

Hong Kong Housing Authority  
**Public Housing Development at  
Wang Chau, Yuen Long**  
Final Water Impact Assessment

REP-033-01

Final | Oct 2014

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Job number 226464

**Ove Arup & Partners Hong Kong Ltd**  
Level 5 Festival Walk  
80 Tat Chee Avenue  
Kowloon Tong  
Kowloon  
Hong Kong  
[www.arup.com](http://www.arup.com)

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# 1 INTRODUCTION

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## 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 water impact assessment (WIA) 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 WIA is to assess the impacts of the proposed development on the water supply system in the vicinity of Project site and substantiate the feasibility of the Project in terms of capability and serviceability of the system. Any necessary enhancement and improvements to the local water supply system will be recommended.
- 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 WIA due to the proposed PH development at Wang Chau, Yuen Long. It formulates the proposed water supply systems with mitigation measures with an aim to minimize both the short-term and long-term impacts on the existing water supply system.
- 1.2.1.2 Specifically, the objectives of this report are set out as follows:
- to take cognisance of the existing and proposed studies and projects which may have bearing on the development;
  - to assess the water demands for the developments;
  - to assess the short-term and long-term impacts on water mains and demands for the development;
  - to propose and design the water supply scheme arising from the development including carrying out all necessary hydraulic analysis to substantiate the proposed water supply scheme;
  - to ensure that the interfaces with the works facilities are properly resolved, and that adequate mitigation and protection measures are practically developed for construction and operation phases of the developments and incorporated for future development into the detailed design;
  - to formulate and recommend suitable protection schemes and measures and/or diversion schemes and arrangements to protect the works facilities, and minimise the disturbance to the normal operation of the facilities during both construction and operation stages;

- to enable an agreement in principle to be reached with WSD 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 Carry out the WIA and assesses the impacts on the existing and planned water supply systems due to the development and recommend the 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
AT	Au Tau
DSD	Drainage Services Department
EPD	Environmental Protection Department
FSD	Fire Service Department
FWPSR	Fresh Water Primary Service Reservoir
FWSR	Fresh Water Service Reservoir
GB	Green Belt
GFA	Gross Floor Area
G/IC	Government/ Institution/ Community
HKPSG	Hong Kong Planning Standards and Guidelines
HOS	Home Ownership Scheme
IL	Invert Level
ISWB	Integrated Social Welfare Building
LOS	Local Open Space
MDD	Mean Daily Demand
NT	New Territories
NTM	Ngau Tam Mei
OS	Open Storage
OZP	Outline Zoning Plan
PE	Polyethylene
PRH	Public Rental Housing
PR	Plot Ratio
PTI	Public Transport Interchange
TWL	Top Water Level

<b>Abbreviations</b>	<b>Term</b>
VE	Village Environs
WC	Wang Chau
WSD	Water Supplies Department
WTW	Water Treatment Works

## 2 PROJECT DESCRIPTION

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### 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 WIA, 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 (1897 for HOS and 2122 for PRH, with total estimated population of 12,338 <sup>[1]</sup> )
Non-domestic uses (including refuse collection point (RCP), covered walkway, etc)	4,000 GFA <sup>[2]</sup> (m <sup>2</sup> )
Retail	3,209 GFA <sup>[2]</sup> (m <sup>2</sup> ) 2,118 IFA <sup>[2]</sup> (m <sup>2</sup> )
Primary School	24 Classrooms
Social Welfare Facilities	4,450 NOFA <sup>[3]</sup> (m <sup>2</sup> )

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 WATER IMPACT ASSESSMENT

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### 3.1 Introduction

3.1.1.1 Liaison with WSD has been made to obtain relevant information, including but not limited to the existing capacity of water supply system, water consumption statistic and planned waterworks near the Project site.

### 3.2 Methodology and Design Criteria

#### 3.2.1 Design Guidelines

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

- a) Review interface projects which may have bearing on the development;
- b) Identify existing and planned water supply systems within the study area;
- c) Assess the water demands for the development;
- d) Propose the water supply scheme arising from the development including preparation of a hydraulic analysis;
- e) Examine the short- and long-term impacts on existing water mains and any interface projects;
- f) Recommend suitable mitigation measures and/or diversion schemes and arrangements to mitigate the permanent impacts on existing water supply system and minimise the disturbance to the normal operation of the system during construction stage;

3.2.1.2 The estimate of water demands for the proposed development is based on the development parameters shown in Section 2. Estimates are generally based on unit water demands provided by WSD Departmental Instruction (DI) No. 1309.

3.2.1.3 The assessment of water mains under Fire-fighting scenario is performed based on the requirement stipulated in WSD DI No.1309 and Fire Service Department (FSD) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment (April 2012 revision).

#### 3.2.2 Hydraulic Analysis

3.2.2.1 The existing fresh water trunk system is modelled under the following conditions:

Demand for fresh and flushing water = 1.5 x MDD (Mean Daily Demand)

- 3.2.2.2 The proposed fresh water distribution system is modelled under the following conditions:

$$\text{Service Reservoir Water Level} = (\text{TWL} - \text{IL})/2$$

$$\text{Demand for fresh water} = 3 \times \text{MDD (Mean Daily Demand)}$$

$$\text{Demand for flushing water} = 2 \times \text{MDD (Mean Daily Demand)}$$

- 3.2.2.3 Under fire-fighting scenario, hydraulic analysis has taken account of additional withdrawal at the extremity of the system with adjustment on the demand as below:

$$\text{Demand for fresh water} = 1 \times \text{MDD (Mean Daily Demand)}$$

$$\text{Demand for flushing water} = 1 \times \text{MDD (Mean Daily Demand)}$$

- 3.2.2.4 The analysis assumes concurrent fires will not occur within the same supply zone.

- 3.2.2.5 The fire-fighting requirements are shown in **Table 3.2.1**. Moreover, reading in conjunction with Code of Practice for Minimum Fire Service Installations and Equipment, the hydrant shall be of an accepted standard pattern and, with one 65 mm outlet working, shall be capable of delivering not less than 2,000 litres per minute (33.3 litre/second) with a minimum running pressure of 17m at the outlet. The minimum output and pressure should be made available from two 65 mm outlets of a system delivering at the same time, i.e. a total output of not less than 4,000 litres per minute (66.7 litre/second).

**Table 3.2.1:** Fire Fighting Requirements

Land Use	MDD	Peak Flow Factor
Residential	6000 m <sup>3</sup> /d	1
Industrial	11,000 m <sup>3</sup> /d	1

- 3.2.2.6 Internal diameter of the water mains is used for hydraulic analysis. **Table 3.2.2** shows the nominal diameter and corresponding internal diameter for the common pipe sizes.

**Table 3.2.2:** Internal Diameter for Pipes

Nominal Diameter (mm)	Internal Diameter (mm)	
	Fresh Water Mains	Salt Water Mains
2000	1976	1932
1800	1776	1732
1600	1576	1532
1400	1379	1335
1200	1182	1150
1000	981	945
900	882	847
800	784	750
700	682	648
600	586	567
550	536	536



Nominal Diameter (mm)	Internal Diameter (mm)	
	Fresh Water Mains	Salt Water Mains
525	510	510
500	485	485
450	424	424
400	382	382
375	358	358
350	334	334
300	282	282
250	233	233
200	189	189
150	138	138
100	95	95
80	80	80
50	50	50
40	40	40
25	25	25
20	20	20

3.2.2.7 To cater for bend losses, the pipe length is factored by:

- a) For urban areas = 1.2
- b) For rural areas = 1.1

3.2.2.8 The pipeline headloss is calculated based on Hazen-Williams equation. The corresponding roughness coefficient is shown in **Table 3.2.3**.

**Table 3.2.3:** Hazen-Williams Roughness Coefficients

Water Main	Pipe Diameter (mm)	Roughness Coefficient
Fresh	< DN600	110
	≥ DN600	120
TMF	All	90

3.2.2.9 The design criteria for TMF will follow the salt water supply design criteria under DI 1309. The system should meet the criteria as shown in **Table 3.2.4** below.

**Table 3.2.4:** Design Criteria for Fresh Water Main and Temporary Main for Flushing

Scenario ID	Description	Minimum Residual Head (m)			Velocity of Distribution Pipeline under Peak Flow Condition (m/s)	
		Fresh Water Main	TMF	Fire Location	Minimum	Maximum
A	Daily Operation (Without Fire-Fighting)	20	15	N/A	0.9	3
B	With Fire-Fighting			17	N/A	N/A

3.2.2.10 The hydraulic analysis is performed by InfoWater. The analysis assesses the impact on existing water system as well as conducting hydraulic analysis on the proposed pipeline within the Project site with the aim to substantiate the proposed water supply scheme.

3.2.2.11 Two scenarios namely A and B are considered in the analysis as shown in **Table 3.2.5** below.

**Table 3.2.5:** Scenarios Considered in Hydraulic Modelling

Scenario ID	Water Demand	Description
A	Existing + Project Site	Daily Operation (Without Fire-Fighting)
B	Existing + Project Site	With Fire-Fighting

### 3.3 Existing and Planned Water Supply System

3.3.1.1 The Project site is located within the distribution zone of Ngau Tam Mei Water Treatment Works (NTM WTW) and Au Tau Water Treatment Works (AT WTW). According to WSD, the AT WTW has been mothballed while NTM WTW serves Wang Chau, Tin Shui Wai, Ngau Tam Mei, San Tin and Mai Po and the north-western part of Tuen Mun areas. Currently, NTM WTW can singly meet the existing water demands within the whole supply zone.

3.3.1.2 **Table 3.3.1** provides a summary of information obtained from WSD regarding the Water Treatment Works serving the Project site, which shows the NTM WTW has nearly reached its capacity. Therefore it alone does not have spare capacity to cater for additional water demand by the proposed development. Furthermore, it is anticipated that future development within North West NT will source water from the NTM WTW/AT WTW supply zone; therefore it is proposed to activate AT WTW and operate in parallel with NTM WTW.

**Table 3.3.1:** Existing daily water demand (m<sup>3</sup>/d) at Water Treatment Works in 2012

Water Treatment Works (WTW)	Recorded Maximum Outputs in 2012	Existing Capacity
NTM WTW	229,200 <sup>(1)</sup>	230,000
AT WTW	N/A <sup>(2)</sup>	330,000

(1) As recorded at Ngau Tam Mei WTW in June 2012

(2) As per information provided by WSD, AT WTW has been mothballed

3.3.1.3 The Project site is located within supply zones served by the Ngau Tam Mei Fresh Water Primary Service Reservoir (NTM FWPSR), Au Tau Fresh Water Primary Service Reservoir (AT FWPSR), Wang Chau Fresh Water Service Reservoir (WC FWSR) and the Tan Kwai Tsuen North Fresh Water Service Reservoir (TKTN FWSR). The key waterworks and fresh water service reservoir supply zones are shown in **Drawing No. 226464/OAP/C/030**.

3.3.1.4 With reference to WSD record plans and WSD schematic layout of fresh water supply in Tuen Mun and Yuen Long areas, the existing fresh water supply services in the vicinity of the Project site comprise the following:

**Table 3.3.1a:** Existing Fresh Water Supply Services

Services	System	Location
DN900 pipe	Trunk water main delivery from NTM FWPSR to WC FWSR	Along Fuk Hi Street
DN250 and DN80 pipes	Distribution mains connected to DN900 trunk main to supply water for existing open storage area and housing within and near the Project site.	Along Long Ping Road
DN900 pipe	Distribution main (TMF) from WC FWSR serving Tin Shui Wai (TSW)	From WC FWSR to TSW
DN600 and DN450 pipes	Distribution mains from WC FWSR	Along Fuk Shun Street
DN300 pipes	Distribution mains from WC FWSR, branch of the above DN600 distribution main	Along Fuk Hi Street

3.3.1.5 A record of the existing fresh water supply services in the vicinity of the Project site is shown in **Drawing No. 226464/OAP/C/031**.

3.3.1.6 The estimation of water demand for service reservoirs in year 2012 as shown in **Table 3.3.2** is based on the Working Group on Population Distribution Projections (2013-2021) - by District Council District, New Town and Tertiary Planning Unit (March 2013). The unit demand for existing developments is derived based on the benchmark of maximum water daily consumption of service reservoirs in year 2012. It is assumed that the unit demand takes into account of the residential uses, industrial uses and other land uses. A review of benchmark maximum water consumption rates in **Table 3.3.2** reveals that the estimated demands are reasonably accurate. Detailed calculations are attached in **Appendix A**.



**Table 3.3.2:** Existing daily water demand (m<sup>3</sup>/d) at Fresh Water Service Reservoirs in Year 2012

Existing Fresh Water Service Reservoirs (FWSRs)	Estimated Fresh Water Demand (m <sup>3</sup> /d)	Estimated Flushing Water Demand (m <sup>3</sup> /d)	Total Estimated Water Demand without Using Recycled Water (m <sup>3</sup> /d)	Benchmark of Maximum Water Consumption Rate in Year 2012 (m <sup>3</sup> /d) <sup>(1)</sup>	Required Capacity of FWSR in 2012 (m <sup>3</sup> )	Existing Capacity of FWSR (m <sup>3</sup> )
Ngau Tam Mei Primary	17,828 (Direct Feed)	5,963 (Direct Feed)	23,790 (Direct Feed)	127,090 <sup>(2)</sup> (Direct Feed)	66,174	40,750
Wang Chau	3,941	21,568	25,510	17,310	8,348	58,790
Tan Kwai Tsuen North	63,624	2,066	65,690	65,560	48,235	81,516
Au Tau Primary	43,178 (Direct Feed)	15,112 (Direct Feed)	58,290 (Direct Feed)	n/a	46,929	100,548
Tuen Mun North	39,880	13,958	53,838	n/a	33,400	60,564
<b>Total</b>	<b>168,451</b>	<b>58,667</b>	<b>227,118 <sup>(3)</sup></b>	<b>229,200</b>	<b>n/a</b>	<b>342,168</b>

(1) Data provided by WSD under letter dated 22 January 2013, Ref: (22) in WSD 1556/406/11 Pt.1

(2) Currently AT WTW is suspended, therefore NTM Primary S/R also serves AT Primary S/R supply zone. The total estimated water consumption of NTM Primary S/R (Direct Feed) is 23,790 + 58,290 + 53,838= 135,918 m<sup>3</sup>/d, which is comparable to the recorded consumption rate 127,090 m<sup>3</sup>/d.

(3) Total estimated consumption rate of NTM WTW is 227,118 m<sup>3</sup>/d which is comparable to the recorded consumption rate 229,200 m<sup>3</sup>/d

(4) Currently AT WTW is suspended, therefore NTM Primary S/R also serves AT Primary S/R, the required capacity summary includes AT WTW supply zone. No secondary storage allowance for San Tin/Mai Po area as stated in WSD's Planning Report No. 6/93.

(5) Capacity of FW S/R = 0.75 MDD (FW) + 0.25 MDD (TMF)

(6) Capacity of Primary FW S/R = 0.75 MDD (FW) + 0.25 MDD (TMF) + 0.2 MDD of S/R

3.3.1.7 It is anticipated that future developments in Yuen Long South and Hung Shui Kiu will have implications on AT FWPSR, as elaborated in **Section 3.5** below. Furthermore, the TKTN FWSR is located far away from the Project site, it is not suggested to source water from this reservoir.

3.3.1.8 The Project Site is currently occupied by few open storage, farmland, fallow land, rural residential dwellings and temporary structures etc. These facilities and residential dwellings near the Project Site currently source water from the DN900 fresh water trunk main directly feed from NTM FWPSR. Although direct feed is currently adopted for supplying water to Project Site, it is not preferred from operation and maintenance point of view as advised by WSD. Therefore, it is expected that the proposed development should source water from WC FWSR and corresponding distribution system in view of the close proximity and available capacity of WC FWSR. The impacts and corresponding mitigation measures are presented in **Section 3.8**.

3.3.1.9 Although NTM FWPSR is currently overloaded, it is anticipated that the proposal to operate AT WTW in parallel with the NTM WTW will reduce the consumption rate from NTM FWPSR. Further explanations and assessment are provided in **Section 3.8**.

3.3.1.10 WSD has planned the salt water supply system to serve North West New Territories and Yuen Long (ref. Planning Report No. 10/2008) and the system as shown in **Drawing No. 226464/OAP/C/031** is under construction. However, the proposed development has not been

included in the plan and there is no existing salt water supply system available to the Project site for flushing.

3.3.1.11 **Table 3.3.4** provides a summary of information obtained from WSD which shows there is no existing or planned capacity in the salt water supply system to cater for the proposed development at this time.

**Table 3.3.4:** Planned Daily Water Demand (m<sup>3</sup>/d) within Tan Kwai Tsuen Salt Water Service Reservoir Supply Zone in Year 2012 and Later

	Year 2012 <sup>(1)</sup>	Later <sup>(1)</sup>
Residential		
Tan Kwai Tsuen Salt Water Service Reservoir Supply Zone (PWP No. 9045WS)	43,851	43,441
Tan Kwai Tsuen Salt Water Service Reservoir Extension Supply Zone (PWP No. 9048WS)	17,186	18,045
Industrial, Commercial & Hospital Uses	6,000	6,000
Total MDD	67,037	67,486
Salt Water Pumping Station at Lok On Pai (Required Capacity) <sup>(2)</sup>	80,444	80,983
Salt Water Pumping Station at Lok On Pai (Planned Capacity)	83,000	83,000
Tan Kwai Tsuen Salt Water Service Reservoir (Required Capacity) <sup>(3)</sup>	17,597	17,715
Tan Kwai Tsuen Salt Water Service Reservoir (Planned Capacity)	18,100	18,100

(1) Data provided by WSD under letter dated 22 January 2013, Ref: (22) in WSD 1556/406/11 Pt. 1

(2) Required Capacity of Salt Water Pumping Station = 1.2\*MDD

(3) Required Capacity of Salt Water Service Reservoir = 0.25\*MDD\*1.05

## 3.4 Water Demand Estimations

### 3.4.1 Water Demand Estimation and Projection – Wang Chau

3.4.1.1 The estimate of fresh and flushing water demand for the proposed development is 3,311 m<sup>3</sup>/d and 1,852 m<sup>3</sup>/d respectively. Thus, the total estimated water consumption for the proposed development is about 5,163 m<sup>3</sup>/d.

3.4.1.2 With reference to Table 1 of DI No. 1309, the water demand for the proposed development is estimated in **Table 3.4.1** below.

**Table 3.4.1:** Estimated Ultimate Daily Water Demand (m<sup>3</sup>/d) from the Proposed Development

Accommodation Type	Data	Remarks
<b>Residential – HOS Site</b>		
Gross Site Area	1.84	Project Planning Data
Population	6,406	For assessment purpose, 10% increment is applied
Fresh Water Unit Demand (m <sup>3</sup> /person/day)	0.27	Tables 1 & 2, DI No. 1309; Included Service Trades
FWMDD (m <sup>3</sup> /day)	1,730	Fresh Water Mean Daily Demand
Landscape Area	0.55	Assume 30% of Site Area
Irrigation Water Unit Demand (m <sup>3</sup> /ha/day)	100	Average daily requirement of 10mm for landscape

Accommodation Type	Data	Remarks
Irrigation Water MDD (m <sup>3</sup> /day)	55	Mean Daily Demand
Flushing Water Unit Demand (m <sup>3</sup> /person/day)	0.13	As advised by WSD
FLWMDD (m <sup>3</sup> /day)	833	Flushing Water Mean Daily Demand
<b>Residential – PRH Site</b>		
Gross Site Area	1.98	Project Planning Data
Population	7,166	For assessment purpose, 10% increment is applied
Fresh Water Unit Demand (m <sup>3</sup> /person/day)	0.18	Tables 1 & 2, DI No. 1309; Included Service Trades
FWMDD (m <sup>3</sup> /day)	1,290	Fresh Water Mean Daily Demand
Landscape Area	0.59	Assume 30% of Site Area
Irrigation Water Unit Demand (m <sup>3</sup> /ha/day)	100	Average daily requirement of 10mm for landscape
Irrigation Water MDD (m <sup>3</sup> /day)	59	Mean Daily Demand
Flushing Water Unit Demand (m <sup>3</sup> /person/day)	0.13	As advised by WSD
FLWMDD (m <sup>3</sup> /day)	932	Flushing Water Mean Daily Demand
<b>Education - Schools</b>		
No. of Primary Schools	1.00	Table 4, Chapter 3, HKPSG
Students per School	765	
No. of Kindergarten	1.00	Conservative value from Table 4, Chapter 3, HKPSG
Students per School	980	
Total No. of Students	1,745	Table 1, DI No. 1309
Fresh Water Unit Demand (m <sup>3</sup> /person/day)	0.025	
FWMDD (m <sup>3</sup> /day)	44	Table 1, DI No. 1309
Flushing Water Unit Demand (m <sup>3</sup> /person/day)	0.025	
FLWMDD (m <sup>3</sup> /day)	44	Estimated from number of places for different types of facilities
<b>Social Welfare Facilities</b>		
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	Assume commercial activities J11 with total sewage of 0.28 m <sup>3</sup> /person
No. of Employees	553	
Fresh Water Unit Demand (m <sup>3</sup> /person/day)	0.21	

Accommodation Type	Data	Remarks
		/day according to Table T-2, EPD's GESF
FWMDD (m <sup>3</sup> /day)	116	Assume commercial activities J11
Flushing Water Unit Demand (m <sup>3</sup> /person/day)	0.07	
FLWMDD (m <sup>3</sup> /day)	39	
<b>Retail/Market</b>		Project Planning Data Clause 2.1, Chapter 6, HKPSG
IFA (m <sup>2</sup> )	2,118	
IFA per Person (m <sup>2</sup> /employee)	26.15	Assume commercial activities J11 with total sewage of 0.28 m <sup>3</sup> /person/day
No. of Employee	81	
Fresh Water Unit Demand (m <sup>3</sup> /person/day)	0.21	
FWMDD (m <sup>3</sup> /day)	17	Assume commercial activities J11
Flushing Water Unit Demand (m <sup>3</sup> /person/day)	0.07	
FLWMDD (m <sup>3</sup> /day)	6	
<b>Total FWMDD (m<sup>3</sup>/day)</b>	<b>3,311</b>	Total Fresh Water Mean Daily Demand
Peaking Factor for Distribution Mains	3	For FW Distribution Main Design
<b>Fresh Water Peak Flow (m<sup>3</sup>/day)</b>	<b>9,933</b>	
<b>Total FLWMDD (m<sup>3</sup>/day)</b>	<b>1,852</b>	Total Flushing Water Mean Daily Demand
Peaking Factor for Distribution Mains	2	For FLW Distribution Main Design
<b>Flushing Water Peak Flow (m<sup>3</sup>/day)</b>	<b>3,705</b>	
<b>Total MDD (m<sup>3</sup>/day)</b>	<b>5,163</b>	Total Mean Daily Demand

3.4.1.3 The proposed development is anticipated to be commissioned in Year 2025. The demands are summarized in **Table 3.4.2**.



**Table 3.4.2:** Wang Chau Water Demand Estimation in Year 2025

Water Treatment Works (WTW)	Existing Fresh Water Service Reservoirs (FWSRs)	Estimated Fresh Water Demand in Year 2025 (m <sup>3</sup> /d)	Estimated Flushing Water Demand in Year 2025 (m <sup>3</sup> /d)	Total Estimated Water Demand in Year 2025 without Using Recycled Water (m <sup>3</sup> /d)
Ngau Tam Mei WTW	Ngau Tam Mei Primary (Direct Feed)	0	0	0
	Wang Chau	3,311	1,852	5,163
	Tan Kwai Tsuen North	0	0	0
<b>Total</b>		<b>3,311</b>	<b>1,852</b>	<b>5,163</b>

## 3.5 Interface Projects

3.5.1.1 The assessment has also taken into account the following existing, planned and proposed developments:

- Existing developments within supply zone of NTM WTW with planned population growth;
- North East New Territories (NENT) New Development Areas (NDA) Planning and Engineering Study;
- Salt Water Supply for Northwest New Territories (NWNT) – Mainlaying in Yuen Long;
- Salt Water Supply for Northwest New Territories – Construction of Tan Kwai Tsuen Salt Water Service Reservoir and Associated Works; and
- Replacement and Rehabilitation of Water Mains Stage 4.

### 3.5.2 Water Demand Estimation and Projection – Existing Development and Planned Growth

3.5.2.1 Population projections for existing developments within NTM WTW supply zone to year 2025 are based on the Working Group on Population Distribution Projections (2013-2021) - by District Council District, New Town and Tertiary Planning Unit (March 2013). The corresponding estimated water demands are summarized in the **Table 3.5.1** below.

**Table 3.5.1:** Water Demand Projection of Existing and Planned Growth in Year 2025

Water Treatment Works (WTW)	Existing Fresh Water Service Reservoirs (FWSRs)	Estimated Fresh Water Demand in Year 2025 (m <sup>3</sup> /d)	Estimated Flushing Water Demand in Year 2025 (m <sup>3</sup> /d)	Total Estimated Water Demand in Year 2025 without Using Recycled Water (m <sup>3</sup> /d)
Ngau Tam Mei WTW	Ngau Tam Mei Primary (Direct Feed)	19,375	6,483	25,858
	Wang Chau	12,676	4,346	17,022
	Tan Kwai Tsuen North	67,115	1,274	68,389
<b>Total</b>		<b>99,166</b>	<b>12,103</b>	<b>111,269</b>

### 3.5.3 NENT NDA Planning and Engineering Study

- 3.5.3.1 The Agreement No. CE61/2007(CE) NENT NDA planning and engineering study is underway. According to the latest Draft Technical Report No. 10E - WUIA issued in Nov 2013, the population within the NDAs will be built up in stages with the anticipated first population intake in 2023 and last population intake in 2031.
- 3.5.3.2 According to the report, it is recommended to source water from NTM WTW ultimately by laying a trunk main from NTM WTW to the proposed water supply facilities within the proposed development. The study also proposed that the NTM WTW will be expanded with a design capacity increase from 230 MLD to 450 MLD to cater for the additional water demand (about 73 MLD) from the NDAs.
- 3.5.3.3 It is noted that the expansion of NTM WTW will only be carried out under NENT NDA. Therefore, the current assessment has been carried out assuming that the design capacity of the NTM WTW remains at 230MLD. The additional impact on the current design capacity of NTM WTW (230MLD) arising from NENT NDA and corresponding mitigation measures should be confirmed in the NENT NDA study.

### 3.5.4 Other Planned Developments in NWNT

- 3.5.4.1 According to the Planning and Engineering Study reports of other planned developments including Hung Shui Kiu New Development Area and Yuen Long South Development, fresh water will be sourced from AT WTW via AT FWPSR or newly proposed FWSR which is independent of proposed NTM WTW supply zone. Therefore, there are no interfaces between the proposed developments and these planned developments.

### 3.5.5 Salt Water Supply for Northwest New Territories (NWNT) – Yuen Long

- 3.5.5.1 According to the information provided by WSD, a proposed salt water supply system to NWNT and Yuen Long is now under construction. It is anticipated that the works would be completed by June 2014.

- 3.5.5.2 The fresh water demand for flushing in Yuen Long area would be greatly reduced upon completion of the salt water supply system, in particular for Tin Shui Wai area with a total demand of about 20MLD for flushing purpose (currently source water from WCFWSR).

## 3.6 Total Water Demand Estimation

- 3.6.1.1 The total water demand from all known existing and proposed developments within the supply zones of NTM WTW in 2025 is summarized in **Table 3.6.1** below. The detailed calculations are provided in **Appendix A**.

**Table 3.6.1:** Total Water Demand Estimation in Year 2025

Water Treatment Works (WTW)	Existing Fresh Water Service Reservoirs (FWSRs)	Estimated Fresh Water Demand in Year 2025 (m <sup>3</sup> /d)	Estimated Flushing Water Demand in Year 2025 (m <sup>3</sup> /d)	Total Estimated Water Demand in Year 2025 without Using Recycled Water (m <sup>3</sup> /d)	Required Capacity of FWSR <sup>[1]</sup> in 2025 (m <sup>3</sup> /d)	Existing Capacity of FWSR (m <sup>3</sup> /d)
Ngau Tam Mei WTW	Ngau Tam Mei Primary	19,375 (Direct Feed)	6,483 (Direct Feed)	25,858 (Direct Feed)	19,381	40,750
	Wang Chau	15,987	6,198	22,185	13,540	58,790
	Tan Kwai Tsuen North	67,115	1,274	68,389	50,655	81,516
<b>Total</b>		<b>102,477</b>	<b>13,956</b>	<b>116,432</b>	<b>n/a</b>	<b>n/a</b>

Notes:

- (1) Capacity of FW S/R = 0.75 MDD (FW) + 0.25 MDD (TMF);
- (2) Capacity of Primary FW S/R = 0.75 MDD (Direct Feed FW) + 0.25 MDD (Direct Feed TMF) + 0.2 MDD of S/R;
- (3) Required capacity of NTM Primary FW S/R is calculated without secondary storage allowance for San Tin/Mai Po area as of the existing situation

## 3.7 Proposed Water Supply Scheme and Hydraulic Analysis

### 3.7.1 Proposed Fresh Water Supply Scheme

- 3.7.1.1 Since the NTM WTW has nearly reached its capacity and it alone has no spare capacity to cater for additional water demand, it is proposed to operate the AT WTW in parallel with NTM WTW in the long term to supply fresh water to the proposed development.
- 3.7.1.2 It is proposed to shift the supply zone of AT FWPSR (direct feed) and Tan Kwai Tsuen South (TKTS) FWSR to AT WTW while utilizing NTM WTW supply zone comprising NTM FWPSR (direct feed), Wang Chau FWSR and TKTN FWSR as per the proposed supply scheme presented in WSD Planning Report No. 10/95 shown in **Appendix B**. This supply scheme is readily achievable by controlling the existing cut-line valves. Under such case, it is anticipated that water consumption from NTM FWPSR will be reduced due to a portion of demand being offset by the AT WTW and AT FWPSR supply zone.



- 3.7.1.3 Although direct feed is currently adopted for supplying water to Project Site, it is not preferred from operation and maintenance point of view as advised by WSD. Moreover, in view of the proximity of WC FWSR, it is proposed to source water from WC FWSR and corresponding distribution mains.
- 3.7.1.4 One of the major considerations in deriving the proposed water supply system is the close proximity of the project site to the Wetland Buffer Area (WBA) and Conservation Area (CA) in Kai Shan. There is a general presumption against development within any WBA and CA zone and they should always be conserved as top priority. Any construction works within such zones will trigger potential ecological impacts and will very likely attract adverse comment and strong objection from AFCD/green groups. The existing WC FWSR is located within the WBA and CA area; and therefore it is not preferable to lay a separate distribution main directly from the WC FWSR although this could minimize the impact on the existing distribution system and the public. It is therefore proposed to serve the proposed development by connecting to the existing DN600 distribution main at the junction of Fuk Shun Street and Fuk Hi Street.
- 3.7.1.5 **Drawing Nos. 226464/OAP/C/032 and 301–304** illustrate the proposed water supply scheme. Common utility sections are provided in **Drawing No. 226464/OAP/C/701** to illustrate sufficient space is available within the street sections. It is proposed that mainlines will be either ductile iron or polyethylene. Adherence to WSD standards for mainlaying and equipment shall be maintained during detailed design and construction.

### 3.7.2 Proposed Salt Water Supply Scheme

- 3.7.2.1 Currently, there is no existing or planned delivery of salt water supply system within or in the vicinity of the Project site for flushing. Therefore, it is proposed to use Temporary Mains Water for Flushing (TMF) within the Project site. Separate fresh and flushing water supply mains within the Project site will allow the flexibility of changing the source of flushing water supply from fresh water to others, i.e. salt water or treated sewage effluent in the future by WSD if required.
- 3.7.2.2 The sustainable option for permanent flushing water supply source should be further developed in detailed design stage. For example, a proposal to reuse treated effluent from Yuen Long Sewage Treatment Works and adopt a grey water flushing system can be explored though certain degree of technical difficulties would have to be overcome.
- 3.7.2.3 In this study, it is assumed that flushing water will be supplied by fresh water supply system permanently. Therefore, the assessment on the capability of the existing / proposed fresh water distribution system has taken into account the flushing water demand.

### 3.7.3 Hydraulic Analysis

- 3.7.3.1 The fresh water distribution system is modelled under the following conditions:

$$\text{Wang Chau Service Reservoir Water Level} = (\text{TWL} - \text{IL})/2 = (67.0 - 60.845) / 2 = 63.9\text{mPD}$$

$$\text{Demand for fresh water} = 3 \times \text{MDD (Mean Daily Demand)}$$

$$\text{Demand for flushing water} = 2 \times \text{MDD (Mean Daily Demand)}$$

- 3.7.3.2 Detailed hydraulic analysis and modelling results are provided in **Appendix C**.

## 3.8 Potential Impact to Existing and Planned Waterworks Facilities

### 3.8.1 Impact on Water Treatment Works and Water Service Reservoirs

- 3.8.1.1 As AT WTW has been suspended and all water demands within the NTM WTW and AT WTW supply zones are supplied by NTM WTW and NTM FWPSR solely, currently the NTM WTW has reached its design capacity while NTM FWPSR has been overloaded.
- 3.8.1.2 There is insufficient capacity at NTM WTW alone to cater for the water demand arising from the proposed development. Therefore it is proposed to activate and operate AT WTW in parallel with the NTM WTW. The supply zone of AT FWPSR (direct feed) and Tan Kwai Tsuen South (TKTS) FWSR will be shifted to AT WTW while NTM WTW will supply the NTM FWPSR (direct feed), Wang Chau FWSR and TKTN FWSR.
- 3.8.1.3 Under such proposal, the total water demand of NTM WTW in year 2025 is estimated to be 116MLD approximately which is far lower than the design capacity of NTM WTW i.e. 230 MLD. NTM WTW will be capable to cater for the additional water demand arising from this Project.
- 3.8.1.4 The NTM FWPSR currently supplies water to San Tin and Mai Po areas directly via trunk main. According to WSD's planning report no. 6/93, the capacity of NTM FWPSR had been designed for the primary storage, which is equal to 20% of the maximum MDD of the NTM WTW. Secondary storage for direct supply areas (San Tin/Mai Po) was considered not necessary since it is a temporary arrangement.
- 3.8.1.5 Under the proposal that AT WTW operate in parallel with the NTM WTW, the consumption rate from NTM FWPSR will be reduced. The required capacity of the PSR in year 2025 is 19.4 MLD approximately which is lower than the design capacity of NTM FWPSR i.e. 40.8 MLD. The NTM FWPSR therefore has adequate capacity to cater for the additional water demand arising from the Project. The required



capacity of the NTM FWPSR is calculated based on the assumption that no secondary storage for San Tin/Mai Po area is allowed as per the existing situation. However, if necessity arises, the surplus storage at both NTM FWPSR and AT FWPSR will be available.

- 3.8.1.6 It is anticipated that AT WTW and AT FWPSR could cater for both the existing and planned developments within the proposed supply zone (TKTS FWSR and Tuen Mun North FWSR) according to WSD Planning Report No. 5/96. Detailed assessment on AT WTW and AT FWPSR shall be conducted under separate Planning and Engineering Study for those planned developments as mentioned in Section 3.5.4.
- 3.8.1.7 According to the WSD Planning Report No. 6/93, the trunk feed system from NTM FWPSR - DN1400 and DN900 trunk mains has a design capacity to cater for a maximum water demand of 139 MLD. The total water demand of NTM FWPSR supply zone in year 2025 is estimated to be 116MLD which is lower than the design capacity of the trunk feed system from NTM FWPSR i.e. 139 MLD. The trunk feed system will be capable to cater for the additional water demand arising from this Project.

### 3.8.2 Impact on Existing Water Main and Design of Proposed Water Main Network

- 3.8.2.1 There are no long-term (Year 2025) adverse impacts on the existing DN600 water main as the maximum velocity is estimated to increase to 1.64m/s which still satisfies the requirement stated in **Table 3.2.4**.
- 3.8.2.2 The proposed water main would connect to the existing DN600 fresh water main at the junction of Fuk Shun Street and Fuk Hi Street (one connection point) which would impose short-term impact on the existing water supply system during construction stage.
- 3.8.2.3 The existing branches within the Project site and its corresponding connection points are to be modified or abandoned.
- 3.8.2.4 Under daily operation of the water supply system (Scenario A), the residual heads at the proposed distribution mains within the Project site are sufficient to meet the minimum design criteria as stated in **Table 3.2.4**. The minimum residual heads for fresh water main and flushing water main are 32m and 26m respectively. The corresponding velocity within the proposed pipeline ranges from 0.58m/s to 1.64m/s which also meet the necessary design criteria.
- 3.8.2.5 In addition, both the existing and proposed system could also meet the necessary design criteria for the fire-fighting scenario (Scenario B). With the design fire flow demand, the minimum residual head within the distribution system is about 34.5m.
- 3.8.2.6 There is no spare capacity on the planned salt water supply system from Lok On Pai and Tan Kwai Tsuen to cater for the flushing water demand of the proposed development. Separate fresh and flushing water supply systems will be provided within the Project site to allow

the flexibility of changing the source of flushing water supply to the Project site in the future. The project will carry long-term impacts on the fresh water supply network until such time that alternatively sourced flushing water, such as salt water or treated sewage effluent (TSE) can be provided.

### 3.9 Proposed Mitigation Measures

- 3.9.1.1 To serve the proposed development, a proposed DN450-DN600 fresh water main is proposed along Long Ping Road and Fuk Hi Street and connects to the existing DN600 fresh water main at junction of Fuk Shun Street and Fuk Hi Street.
- 3.9.1.2 To serve buildings in the proposed development, DN150 flushing and DN250 fresh water mains are proposed along the new public road. The flushing main will be supplied with fresh water until such time that alternative water supply is provided to serve the Project site.
- 3.9.1.3 PH buildings that are not adjacent to flushing and fresh water mains at public roadways will be served by internal private water mains and maintained by HKHA.
- 3.9.1.4 Due considerations (in terms of schedule of works and detailing) should be given during the detailed design of the proposed connection points to the DN600 fresh water main in order to minimize the short-term impact to the public and the user. The short-term diversion of water mains may be necessary only to make the connection between existing and proposed water mains.
- 3.9.1.5 Due care should be taken during detailed design and construction to protect existing waterworks, including all above- and below-grade equipment, so as to maintain original working condition and full operation at all times. **Drawing Nos. 226464/OAP/C/301–304** illustrate the proposed fresh and flushing water connections and mitigation works.



## 4 CONCLUSION

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- 4.1.1.1 Since the NTM WTW has nearly reached its capacity and it alone has no spare capacity to cater for additional water demand, it is proposed to operate the AT WTW in parallel with NTM WTW in the long term to supply water to the proposed development.
- 4.1.1.2 It is proposed to shift the supply zone of AT FWPSR (direct feed) and Tan Kwai Tsuen South (TKTS) FWSR to AT WTW while utilizing the NTM WTW supply zone comprising NTM FWPSR (direct feed), Wang Chau FWSR and TKTN FWSR as per the proposed supply scheme presented in WSD Planning Report No. 10/95. Shifting the water supply zone should be readily achievable by WSD by controlling the existing cut-line valves.
- 4.1.1.3 It is proposed to serve the proposed development by connecting to the existing DN600 distribution main from WC FWSR at the junction of Fuk Shun Street and Fuk Hi Street
- 4.1.1.4 From the hydraulic point of view, the proposed water supply system is viable for supplying water to the proposed development with no adverse impacts on the existing water supply systems including WTW, PFWSR, FWSR, trunk mains and distribution mains.
- 4.1.1.5 The water demand and corresponding mitigation measures of other interfacing proposed developments, in particular for those currently at feasibility study stage, should be further reviewed and confirmed under their own studies.

## 5 REFERENCES

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- Advice Note No. 1 – Application of the Drainage Impact Assessment Process to Private Sector Projects issued by Drainage Services Department, September 2010.
- Drainage Services Department Stormwater Drainage Manual, December 2000.
- EPD Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning No.: EPD/TP 1/05.
- Hong Kong Planning Standards and Guidelines, August 2011.
- Planning Department – Projections of Population Distribution (2013-2021) by District Council District, New Town and Tertiary Planning Unit, March 2013.
- Agreement No. CE 2/2001 (CE) Hung Shui Kiu New Development Area Planning and Engineering Study.
- PWP Item No. 752CL Planning and Engineering Study for Housing Sites in Yuen Long South – Investigation

# Drawings



**LEGEND:**

PUBLIC HOUSING SITE



Rev	Description	KHC	Date
A	FIRST ISSUE		09/13

**ARUP**

Project title  
 Agreement No. CB20120293  
 Public Housing Development at Wang Chan, Yuen Long

Drawing title  
 LOCATION OF PROJECT SITE

Drawing no.	Rev.	Checked	Approved
226464/OA/P/011	A		
Date	KHC	DW	CC
09/13			
Scale	Status	PRELIMINARY	
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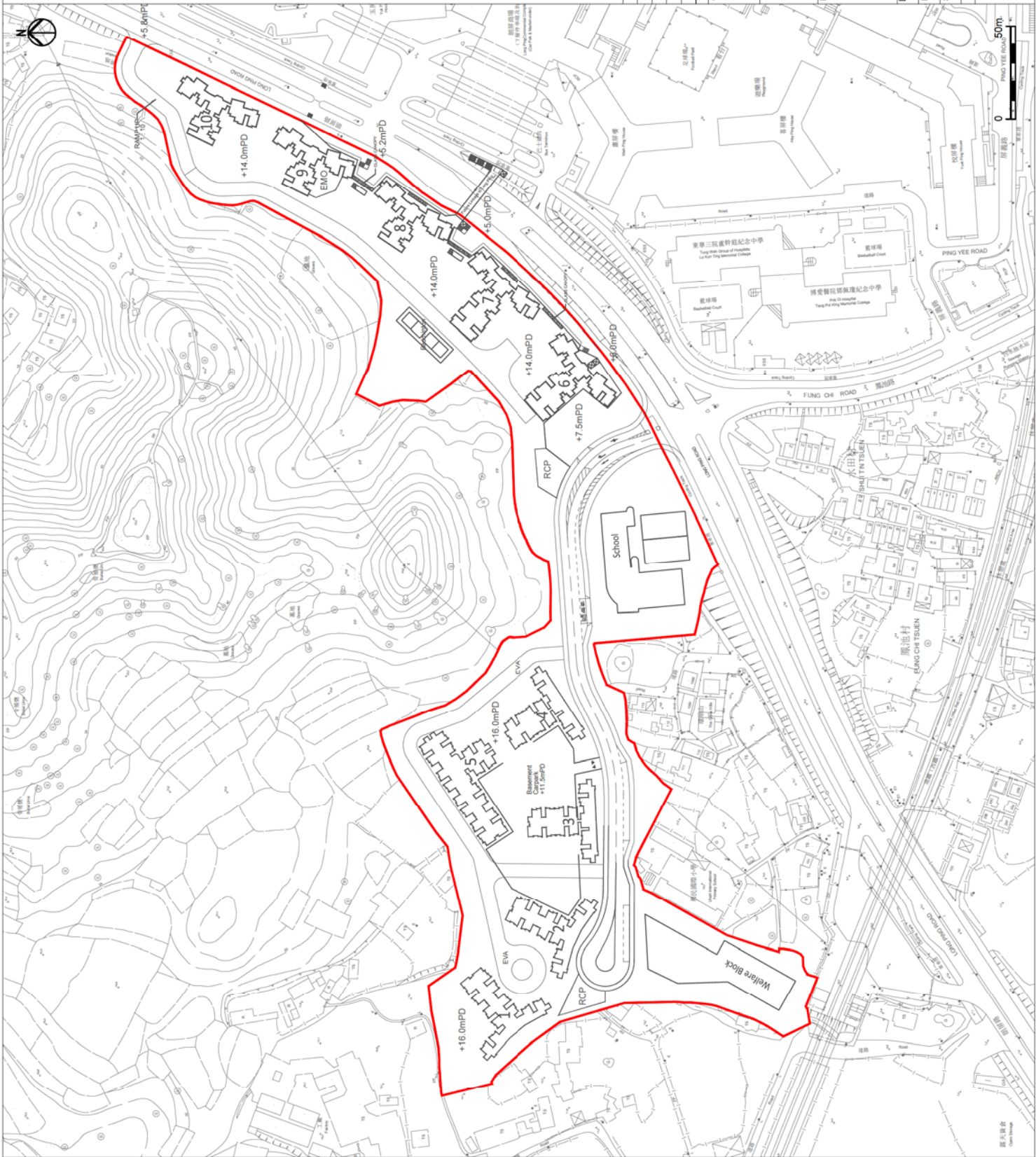
HONG KONG HOUSING AUTHORITY



Legend



Development Boundary



Rev	Description	GL	By	Date
A	FIRST ISSUE			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

Drawn	GL	Date	Checked	IL	Approved	Rev.
AS SHOWN		07/14				A


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AS SHOWN  
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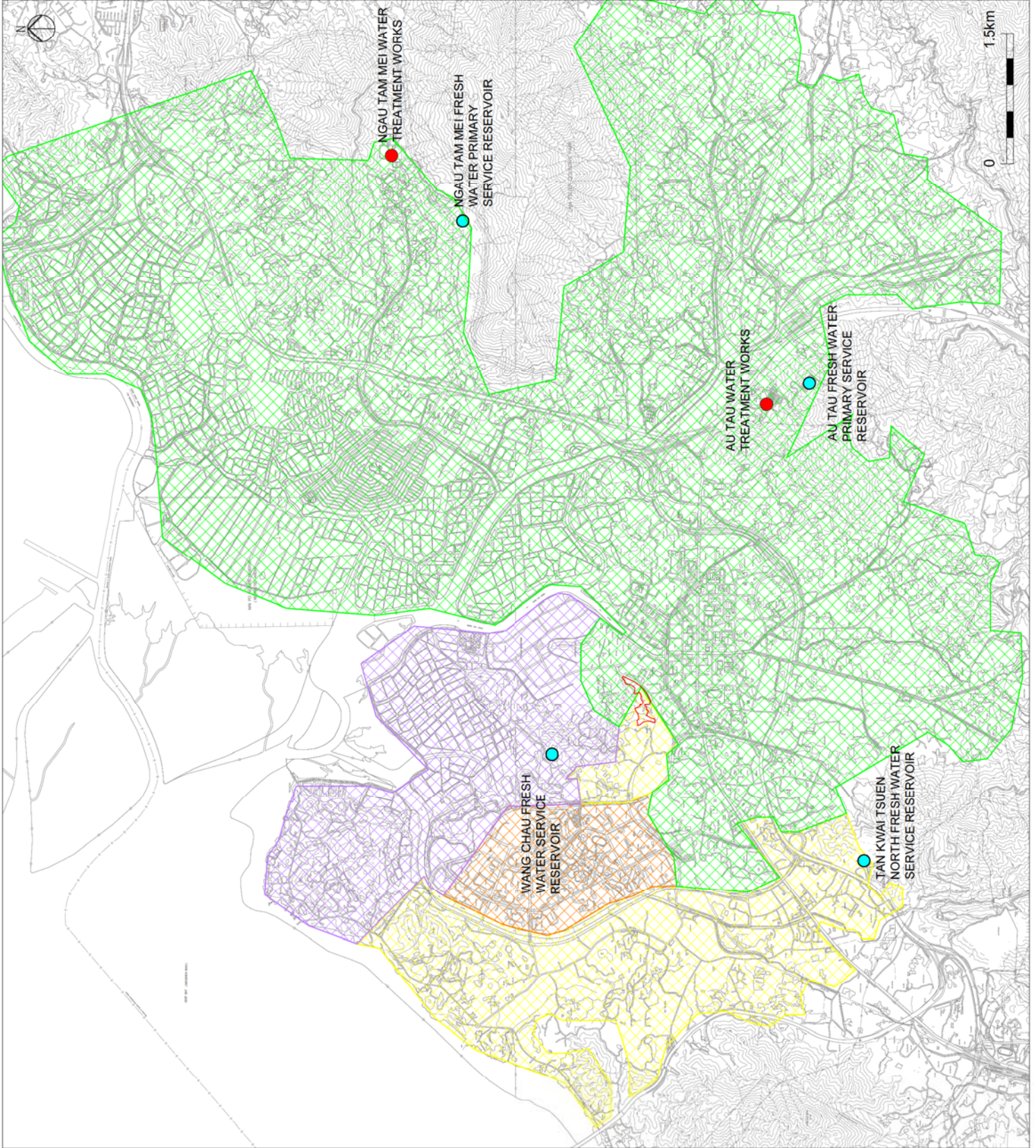


HONG KONG HOUSING AUTHORITY



**LEGEND:**

-  DEVELOPMENT BOUNDARY
-  WANG CHAU FRESH WATER SERVICE RESERVOIR SUPPLY ZONE
-  TAN KWAI TSUEN NORTH FRESH WATER SERVICE RESERVOIR SUPPLY ZONE
-  JOINT WANG CHAU AND TAN KWAI TSUEN NORTH FRESH WATER SERVICE RESERVOIR SUPPLY ZONE
-  NGAU TAM MEI FRESH WATER PRIMARY SERVICE RESERVOIR SUPPLY ZONE
-  EXISTING FRESH WATER SERVICE RESERVOIRS
-  WATER TREATMENT WORKS



Rev	Description	By	Date
1	FIRST ISSUE	GL	06/14

**ARUP**

Project title  
Public Housing Development at Wang Chau, Yuen Long

Drawing title  
KEY WATERWORKS AND FRESH WATER SERVICE RESERVOIR SUPPLY ZONES

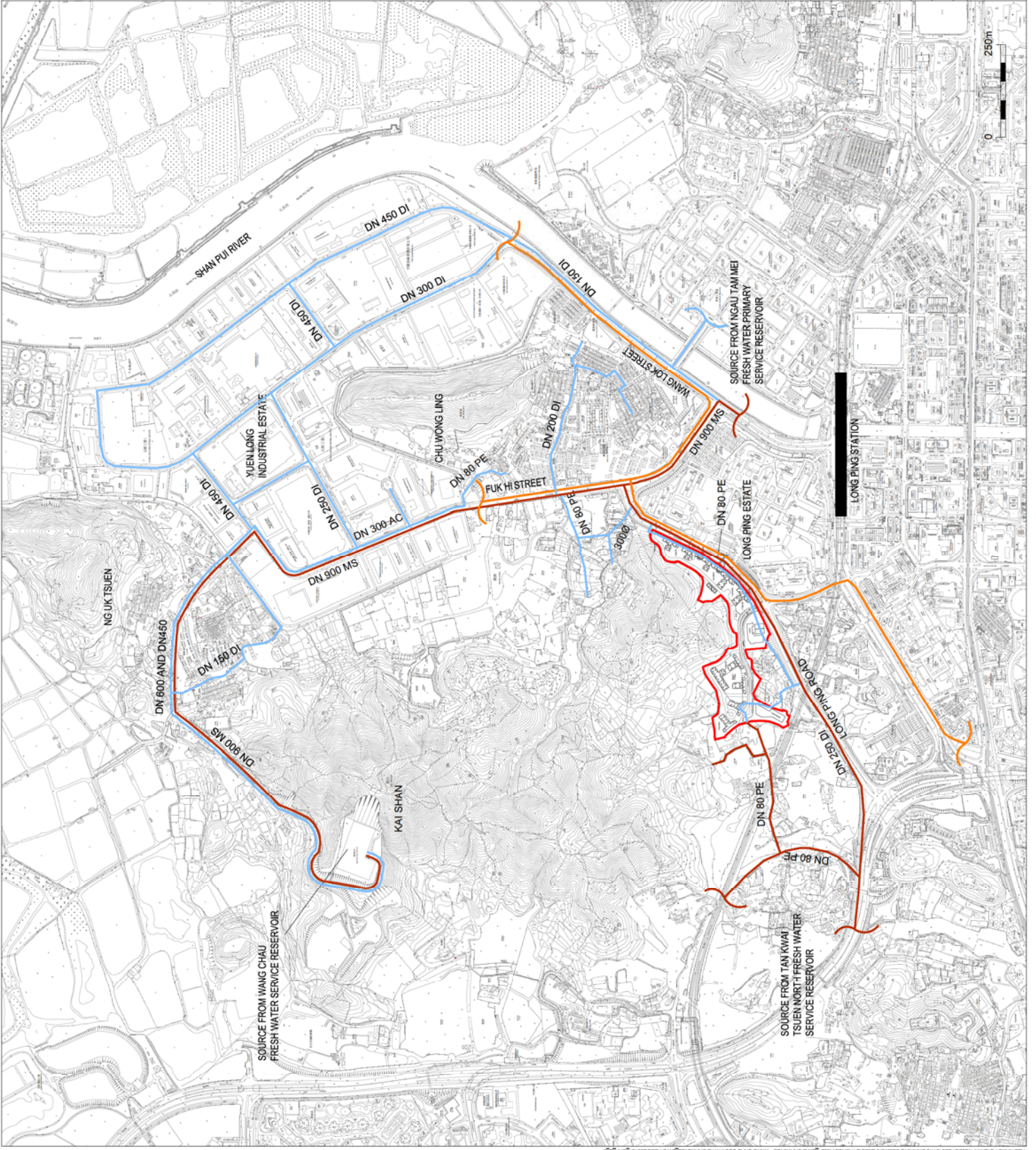
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- NOTES:**
- DEVELOPMENT BOUNDARY
  - EXISTING FRESH WATER DISTRIBUTION MAIN
  - PLANNED FRESH WATER DISTRIBUTION MAIN (BY WSD)
  - EXISTING FRESH WATER TRUNK MAIN



Rev	Description	By	Date
1	FIRST ISSUE	GL	06/14

# ARUP

Project title  
Public Housing Development at Wang Chau, Yuen Long

Drawing title  
EXISTING AND PLANNED WATER SUPPLY LAYOUT

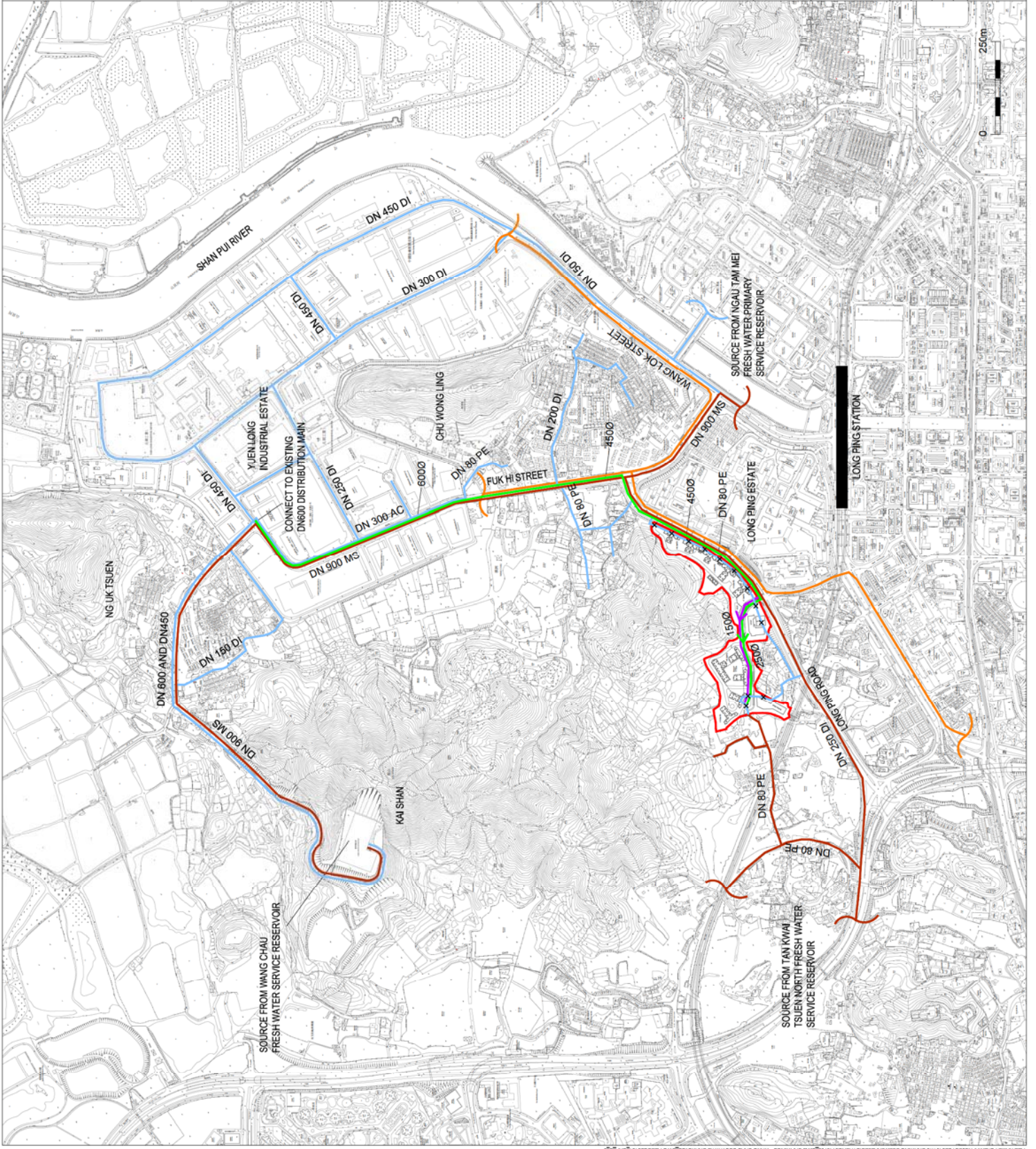
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Drawn	GL	Checked	MB
Date	06/14	Approved	ST
Scale	1:4000 (A1)	Status	PRELIMINARY



HONG KONG HOUSING AUTHORITY



- NOTES:
- DEVELOPMENT BOUNDARY
  - EXISTING FRESH WATER DISTRIBUTION MAIN
  - PLANNED FLUSHING WATER DISTRIBUTION MAIN (BY WSD)
  - EXISTING FRESH WATER TRUNK MAIN
  - PROPOSED FLUSHING WATER MAIN
  - PROPOSED FRESH WATER MAIN
  - EXISTING FRESH WATER MAIN TO BE DIVERTED
  - x-x EXISTING FRESH WATER MAIN TO BE DIVERTED



HONG KONG HOUSING AUTHORITY

# ARUP

Project title		Public Housing Development at Wang Chau, Yuen Long	
Drawing title			
OVERVIEW OF PROPOSED WATER SUPPLY			
Drawing no.	226464/OAPC/032	Rev.	A
Drawn	GL	Checked	MB
Date	09/14	Approved	ST
Scale	1:4000 (A1)	Status	PRELIMINARY
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Rev	Description	By	Date
A	RESPONSE TO COMMENT	GL	09/14
-	FIRST ISSUE	GL	05/14





LOCATION KEY PLAN

**NOTES:**  
 1. THERE IS NO SPARE CAPACITY FOR THE EXISTING PLANNED SALT WATER SUPPLY SYSTEM. EXISTING SALT WATER MAINS WITHIN YUEN LONG INDUSTRIAL ESTATE ARE NOT SHOWN FOR CLARITY.

**LEGEND:**

- DEVELOPMENT BOUNDARY
- @- PROPOSED FRESHWATER MAIN
- o- PROPOSED FLUSHING WATER MAIN
- x- EXISTING FRESH WATER MAIN TO BE OVERTAKEN
- x- EXISTING FRESHWATER MAIN
- SITE

Rev	Description	By	Date
A	RESPONSE TO COMMENT	GL	09/14
-	FIRST ISSUE	GL	05/14

**ARUP**

Project title  
 Public Housing Development at Wang Chau, Yuen Long

Drawing title  
 PROPOSED WATER SUPPLY LAYOUT PLAN

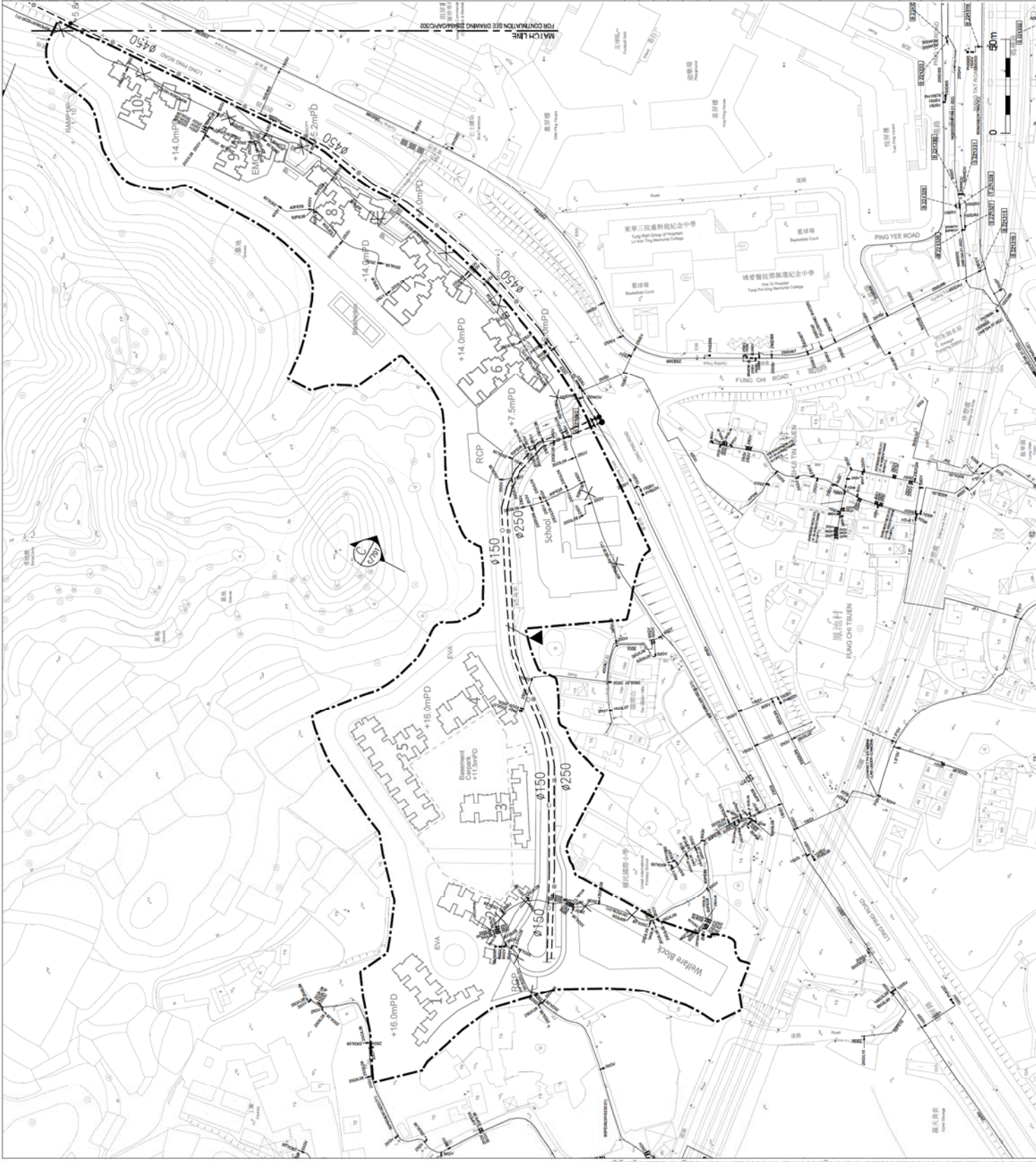
SHEET 1 OF 4

Drawing no.	226464/0A/PC/301	Rev.	A
Drawn	GL	Date	09/14
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LOCATION KEY PLAN

NOTES:  
1. FOR NOTES AND LEGEND REFER TO DRAWING NO. Z26464/PC/301.

Rev	Description	By	Date
A	RESPONSE TO COMMENT	GL	09/14
-	FIRST ISSUE	GL	05/14

Consultant  
**ARUP**

Project title  
Public Housing Development at Wang Chau, Yuen Long

Drawing title  
PROPOSED WATER SUPPLY  
LAYOUT PLAN

SHEET 3 OF 4

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LOCATION KEY PLAN

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1. FOR NOTES AND LEGEND REFER TO DRAWING NO. ZS6640A/C304.



Rev	DESCRIPTION	By	Date
05/14 <td>GL <td></td> <td></td> </td>	GL <td></td> <td></td>		

ARUP

Project title  
Public Housing Development at Wang Chau, Yuen Long

Drawing title  
PROPOSED WATER SUPPLY LAYOUT PLAN

Drawing no.		226464/IOAP/C/304	
Drawn	GL	Date	05/14
Checked	MB	Status	PRELIMINARY
Scale	1:1000 (A1)		
SHEET 4 OF 4			

Rev. Approved ST

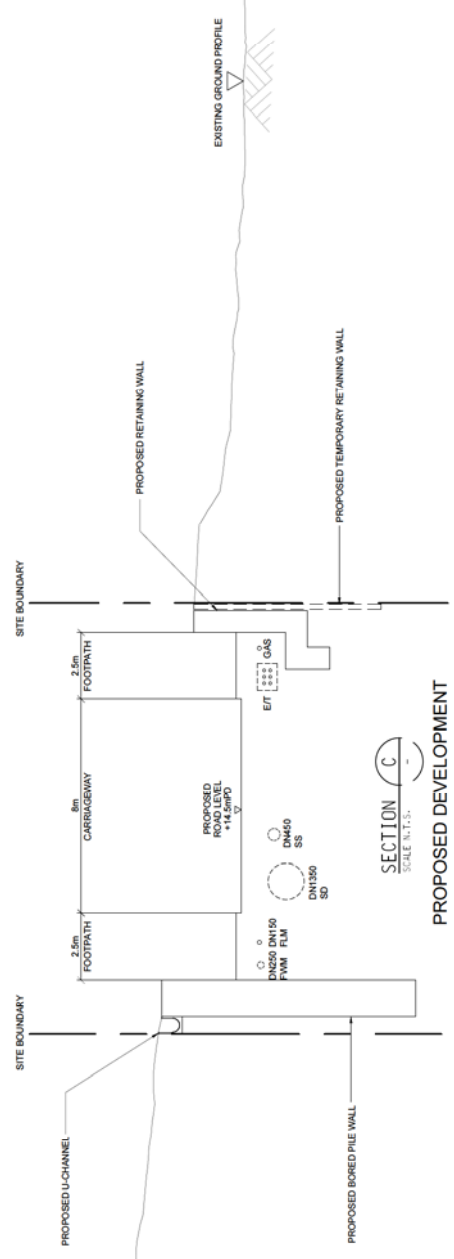
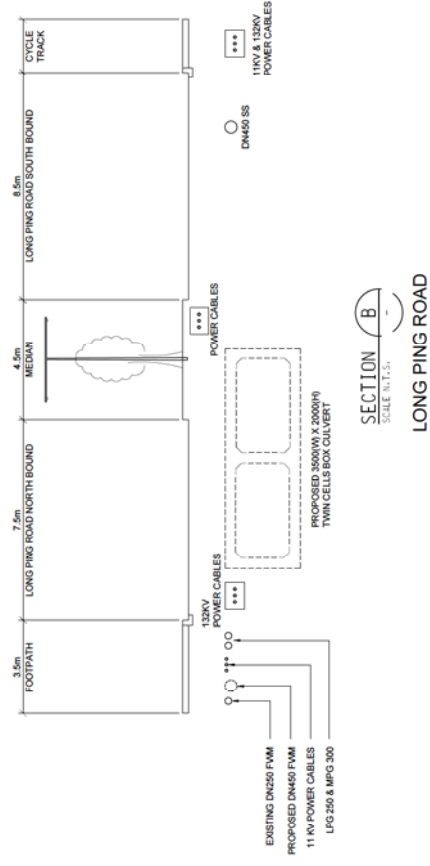
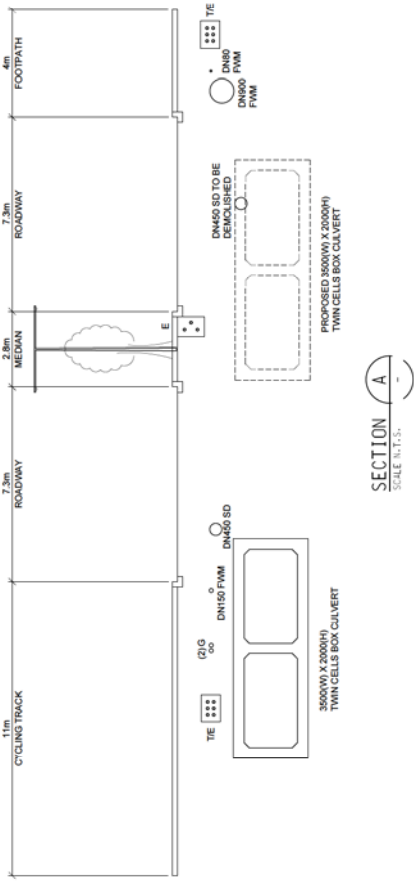
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NOTES:  
 1. UTILITIES SHOWN IN THIS DRAWING ARE INDICATIVE ONLY BASED ON AVAILABLE INFORMATION OBTAINED FROM UTILITY UNDERTAKERS. THE EXACT DETAILS INCLUDING SIZES, ALIGNMENTS AND LEVELS TO BE FURTHER VERIFIED AT DETAILED DESIGN.

- LEGEND:
- FWM FRESH WATER MAIN
  - FLM FLUSHING WATER MAIN
  - SS SANITARY SEWER
  - SD STORM DRAIN
  - E ELECTRICAL
  - T TELECOM
  - MPG MEDIUM PRESSURE GAS
  - LPG LOW PRESSURE GAS
  - O.D. OUTER DIAMETER
  - I.D. INNER DIAMETER
  - EXISTING UTILITIES
  - PROPOSED UTILITIES



Rev	Description	By	Date
-	FIRST ISSUE	GL	05/14

Consultant  
**ARUP**

Project title  
 Public Housing Development at Wang Chau, Yuen Long

Drawing title  
 COMMON UTILITIES SECTIONS

Drawing no.	226464/OA/PC/701	Rev.	-
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PROPOSED DEVELOPMENT

## Appendix A

# Water Demand Estimation





<b>ARUP</b>	Job No.	Sheet No.	Rev.
	226464		
Job Title	Planning and Engineering Study for Wang Chau South		Dr. Ref.
Calculation	Population Projection		Made by LTT Date 11/05/2014 Chd.

Water Treatment Works (WTW)	FWSR	Supply Zone TPU	Location/Estate	Projected Population <sup>(1)</sup>						Average Yearly-Based Projections
				2012	2013	2014	2015	2016	2017	2025
Ngau Tam Mei WTW	Wang Chau	510 (TMF)	Tin Shui Wai	288,600	290,800	290,200	289,600	288,600	287,700	286,260
		516		3,000	3,100	3,100	3,200	3,200	3,300	3,780
		0.33*517		1,750	1,800	1,833	2,067	3,883	3,967	7,514
		514*0.2		480	480	520	540	560	600	792
		<b>Sub-total</b>		<b>293,830</b>	<b>296,180</b>	<b>295,653</b>	<b>295,407</b>	<b>296,243</b>	<b>295,567</b>	<b>298,346</b>
	Tan Kwai Tsuen North	510 (FW)	Tin Shui Wai	288,600	290,800	290,200	289,600	288,600	287,700	286,260
		511		6,100	6,400	6,600	6,800	7,000	7,100	8,700
		512		6,700	6,800	6,800	6,800	6,800	6,900	7,220
		514*0.8		1,920	1,920	2,080	2,160	2,240	2,400	3,168
		0.66*517		3,500	3,600	3,668	4,132	7,768	7,934	15,028
		519		11,300	11,800	11,900	12,200	12,600	12,800	15,200
	<b>Sub-total</b>		<b>318,120</b>	<b>321,320</b>	<b>321,248</b>	<b>321,692</b>	<b>325,008</b>	<b>324,834</b>	<b>335,576</b>	
	Ngau Tam Mai Primary (Direct Feed)	541	San Tin/Mai Po	19,200	19,500	19,500	19,500	19,300	19,100	18,940
		542		11,100	11,300	11,600	12,000	12,200	12,500	14,740
		543		3,100	3,200	3,200	3,300	3,300	3,400	3,880
		544		3,700	3,900	3,900	3,900	3,900	3,900	4,220
		545 & 546		2,700	2,800	2,800	2,800	2,800	2,900	3,220
		528	Wang Chau	6,000	6,300	6,400	6,500	6,600	6,600	7,560
	<b>Sub-total</b>		<b>39,800</b>	<b>40,700</b>	<b>41,000</b>	<b>41,500</b>	<b>41,500</b>	<b>41,800</b>	<b>45,000</b>	
	Au Tau WTW	Au Tau Primary (Direct Feed)	515		5,250					
518				2,200						
521				9,700						
523				8,100						
524			YL Town	63,400						
525 & 526				3,300						
527			YL Town	65,500						
529			YL Town	15,400						
532				10,000						
522				17,700						
531				14,300						
0.2*533				1,040						
<b>Sub-total</b>				<b>215,890</b>						
Tuen Mun North		441	Rural NWNT	17,100						
	442	Rural NWNT	7,600							
	423	Tuen Mun	174,700							
	<b>Sub-total</b>		<b>199,400</b>							

Notes

(1) Population from Planning Department WGPD Report, Table 15: Projected Population by TPU, 2013-2017

<b>ARUP</b>	Job No.	Sheet No.	Rev.
	226464		
Job Title	Planning and Engineering Study for Wang Chau South		
Calculation	Water Demand Projection		
	Member/Location	Dr. Ref.	
	Made by	LTT	Date 11/05/2014 Chd.

Water Treatment Works (WTW)	FWSR	Supply Zone TPU <sup>(1)</sup>	Location/Estate	Projected Population <sup>(2)</sup>				Average Yearly-Based Projections				
				2012				2025				
				Population/Area	FW Demand (m <sup>3</sup> /d) <sup>(3)</sup>	FLW Demand (m <sup>3</sup> /d) <sup>(4)</sup>	Total Demand (m <sup>3</sup> /d)	Projected/Planned Population	FW Demand (m <sup>3</sup> /d)	FLW Demand (m <sup>3</sup> /d)	Total Demand (m <sup>3</sup> /d)	
Ngau Tam Mei WTW	Wang Chau	510 (TMF)	Tin Shui Wai	288,600	-	20,202	20,202	286,260	-	-	-	
		516		3,000	540	210	750	3,780	680	265	945	
		0.33*517		1,750	315	123	438	7,514	1,353	526	1,879	
		528	YLIE <sup>(6)(7)</sup>	-	3,000	1,000	4,000	-	10,500	3,500	14,000	
		514*0.2		480	86	34	120	792	143	55	198	
		Proposed WC South Development		-	-	-	-	13,572	3,311	1,852	5,164	
	<b>Sub-total</b>				<b>293,830</b>	<b>3,941</b>	<b>21,568</b>	<b>25,510</b>	<b>311,918</b>	<b>15,987</b>	<b>6,198</b>	<b>22,185</b>
	Tan Kwai Tsuen North	510 (FW)	Tin Shui Wai	288,600	57,720	-	57,720	286,260	57,252	-	57,252	
		511		6,100	1,220	427	1,647	8,700	1,740	-	1,740	
		512		6,700	1,340	469	1,809	7,220	1,444	-	1,444	
		514*0.8		1,920	384	134	518	3,168	634	222	855	
		0.66*517		3,500	700	245	945	15,028	3,006	1,052	4,058	
		519		11,300	2,260	791	3,051	15,200	3,040	-	3,040	
	<b>Sub-total</b>				<b>318,120</b>	<b>63,624</b>	<b>2,066</b>	<b>65,690</b>	<b>335,576</b>	<b>67,115</b>	<b>1,274</b>	<b>68,389</b>
	Ngau Tam Mai Primary (Direct Feed)	San Tin/Mai Po	541		19,200	8,547	2,849	11,396	18,940	8,442	2,814	11,256
			542		11,100	3,443	1,148	4,591	14,740	4,424	1,475	5,899
			543		3,100	815	272	1,086	3,880	1,060	353	1,413
			544		3,700	3,106	1,035	4,141	4,220	3,155	1,052	4,207
			545 & 546		2,700	717	239	956	3,220	782	261	1,042
		528	Wang Chau	6,000	1,200	420	1,620	7,560	1,512	529	2,041	
	<b>Sub-total</b>				<b>45,800</b>	<b>17,828</b>	<b>5,963</b>	<b>23,790</b>	<b>52,560</b>	<b>19,375</b>	<b>6,483</b>	<b>25,858</b>
	Au Tau WTW	Au Tau Primary (Direct Feed)	515		5,250	1,050	368	1,418				
			518		2,200	440	154	594				
			521		9,700	1,940	679	2,619				
			523		8,100	1,620	567	2,187				
			524	YL Town	63,400	12,680	4,438	17,118				
525 & 526				3,300	660	231	891					
527			YL Town	65,500	13,100	4,585	17,685					
529			YL Town	15,400	3,080	1,078	4,158					
532				10,000	2,000	700	2,700					
522				17,700	3,540	1,239	4,779					
531				14,300	2,860	1,001	3,861					
0.2*533				1,040	208	73	281					
<b>Sub-total</b>						<b>215,890</b>	<b>43,178</b>	<b>15,112</b>	<b>58,290</b>			
Tuen Mun North		441	Rural NWNT	17,100	3,420	1,197	4,617					
		442	Rural NWNT	7,600	1,520	532	2,052					
	423	Tuen Mun	174,700	34,940	12,229	47,169						
	<b>Sub-total</b>			<b>199,400</b>	<b>39,880</b>	<b>13,958</b>	<b>53,838</b>					

Notes

- (1) Existing supply zone of reservoirs as of Oct 2012, refers to WSD drawing no. R2012018
- (2) Population from Planning Department WGPD Report, Table 15: Projected Population by TPU, 2013-2017
- (3) Fresh Water Unit Demand (UD) : Existing area UD = 0.2 m<sup>3</sup>/h/d derived from consumption rate in year 2012
- (4) Flushing Water Unit Demand (UD) : Existing area UD = 0.07 m<sup>3</sup>/h/d derived from consumption rate in year 2012
- (5) Assume construction works of Salt Water Supply to NWNT and YL completed by year 2022.  
Supply area as per WSD Sketch no. 90182/1 included Tin Shui Wai, Yuen Long Town, Tuen Mun-Yuen Long Corridor and Tuen Mun Town East.
- (6) The existing total water consumption in YLIE is about 4,000 m<sup>3</sup>/per day according to HKSTP's estimation
- (7) Assuming that all 52 existing factories in YLIE are in full operation, the ultimate total water consumption would be about 14,000 m<sup>3</sup>/per day according to HKSTP's estimation

## Appendix B

### Proposed supply scheme in WSD Planning Report No. 10/95





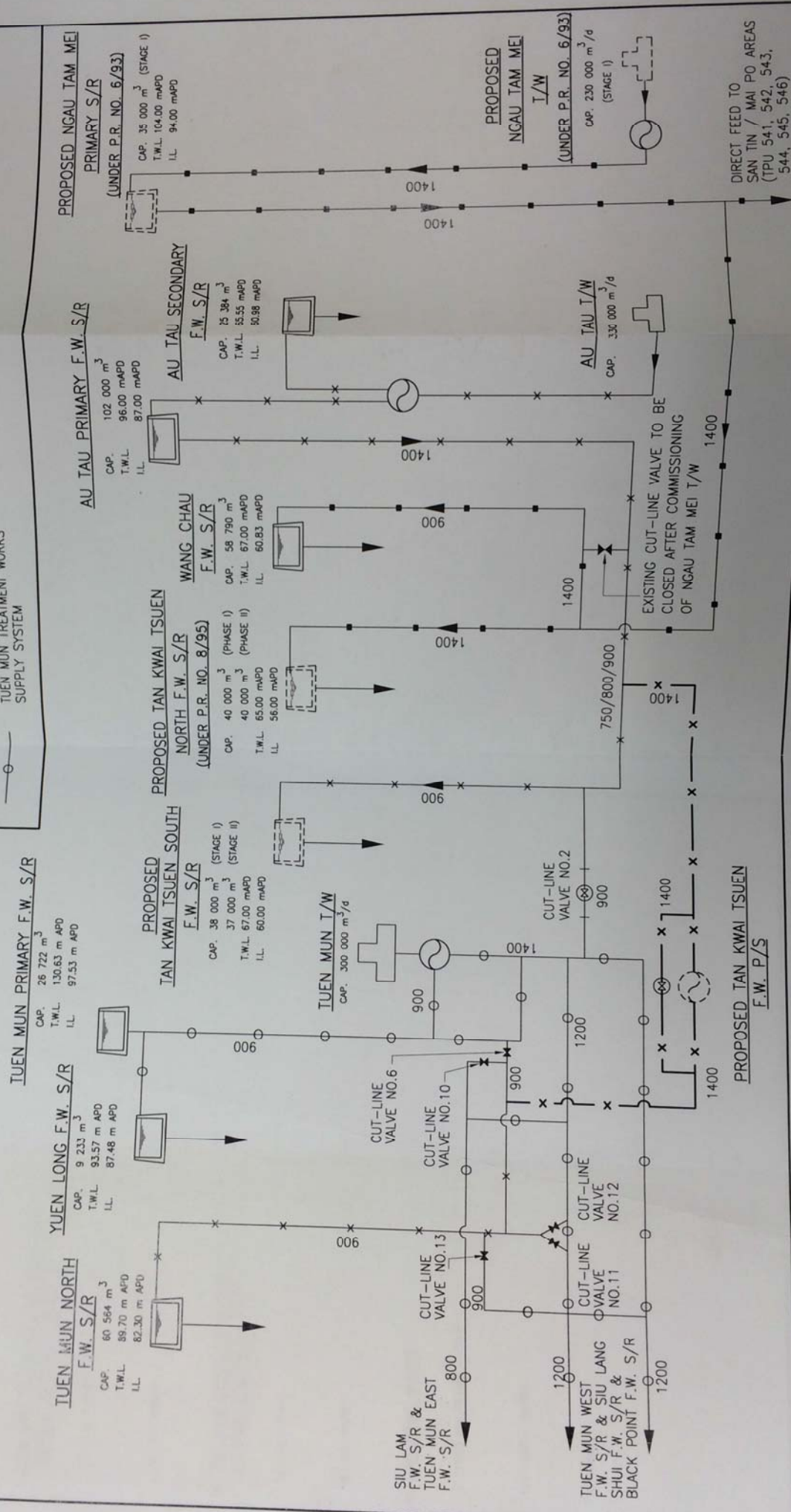
**NOTES**

1. ALL WATER MAIN SIZES ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED

**LEGENDS**

- x — EXISTING AND PROPOSED F.W. TRUNK MAIN UNDER IMPLEMENTATION
- x — PROPOSED F.W. TRUNK MAIN
- x — NGAU TAM MEI TREATMENT WORKS SUPPLY SYSTEM
- x — TUEN MUN TREATMENT WORKS SUPPLY SYSTEM

CUT LINE VALVE NO.6,10,11,12 & 13 TO BE CLOSED AFTER COMMISSIONING OF TAN KWAI TSUEN F.W. P/S  
 CUT LINE VALVE NO.2 TO BE CLOSED AFTER COMMISSIONING OF TAN KWAI TSUEN SOUTH F.W. S/R  
 STAGE I (PLANNING REPORT 18/89 REFERS)  
 AU TAU TREATMENT WORKS SUPPLY SYSTEM



DIRECT FEED TO  
 SAN TIN / MAI PO AREAS  
 (TPU 541, 542, 543,  
 544, 545, 546)

APPROVED: \_\_\_\_\_

DATE: 24-1-96

TAN KWAI TSUEN SOUTH FRESH WATER SERVICE RESERVOIR STAGE II AND  
 ADDITIONAL TRUNK TRANSFER FACILITIES BETWEEN YUEN LONG AND TUEN MUN  
 SCHEMATIC LAYOUT OF TRUNK TRANSFER SYSTEM FOR AU TAU TREATMENT WORKS AND TUEN MUN TREATMENT WORKS

WATER SUPPLIES DEPARTMENT  
 HONG KONG

SKETCH NO. 09947/18

## Appendix C

# Hydraulic Modelling Calculations





Job No.	226464	Sheet No.	Rev.
Member/Location			
Dwg. Ref.			
Made by	LTT	Date	20/05/2014
		Chd.	NY

Table B3 - Summary of Water Demand

Area	Type	MDD (m <sup>3</sup> /d)	Normal Operation Demand Multiplier	Fire-Flow Scenario Demand Multiplier	Fire-Flow Scenario Demand (m <sup>3</sup> /d)
Existing WC FWSR Supply Zone (DN600 Distribution Main) <sup>(1)</sup>	FW	8,113	3	1	8,113
Existing WC FWSR Supply Zone (DN600 Distribution Main) <sup>(1)</sup>	FLW	2,781	2	1	2,781
PRH Site	FW	1,391	3	1	1,391
PRH Site	FLW	963	2	1	963
HOS Site	FW	1,920	3	1	1,920
HOS Site	FLW	891	2	1	891

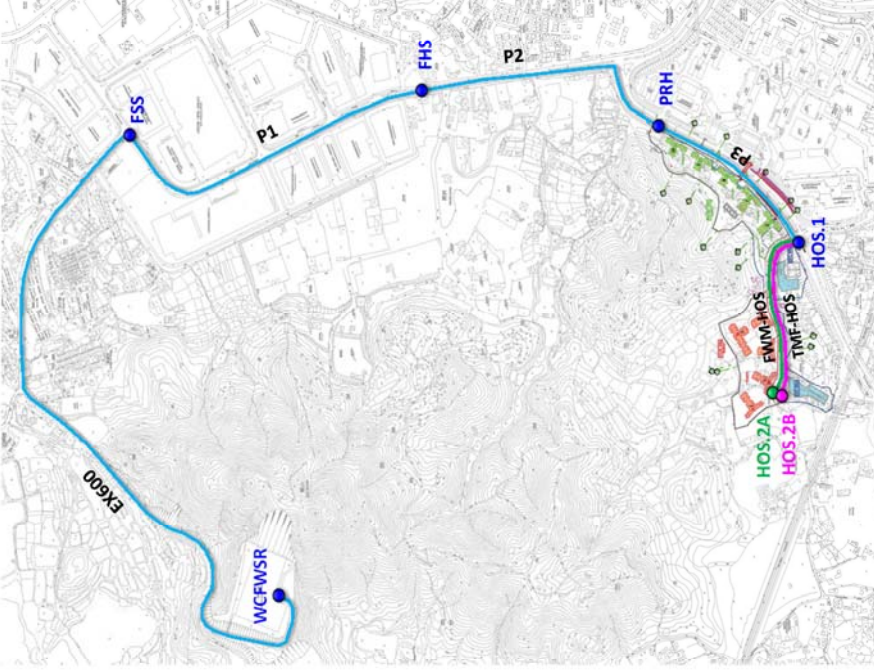
Table B4 - Pipe Network Input Data and Water Demand Distribution according to Population Distribution

Location	Existing / Proposed	Pipe ID in Model	Downstream Node ID in Model	Type	Nominal Pipe Size (mm)	Internal Diameter (mm)	Length (m)	Minor Loss Factor	Factored Length <sup>(2)</sup> (m)	C Value	Daily Operation Demand (m <sup>3</sup> /d)	Fire-Flow Scenario Demand (m <sup>3</sup> /d)
PRH Site	Proposed	-	HOS.1	FW	-	-	-	1.2	-	-	4,172	1,391
PRH Site	Proposed	-	HOS.1	FLW	-	-	-	1.2	-	-	1,925	963
HOS Site	Proposed	FWM-HOS	HOS.2A	FW	250	233	320	1.2	384	110	5,760	1,920
HOS Site	Proposed	TMF-HOS	HOS.2B	FLW	150	138	320	1.2	384	90	1,782	891
From WCFWSR to Fuk Shur Street	Existing	EX600	FSS	FW	600	586	1493	1.2	1792	120	29,901	10,894
Fuk Shun Street to Fuk Hi Street	Proposed	P1	FHS	FW	600	586	680	1.2	816	120	-	-
Fuk Hi Street	Proposed	P2	PRH	FW	450	424	554	1.2	665	110	-	-
Long Ping Road	Proposed	P3	HOS.1	FW	450	424	358	1.2	430	110	-	-

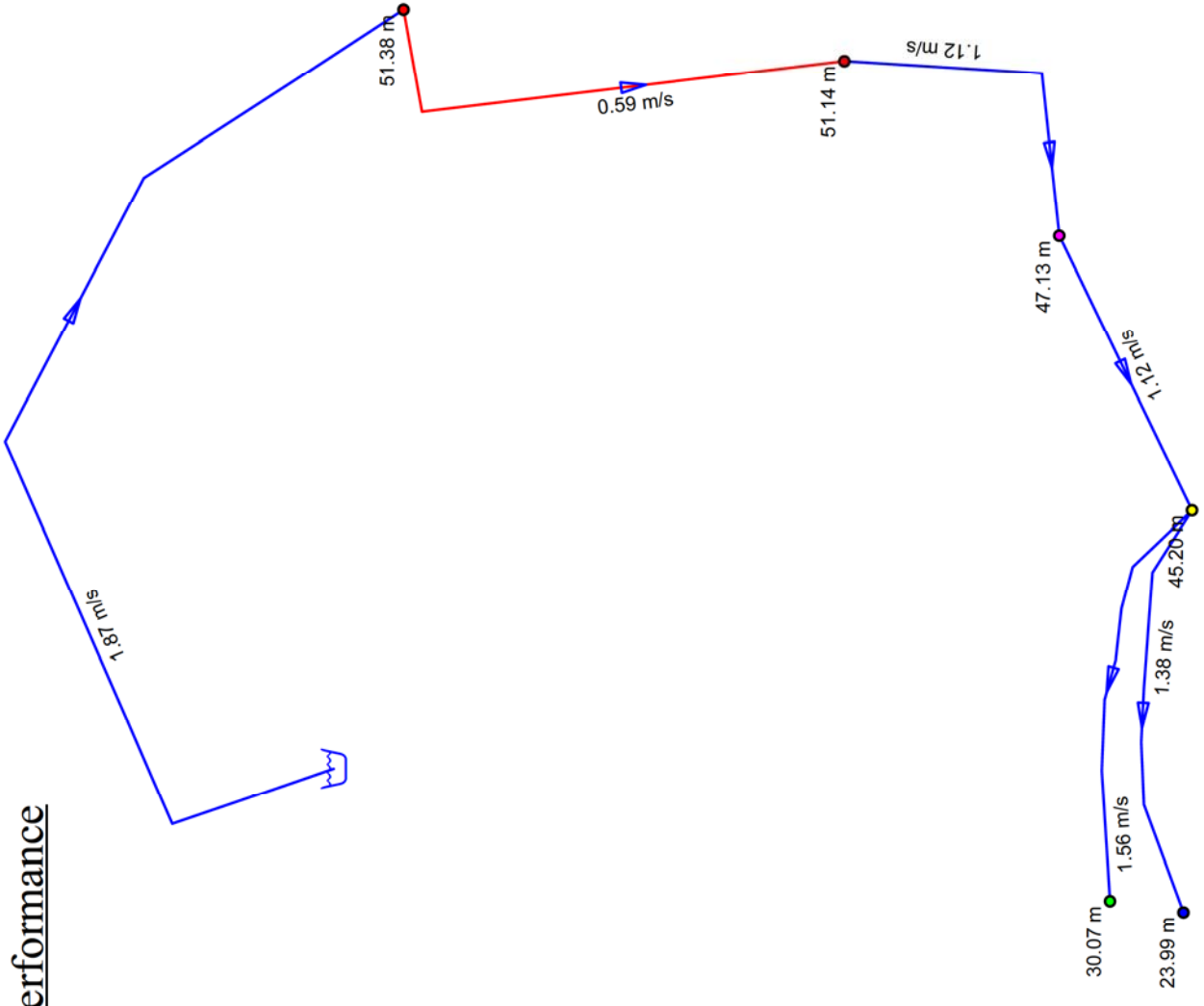
Notes

(1) There are two FW distribution mains for existing Wang Chau Supply Zone (Sizes DN600 and DN450), the estimated flow in DN600 main is prorata by pipe area

(2) The minor loss factor is used to multiply the length of the water mains to model the minor headlosses (due to bends and fittings)



# Scenario A - Performance





# Scenario A

## Daily Operation - Junction

	ID	Demand (m3/d)	Elevation (m)	Head (m)	Pressure (m)
1	FHS	0.00	2.00	53.14	51.14
2	FSS	29,900.80	2.30	53.68	51.38
3	HOS.1	6,096.96	3.80	49.00	45.20
4	HOS.2A	5,759.96	13.50	43.57	30.07
5	HOS.2B	1,781.99	13.50	37.49	23.99
6	PRH	0.00	3.50	50.63	47.13

Residual Pressure at Fresh Water Main is adequate  
 Residual Pressure at Flushing Water Main is adequate

# Scenario A

## Daily Operation-Pipe

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (m3/d)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)	Status
1	WCFWSR	FSS	1,792.00	586.00	120.00	43,539.71	1.87	10.24	5.71	Open
2	HOS.1	HOS.2A	384.00	233.00	110.00	5,759.96	1.56	5.43	14.15	Open
3	FSS	FHS	816.00	586.00	120.00	13,638.91	0.59	0.54	0.67	Open
4	FHS	PRH	665.00	424.00	110.00	13,638.91	1.12	2.51	3.78	Open
5	PRH	HOS.1	430.00	424.00	110.00	13,638.91	1.12	1.63	3.78	Open
6	HOS.1	HOS.2B	384.00	138.00	90.00	1,781.99	1.38	11.51	29.97	Open

# Scenario B

## Fire Flow - Junction

ID	Static Demand (m3/d)	Static Pressure (m)	Static Head (m)	Fire-Flow Demand (m3/d)	Residual Pressure (m)	Available Flow @Hydrant (m3/d)	Available Flow Pressure (m)
1	0.00	60.22	62.22	5,999.96	58.64	42,884.07	38.39
2	10,893.93	60.01	62.31	5,999.96	58.71	57,374.80	41.61
3	2,353.98	57.73	61.53	5,999.96	53.98	29,292.77	27.26
4	1,919.99	47.32	60.82	5,999.96	34.48	11,660.86	20.95
5	0.00	58.30	61.80	5,999.96	55.40	31,186.27	29.73

Residual Pressure is adequate



# Scenario B

## Fire Flow Design

ID	Total Demand (m3/d)	Critical Node 1 ID	Critical Node 1 Pressure (m)	Critical Node 1 Head (m)
1 <input type="checkbox"/>	5,999.96	HOS.2A	45.74	59.24
2 <input type="checkbox"/>	16,893.89	HOS.2A	46.03	59.53
3 <input type="checkbox"/>	8,353.95	HOS.2A	43.57	57.07
4 <input type="checkbox"/>	7,919.95	HOS.2A	34.48	47.98
5 <input type="checkbox"/>	5,999.96	HOS.2A	44.42	57.92

# Scenario B

## Fire Flow Design

ID	Adjusted Fire-Flow (m3/d)	Available Flow @Hydrant (m3/d)	Critical Node 2 ID	Critical Node 2 Pressure (m)
1 <input type="checkbox"/>	FHS 49,591.29	42,884.07	HOS.2A	25.49
2 <input type="checkbox"/>	FSS 71,143.90	57,374.80	HOS.2A	28.92
3 <input type="checkbox"/>	HOS.1 27,444.87	29,292.77	HOS.2A	16.85
4 <input type="checkbox"/>	HOS.2A 11,884.97	11,660.86	HOS.2A	20.95
5 <input type="checkbox"/>	PRH 30,296.98	31,186.27	HOS.2A	18.75

# Scenario B

## Fire Flow Design

ID	Critical Node 2 Head (m)	Adjusted Available Flow (m3/d)	Design Flow (m3/d)
1 <input type="checkbox"/>	FHS 38.99	49,592.51	49,591.28
2 <input type="checkbox"/>	FSS 42.42	71,144.41	71,143.90
3 <input type="checkbox"/>	HOS.1 30.35	27,447.97	27,444.87
4 <input type="checkbox"/>	HOS.2A 34.45	11,887.66	11,884.97
5 <input type="checkbox"/>	PRH 32.25	30,297.20	30,296.98