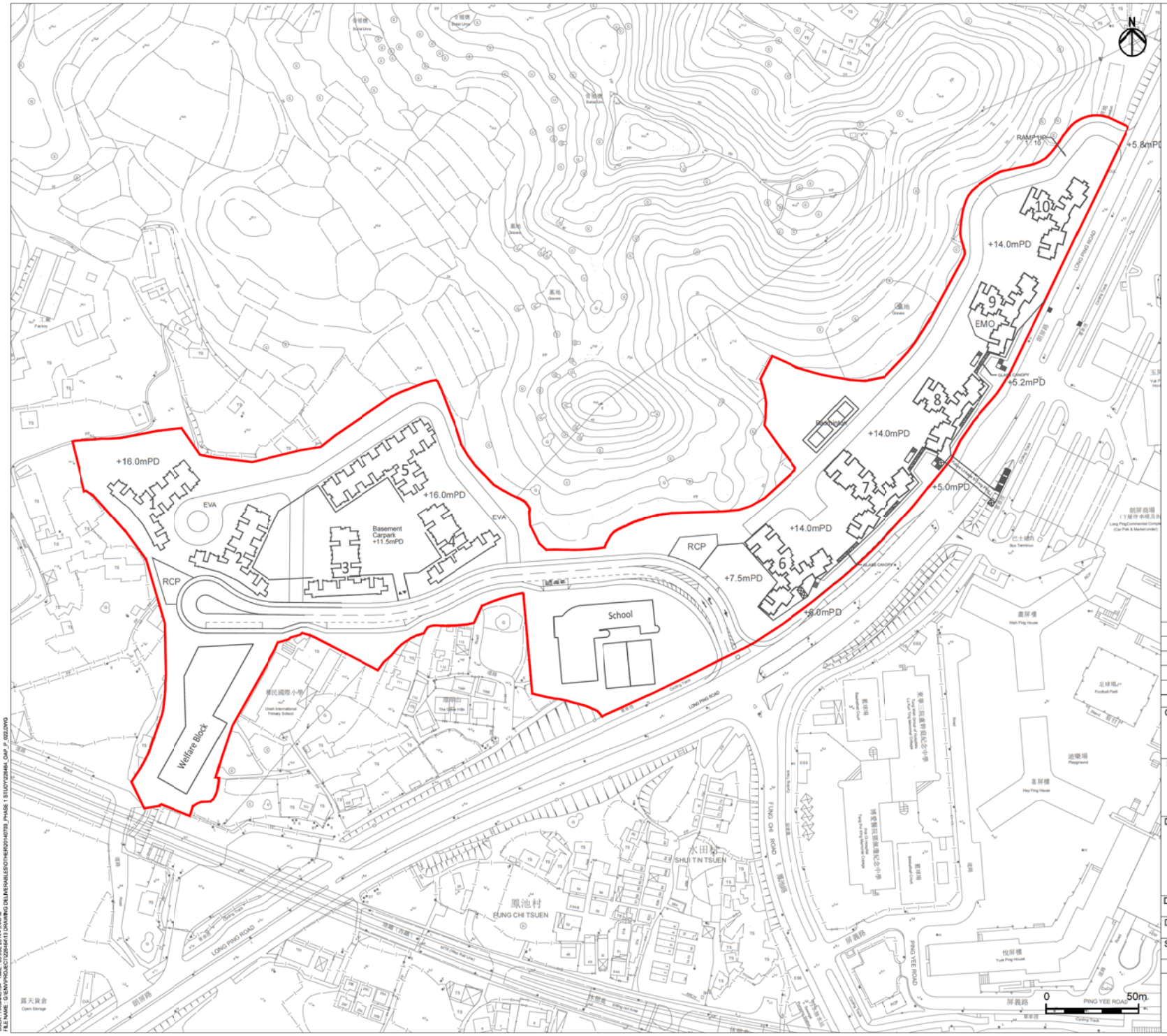
Agreement No. CB20120293
Public Housing Development at Wang Chau, Yuen Long

Drawing title

LOCATION OF PROJECT SITE

Drawing no.			Rev.
226464/OAP/P/011			A
Drawn: KHC	Date: 09/13	Checked: DW	Approved: CC
Scale: 1:15000 (A3)		Status: PRELIMINARY	

HONG KONG HOUSING AUTHORITY



Legend

Development Boundary

Rev	Description	By	Date
A	FIRST ISSUE	GL	07/14

Consultant

ARUP

Project title

Agreement No. CB20120293
Planning and Engineering Study for the Public Housing Site and Yuen Long Industrial Estate Extension at Wang Chau

Drawing title

Proposed Option Layout Plan - PH Site

Drawing no.		Rev.
226464/OAP/P/022		A
Drawn: GL	Date: 07/14	Checked: IL	Approved: ST
Scale: AS SHOWN		Status: PRELIMINARY

HONG KONG HOUSING AUTHORITY

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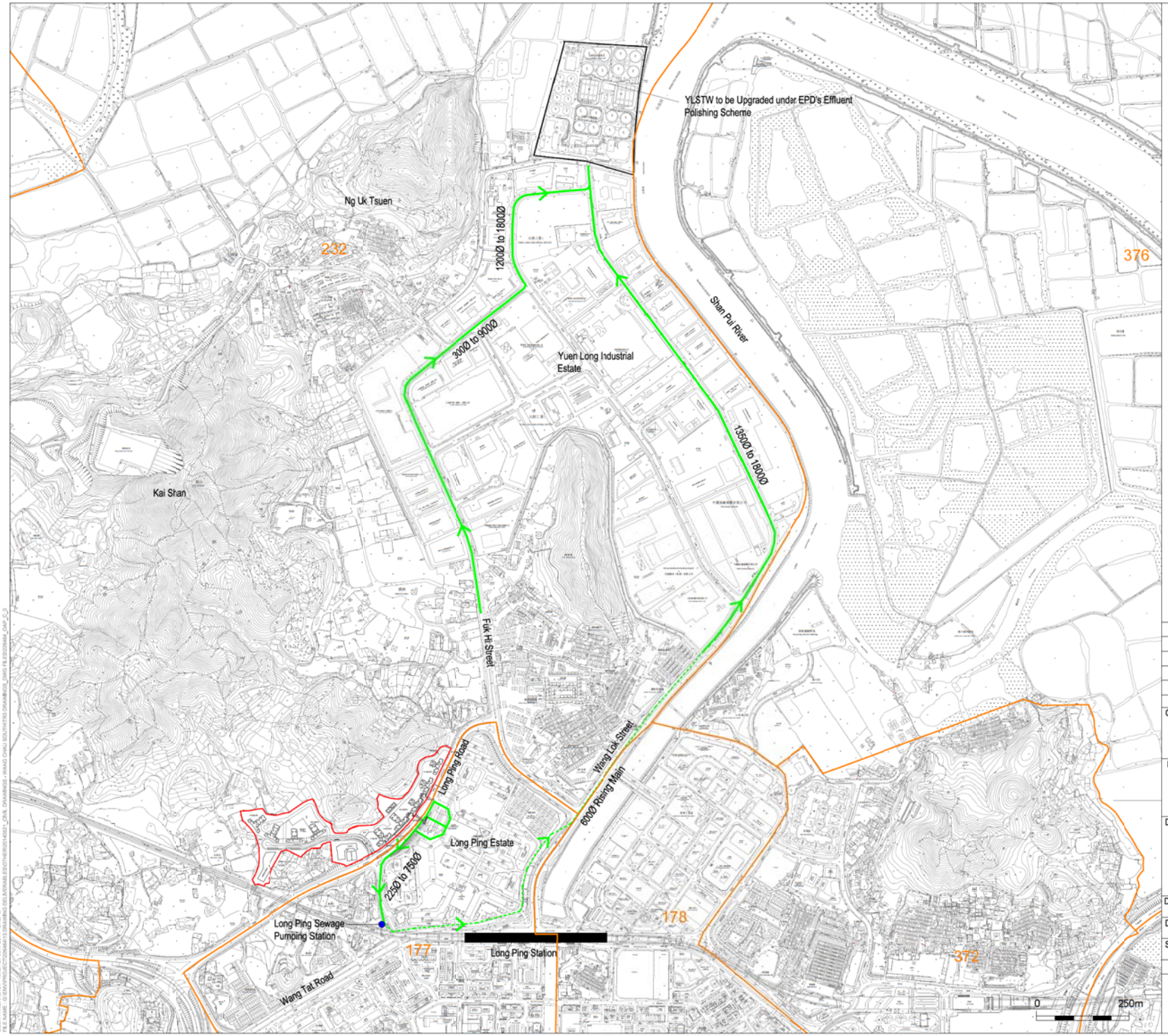


Rev	Description	By	Date
-	FIRST ISSUE	GL	05/14

Consultant

ARUP

Project title

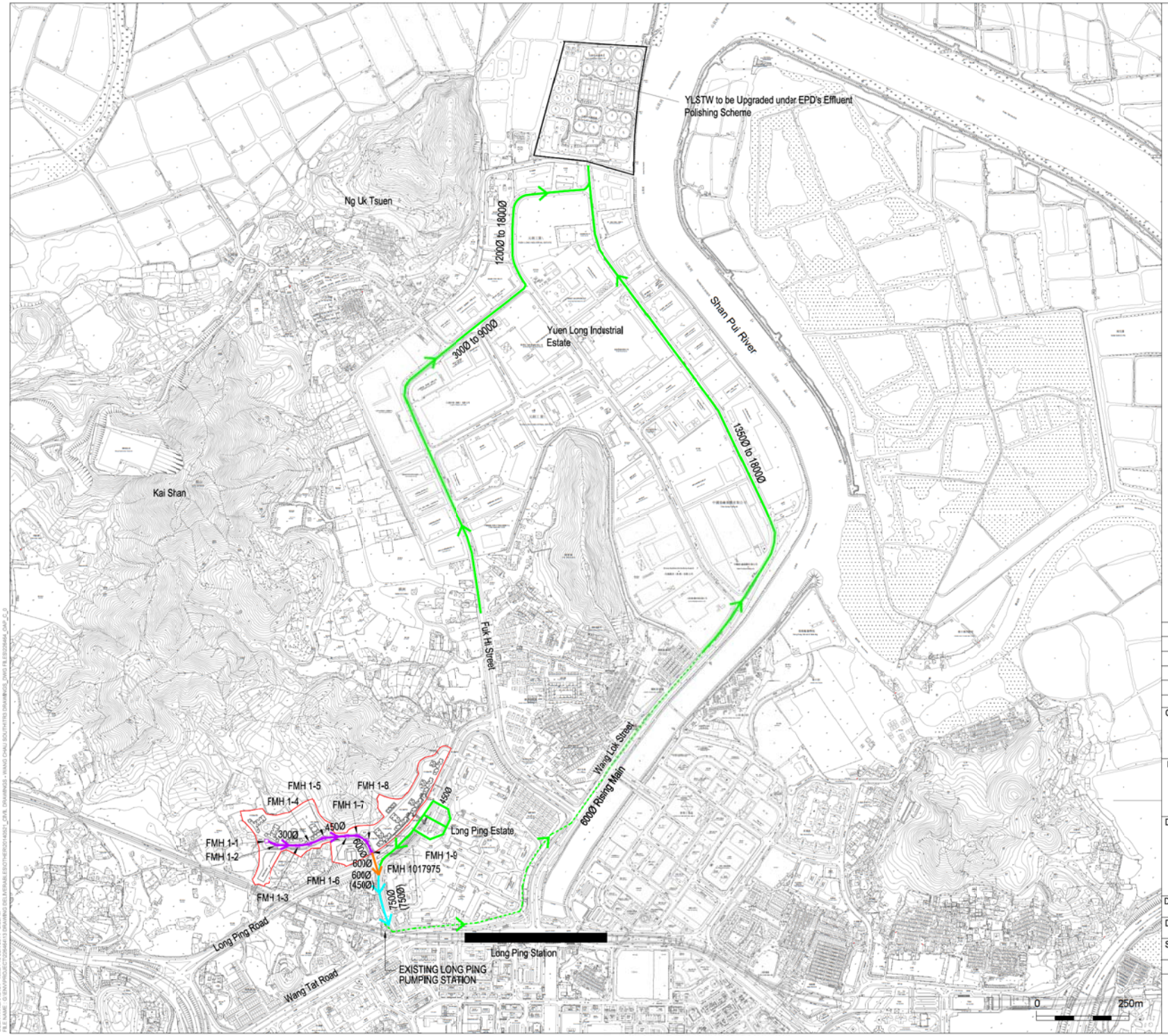
Public Housing Development at Wang Chau, Yuen Long

Drawing title

EXISTING SEWERAGE LAYOUT

Drawing no.			Rev.
226464/OAP/C/021			-
Drawn	Date	Checked	Approved
GL	05/14	MB	ST
Scale		Status	
N.T.S.		PRELIMINARY	

HONG KONG HOUSING AUTHORITY



LEGEND:

- DEVELOPMENT BOUNDARY
- EXISTING SEWER
- EXISTING RISING MAIN
- 900Ø (450Ø) EXISTING DN450 SEWERAGE TO BE UPGRADED TO DN900/RECONSTRJCTED
- PROPOSED OFFSITE SEWERAGE
- PROPOSED ONSITE SEWERAGE

Rev	Description	By	Date
-	FIRST ISSUE	GL	06/14

Consultant

ARUP

Project title

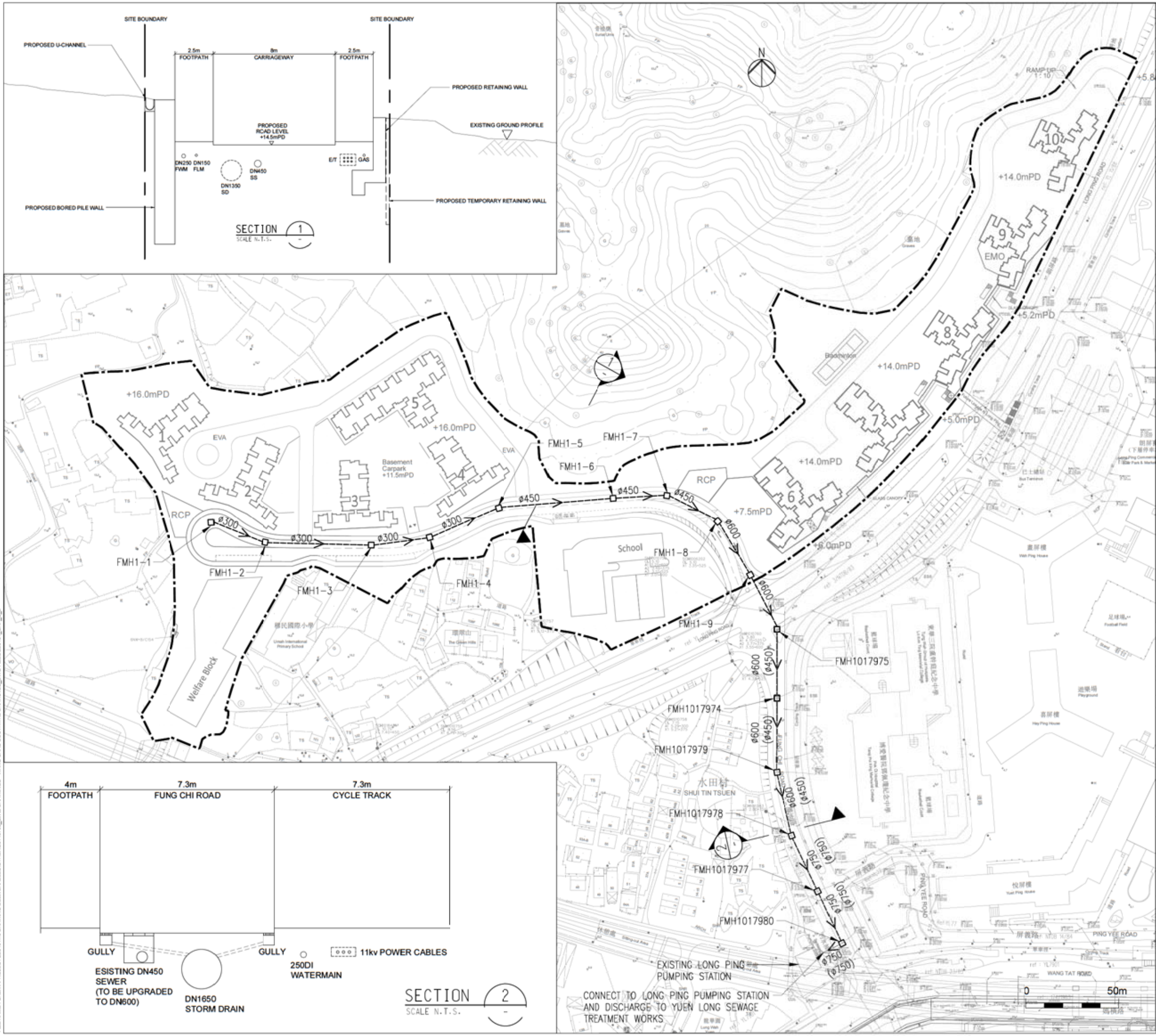
Public Housing Development at Wang Chau, Yuen Long

Drawing title

OVERVIEW OF PROPOSED SEWERAGE

Drawing no.			Rev.
226464/OAP/C/022			-
Drawn	Date	Checked	Approved
GL	06/14	MB	ST
Scale		Status	
N.T.S.		PRELIMINARY	

HONG KONG HOUSING AUTHORITY



Rev	Description	By	Date
A	RESPONSE TO COMMENT	GL	09/14
-	FIRST ISSUE	GL	06/14

Consultant: ARUP

Project title: Public Housing Development at Wang Chau, Yuen Long

Drawing title: PROPOSED SEWERAGE LAYOUT PLAN

SHEET 1 OF 1

Drawing no. 226464/OAP/C/201 Rev. A

Drawn GL Date 06/14 Checked MB Approved ST

Scale 1:1000 (A1) Status PRELIMINARY

HONG KONG HOUSING AUTHORITY

PROPOSED SEWER WITHIN PROJECT SITE

MANHOLE NO.		DIAMETER	LENGTH	GROUND LEVEL (mPD)		INVERT LEVEL (mPD)		GRADIENT
FROM	TO	(mm)	(m)	U/S	D/S	U/S	D/S	1 in X
FMH 1-1	FMH 1-2	300	33	16.00	16.00	14.20	14.04	200
FMH 1-2	FMH 1-3	300	60	16.00	16.00	14.04	13.74	200
FMH 1-3	FMH 1-4	300	27	16.00	16.00	13.74	13.60	200
FMH 1-4	FMH 1-5	300	42	16.00	16.00	13.60	13.39	200
FMH 1-5	FMH 1-6	450	60	16.00	13.00	11.39	11.09	200
FMH 1-6	FMH 1-7	450	31	13.00	10.00	8.09	7.94	200
FMH 1-7	FMH 1-8	450	34	10.00	7.50	5.94	5.77	200
FMH 1-8	FMH 1-9	450	34	7.50	5.80	3.77	3.60	200

EXISTING SEWER ALONG FUNG CHI ROAD (CONNECT TO LONG PING SPS) - UPGRADED

MANHOLE NO.		DIAMETER	LENGTH	GROUND LEVEL (mPD)		INVERT LEVEL (mPD)		GRADIENT
FROM	TO	(mm)	(m)	U/S	D/S	U/S	D/S	1 in X
FMH 1-9	FMH 1017975	600	31	5.80	6.00	1.70	1.62	400
FMH 1017975	FMH 1017974	600	37	6.00	6.03	0.31	0.22	400
FMH 1017974	FMH 1017979	600	39	6.03	5.82	0.22	0.12	400
FMH 1017979	FMH 1017978	600	35	5.82	5.54	0.12	0.03	400
FMH 1017978	FMH 1017977	750	34	5.54	5.23	0.03	-0.05	400
FMH 1017977	FMH 1017980	750	31	5.23	4.96	-0.05	-0.13	388
FMH 1017980	FMH 1017981	750	11	4.96	5.04	-0.13	-0.16	388
FMH 1017981	Long Ping SPS	750	4	5.04	5.04	-0.30	-0.31	388

Rev	Description	By	Date
-	FIRST ISSUE	GL	05/14

Consultant

ARUP

Project title

Public Housing Development at Wang Chau, Yuen Long

Drawing title

PROPOSED SEWERAGE MANHOLE SCHEDULE

Drawing no. 226464/OAP/C/210 Rev. -

Drawn GL Date 05/14 Checked MB Approved ST

Scale N.T.S. Status PRELIMINARY

HONG KONG HOUSING AUTHORITY

Appendix A

Hydraulic Calculations

ARUP

Ove Arup & Partners

Job Title: **Planning and Engineering Study for Wang Chau**
Population Projection and Distribution of Existing Zone

Job No. 226464

Made by LTT Date 12-Apr-2014 Checked NY

Table B1 - Population Projection of YLSTW Catchment

Planning Data Zone	Population [1]					
	2016			2026		
	Residential	School Place	Employment	Residential	School Place	Employment
232 [2]	11,150	1,800	6,150	11,150	1,800	6,150
177	43,150	5,800	22,450	42,800	7,400	18,600
372	25,600	4,100	14,050	34,600	5,950	17,650

Table B2 - Distribution of Population for Planning Data Zones

Planning Data Zone [4]	No.	Location	Maximum Plot Ratio (Domestic)	Approx. Site Area (m^2)			2016			2026		
				Residential	School Place	Employment	Residential	School Place	Employment	Residential	School Place	Employment
232	1	OU	5.00			0	0	0	0	0	0	0
	2	OU	-			968,000	0	0	4,999	0	0	4,999
	3	V		311,597			3,870	0	0	3,870	0	0
	4	V	5.00	16,394			204	0	0	204	0	0
	5	V	-	114,871			1,427	0	0	1,427	0	0
	6	CDA	-	222,973	222,973	222,973	2,769	1,800	1,151	2,769	1,800	1,151
	7	V	-	231,926			2,880	0	0	2,880	0	0
	8	G/IC	5.00		0		0	0	0	0	0	0
		Total		897,761	222,973	1,190,973	11,150	1,800	6,150	11,150	1,800	6,150
177	1	R(E)	-	136,751			16,061	0	0	15,931	0	0
	2	R(E)	-	113,117			13,286	0	0	13,178	0	0
	3	CDA		13,836		13,836	1,625	0	22,450	1,612	0	18,600
	4	R		13,444			1,579	0	0	1,566	0	0
	5	R		60,529			7,109	0	0	7,051	0	0
	6	R		29,713			3,490	0	0	3,461	0	0
	7	S			53,497		0	5,800	0	0	7,400	0
		Total		367,390	53,497	13,836	43,150	5,800	22,450	42,800	7,400	18,600
372	1	CDA	-	36,583		36,583	1,732	0	2,349	2,341	0	2,951
	2	R	-	50,373			2,385	0	0	3,224	0	0
	3	R		22,034			1,043	0	0	1,410	0	0
	4	R		234,288			11,093	0	0	14,993	0	0
	5	CDA		182,189		182,189	8,626	0	11,701	11,659	0	14,699
	6	S			43,268		0	4,100	0	0	5,950	0
	7	R(C)		15,212			720	0	0	973	0	0
		Total		540,679	43,268	218,772	25,600	4,100	14,050	34,600	5,950	17,650

(1) - Residential data, school and employment data are extracted from TPEDM 2011 - Table 1, Table 6 and Table 8 respectively.

(2) - Other than this proposed development, it is unlikely that there exist other planned development within Zone No. 232 that is not known in this stage, adding that the ability for further development within Zone No. 232 is characteristic of the land (either within the wetland buffer zone or already developed). According to the planning data in TPEDM 2011, the population within Zone No.232 grows up rapidly between year 2016 and 2026, which matched with the proposed commission programme of this proposed development. Therefore, it is reasonably believed that the population growth is attributed to this proposed development only. For estimating the population in year 2031, the population contributed from this proposed development should be eliminated and therefore population data in year 2016 is adopted.

(3) - Zone No. and corresponding Land Use Zoning refer to zoning plan in TPEDM 2011.

ARUP		Job No. 226464					
		Member/Location					
Job Title	Planning and Engineering Study for Wang Chau South	Drg. Ref.					
Calculation	Sewage Discharge Schedule- Existing and Planned Developement	Made by	LTT	Date	24/09/2014	Chd.	NY

Unit Flow Factor ($m^3/h/d$) for Different Types of Flow

Types of Flow					
Residential		School	Employment		
PRH	0.19	0.04	Employment	0.28	
Village	0.15		Social Welfare	0.08	
New Housing Site	0.25		Retail/Market	0.28	
Domestic - Yuen Long Distrcit	0.23		Industrial	2.08	

Table B3 - Populations, Existing and Planned Sewage Flows in 2026

	Connecting Manhole Ref. (1)	PDZ Zone No. (2)	2011-based TPEDM Population Projection				ADWF		
			Residential	School	Employment	Cumulative	Increment (m^3/d)	Cumulative (m^3/d)	Cumulative (L/s)
Existing Seweage Catchment	FMH 1008697	232	2880	0	52	2,933	562	19,984	231.3
	FMH 1008696		0	0	46	46	13		
	FMH 1008685		0	0	155	155	44		
	FMH 1008684		0	0	53	53	15		
	FMH 1008693		0	0	43	43	12		
	FMH 1008677		0	0	274	274	77		
	FMH 1008676		0	0	88	88	25		
	FMH 1008674		0	0	207	207	58		
	FMH 1008647		0	0	224	224	63		
	FMH 1008643		0	0	112	112	31		
	FMH 1008626		0	0	255	255	71		
	FMH 1008630		0	0	129	129	36		
	FMH 1008582		0	0	1341	1,341	375		
	FMH 1008580		0	0	175	175	49		
	FMH 1008585		0	0	45	45	13		
	FMH 1008588		0	0	171	171	48		
	FMH 1008736		0	0	1551	1,551	434		
	FMH 1008593		0	0	76	76	21		
	FMH 1008736	232	8,270	1,800	1,151	11,221	1,966		
	FMH 1017975	177	15,931	0	0	15,931	3,027		
	FMH 1008736	177 (6)	26,869	5,600	17,449	49,917	11,289		
	FMH 1008736	372	2,341	0	2,951	5,293	1,271		
	FMH 1008736	372	3,224	0	0	3,224	484		
Planned Seweage Catchment	YLSTW	182	Replace by Kam Tin South Development				0	27,792	321.7
	YLSTW	183	7,350	1,150	2,200	10,700	2,353		
	YLSTW	184	18,050	3,150	3,800	25,000	5,342		
	YLSTW	316	13,300	2,300	3,700	19,300	4,187		
	YLSTW	331	550	100	500	1,150	271		
	YLSTW	333	500	100	400	1,000	231		
	YLSTW	334	2,350	400	800	3,550	781		
	YLSTW	374	5,250	900	1,100	7,250	1,552		
	YLSTW	375	16,100	2,700	2,900	21,700	4,623		
	YLSTW	376	3,650	600	950	5,200	1,130		
	YLSTW	401	800	100	300	1,200	272		
	YLSTW	402	5,500	900	3,950	10,350	2,407		
	YLSTW	405	0	0	0	0	0		
	YLSTW	447	8,950	1,350	1,600	11,900	2,561		
	YLSTW	448	2,700	450	550	3,700	793		
	YLSTW	449	1,200	200	3,600	5,000	1,292		
Planned Developments / Projects (4, 5)	FMH 1008736	-	DWF interceptor system - Yuen Long Nullah Improvement Works				18,000	40,000	463.0
	YLSTW	-	Kam Tin South Development				22,000		
Total								**87,775**	**1,016**

(1) - Manhole Ref. as per DSD Record Plan

(2) - Zoning plan for TPEDM 2011 refers to **Figure B**

(3) - Residential and employment population for the existing development refer to **Tables B1 & B2**

(4) - Estimated Sewerage Flow provided by EPD dated 28 Feb 2014

(5) - Planned developments / projects is not necessarily be completed before 2026 but are included for assessment purpose

(6) - Assume Ping Shung Street SPS divert 177 Zone sewage catchment to YLSTW

ARUP		Job No. 226464				
		Member/Location				
Job Title	Planning and Engineering Study for Wang Chau South	Drg. Ref.				
Calculation	Sewage Discharge Schedule- Existing and Planned Developement	Made by LTT	Date 24/09/2014	Chd. NY		

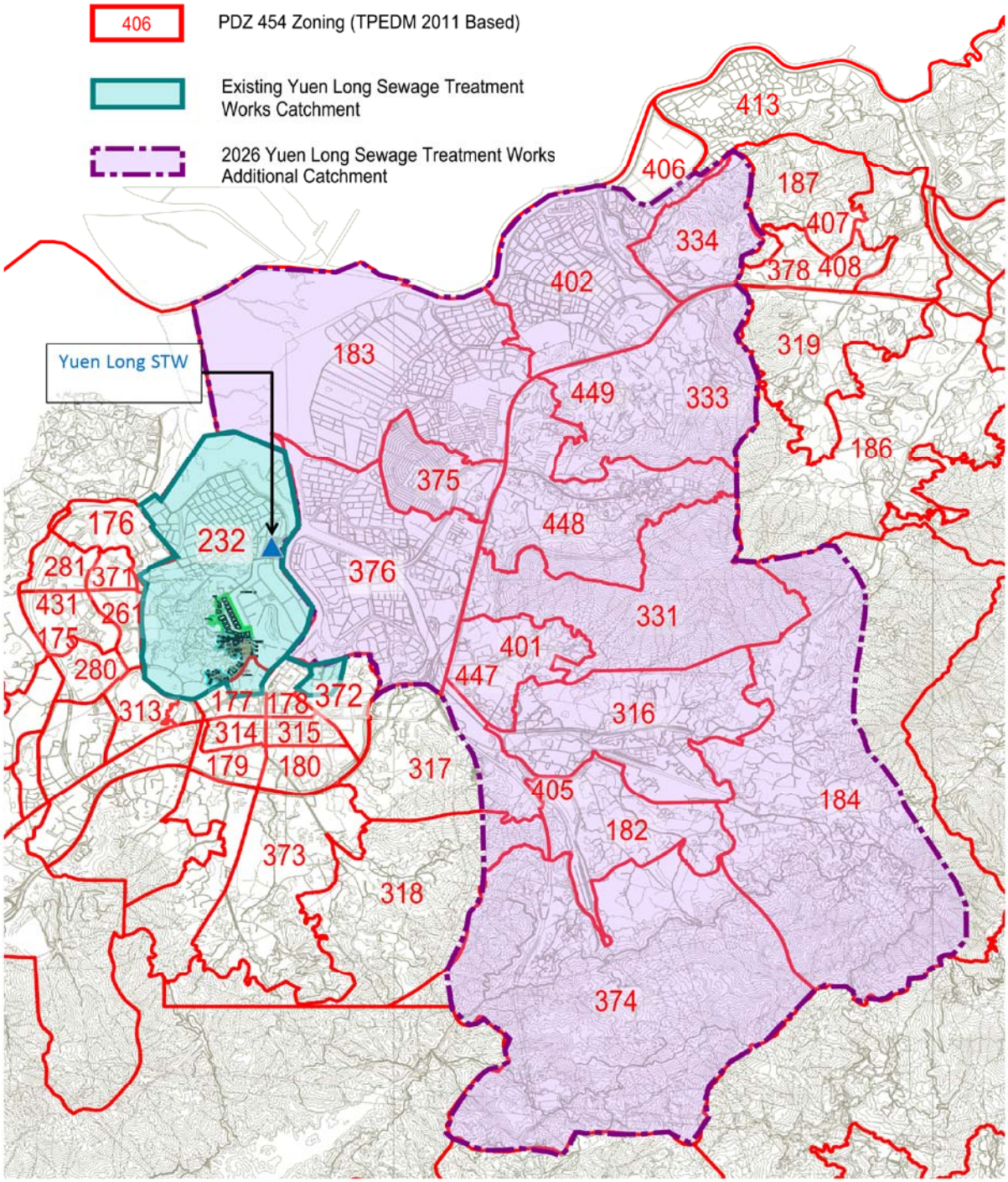


Figure B - Outline Zoning Plan (From 2011 based TPEDM)

ARUP	Job	Sheet No.	Rev
	226464		
	Member/Location		
Job Title: Planning and Engineering Study for Wang Chau South	Drg.		
Calculation: Sewage Discharge Schedule- Proposed Developement	Made by LTT	Date 24/09/2014	Chd.

Unit Flow Factor (m3/h/d) for Different Types of Flow

Types of Flow	UFF	
HOS / PRH	0.19	Table T-1, EPD's GESF
School	0.04	Table T-2, EPD's GESF
Social Welfare	0.08	Assuming the same as Commercial Employee, Table T-2, EPD's GESF
Retail/ Market/ J11 Activity	0.28	Table T-2, EPD's GESF

Table B4 - Populations and Proposed Sewage Flows

Land Use	ID	No. of units	Residential Population	ADWF (m3/day)	Discharge Manhole (1)	Remarks	
HOS Site	1	335	1,131	215	FMH 1-1		Population Included 10% Inclement
	2	335	1,131	215	FMH 1-1		
	3	299	1,010	192	FMH 1-3		
	4	299	1,010	192	FMH 1-5		
	5	629	2,124	404	FMH 1-5		
PRH Site	6	479	1,618	307	FMH 1-8		
	7	524	1,770	336	FMH 1-8		
	8	384	1,297	246	FMH 1-8		
	9	384	1,297	246	FMH 1-8		
	10	351	1,185	225	FMH 1-8		
Residential	**Sub-Total**	**4,019**	**13,572**	**2,579**			
			Student	**ADWF (m3/day)**	**Discharge Manhole (1)**		**Remarks**
Primary School	-	1	765	31	FMH 1-8	765	Students per School as per Table 4, Chapter 3, HKPSG
Kindergarten	-	1	980	39	FMH 1-8	980	Students per School as per Table 4, Chapter 3, HKPSG
Schools	**Sub-Total**	**2**	**1,745**	**70**			
		NOFA / IFA (m2)	**Employee**	**ADWF (m3/day)**	**Discharge Manhole (1)**		**Remarks**
Social Welfare Block	Day Activity Centre	319	50	4	FMH 1-1		
	Hostel	1,438	120	10	FMH 1-1		
	Vocational and Rehabilitation Services Centre	653	120	10	FMH 1-1		
	Residential Care Home for Elderly	1,096	100	8	FMH 1-1		
	Day Care Centre for Elderly	358	60	5	FMH 1-1		
	Family Service Centre	589	103	8	FMH 1-1		Being conservative, taking Q1 amongst various types of facilities in Table 3, Chapter 3, HKPSG
Retail / Market		2,118	81	23	FMH 1-8	26	Employee per IFA; Clause 2.1, Chapter 6, HKPSG
Welfare/ Retail/ Market	**Sub-Total**	**6,571**	**634**	**67**			
		GFA (m2)	**Employee**	**ADWF (m3/day)**	**Discharge Manhole (1)**		**Remarks**
RCP in HOS Site		1,100	55	15	FMH 1-1	20	m^2/person (Assume same as J11 activity)
RCP in PRH Site		2,900	145	41	FMH 1-8	20	m^2/person (Assume same as J11 activity)
Others	**Sub-Total**	**4,000**	**200**	**56**			
WC South Development	**Total**	**-**	**16,151**	**2,771**			

Capacity Performance of Existing and Proposed Sewers in 2025

Notes:
(1) Calculate by Colebrook-White Equation

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

where ks is equivalent roughness with value equals 1.5mm for existing sewers.
v is kinematic viscosity of fluid = 1.14 x 10-6 m^2/s and g is the gravity = 9.81m/s^2
V is the velocity, D is the diameter of the sewer and S is the gradient of the sewer.

(2) Peaking Factor refers to EPD's GESF Table T-5, excluding stormwater allowance for proposed sewers

Abbreviation:

UP_MAN	Upstream Manhole	ACC_POP	Accumulated Population	UP_GL	Upstream Ground Level	F/C	Peak Flow/Capacity
DN_MAN	Downstream Manhole	CON_POP	Contributing Population	DN_GL	Downstream Ground Level	DN_INV	Downstream Invert Level
ADWF	Average Dry	DIA	Diameter	UP_INV	Upstream Invert Level	VEL	Velocity
ACC_ADWF	Accumulated Average Dry Weather Flow	LEN	Length	CAP	Capacity		

1. Proposed Sewer within Proposed Site

Manhole								Pipe Parameter										
UP_MAN No.	DN_MAN No.	ADWF (m3/d)	ACC_ADWF (m3/d)	CON_POP	PEAKING FACTOR	Peak Flow (m3/d)	Peak Flow (L/s)	DIA (D) (mm)	LEN (m)	UP_GL (mPD)	DN_GL (mPD)	UP_INV (mPD)	DN_INV (mPD)	Gradient (S), 1 in XX	VEL (m/s)	CAP (L/s)	F/C (%)	Adequate Capacity?
FMH 1-1	FMH 1-2	490	490	1,813	5.00	2,448	28.3	300	33	16.00	16.00	14.20	14.04	200.00	0.98	69.2	40.96%	YES
FMH 1-2	FMH 1-3	0	490	1,813	5.00	2,448	28.3	300	60	16.00	16.00	14.04	13.74	200.00	0.98	69.2	40.96%	YES
FMH 1-3	FMH 1-4	192	681	2,524	5.00	3,407	39.4	300	27	16.00	16.00	13.74	13.60	200.00	0.98	69.2	57.02%	YES
FMH 1-4	FMH 1-5	0	681	2,524	5.00	3,407	39.4	300	42	16.00	16.00	13.60	13.39	200.00	0.98	69.2	57.02%	YES
FMH 1-5	FMH 1-6	595	1,277	4,729	5.00	6,384	73.9	450	60	16.00	13.00	11.39	11.09	200.00	1.27	202.6	36.48%	YES
FMH 1-6	FMH 1-7	0	1,277	4,729	5.00	6,384	73.9	450	31	13.00	10.00	8.09	7.94	200.00	1.27	202.6	36.48%	YES
FMH 1-7	FMH 1-8	0	1,277	4,729	5.00	6,384	73.9	450	34	10.00	7.50	5.94	5.77	200.00	1.27	202.6	36.48%	YES
FMH 1-8	FMH 1-9	1,495	2,771	10,265	3.00	8,314	96.2	600	34	7.50	5.80	3.77	3.60	200.00	1.53	433.2	22.21%	YES

2. Existing Sewer along Fung Chi Road (Connect to Long Ping SPS) - Upgraded

Denotes upgrade on existing sewer system

Manhole								Pipe Parameter										
UP_MAN No.	DN_MAN No.	ADWF (m3/d)	ACC_ADWF (m3/d)	CON_POP	PEAKING FACTOR	Peak Flow (m3/d)	Peak Flow (L/s)	DIA (D) (mm)	LEN (m)	UP_GL (mPD)	DN_GL (mPD)	UP_INV (mPD)	DN_INV (mPD)	Gradient (S), 1 in XX	VEL (m/s)	CAP (L/s)	F/C (%)	Adequate Capacity?
FMH 1-9	FMH 1017975	0	2,771	10,265	4.00	11,086	128.3	600	31	5.80	6.00	1.70	1.62	400.00	1.08	305.8	41.95%	YES
FMH 1017975	FMH 1017974	3,027	5,798	21,475	4.00	23,193	268.4	600	37	6.00	6.03	0.31	0.22	400.00	1.08	305.8	87.77%	YES
FMH 1017974	FMH 1017979	0	5,798	21,475	4.00	23,193	268.4	600	39	6.03	5.82	0.22	0.12	400.00	1.08	305.8	87.77%	YES
FMH 1017979	FMH 1017978	0	5,798	21,475	4.00	23,193	268.4	600	35	5.82	5.54	0.12	0.03	400.00	1.08	305.8	87.77%	YES
FMH 1017978	FMH 1017977	0	5,798	21,475	4.00	23,193	268.4	750	34	5.54	5.23	0.03	-0.05	400.00	1.25	551.0	48.72%	YES
FMH 1017977	FMH 1017980	0	5,798	21,475	4.00	23,193	268.4	750	31	5.23	4.96	-0.05	-0.13	387.50	1.27	559.9	47.95%	YES
FMH 1017980	FMH 1017981	0	5,798	21,475	4.00	23,193	268.4	750	11	4.96	5.04	-0.13	-0.16	387.50	1.27	559.9	47.95%	YES
FMH 1017981	Long Ping SPS	0	5,798	21,475	4.00	23,193	268.4	750	4	5.04	5.04	-0.30	-0.31	387.50	1.27	559.9	47.95%	YES

Capacity Performance of Existing Sewers in 2025

Notes:
(1) Calculate by Colebrook-White Equation

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

where ks is equivalent roughness with value equals 1.5mm for existing sewers.
v is kinematic viscosity of fluid = 1.14 x 10-6 m^2/s and g is the gravity = 9.81m/s^2
V is the velocity, D is the diameter of the sewer and S is the gradient of the sewer.

(2) Peaking factor refers to EPD's GESF Table T-5, excluding stormwater allowance for proposed sewers

Abbreviation:

UP_MAN	Upstream Manhole	ACC_POP	Accumulated Population	UP_GL	Upstream Ground Level	F/C	Peak Flow/Capacity
DN_MAN	Downstream Manhole	CON_POP	Contributing Population	DN_GL	Downstream Ground Level	DN_INV	Downstream Invert Level
ADWF	Average Dry Weather	DIA	Diameter	UP_INV	Upstream Invert Level	VEL	Velocity
ACC_ADWF	Accumulated Average Dry Weather Flow	LEN	Length	CAP	Capacity		

3. Existing DN600 Rising Main from Long Ping SPS to YLSTW

Manhole		ADWF	ACC_ADWF	CON_POP	PEAKING FACTOR	Peak Flow	Peak Flow	Pipe Parameter		VEL	Velocity
UP_MAN No.	DN_MAN No.	(m3/d)	(m3/d)			(m3/d)	(L/s)	DIA (D) (mm)	Area (m^2/s)	(m/s)	Acceptable?
Long Ping SPS	FMH 1008736	5,798	5,798	21,475	3.50	20,294	234.9	600	0.28	71.78	YES

4. Existing DN1350 to DN1800 Sewerage System from Long Ping SPS to YLSTW

Manhole		ADWF	ACC_ADWF	CON_POP	PEAKING FACTOR	Peak Flow	Peak Flow	Pipe Parameter							VEL	CAP	F/C	Adequate Capacity?
UP_MAN No.	DN_MAN No.	(m3/d)	(m3/d)			(m3/d)	(L/s)	DIA (D) (mm)	LEN (m)	UP_GL (mPD)	DN_GL (mPD)	UP_INV (mPD)	DN_INV (mPD)	Gradient (S), 1 in XX	(m/s)	(L/s)	(%)	
FMH 1008736	FMH 1008737	33,444	39,243	145,343	3.46	135,744	1571.1	1350	29	3.90	4.12	1.32	1.27	580.00	1.50	2146.3	73.20%	YES
FMH 1008737	FMH 1008735	0	39,243	145,343	3.46	135,744	1571.1	1350	42	4.12	3.89	1.27	1.21	700.00	1.36	1952.9	80.45%	YES
FMH 1008735	FMH 1008733	0	39,243	145,343	3.46	135,744	1571.1	1350	39	3.89	4.29	1.21	1.10	354.55	1.92	2747.5	57.18%	YES
FMH 1008733	FMH 1008732	0	39,243	145,343	3.46	135,744	1571.1	1500	44	4.29	4.14	1.10	1.03	628.57	1.54	2718.1	57.80%	YES
FMH 1008732	FMH 1008731	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.14	4.02	1.03	0.93	420.00	1.88	3327.6	47.21%	YES
FMH 1008731	FMH 1008730	0	39,243	145,343	3.46	135,744	1571.1	1500	39	4.02	4.15	0.93	0.85	487.50	1.75	3087.9	50.88%	YES
FMH 1008730	FMH 1008729	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.15	4.35	0.85	0.76	466.67	1.79	3156.3	49.78%	YES
FMH 1008729	FMH 1008728	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.35	4.41	0.76	0.89	-323.08	-	-	-	YES
FMH 1008728	FMH 1008727	0	39,243	145,343	3.46	135,744	1571.1	1500	29	4.41	4.49	0.89	0.86	966.67	1.24	2189.8	71.75%	YES
FMH 1008727	FMH 1008726	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.49	4.55	0.86	0.82	1050.00	1.19	2100.7	74.79%	YES
FMH 1008726	FMH 1008719	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.55	4.46	0.82	0.78	1050.00	1.19	2100.7	74.79%	YES
FMH 1008719	FMH 1008720	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.46	4.36	0.78	0.74	1050.00	1.19	2100.7	74.79%	YES
FMH 1008720	FMH 1008716	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.36	4.26	0.74	0.70	1050.00	1.19	2100.7	74.79%	YES
FMH 1008716	FMH 1008717	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.26	4.25	0.70	0.66	1050.00	1.19	2100.7	74.79%	YES
FMH 1008717	FMH 1008718	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.25	4.36	0.66	0.62	1050.00	1.19	2100.7	74.79%	YES
FMH 1008718	FMH 1008713	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.36	4.48	0.62	0.58	1050.00	1.19	2100.7	74.79%	YES

Manhole								Pipe Parameter										
UP_MAN No.	DN_MAN No.	ADWF (m3/d)	ACC_ADWF (m3/d)	CON_POP	PEAKING FACTOR	Peak Flow (m3/d)	Peak Flow (L/s)	DIA (D) (mm)	LEN (m)	UP_GL (mPD)	DN_GL (mPD)	UP_INV (mPD)	DN_INV (mPD)	Gradient (S), 1 in XX	VEL (m/s)	CAP (L/s)	F/C (%)	Adequate Capacity?
FMH 1008713	FMH 1008714	0	39,243	145,343	3.46	135,744	1571.1	1500	31	4.48	4.48	0.58	0.54	861.11	1.31	2320.8	67.70%	YES
FMH 1008714	FMH 1008715	0	39,243	145,343	3.46	135,744	1571.1	1500	54	4.48	4.45	0.54	0.51	1384.62	1.03	1828.0	85.95%	YES
FMH 1008715	FMH 1008711	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.45	4.24	0.51	0.46	933.33	1.26	2228.8	70.49%	YES
FMH 1008711	FMH 1008712	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.24	4.15	0.46	0.42	1050.00	1.19	2100.7	74.79%	YES
FMH 1008712	FMH 1008702	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.15	4.26	0.42	0.37	840.00	1.33	2349.9	66.86%	YES
FMH 1008702	FMH 1008699	0	39,243	145,343	3.46	135,744	1571.1	1500	44	4.26	4.38	0.37	0.33	1100.00	1.16	2052.2	76.56%	YES
FMH 1008699	FMH 1008700	0	39,243	145,343	3.46	135,744	1571.1	1500	39	4.38	4.46	0.33	0.29	975.00	1.23	2180.4	72.06%	YES
FMH 1008700	FMH 1008701	0	39,243	145,343	3.46	135,744	1571.1	1500	34	4.46	4.37	0.29	0.25	850.00	1.32	2336.0	67.26%	YES
FMH 1008701	FMH 1008625	0	39,243	145,343	3.46	135,744	1571.1	1500	44	4.37	4.27	0.25	0.21	1100.00	1.16	2052.2	76.56%	YES
FMH 1008625	FMH 1008624	0	39,243	145,343	3.46	135,744	1571.1	1500	42	4.27	4.21	0.21	0.17	1050.00	1.19	2100.7	74.79%	YES
FMH 1008624	FMH 1008623	0	39,243	145,343	3.46	135,744	1571.1	1500	34	4.21	4.20	0.17	0.13	850.00	1.32	2336.0	67.26%	YES
FMH 1008623	FMH 1008604	0	39,243	145,343	3.46	135,744	1571.1	1500	39	4.20	4.70	0.13	0.09	975.00	1.23	2180.4	72.06%	YES
FMH 1008604	FMH 1008603	0	39,243	145,343	3.46	135,744	1571.1	1500	36	4.70	4.49	0.09	0.05	900.00	1.28	2269.8	69.22%	YES
FMH 1008603	FMH 1008602	0	39,243	145,343	3.46	135,744	1571.1	1500	36	4.49	4.40	0.05	0.01	900.00	1.28	2269.8	69.22%	YES
FMH 1008602	FMH 1008601	0	39,243	145,343	3.46	135,744	1571.1	1500	29	4.40	4.30	0.01	-0.02	1000.00	1.22	2152.8	72.98%	YES
FMH 1008601	FMH 1008600	0	39,243	145,343	3.46	135,744	1571.1	1500	39	4.30	4.30	-0.02	-0.05	1258.06	1.09	1918.2	81.90%	YES
FMH 1008600	FMH 1008599	0	39,243	145,343	3.46	135,744	1571.1	1500	39	4.30	4.20	-0.05	-0.09	975.00	1.23	2180.4	72.06%	YES
FMH 1008599	FMH 1022261	0	39,243	145,343	3.46	135,744	1571.1	1500	39	4.20	4.00	-0.09	-0.13	975.00	1.23	2180.4	72.06%	YES
FMH 1022261	FMH 1008597	0	39,243	145,343	3.46	135,744	1571.1	1500	21	4.00	3.90	-0.13	-0.16	814.29	1.35	2386.9	65.82%	YES
FMH 1008597	FMH 1008596	0	39,243	145,343	3.46	135,744	1571.1	1800	36	3.90	3.91	-0.16	-0.20	814.29	1.51	3850.5	40.80%	YES