Appendix A

Pump Station Design Report

Tung Lo Wan Hill Road – Private residential development

Section 16 Planning Application for Proposed Utility Installation for Private Project (Sump and Pump Station for Salt and Fresh Water Supply) in "Government, Institution or Community" Zone on Government Land in D.D. 186 (under GLA-ST 336), Sha Tin, New Territories

Pump Room Design Report

C M WONG & ASSOCIATES LTD
黃志明建築工程師有限公司
11/F Universal Trade Centre
3-5A Arbuthnot Road, Hong Kong
Tel: (852)2522-1068
Fax: (852)2526-3111
www.cmwal.com
cmwal@cmwal.com

CMA

Document Verification

Project title		Tung Lo Wan Hill Road – Private residential development			Job number TLWSR
Document title		Section 16 Planning Application for Proposed Utility Installation for Private Project (Sump and Pump Station for Salt and Fresh Water Supply) in "Government, Institution or Community" Zone on Government Land in D.D. 186 (under GLA-ST 336), Sha Tin, New Territories Pump Room Design Report			File reference TLWSR/PSDR
Document ref					
Revision	Date				
0	August 2024		Prepared by	Checked by	Approved by
		Name	Sing Wong/ Angela Chao	Angela Chao	Terence Yau
		Signature			
1	October 2024				
			Prepared by	Checked by	Approved by
		Name	Angela Chao	Angela Chao	Terence Yau
		Signature			
		Filename			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Table of Contents

Tables

Figures

Appendix

1. Introduction

1.1 Background

1.1.1 On 13 January 2023, the Town Planning Board accepted and approved the Section 12A Rezoning Application for Amendment to the Approved Sha Tin Outline Zoning Plan No. S/ST/36 at Lot 380 RP (Part) in DD 186, Tung Lo Wan Hill Road, Sha Tin (hereafter referred to as "Application Site"). The previously approved Indicative Master Layout Plan showing the Proposed Layout and Proposed Access Road are presented in **Appendix A**.

1.1.2 Under the same s. 12A Rezoning Application, Water Supply Impact Assessment (WSIA) was prepared and an off-site pump station (comprising sump and pump system and associated rising main) was proposed to supply of fresh water and salt water to the Application Site. The approved WSIA is adopted herein and presented in **Appendix B**.

1.1.3 This Pump Station Design Report (PSDR) serves as a supplementary document to the WSIA approved under Section 12A of Town Planning Ordinance in support of a Section 16 Planning Application for Proposed Utility Installation for Private Project (Sump and Pump Station for Salt and Fresh Water Supply) in "Government, Institution or Community" Zone on Government Land in D.D. 186 (under GLA-ST 336), Sha Tin, New Territories (herein after referred to as the "Proposed Pump Station Site").

1.2 Objectives

1.2.1 The main objectives of this report are as follow:-

A. Summarize the proposed water supply system from previous approved WSIA and justify the need of the pump station;

B. Outline the design of the pump station.

1.3 Report Structure

1.3.1 Following this introductory chapter, the report is structured as follows:

1.3.2 **Chapter 2 - The Application Site and Water Supply System**

1.3.3 This section outlines the details of the proposed development, the assessment methodology and water demand estimation of previous WSIA, and the proposed water supply system;

Chapter 3 - Proposed Pump Station

1.3.4 This section describes the site condition, design standards, guideline and references, and the detailed design and arrangement of the Proposed Pump Station;

Chapter 4 - Maintenance Responsibility

1.3.5 This section outlines the maintenance responsibility of Proposed Pumping Station and water supply;

Chapter 5 - Conclusion

2. The Application Site and Water Supply System

2.1 The Proposed Development (recap from s. 12A)

2.1.1 The Application Site has an area of approximately 6,150m^2. The existing topography across the Application Site varies in height, from the site entrance at +76.60mPD up to about +79.10mPD overall ground level.

2.1.2 The proposed development has a domestic Gross Floor Area (GFA) of not more than 15,375m^2. The proposed development comprises of 2 mid-rise residential towers, 1 clubhouse and 2 levels of basement carpark.

Table 2.1 – Development Schedule of the Application Site

Application Site Area	About 6,150 m^2
Plot Ratio	2.5
Total Domestic GFA	Not more than 15,375 m^2
No. of Blocks	2
Average Flat Size	About 96 m^2
No. of Units	About 160
Person/Unit	2.7
Anticipated Population	About 432
Clubhouse GFA	Not more than 768 m^2

For details, see Appendix B – WSIA Section 2

2.2 Water Demand Estimation (recap from s. 12A)

2.2.1 The water supply assessment methodology and water demand estimation are available in Sections 4 and 5 of the previous WSIA (Appendix B), and the water demands are summarized in Table 2.2 below. (Details available in Appendix B - WSIA Section 4 and Section 5.)

Table 2.2 – Summary of Water Demand Estimation

Development Type	**Fresh Water Demand (m^3/day)**	**Salt Water Demand (m^3/day)**
Domestic	130	30
Clubhouse	19	-
Total Demand	**149**	**30**

2.3 The Proposed Water Supply System (recap from s. 12A)

2.3.1 According to WSD Record Plans, Sha Tin North Fresh Water Service Reservoir (STNFWSR) is immediately next to the Application Site. There are existing fresh water mains along Tung Lo Wan Hill Road. Salt water mains are located on Tung Lo Wan Hill Road near Tung Lo Wan Hill Road Garden, as shown on **Figure 1**.

2.3.2 The existing Application Site currently has no fresh and salt water supply. New pipe system will be required to cater to the water demand from the proposed development. Due to the large level difference of the existing water mains connection point (around +37mPD) and the Application Site (around +77mPD), an off-site pump station was proposed. (Details of the water demand estimate and the proposed design are shown in Appendix B – WSIA Section 3-6 and are not repeated herein.)

2.3.3 New fresh water mains and salt water mains will be constructed from the existing fresh water main and salt water main located near the Tung Lo Wan Hill Road Garden to the Application Site. The proposed salt water and fresh water mains will be connected to the proposed private off-site sump and pump system with booster pump, housed in the Proposed Pump Station to be located near Tung Lo Wan Hill Road Garden. The proposed water supply layout plan is shown on **Figure 2**.

3. Proposed Pump Station

3.1 Site Description of the Proposed Pump Station

3.1.1 The Proposed Pump Station Site is located at Tung Lo Wan Hill Road, Sha Tin. To the north and west sides, the Proposed Pump Station Site is bound by existing slopes. To the south side, the Proposed Pump Station Site is bound by a Refuse Collection Point and its access road. To the east side, the Proposed Pump Station Site is bound by Tung Lo Wan Hill Road. The Proposed Pump Station Site is located at the man-made slope area and is sloping up from southern side to northern side with existing ground level ranging from +41mPD to +47mPD. **Figure 1** illustrates the location of the Proposed Pump Station Site. The proposed pump station general arrangements are presented on **Figures 3 and 4**.

3.2 Design standards, guideline and references

3.2.1 The following list of documents are used as reference for the design of the pump station:

a) EPD/TP1/05 Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0 (GESF) (Published by EPD, HK)

b) Plumbing Engineering Services Design Guide (IOP) 2002 (Published by The Institute of Plumbing, UK)

c) Technical Requirement for Plumbing Works in Buildings 2021 (TR) (Published by Water Supplies Department, HK)

d) 2021 Population By-Census (C&SD) (Published by Census and Statistics Department, HK)

e) Commercial and Industrial Floor Space Utilization Survey (CIFSUS) (Published by Planning Department, HK)

f) Manual of Mainlaying Practice 2012 (Published by Water Supplies Department, HK)

g) BS EN 12845:2004 (Published by the Authority of the Standards Policy and Strategy Committee, UK)

h) ASD Design Guide for Plumbing Installation (Published by ASD, HK)

i) ASD Design Guide for Public Swimming Pools (Published by ASD, HK)

j) HK Regulation CAP 132CA

k) WSIA (By AECOM)

l) Installation Notes of Different Types of Corrosion Resistant Pipe Materials as Inside Service in Buildingds (Published by Water Supplies Department, HK)

3.3 Design Parameters

3.3.1 The proposed pipe materials to be adopted in the water supplies system shall comply with WSD Manual of Mainlaying Section 1.1 and as shown in Table 3.1 below.

Table 3.1 – Proposed Pipe Size and Pipe Materials

Pipe Size (nominal diameter in mm)	**Type of Pipe Material**
700 and above	● Steel
200 to 600	● Ductile Iron (DI) ● Steel
150	● Buried Pipe: Blue Polyethylene (PE), steel, DI ● Exposed Pipe: Steel, DI
100 and below	● Buried Pipe: Blue PE, DI ● Exposed Fresh Water Pipe: steel, DI ● Exposed Salt Water Pipe: Black PE
Service Connections	● Buried Fresh Water Pipe: Blue PE ● Buried Salt Water Pipe: Blue PE ● Exposed Fresh Water Pipe: Stainless Steel, Corrugated Stainless Steel Tubes ● Exposed Salt Water Pipe: Black PE

3.3.2 Pipe and Pipe Fitting Loss shall adopt Hazen-Williams Formula: (BS EN 12845):

$$p = \frac{6.05 \times 10^{5}}{C^{1.85} \times d^{4.87}} \times L \times Q^{1.85}$$

where:

p is the pressure loss in the pipe, in bar;
Q is the flow through the pipe, in L/min;
d is the mean internal diameter of the pipe, in mm;
C is a constant for the type and condition of the pipe

3.3.3 C values and equivalent length of pipe and fittings shall comply with BS EN 12845:2004 Table 22 and Table 23, and as shown in in Table 3.2 and Table 3.3 below .

Table 3.2 – Equivalent length of fittings and valves (Extract from BS EN 12845:2004 Table 22)

EN 12845:2004 (E)

L is the equivalent length of pipe and fittings, in metres.

The values of *C* indicated in Table 22 shall be used.

Table 22 — C values for various types of pipe

Type of pipe	Value of *C*
cast iron	100
ductile iron	110
mild steel	120
galvanized steel	120
spun cement	130
cement lined cast iron	130
stainless steel	140
copper	140
reinforced glass fibre	140
NOTE The list is not exhaustive	

Table 3.3 – Equivalent length of fittings and valves (Extract from BS EN 12845:2004 Table 23)

Table 23 — Equivalent length of fittings and valves

Fittings and valves	Equivalent length of steel straight pipe for a *C* value of 120[a] (m)										
	Nominal diameter (mm)										
	20	25	32	40	50	65	80	100	150	200	250
90° Screwed elbow (standard)	0,76	0,77	1,0	1,2	1,5	1,9	2,4	3,0	4,3	5,7	7,4
90° Welded elbow (r/d = 1,5)	0,30	0,36	0,49	0,56	0,69	0,88	1,1	1,4	2,0	2,6	3,4
45° Screwed elbow (standard)	0,34	0,40	0,55	0,66	0,76	1,0	1,3	1,6	2,3	3,1	3,9
Standard screwed Tee or cross (flow through branch)	1,3	1,5	2,1	2,4	2,9	3,8	4,8	6,1	8,6	11,0	14,0
Gate valve - straight way	-	-	-	-	0,38	0,51	0,63	0,81	1,1	1,5	2,0
Alarm or non-return valve (swinging type)	-	-	-	-	2,4	3,2	3,9	5,1	7,2	9,4	12,0
	-	-	-	-	12,0	19,0	19,7	25,0	35,0	47,0	62,0
Alarm or non-return valve (mushroom type)	-	-	-	-	2,2	2,9	3,6	4,6	6,4	8,6	9,9
Butterfly valve Globe valve	-	-	-	-	16,0	21,0	26,0	34,0	48,0	64,0	84,0

[a] These equivalent lengths may be converted as necessary for pipes with other *C* values by multiplying by the following factors:

C value	100	110	120	130	140
Factor	0,714	0,85	1,00	1,16	1,33

3.3.4 The proposed arrangements of the Pump Station are presented in the following sub-sections, whereas details of the design of the proposed pump station are presented in **Appendix C**.

3.4 Proposed Pumps and Arrangement

3.4.1 The proposed water pump type, pump arrangement, material and speed are presented in Table 3.4 below:

Table 3.4 – Proposed Water Pump Type, Pump Arrangement, Material and Speed

Pump	Arrangement	Speed (rpm)	Pump Casing Material	Type
Fresh Water Transfer Pump Set	1 Duty, 1 Stand-by	1450	Casted Stainless Steel Grade 316	Constant Speed
Flush Water Transfer Pump Set	1 Duty, 1 Stand-by	1450	Close Grain Cast Iron	Constant Speed

3.5 Proposed Water Tank

3.5.1 The proposed water tank material and arrangement are presented in Table 3.5 below:

Table 3.5 – Proposed Water Tank Material and Arrangement

Water Tank	Water Tank Material	Water Tank Arrangement
Fresh Water Sump Tank	Reinforced Concrete	Twin-Tank
Flush Water Sump Tank	Fibreglass	Twin-Tank

3.5.2 The proposed size of the water tanks is presented in Table 3.6 below:

Table 3.6 – Proposed Size of Water Tanks

Water Tank	Storage Capacity (L)		
	Chamber 1 of Twin Tank	Chamber 2 of Twin Tank	Total
Fresh Water Sump Tank	7850	7850	15700
Flush Water Sump Tank	1400	1400	2800

3.6 Proposed Check meters

3.6.1 Fresh water and flush water check meters shall be provided on ground floor of the sump pump room with the following details:

Table 3.7 – Details of Proposed Check Meters

	Size of Check Meter	Water Distribution Main Size (mm dia.)	Water Distribution Main Material (By WSD Manual of Mainlaying Section 1.1)	
			Buried	Exposed
Fresh Water Check Meter Position	150	150	DI	DI
Flush Water Check Meter Position	50	50	Blue PE	Black PE

4. Maintenance Responsibility

4.1 Proposed Water Supply Lead-in within the Application Site

4.1.1 The Applicant is responsible for the construction and maintenance of all water supply facilities within the Application Site Boundary, including all internal watermains and water supply lead-in valves.

4.2 Proposed Private Off-site Pump Station

4.2.1 The proposed private off-site pump station is proposed to be constructed, operated and maintained by the Applicant.

4.3 Proposed External Water Supply Rising Main

4.3.1 The Applicant is responsible for the construction and maintenance of the proposed external watermains within the private section of widened Tung Lo Wan Hill Road to be managed and maintained by the Applicant (exact extent of the private section of widened Tung Lo Wan Hill Road shall be ascertained by Lands Department in the approval for the Land Exchange of the Development Site).

4.3.2 The proposed external watermains between the existing fresh water and salt water main and the private section of the widened Tung Lo Wan Hill Road (i.e. water mains to be laid in government land) will be constructed by the Applicant and are proposed to be handed over to Water Supplies Department after construction.

4.3.3 It is understood that the section of Tung Lo Wan Hill Road leading to Sha Tin North Fresh Water Service Reservoir (STNFWSR) has been allocated to Water Supplies Department (WSD) as waterwork maintenance access. The project proponent proposes to take up the management and maintenance responsibility of the widened section of road. Right of way will be given to the government at all times for vehicular access and maintenance purpose, as well as given to public for access to the Archery Ground above the STNFWSR.

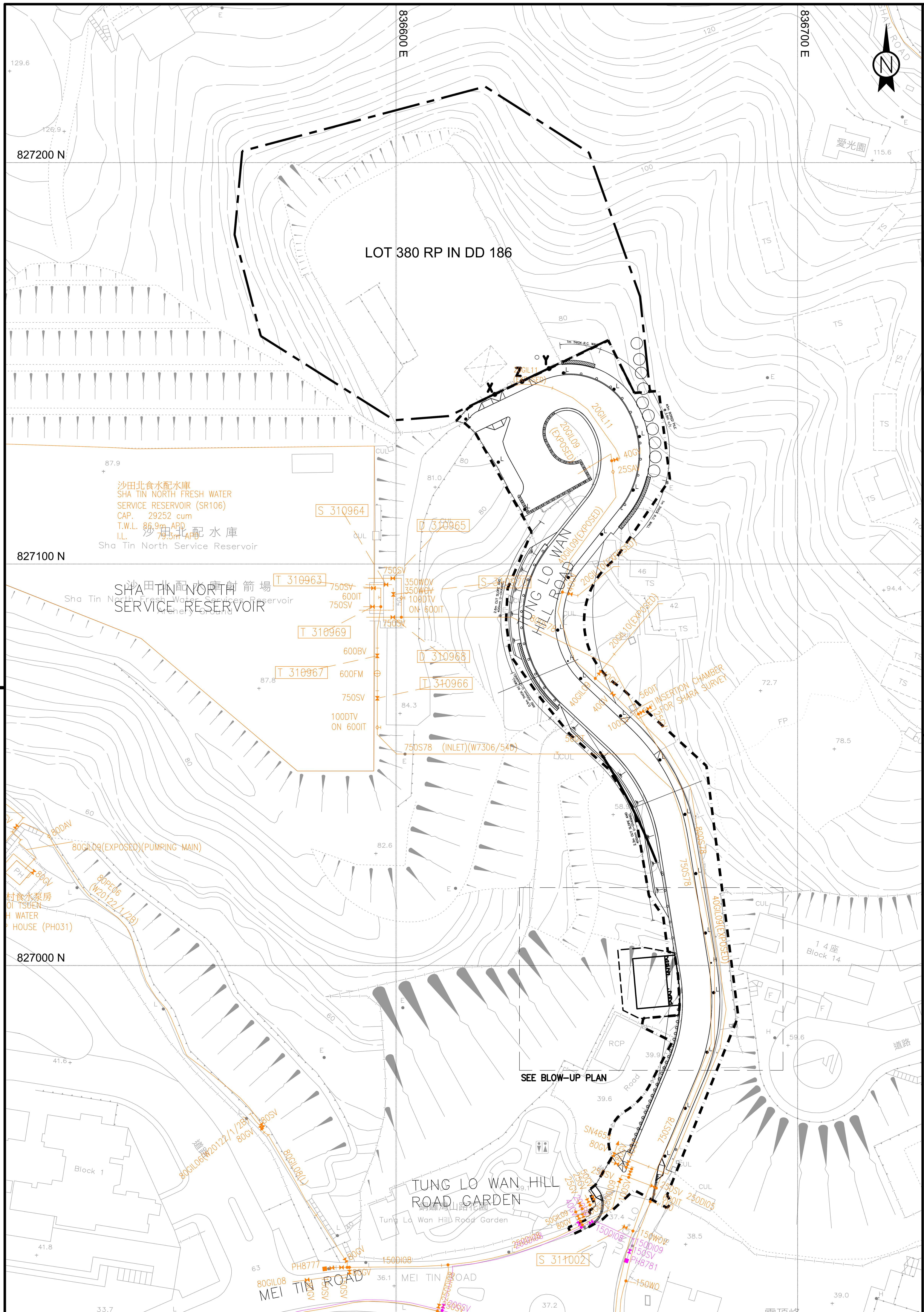
5. Conclusion

5.1.1 This report serves as a supplementary document to the WSIA approved under Section 12A of Town Planning Ordinance, for the application of pump station under Section 16 of Town Planning Ordinance (Cap 131). The water demand estimation, assessment methodology and proposed water supply system of the previously approved WSIA are adopted for the design of the Proposed Pump Station.

5.1.2 The Proposed Pump Station Site is located at Tung Lo Wan Hill Road near the Tung Lo Wan Hill Road Garden, and falls within an area zoned as "Government, Institution and Community" ("G/IC") on the Draft ed Sha Tin Outline Zoning Plan (OZP) No. S/ST/35.

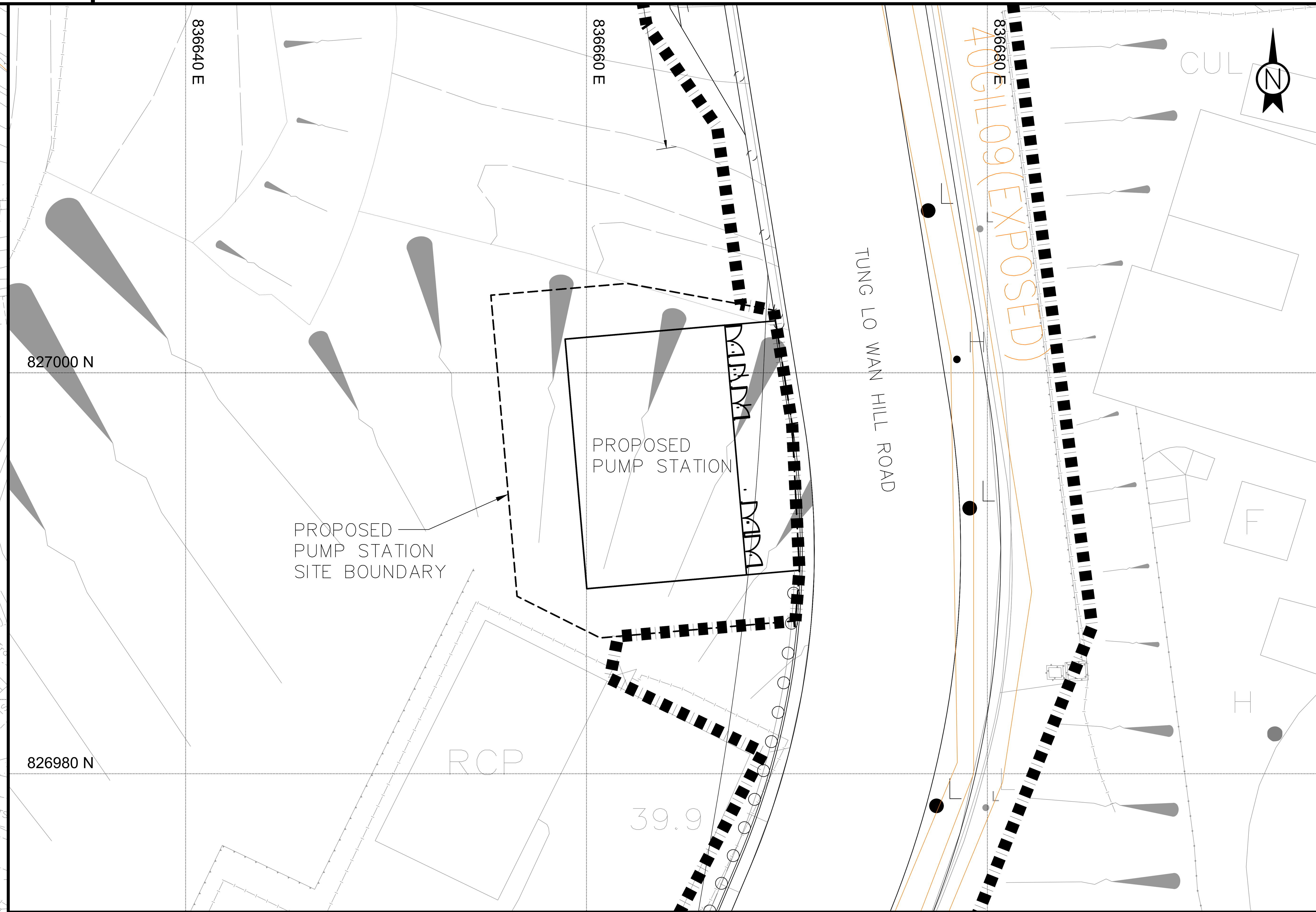
5.1.3 Preliminary design has been conducted for the Proposed Pump Station to supply the fresh water and flush water demand of the proposed Application Site, and as presented on **Figures 2 to 4**.

Figures



LOCATION PLAN

SCALE 1 : 600



BLOW-UP PLAN

SCALE 1 : 150

LEGEND :

- LOT BOUNDARY
- PROPOSED ACCESS ROAD EXTENT
- EXISTING SALT WATER MAINS
- EXISTING FRESH WATER MAINS

REVISION	DATE	DESCRIPTION	BY	CHK
-	AUG 24	FOR PUMP STATION DESIGN REPORT	KCW	ACS

DRG. TITLE: PROPOSED PUMP STATION LOCATION PLAN AND EXISTING WATERMAINS LAYOUT PLAN

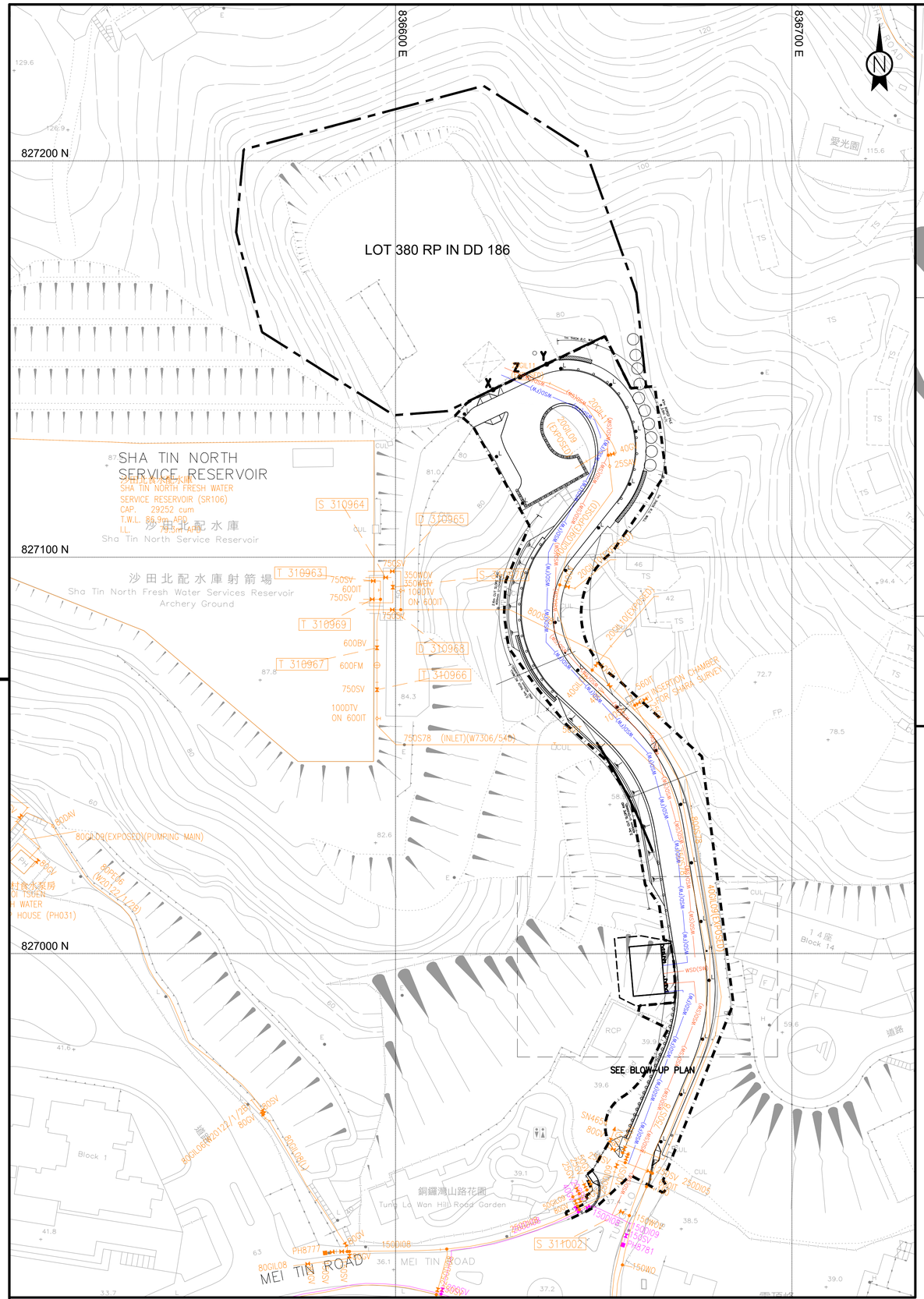
PROJECT: TUNG LO WAN SHAN ROAD

DRG. TYPE: PROPOSED ACCESS ROAD EXTENT

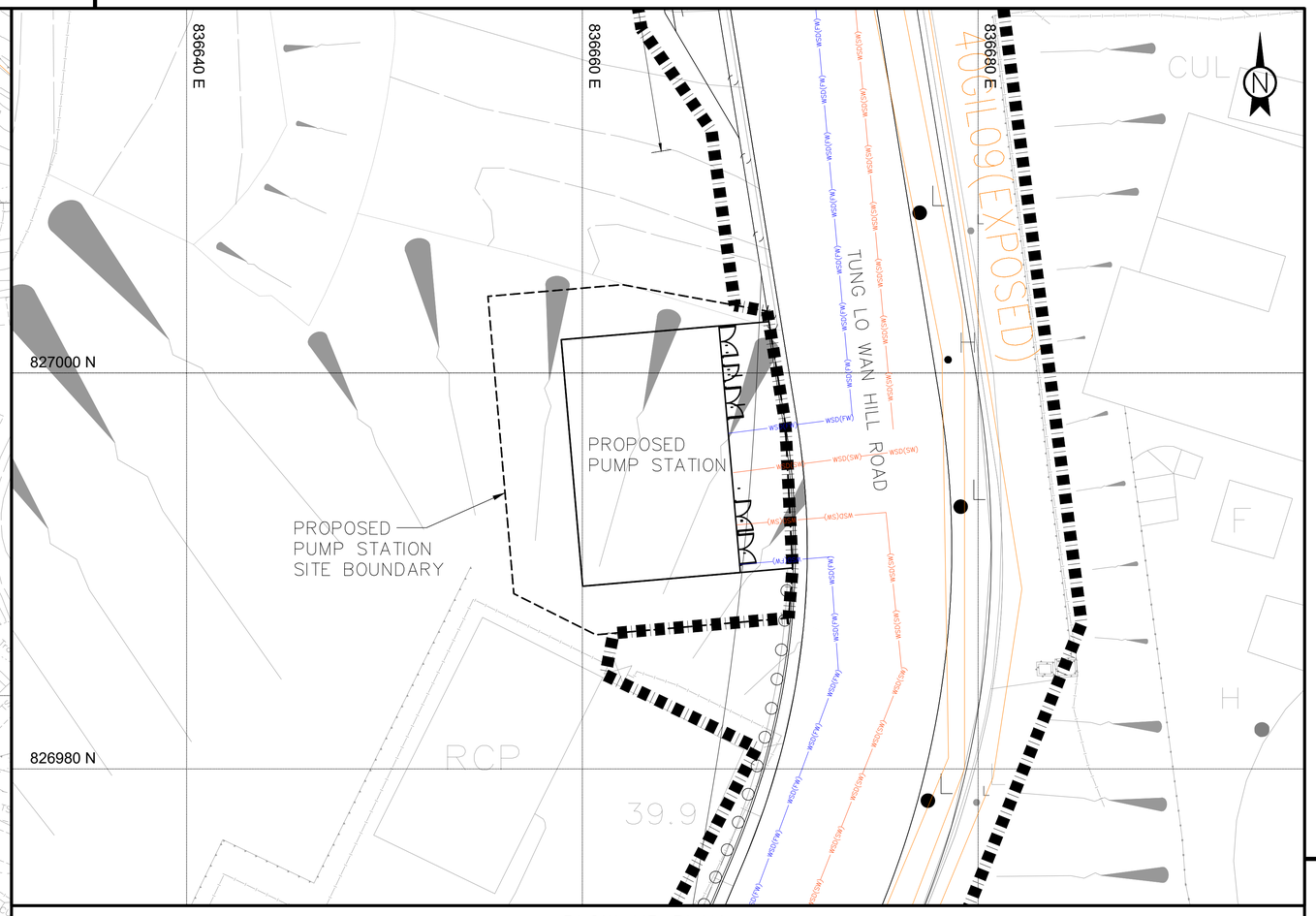
DRG. NO: PSDR-FIG-01

SCALE	1 : 600
DATE	JUL 2024
DESIGNED	ACS
DRAWN	KCW
CHECKED	ACS
APPROVED	LTL

C M WONG & ASSOCIATES LTD
TEL: (852) 2522 1068
E-mail: cmwal@cmwal.com



LOCATION PLAN
SCALE 1 : 600



BLOW-UP PLAN
SCALE 1 : 150

LEGEND :

- LOT BOUNDARY
- PROPOSED ACCESS ROAD EXTENT
- EXISTING SALT WATER MAINS
- EXISTING FRESH WATER MAINS
- WSD(SW) PROPOSED SALT WATER MAINS
- WSD(FW) PROPOSED FRESH WATER MAINS

REVISION	DATE	DESCRIPTION	BY	CHK
–	AUG 24	FOR PUMP STATION DESIGN REPORT	KCW	ACS
A	DEC 24	FOR S16 PUMP STATION DESIGN REPORT	KCW	ACS

DRG. TITLE

PROPOSED WATERMAINS LAYOUT PLAN

PROJECT: TUNG LO WAN SHAN ROAD	SCALE: 1 : 600
	DATE: JUL 2024
DRG. TYPE: PROPOSED ACCESS ROAD EXTENT	DESIGNED: ACS
	DRAWN: KCW
DRG. NO: PSDR–FIG–02	CHECKED: ACS
	APPROVED: LTL

C M WONG & ASSOCIATES LTD
TEL: (852) 2522 1068
E-mail: cmwal@cmwal.com

WATER TANK SCHEDULE

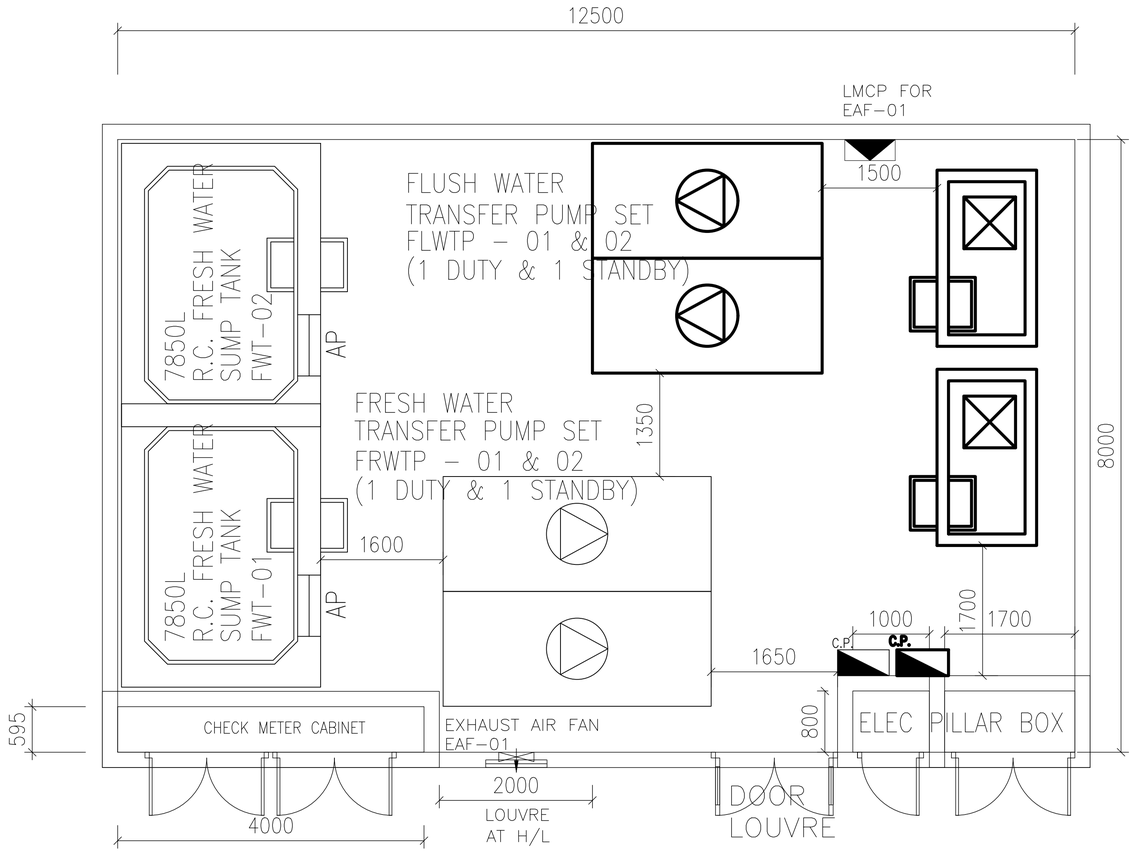
System	Water Tank Name	Tank Material	Water Tank Arrangement	Water Tank Designation	Location	Storage Capacity (L)		
						Chamber 1 of Twin Tank	**Chamber 2 of Twin Tank**	**Total**
Fresh Water System	Fresh Water Sump Tank	Reinforced Concrete	Twin-Tank	FRWT-01 & 02	G/F Sump Pump Room	**7850**	**7850**	**15700**
Flush Water System	Flush Water Sump Tank	Fibreglass	Twin-Tank	FLWT-01 & 02	G/F Sump Pump Room	**1400**	**1400**	**2800**

WATER PUMP SCHEDULE

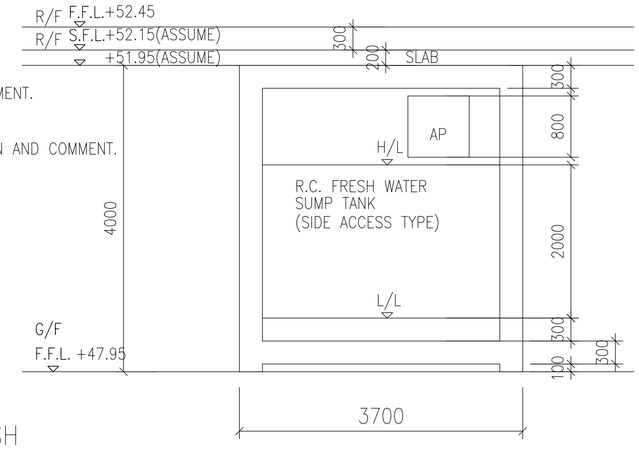
Pump No.	Pump Servies	Location	Flow Rate (L/s)	Pump Head (m)	Speed (rpm)	Required Pump Power (kW)	Rated Motor Power (kW)	Starting Method	Pump Casing
FRWTP-01&02	Fresh Water Transfer Pump Set (1 Duty & 1 Standby)	G/F Sump Pump Room	30.00	95.00	1450	58.25	75	3-phase, Star-delta	Casted Stainless Steel Grade 316
FLWTP-01&02	Flush Water Transfer Pump Set (1 Duty & 1 Standby)	G/F Sump Pump Room	4.00	85.00	1450	6.95	7.5	3-phase, Star-delta	Close Grain Cast Iron

REMARKS:

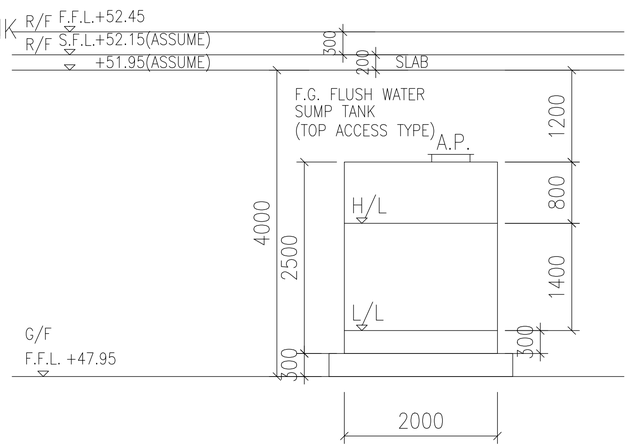
1. THE LOURVE AND EXHAUST AIR FAN AS SHOWN IN THE LAYOUT DRAWING ARE INDICATIVE ONLY. THE VENTILATION DESIGN AND THE CORRESPONDING PROVISION AND SPECIFICATION SHALL BE SUBJECTED TO MVAC DESIGNER'S INPUT. THE OVERALL PUMP ROOM SIZE SHALL BE FURTHER ADJUSTED IF NECESSSARY SUBJECTED TO MVAC DESIGNER'S DESIGN AND COMMENT.
2. THE ELECTRICAL PILLAR BOX AS SHOWN IN THE LAYOUT DRAWING IS INDICATIVE ONLY. THE ELECTRICAL SYSTEM DESIGN AND THE CORRESPONDING SPECIFICATION SHALL BE SUBJECTED TO ELECTRICAL DESIGNER'S INPUT. THE OVERALL PUMP ROOM SIZE SHALL BE FURTHER ADJUSTED IF NECESSSARY SUBJECTED TO ELECTRICAL DESIGNER'S DESIGN AND COMMENT.



PROPOSED ROOM INTERNAL DIMENSION
= 12.5m(L) X 8m(W) X 4m(H)
(WITH 4m CLEAR HEADROOM REQUIRED)



REQUIRED TANK CAPACITY = 7850L = 7.85m3
EFFECTIVE HEIGHT = 2m
REQUIRED EFFECTIVE AREA = 7.85/2 = 3.925m2
PROPOSED TANK AREA = 3.1m (L) X 2m (W) = 6.2m2
ASSUMING 50mm INTERNAL WALL FINISHING WITH CHAMFER:
PROPOSED TANK EFFECTIVE AREA = 5.55m2 (MEASURED FROM CAD)
PROPOSED TANK OVERALL DIMENSION = 3.7m (L) X 2.6m (W) X 4m (H)
(WITH 4m CLEAR HEADROOM REQUIRED)



REQUIRED TANK CAPACITY = 1400L = 1.4m3
EFFECTIVE HEIGHT = 1.5m
REQUIRED EFFECTIVE AREA = 1.4/1.4 = 1m2
PROPOSED TANK EFFECTIVE AREA = 2m (L) X 1m (W) = 2m2
PROPOSED TANK OVERALL DIMENSION = 2m (L) X 1m (W) X 2.5m (H)
(WITH 4m CLEAR HEADROOM REQUIRED)

PROPOSED PUMP STATION LAYOUT (SCALE: 1:40@A1)

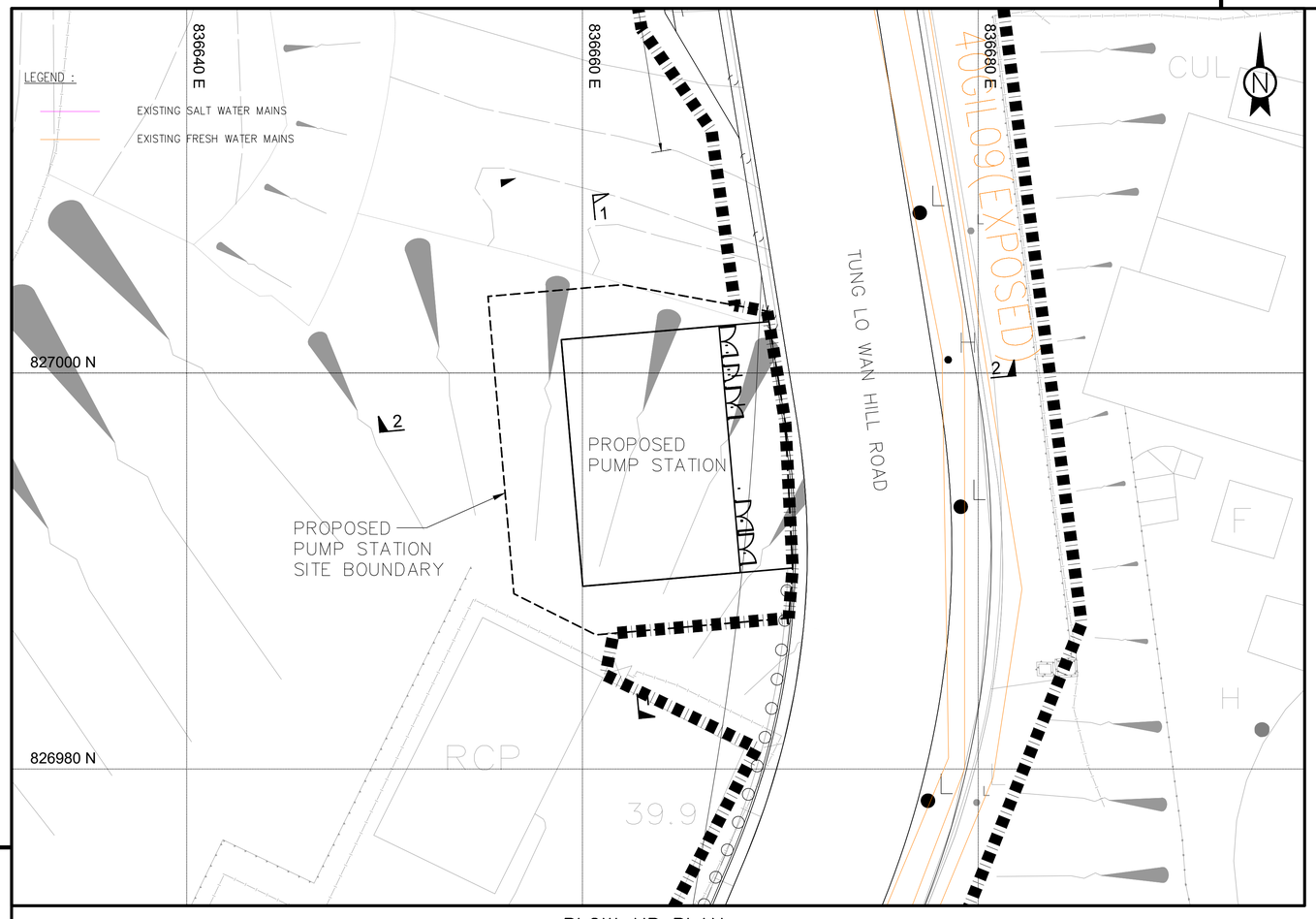
REVISION	DATE	DESCRIPTION	BY	CHK
–	AUG 24	FOR PUMP STATION DESIGN REPORT	KCW	ACS

DRG. TITLE

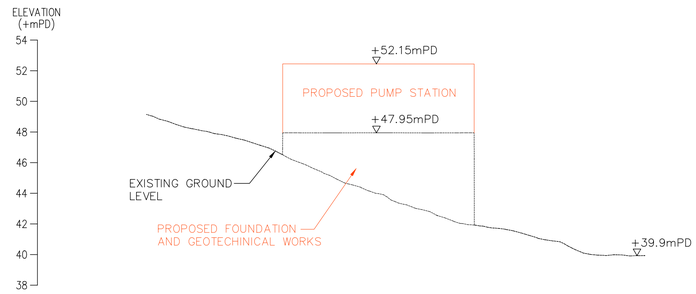
PROPOSED PUMP STATION GENERAL ARRANGEMENT

PROJECT: TUNG LO WAN SHAN ROAD	SCALE: N.T.S.
	DATE: AUG 2024
	DESIGNED: ACS
DRG. TYPE: PROPOSED ACCESS ROAD EXTENT	DRAWN: KCW
	CHECKED: ACS
DRG. NO: PSDR–FIG–03	APPROVED: LTL

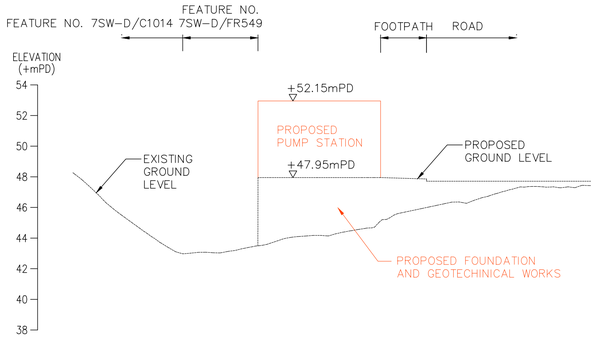
C M WONG & ASSOCIATES LTD
TEL: (852) 2522 1068
E-mail: cmwal@cmwal.com



BLOW–UP PLAN
SCALE 1 : 150



SECTION 1–1
SCALE 1 : 200



SECTION 2–2
SCALE 1 : 200

–	AUG 24	FOR PUMP STATION DESIGN REPORT	KCW	ACS
REVISION	DATE	DESCRIPTION	BY	CHK

DRG. TITLE
PROPOSED PUMP STATION –SECTIONS

PROJECT
TUNG LO WAN SHAN ROAD

DRG. TYPE
PROPOSED ACCESS ROAD EXTENT

DRG. NO
PSDR–FIG–04

SCALE	1 : 600
DATE	JUL 2024
DESIGNED	ACS
DRAWN	KCW
CHECKED	ACS
APPROVED	LTL

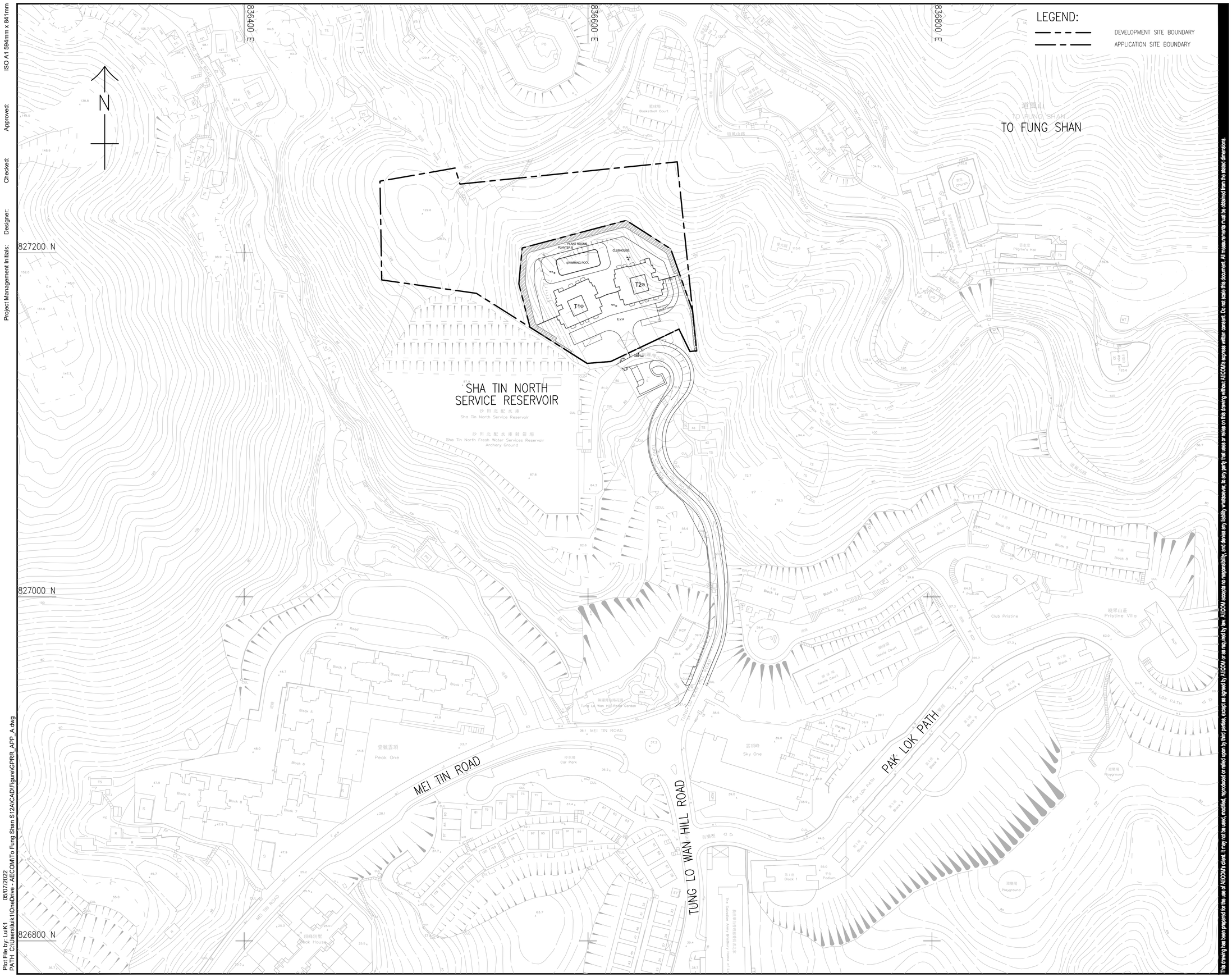
C M WONG & ASSOCIATES LTD
TEL: (852) 2522 1068
E-mail: cmwal@cmwal.com

Appendix A

Indicative Master Layout Plan from s.12A

ISO A1 594mm x 841mm

Project Management Initials: Designer: Checked: Approved:



Plot File by: LuiK1 05/07/2022
PATH: C:\Users\luik1\OneDrive - AECOM\To Fung Shan S12A\CAD\Figure\GPRR_APP_A.dwg

AECOM

PROJECT
項目

SECTION 12A APPLICATION FOR PROPOSED ADMENDMENTS TO THE SHA TIN OUTLINE ZONING PLAN IN SUPPORT OF A PRIVATE RESIDENTIAL DEVELOPMENT ON LOT 380 RP (PART) IN DD186, TUNG LO WAN HILL ROAD, SHA TIN

CLIENT
業主

CONSULTANT
工程顧問公司

AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS
分判工程顧問公司

ISSUE/REVISION
修訂

I/R 修訂	DATE 日期	DESCRIPTION 內容摘要	CHK. 核核

STATUS
用途

SCALE 比例
A1 1 : 1000

DIMENSION UNIT 尺寸單位
METRES

KEY PLAN
索引圖

PROJECT NO. 項目編號
LKC

CONTRACT NO. 合約編號

SHEET TITLE
圖紙名稱
MASTER LAYOUT PLAN

SHEET NUMBER
圖紙編號
GPRR/APPENDIX A

Appendix B

Water Supply Impact Assessment from s.12A

Section 12A Application for Proposed Amendments to the Sha Tin Outline Zoning Plan in Support of a Private Residential Development at Lot 380 RP (Part) in DD 186, Tung Lo Wan Hill Road, Sha Tin

Water Supply Impact Assessment

August 2022

Delivering a better world

Prepared by:

AECOM Asia Company Limited
11/F, Block 2, Grand Central Plaza, 138 Shatin Rural Committee Road, Shatin
Hong Kong
aecom.com

Table of Contents

Tables

Figures

Annex

1. Introduction

1.1 Background

1.1.1 AECOM Asia Company Limited (AECOM) has been commissioned by the Applicant to act as the engineering consultant for the Proposed Development at To Fung Shan, Sha Tin.

1.1.2 The Application Site is situated at the hillside end of Tung Lo Wan Hill Road, adjacent to Sha Tin North Fresh Water Service Reservoir, **WSIA/Figure 1** refers.

1.1.3 The Site largely falls within an area zoned as "Green Belt" ("GB"), and minor portion of "Government, Institution and Community" ("G/IC") on the Draft Sha Tin Outline Zoning Plan (OZP) No. S/ST/35. The current proposal is to rezone the Subject Site into a new sub-zone under the "Residential (Group B)" ("R(B)") zoning, i.e. "R(B)3". This Water Supply Impact Assessment (WSIA) report serves as a supportive document for rezoning application under Section 12A of Town Planning Ordinance (Cap 131).

1.2 Objective of this Submission

1.2.1 This report outlines the assessment results of the potential water supply impacts caused by the Proposed Development at the Application Site. The main objectives of this assessment include the followings:

(i) Review the existing water supply condition of the Application Site;

(ii) Outline the methodology adopted in this assessment;

(iii) Identify any potential impact on the current water supply system due to the additional water supply demand from the proposed development;

(iv) Propose water supply mitigation measures where appropriate to mitigate the potential water supply impact.

1.3 Nomenclature

1.3.1 The following abbreviations and shortened expressions in **Table 1** are adopted in this report.

AC	Asbestos Cement
AECOM	AECOM Asia Company Limited
CIFSUS	Commercial and Industrial Floor Space Utilization Survey (PlanD)
EPD	Environmental Protection Department
F&B	Food and Beverage
GESF	Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0 (EPD)
GFA	Gross Floor Area
MDD	Mean Daily Demand
MLD	Million Litres per Day
mPD	Metres above Principal Datum
PlanD	Planning Department
STNFWSR	Sha Tin North Fresh Water Service Reservoir
UDD	Unit Daily Demand
WSD	Water Supplies Department
WSIA	Water Supply Impact Assessment

Table 1 – Nomenclature

2. Development Proposal

2.1 The Proposed Development

2.1.1 The Application Site has an area of approximately 6,150m^2 with a domestic Gross Floor Area (GFA) of not more than 15,375m^2. The proposed development comprises of 2 mid-rise residential towers, 1 clubhouse and 2 levels of basement carpark.

2.1.2 The anticipated completion year of the Proposed Development is 2028.

2.1.3 The Master Layout Plan (MLP) of the Proposed Development is shown in **WSIA/Figure 2**. The proposed development schedule is summarized in **Table 2** below.

Application Site Area	About 6,150m^2
Plot Ratio	2.5
Total Domestic GFA	Not more than 15,375m^2
No. of Blocks	2
Average Flat Size	About 96m^2
No. of Units	About 160
Person/Unit(1)	2.7
Anticipated Population	About 432
Clubhouse GFA	Not more than 768m^2

(1): Based on a person-per-flat ratio of 2.7 referenced to Population By-Census 2021.

Table 2 – Development Schedule

3. The Application Site

3.1 Site Description

3.1.1 The Application Site occupies an area of about 6,150 m^2, it is irregular in shape and is currently vacant. The existing topography across the Application Site varies in height, from the site entrance at 76.60mPD up to about 79.10mPD overall ground level.

3.2 Existing Water Supply System

3.2.1 According to WSD Fresh Water / Salt Water Record Plan, Sha Tin North Fresh Water Service Reservoir (STNFWSR) is immediately next to the Application Site. However, it is observed that the overall elevation of the proposed development is higher than that of STNFWSR, such that the operation invert level of the reservoir may not have adequate head to serve the proposed development.

3.2.2 Existing salt water mains are located on Tung Lo Wan Hill Road near Tung Lo Wan Hill Road Garden. Please refer to **WSIA/Figure 3** and **WSIA/Figure 4** for the existing fresh water and salt water supply layout respectively.

3.3 Proposed Water Supply System

3.3.1 Proposed water supply to the Application Site shall come from the existing STNFWSR, the location of which is indicated on **WSIA/Figure 3** and **WSIA/Figure 4**. However, due to the level difference, pump system is required.

3.3.2 An off-site sump and pump system is proposed. The tentative proposed location in the vicinity of the existing Tung Lo Wan Hill Road Garden, adjacent to the existing refuse collection point.

3.3.3 The proposed private off-site sump and pump system with booster pump and rising mains along Tung Lo Wan Hill Road can supply fresh and salt water to the Application Site. The indicative proposed pipe alignment is illustrated in **WSIA/Figure 3** and **WSIA/Figure 4**.

4. Assessment Methodology

4.1 Unit Demand

4.1.1 For estimation of water demands of non-domestic nature, "*EPD/TP1/05 Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0*" (GESF) published by Environmental Protection Department has been used as reference.

4.1.2 Unit demand of 300 L/head/day and 70 L/head/day have been adopted for domestic fresh water demand and salt water demand respectively; and 45 L/h/d has been adopted for service trades in Sha Tin.

4.1.3 A summary of the unit daily demand (UDD) used for different development types is shown in **Table 3** below.

Development Type	Flow Type	Fresh Water UDD (L/head/day)	Salt Water UDD (L/head/day)
Domestic	Private Residential – R2	300	70
Clubhouse	Service Trades	45	/

Table 3 – Unit Demand

4.2 Design Population

4.2.1 For domestic population, a person-per-flat ration of 2.7 had been adopted by referring to the 2021 Population By-Census.

4.2.2 A summary of design population can be found in the below **Table 4**.

Development Type	Population
Domestic	432
Non-domestic	Service Trades for a Population of 432

Note: Service trade adopted 100% of domestic population

Table 4 – Design Population

4.3 Peaking Factors

4.3.1 The peak demand factors below shall be adopted for design:

- Peak flow rate in fresh water distribution mains = 3 x mean daily demand (MDD)
- Peak flow in salt water distribution mains = 2 x mean daily demand (MDD)
- Peak flow rate in fresh water trunk mains = 1.5 x mean daily demand (MDD)
- Peak flow rate in salt water trunk mains = 1.2 x mean daily demand (MDD)

4.4 Fire-fighting

4.4.1 In addition to the aforementioned facilities of the Proposed Development, water supply for fire-fighting service has been considered in this WSIA. Fire-fighting requirement for residential zone is 6,000m^3/day with discharge pressure of 17m head. The fire hydrant should be of standard pattern with minimum output pressure of not less than 25 psi. With multiple hydrants operating at the same time, total output of not less than 4,000L/min shall last for 60 minutes. **Table 5** summarises the fire-fighting requirements.

Requirements	Minimum Values
Minimum fresh water supply	6,000 m^3/day
Discharge pressure	17m
Minimum output not less than 25 psi	4,000 L/min to last for an hour

Table 5 – Fire-fighting Requirement

4.5 Design Velocity and Head of Flow

4.5.1 The desirable flow velocities for hydraulic checking are as follows:

Maximum velocity (under peak flow condition)

Fresh water mains:

>DN700	≤ 3 m/s
DN700 – DN525	≤ 2.5 m/s
DN450 – DN375	≤ 2 m/s
DN300 – DN200	≤1.5 m/s

Salt water mains:

≥DN1000	≤ 3 m/s
DN900 – DN800	≤ 2.5 m/s
DN700 – DN300	≤ 2 m/s
DN450 – DN300	≤ 1.5 m/s

Minimum velocity (under peak flow condition)

Fresh water mains:	≥ 0.9 m/s
Salt water mains:	≥ 0.9 m/s

4.5.2 The pipeline shall have a minimum gradient of 1:400. Pipes shall be laid at a minimum separation of 300mm away from existing utilities and underground structures.

4.5.3 The adopted minimum residual heads at extremity of the fresh water and salt water supply system for the proposed development are as follow:

- Fresh water: 20m
- Salt water: 15m

5. Water Demand Estimation

5.1 Water Demand Estimates

5.1.1 By adopting the aforementioned design parameters, the fresh water demand and salt water demand generated by the proposed development are estimated to be 149 m^3/day and 30 m^3/day respectively upon full occupation. The estimation results are summarised in **Table 6** below.

Development Type	Flow Type	Fresh Water Demand (m^3/day)	Salt Water Demand (m^3/day)
Domestic	Private Residential – R2	130	30
Clubhouse	Service Trades	19	/
Total Demand		149	30

Table 6 – Water Demand Estimation

5.1.2 The water demand is anticipated to start at year 2028 which is the same as the completion year.

5.1.3 Please refer to **Annex W1** for the detail estimation of water demand.

6. Potential Water Supply Impacts and Mitigation Measures

6.1 Potential Water Supply Impacts

6.1.1 The existing Application Site currently has no fresh and salt water supply, new pipe system will be required and water demand from the proposed development will be considered additional water demand compared to pre-development scenario which has no water demand.

6.1.2 Subject to WSD's agreement, the proposed development will draw its water supply from the existing Sha Tin North Fresh Water Service Reservoir.

6.2 Proposed Mitigation Measures

6.2.1 New fresh water mains and salt water mains will be constructed and lead in to the Application Site.

6.2.2 The proposed fresh and salt water mains will be connected to the proposed private off-site sump and pump system with booster pump.

6.2.3 Water supply chamber / gate valve will be provided for the fresh water supply, coming from the proposed private off-site sump and pump system.

6.2.4 The proposed private off-site sump and pump system to be located at the existing Tung Lo Wan Hill Road Garden.

6.2.5 The location of the proposed private off-site sump and pump system is subject to the agreement of the relevant parties and shall be further reviewed.

6.2.6 The proposed salt water mains will be tee-off from an existing salt water main near Tung Lo Wan Hill Road Garden.

6.2.7 The proposed fresh and salt water supply layout plan can be found in **WSIA/Figure 3 and WSIA/Figure 4** respectively.

7. Maintenance Responsibility

7.1 Proposed Water Supply Lead-in

7.1.1 The Applicant is responsible for the construction, operation and maintenance of all proposed water supply facilities as mentioned in the WSIA of this Application including all internal water mains, water supply lead-in valves and those proposed water mains as shown in WSIA/Figure 3 and Figure/4.

7.2 Proposed Private Off-site Sump and Pump System

7.2.1 The proposed external water mains, the proposed private off-site sump and pump system with booster pump is proposed constructed, operated and maintained by the Applicant.

7.3 Proposed External Water Supply Rising Mains

7.3.1 It is understood that the section of Tung Lo Wan Hill Road leading to Sha Tin North Fresh Water Service Reservoir (STNFWSR) has been allocated to Water Supplies Department (WSD) as waterwork maintenance access. The project proponent proposes to take up the management and maintenance responsibility of the widened section of road. Right of way will be given to the government at all times for vehicular access and maintenance purpose.

8. Conclusion

8.1 Water Supply Impact Assessment

8.1.1 The Application Site is at the end of Tung Lo Wan Hill Road neighbouring WSD Sha Tin North Fresh Water Service Reservoir, the location can be referred to **WSIA/Figure 1**.

8.1.2 AECOM Asia Company Limited (AECOM) has been commissioned by the Applicant to act as the engineering consultant for the Proposed Development in To Fung Shan, Sha Tin.

8.1.3 The proposed amendment is to rezone the Application Site which is currently zoned "GB" with a minor portion zoned "G/IC" on the Draft Sha Tin OZP No. S/ST/35 to "R(B)3" and this Water Supply Impact Assessment (WSIA) report serves as a supportive document for rezoning application under Section 12A of Town Planning Ordinance (Cap 131).

8.1.4 The Application Site is mostly vacant, the plan area of the site is about 6,150 m^2, with hilly topography and heavily vegetated surroundings. The Proposed Development comprises of 2 mid-rise residential towers, 1 clubhouse and 2 levels of basement carpark.

8.1.5 Approximately 149 m^3/day of fresh water demand and 30 m^3/day of salt water demand will be generated by the proposed development. It is proposed to draw water supply from the nearby Sha Tin North Service Reservoir.

8.1.6 An off-site sump and pump system and associated rising main are proposed for the supply of fresh water to the Application Site. The tentative proposed location is at the existing Tung Lo Wan Hill Road Garden and the exact location is subject to the agreement of relevant government department and further review.

8.1.7 Proposed salt water main tee-off is located near the existing Tung Lo Wan Hill Road Garden.

8.1.8 It is concluded that the proposed development will generate additional water demand. The proposed watermains as well as the proposed private off-site sump and pump system will supply fresh water and salt water to the proposed development. The proposed development will draw its water supply from STNFWSR. No adverse water supply impact is envisaged.

End of Report

Figures

ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:

Plot File by: LIANJ2 16/08/2022

PATH P:\PROJECTS\60670879\DRAWING\REPORT\WSIA\WSIA_401.dwg

AECOM

PROJECT 項目

SECTION 12A APPLICATION FOR PROPOSED AMENDMENTS TO THE SHA TIN OUTLINE ZONING PLAN IN SUPPORT OF A PRIVATE RESIDENTIAL DEVELOPMENT AT LOT 380 RP (PART) IN DD 186, TUNG LO WAN HILL ROAD, SHA TIN

CLIENT 業主

CONSULTANT 工程顧問公司

AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS 分判工程顧問公司

ISSUE/REVISION 修訂

I/R 修訂	DATE 日期	DESCRIPTION 內容摘要	CHK. 審核

STATUS 階段

SCALE 比例

A1 1 : 2500

DIMENSION UNIT 尺寸單位

METRES

KEY PLAN 索引圖

PROJECT NO. 項目編號

60670879

CONTRACT NO. 合約編號

SHEET TITLE 圖紙名稱

LOCATION PLAN

SHEET NUMBER 圖紙編號

60670879/WSIA/FIGURE 1

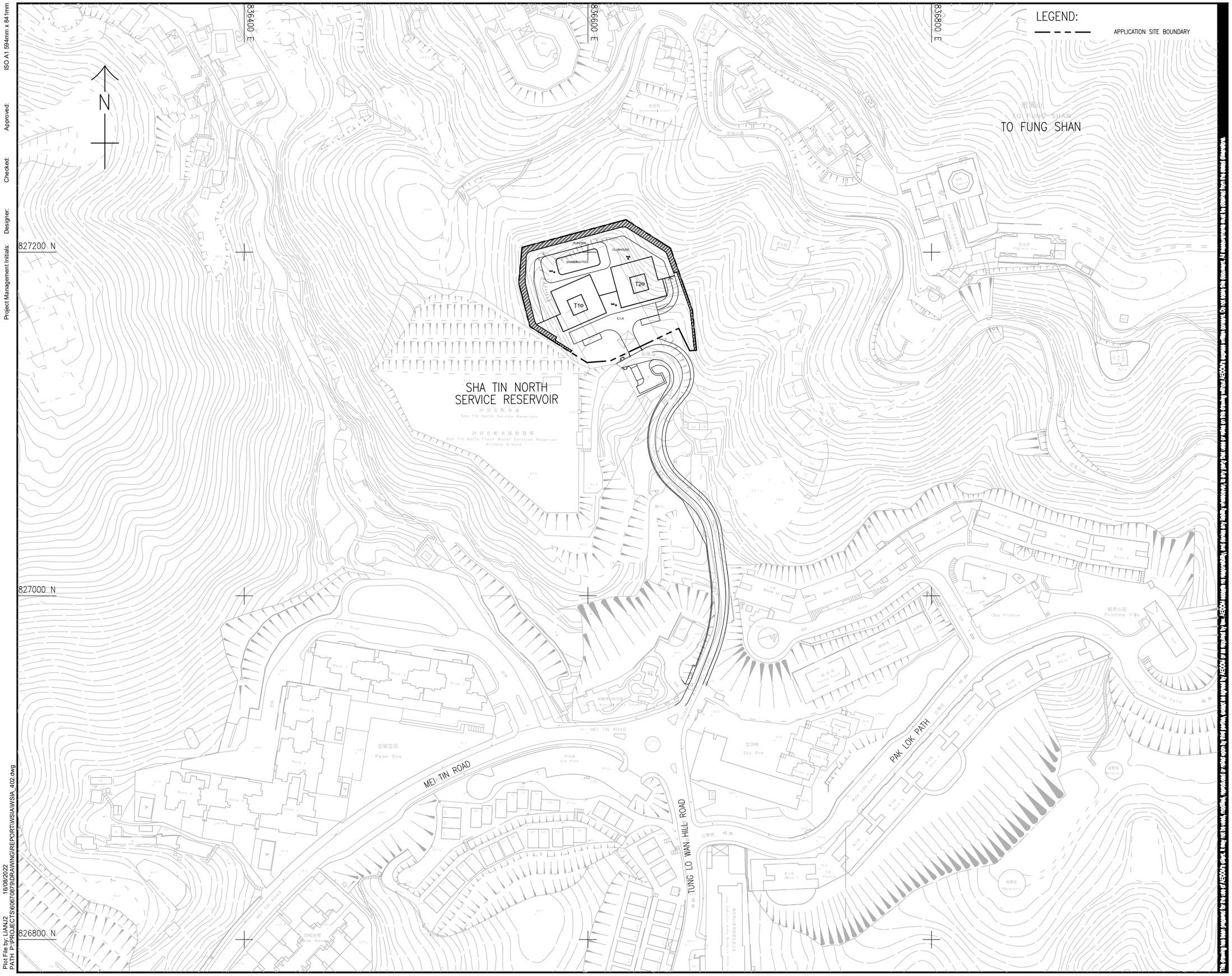
ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:



Plot File by: LIANJ2 16/08/2022
PATH P:\PROJECTS\60670879\DRAWING\REPORT\WSIA\WSIA_402.dwg

AECOM

PROJECT

SECTION 12A APPLICATION FOR PROPOSED AMENDMENTS TO THE SHA TIN OUTLINE ZONING PLAN IN SUPPORT OF A PRIVATE RESIDENTIAL DEVELOPMENT AT LOT 380 RP (PART) IN DD 186, TUNG LO WAN HILL ROAD, SHA TIN

CLIENT

CONSULTANT

AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS

ISSUE/REVISION

I/R	DATE	DESCRIPTION	CHK.

STATUS

SCALE A1 1 : 1000

DIMENSION UNIT METRES

KEY PLAN

PROJECT NO. 60670879

CONTRACT NO.

SHEET TITLE

MASTER LAYOUT PLAN

SHEET NUMBER

60670879/WSIA/FIGURE 2

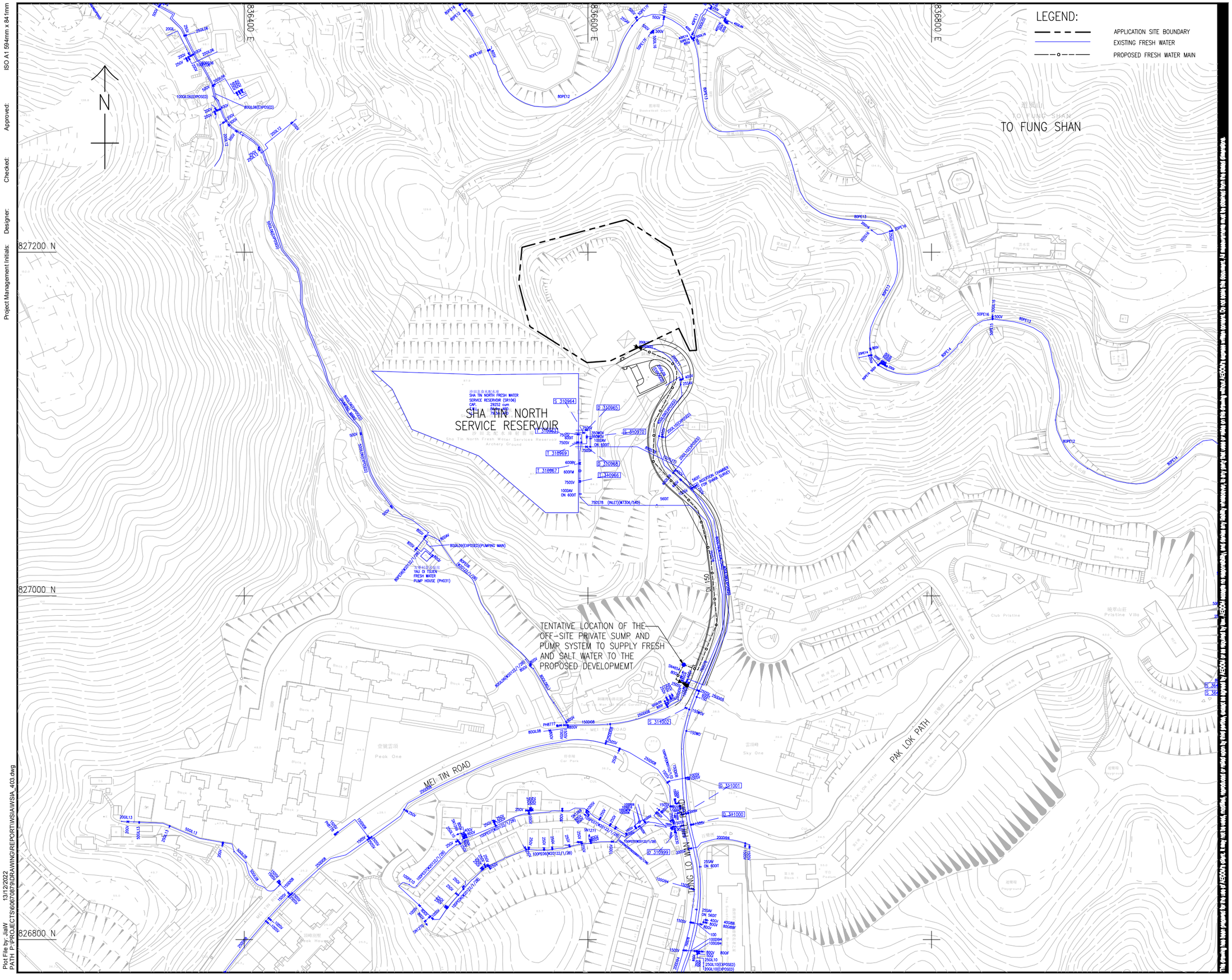
ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:



Plot File by: JiaW 13/12/2022
PATH P:\PROJECTS\60670879\DRAWING\REPORT\WSIA\WSIA_403.dwg

AECOM

PROJECT

SECTION 12A APPLICATION FOR PROPOSED AMENDMENTS TO THE SHA TIN OUTLINE ZONING PLAN IN SUPPORT OF A PRIVATE RESIDENTIAL DEVELOPMENT AT LOT 380 RP (PART) IN DD 186, TUNG LO WAN HILL ROAD, SHA TIN

CLIENT

CONSULTANT

AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS

ISSUE/REVISION

I/R	DATE	DESCRIPTION	CHK

STATUS

SCALE A1 1 : 1000

DIMENSION UNIT METRES

KEY PLAN

PROJECT NO. 60670879

CONTRACT NO.

SHEET TITLE

EXISTING AND PROPOSED FRESH WATER SUPPLY LAYOUT PLAN

SHEET NUMBER

60670879/WSIA/FIGURE 3

ISO A1 594mm x 841mm

Project Management Initials: Designer: Checked: Approved:

836400 E

836600 E

836800 E

827200 N

827000 N

826800 N

N

LEGEND:

APPLICATION SITE BOUNDARY

EXISTING SALT WATER

PROPOSED SALT WATER MAIN

TO FUNG SHAN

SHA TIN NORTH SERVICE RESERVOIR

Sha Tin North Fresh Water Services Reservoir

Archery Ground

TENTATIVE LOCATION OF THE OFF-SITE PRIVATE SUMP AND PUMP SYSTEM TO SUPPLY FRESH AND SALT WATER TO THE PROPOSED DEVELOPMEMT

TUNG LO WAN HILL ROAD GARDEN

MEI TIN ROAD

TUNG LO WAN HILL ROAD

PAK LOK PATH

Peak One

Sky One

Club Pristine

Pristine Villa

Rosewood Court

Tennis Court

Playground

Car Park

Block 1

Block 2

Block 3

Block 4

Block 5

Block 6

Block 7

Block 8

Block 9

Block 10

Block 11

Block 12

Block 13

Block 14

Block A

Block B

Block C

Block D

Block E

Block F

Block G

Block H

Block J

Block K

Block L

Block M

Block N

Block P

Block Q

Block R

Block S

Block T

Block U

Block V

Block W

Block X

Block Y

Block Z

Plot File by: JiaW 13/12/2022
PATH: P:\PROJECTS\60670879\DRAWING\REPORT\WSIA\WSIA_404.dwg

AECOM

PROJECT

SECTION 12A APPLICATION FOR PROPOSED AMENDMENTS TO THE SHA TIN OUTLINE ZONING PLAN IN SUPPORT OF A PRIVATE RESIDENTIAL DEVELOPMENT AT LOT 380 RP (PART) IN DD 186, TUNG LO WAN HILL ROAD, SHA TIN

CLIENT

CONSULTANT

AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS

ISSUE/REVISION

I/R	DATE	DESCRIPTION	CHK.

STATUS

SCALE

A1 1 : 1000

DIMENSION UNIT

METRES

KEY PLAN

PROJECT NO.

60670879

CONTRACT NO.

SHEET TITLE

EXISTING AND PROPOSED SALT WATER SUPPLY LAYOUT PLAN

SHEET NUMBER

60670879/WSIA/FIGURE 4

ISO A1 594mm x 841mm

Approved:

Checked:

Designer:

Project Management Initials:

836400 E

836600 E

836800 E

827200 N

827000 N

826800 N

N

LEGEND:

APPLICATION SITE BOUNDARY

PROPOSED FRESH WATER MAIN

PROPOSED SALT WATER MAIN

TO FUNG SHAN

SHA TIN NORTH SERVICE RESERVOIR

Sha Tin North Fresh Water Services Reservoir

Archery Ground

TENTATIVE LOCATION OF THE OFF-SITE PRIVATE SUMP AND PUMP SYSTEM TO SUPPLY FRESH AND SALT WATER TO THE PROPOSED DEVELOPMEMT

TUNG LO WAN HILL ROAD GARDEN

MEI TIN ROAD

TUNG LO WAN HILL ROAD

PAK LOK PATH

Peck One

Sky One

Club Pristine

Pristine Villa

Tennis Court

Car Park

Block 1

Block 2

Block 3

Block 4

Block 5

Block 6

Block 7

Block 8

Block 9

Block 10

Block 11

Block 12

Block 13

Block 14

Plot File by: LIANJ2 16/08/2022
PATH P:\PROJECTS\60670879\DRAWING\REPORT\WSIA\WSIA_405.dwg

AECOM

PROJECT

SECTION 12A APPLICATION FOR PROPOSED AMENDMENTS TO THE SHA TIN OUTLINE ZONING PLAN IN SUPPORT OF A PRIVATE RESIDENTIAL DEVELOPMENT AT LOT 380 RP (PART) IN DD 186, TUNG LO WAN HILL ROAD, SHA TIN

CLIENT

CONSULTANT

AECOM Asia Company Ltd.
www.aecom.com

SUB-CONSULTANTS

ISSUE/REVISION

I/R	DATE	DESCRIPTION	CHK.

STATUS

SCALE A1 1 : 1000

DIMENSION UNIT METRES

KEY PLAN

PROJECT NO. 60670879

CONTRACT NO.

SHEET TITLE

PROPOSED WATER SUPPLY LAYOUT PLAN (SIMPLIFIED)

SHEET NUMBER

60670879/WSIA/FIGURE 5

Annex W1

Water Demand and Hydraulic Calculation

Section 12A Application for Proposed Amendments to the Sha Tin Outline Zoning Plan in Support of a Private Residential Development at Lot 380 RP (Part) in DD 186, Tung Lo Wan Hill Road, Sha Tin 8/16/2022

Water Demand Estimation for Fresh Water and Salt Water

Development Type	GFA (m^2)	Avg. Unit Size (m^2)	No. of Units	Person/Unit	Person/m^2	Population	Fresh Water UDD (L/head/day)	Daily Fresh Water Demand (m^3/day)	Salt Water UDD (L/head/day)	Daily Salt Water Demand (m^3/day)
Domestic	15,375.00	96.09	160	2.7	0.028	432	300	130	70	30
				Total Residential Population		**432**				
Retails: Service Trades for a Population of	432			/			45	19	/	
							Total Fresh Water Demand (m^3/day)	**149**	**Total Salt Water Demand (m^3/day)**	**30**

Note 1: Assuming the average unit size to be: 1,034.35 ft^2

Hydraulic Analysis by Flow Velocity

Fresh Water

Nominal Diameter of existing fresh water mains =	250	mm	
Internal Diameter of existing fresh water mains =	233	mm	
=	0.233	m	
Pipe Area =	0.043	m^2	
Assuming that the flow velocity of watermain =	1.5	m/s	WSD Manual of Mainlaying Practice Cl 1.2.1
The flow capacity of watermain =	0.064	m^3/s	
The water demand of the proposed development is equivalent to	**2.70%**	**of the existing water main**	
Estimated Fresh Water Demand for Proposed Development =	149	m^3/day	
=	0.0017	m^3/s	
Peaking Factor for Fresh Water Distribution Mains =	3		
Required Peak Flow Rate for Proposed Development =	0.0052	m^3/s	
To supply water for the Proposed Development,			
Nominal Diameter of Proposed Pipe Size =	**150**	**mm**	
Internal Diameter of Proposed Pipe Size=	138	mm	
=	0.138	m	
Pipe Area =	0.015	m^2	
Assuming that the flow velocity of watermain =	0.9	m/s	WSD Manual of Mainlaying Practice Cl 1.2.1
The flow capacity of watermain =	0.013	m^3/s	
Factor of Safety =	**2.60**		
=>	**OK**		

Salt Water	Nominal Diameter of existing salt water mains =	150	mm	
	Internal Diameter of existing salt water mains =	138	mm	
	=	0.138	m	
	Pipe Area =	0.015	m^2	
	Assuming that the flow velocity of watermain =	0.9	m/s	WSD Manual of Mainlaying Practice Cl 1.2.1
	The flow capacity of watermain =	0.013	m^3/s	
	The water demand of the proposed development is equivalent to	**2.60%**	**of the existing water main**	
	Estimated Salt Water Demand for Proposed Development =	30	m^3/day	
	=	0.0004	m^3/s	
	Peaking Factor for Salt Water Distribution Mains =	2		
	Required Peak Flow Rate for Proposed Development =	0.0007	m^3/s	
	To supply water for the Proposed Development,			
	Nominal Diameter of Proposed Pipe Size =	**50**	**mm**	
	Internal Diameter of Proposed Pipe Size=	50	mm	
	=	0.05	m	
	Pipe Area =	0.002	m^2	
	Assuming that the flow velocity of watermain =	0.9	m/s	WSD Manual of Mainlaying Practice Cl 1.2.1
	The flow capacity of watermain =	0.002	m^3/s	
	Factor of Safety =	**2.52**		
	=>	**OK**		

aecom.com

Appendix C

Details of the Design Calculation of the Proposed Pump Station

Project: **Tung Lo Wan Shan Road - Private Residential Development**
Proposed Road Widening Works and Associated Infrastructure
Off-site Private Pump Room Design
Date: **8/11/2024**
Rev.: **2**

(A) Description

A private off-site sump and pump system with booster pump and rising main along Tung Lo Wan Hill Road would be constructed to suppply fresh and flush water to the Application Site.
The private pump room is proposed to be located at the existing Tung Lo Wan Hill Road Garden.

Site Information:

Recap From S.12A		
Site Area	6150	m2
Total GFA	15375	m2
Clubhouse GFA	768	m2
Max. Building Height	140	mPD
No. of Storeys (Residential Floors)	17	storeys
No. of Storeys (Lobby & Clubhouse)	2	storeys
No. of Units	160	units
Average Unit Size	96	m2

(B) Design Guideline / Standard

1) EPD/TP1/05 Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0 (GESF) (Published by EPD, HK)
2) Plumbing Engineering Services Design Guide (IOP) 2002 (Published by The Institute of Plumbing, UK)
3) Technical Requirement for Plumbing Works in Buildings 2021 (TR) (Published by Water Supplies Department, HK)
4) 2021 Population By-Census (C&SD) (Published by Census and Statistics Department, HK)
5) Commercial and Industrial Floor Space Utilization Survey (CIFSUS) (Published by Planning Department, HK)
6) Manual of Mainlaying Practice 2012 (Published by Water Supplies Department, HK)
7) BS EN 12845:2004 (Published by the Authority of the Standards Policy and Strategy Committee, UK)
8) ASD Design Guide for Plumbing Installation (Published by ASD, HK)
9) ASD Design Guide for Public Swimming Pools (Published by ASD, HK)
10) HK Regulation CAP 132CA
11) WSIA (By AECOM)
12) Installation Notes of Different Types of Corrosion Resistant Pipe Materials as Inside Service in Buildingds (Published by Water Supplies Department, HK)

(C) Design Assumptions / Criteria (New Incoming Main)

1) Water Supply Parameters - Unit Demand

Unit Demand (UDD) for Fresh Water Demand:		270	L/head/day	(By GESF, Table III(b), Development Type: Domestic; Flow Type: Private Residential -R2)
	Take	**300**	L/head/day	(By WSIA)
Unit Demand (UDD) for Flush Water Demand:		80	L/head/day	(By GESF, Table III(c), Development Type: Domestic; Flow Type: Private Residential -R2)
	Take	**70**	L/head/day	(By WSIA)
Unit Demand (UDD) for Service Trade:		**45**	L/head/day	(By WSIA assumed, Development Type: Clubhouse; Flow Type: Service Trades)

2) Design Population

No. of Unit:	160	(From Arch)
Person/flat:	2.7	(By C&SD, Average Domestic Household Size)
Domestic Population:	432	
Clubhouse GFA (m2):	768	(From Arch)
Worker per 100m2 GFA:	5.1	(By CIFSUS, Industry Group: Restaurant)
No. of Employees (Clubhouse)	39	

3) Peaking Factors for Water Main

Peak Flow Rate in Fresh Water Distribution Mains:	3 x Mean Daily Demand (MDD)	(By WSIA)
Peak Flow Rate in Salt Water Distribution Mains:	2 x Mean Daily Demand (MDD)	(By WSIA)
Peak Flow Rate in Fresh Water Trunk Mains:	1.5 x Mean Daily Demand (MDD)	(By WSIA)
Peak Flow Rate in Salt Water Trunk Mains:	1.2 x Mean Daily Demand (MDD)	(By WSIA)

4) Fire-fighting

Min. Fresh Water Supply:	6000 m3/day	(By WSIA)
Discharge Pressure:	17 m	(By WSIA)
Fire Hydrant:	Standard Pattern with Min. Output Pressure of Not Less Than 25psi	(By WSIA)
Min. Output of fire hydrant not less than 25 psi:	4000 L/min to last for 60mins	(By WSIA)

Assuming the FS water supply of the proposed development would be supplied by the fresh water main.

5) Design Velocity and Head of Flow

a) Maximum flow velocity under peak flow for both pumping mains and distribution mains should be less than 3 m/s. (By WSD Manual of Mainlaying)

b) Desirable Flow Velocities for Hydraulic Checking: (By WSIA)

Maximum velocity (under peak flow condition)	
Fresh water mains:	
>DN700	**≤ 3 m/s**
DN700 – DN525	**≤ 2.5 m/s**
DN450 – DN375	**≤ 2 m/s**
DN300 – DN200	**≤1.5 m/s**
Salt water mains:	
≥DN1000	**≤ 3 m/s**
DN900 – DN800	**≤ 2.5 m/s**
DN700 – DN300	**≤ 2 m/s**
DN450 – DN300	**≤ 1.5 m/s**
Minimum velocity (under peak flow condition)	
Fresh water mains:	**≥ 0.9 m/s**
Salt water mains:	**≥ 0.9 m/s**

c) Min. Gradient of Pipeline: 1:400 Laid at Min. Separation of 300mm away from Existing Utilities and Underground Structures

d) Min. Residual Heads at Extremity of the Fresh Water and Salt Water Supply System for the Proposed Development:

Fresh Water:	20 m	(By WSD TR)
Salt Water:	15 m	(By WSD TR)

6) Water Main Sizing

The water main sizing shall fulfil the following criteria:

Water Daily Demand of the Proposed Development	< Flow Capacity of the Existing Water Main
Peak Flow Rate for Proposed Development:	= Water Daily Demand x Peaking Factor for Water Distribution Main < Flow Capacity of the Proposed Water Distribution Main

(D) Design Assumptions / Criteria (Sump Pump Room System)

1) Safety Factor for Pump and Pipe Sizing

A 30% safety buffer is allowed for the pump room system design.

2) Pipe Material

The proposed pipe material is shown below and comply with WSD Manual of Mainlaying Section 1.1:

	Incoming Water Distribution Main		Pumped Pipe	
	Buried	Exposed	Buried	Exposed
Fresh Water	DI	DI	DI	DI
Flush Water	Blue PE	Black PE	Blue PE	Black PE

3) Pipe and Pipe Fitting Loss

Pressure loss for pipe and pipe fitting for pump sizing is based on Hazen-Williams Formula: (By BS EN 12845)

$$p = \frac{6.05 \times 10^5}{C^{1.85} \times d^{4.87}} \times L \times Q^{1.85}$$

where:
p is the pressure loss in the pipe, in bar;
Q is the flow through the pipe, in L/min;
d is the mean internal diameter of the pipe, in mm;
C is a constant for the type and condition of the pipe

Based on BS EN 12845:2004, C values and equivalent length of pipe and fittings shall be referred:

EN 12845:2004 (E)

L is the equivalent length of pipe and fittings, in metres.

The values of *C* indicated in Table 22 shall be used.

Table 22 — C values for various types of pipe

Type of pipe	Value of *C*
cast iron	100
ductile iron	110
mild steel	120
galvanized steel	120
spun cement	130
cement lined cast iron	130
stainless steel	140
copper	140
reinforced glass fibre	140
NOTE The list is not exhaustive	

Table 23 — Equivalent length of fittings and valves

Fittings and valves	Equivalent length of steel straight pipe for a *C* value of 120* (m)									
	Nominal diameter (mm)									
	20	25	32	40	50	65	80	100	150	200	250
90° Screwed elbow (standard)	0,76	0,77	1,0	1,2	1,5	1,9	2,4	3,0	4,3	5,7	7,4
90° Welded elbow (r/d = 1,5) 45° Screwed elbow (standard)	0,30	0,36	0,49	0,56	0,69	0,88	1,1	1,4	2,0	2,6	3,4
	0,34	0,40	0,55	0,66	0,76	1,0	1,3	1,6	2,3	3,1	3,9
Standard screwed Tee or cross (flow through branch)	1,3	1,5	2,1	2,4	2,9	3,8	4,8	6,1	8,6	11,0	14,0
Gate valve - straight way	-	-	-	-	0,38	0,51	0,63	0,81	1,1	1,5	2,0
Alarm or non-return valve (swinging type)	-	-	-	-	2,4	3,2	3,9	5,1	7,2	9,4	12,0
	-	-	-	-	12,0	19,0	19,7	25,0	35,0	47,0	62,0
Alarm or non-return valve (mushroom type)	-	-	-	-	2,2	2,9	3,6	4,6	6,4	8,6	9,9
Butterfly valve Globe valve	-	-	-	-	16,0	21,0	26,0	34,0	48,0	64,0	84,0

* These equivalent lengths may be converted as necessary for pipes with other *C* values by multiplying by the following factors:

C value	100	110	120	130	140
Factor	0,714	0,85	1,00	1,16	1,33

4) Water Pump Type, Material and Speed

	Type	Arrangement
Fresh Water	Constant Speed	1 Duty, 1 Stand-by
Flush Water	Constant Speed	1 Duty, 1 Stand-by

5) Water Pump Sizing

a) Pump Head

Pump head (m) = Static Head Loss + Pipe and Pipe Fitting Loss + Required Residual Pressure

where
Pipe and pipe fitting loss shall be calculated by Hazen-Williams Formula
Required Residual Pressure = 20m (for Fresh Water) and 15m (for Flush Water)
Assuming the water would be pumped from the sump pump room to the Master Meter Room of the Proposed Development located at G/F (+80mPD) + 5m head buffer for pumping water to upper floor option

b) Pump Flow (For Fresh and Flush Water)

Assuming Requied Pump Flow (L/s) = Max. Flow Capacity of Pumped Pipe

b) Pump Power (For Fresh and Flush Water)

Required Pump Power (kW):

$$\frac{\text{Flow Rate (m3/hr) x Density of Water (kg/m3) x Acceleration of Gravity (m/s-2) x Pump Head (m)}}{\text{3.6*10\^6 x Pump Efficiency (\%) x Motor Efficiency (\%)}}$$

where

Motor efficiency:	80 %	(By Assumption and shall be complied with latest BEC)
Pump efficiency:	60 %	(By Assumption)
Density of Water:	1000 kg/m3	
Acceleration of Gravity:	9.81 m/s2	

6) Water Tank Material and Arrangement

	Arrangement	Material	Access Type
Fresh Water	Twin Tank	Reinforced Concrete	Side
Flush Water	Twin Tank	Fibreglass	Top

7) Water Tank Sizing

The water tank capacity shall be sized based on WSD TR:
Assuming no rainwater recycling, grey water recycling

a) Fresh Water

i) For Domestic Portion:

#6.2.5.3 Storage criteria for fresh water supply for domestic flats are given in Table 6.2.5.3.1.

Table 6.2.5.3.1 Storage criteria for domestic application (sump and pump system)

Up to 10 flats	135 litres/flat In case of a sump and pump system, the minimum total storage including sump tank is allowed to be 500 litre,
> 10 flats	90 litres for each additional flat

(By WSD TR)

ii) For Clubhouse Portion:

Requied Tank Size for Kitchen = 2.5 L/member (By WSD TR)
Assuming the No. of Member = No. of Resident + No. of Clubhouse Employees

Requied Tank Size for Changing Room = 90 L/shower (hot and cold combined) (By WSD TR)
Assuming the No. of Shower = 10

Required Surge Tank Size for Swimming Pool:
Bather Loading 0.1 m3/person (By ASD Design Guide, min. 0.075 m3/person, take 0.1 m3/person for heavy weight)
Max. No. of Occupant in Swimming Pool: 3 m2/person (By HK Regulation CAP 132CA Section 6 (2))
Proposed Swimming Pool Dimension: 25 m (Length) (By Arch)
10 m (Width) (By Arch)
1.5 m (Height) (By Arch)

$$\text{Surge Volume:} \quad \frac{\text{Swimming Pool Area x Bather Loading}}{\text{Max. No. of Occupant in Swimming Pool}}$$

Surge Volume = 0.5 of Surge Tank Volume (By ASD Design Guide)
Required Surge Tank Size for Swimming Pool = Surge Volume x 2

iii) For Cleansing Portion:

For storage of cleansing water, the calculation is normally based on 1 day consumption: (By ASD Design Guide)

Required Tank Size for Cleansing = 45 L/no. of water points (By ASD Design Guide)

Assuming the No. of Cleansing Point for Carpark = 10
Assuming the No. of Cleansing Point / Sink for Refuse Room = 20
Assuming the No. of Cleansing Point / Sink for Clubhouse = 10

iv) For Irrigation Portion:

For storage of irriagtion water, the calculation is normally based on 1 day consumption: (By ASD Design Guide)

Irrigation Water Daily Consumption: 7 L/day/m2 (By ASD Design Guide)

Assuming the Total Planter Area: 30 % of Site Area (m2)
= 0.3 x 6150
= 1845 m2

Sump Tank to Roof Tank Ratio: 1:3 (By WSD TR, Clause 6.2.5.1)

The Required Tank Size for the Sump Tank of Pump Room: Overall Required Tank Size of the Proposed Site x 1/4
= (Tank Size for Domestic + Tank Size for Clubhouse + Tank Size for Cleansing + Tank Size for Irrigation) x 1/4

b) Flush Water

Building types	Litres per flushing apparatus
1. Residential - Water closet	30

2. Commercial - Urinal - Water closet	30 40

i) For domestic Portion:

Assuming the Average No. of Water Closet per Flat Unit = 1.5

ii) For Clubhouse Portion:

Assuming the total no. of Urinal = 10
Assuming the total no. of Water Closet = 20

Sump Tank to Roof Tank Ratio: 1:3 (By WSD TR)

The Required Tank Size for the Sump Tank of Pump Room: Overall Required Tank Size of the Proposed Site x 1/4
= (Tank Size for Domestic + Tank Size for Clubhouse) x 1/4

8) Check Meter

Check meter cabinet with check meter position for fresh water and salt water shall be provided at G/F Sump Pump Room.
Meter size is based on the daily water consumption and WSD's reference by using the unit demand method with reference to the GESF.
The incoming pipe shall be equal to or max. one more commercial size larger than the check meter size to comply with WSD TR.

(E) Calculations for Daily Water Demand

No. of Unit: 160 (From Arch)
Person/flat: 2.7 (By C&SD, Average Domestic Household Size)
Domestic Population: 432

Clubhouse GFA (m2): 768 (From Arch)
Worker per 100m2 GFA: 5.1 (By CIFSUS, Industry Group: Restaurant)
No. of Employees (Clubhouse) 39

1) Fresh Water Daily Demand (Excluding Fire-fighting)

Unit Demand (UDD) for Fresh Water Demand: 270 L/head/day (By GESF, Table III(b), Development Type: Domestic; Flow Type: Private Residential -R2)
Take 300 L/head/day (By WSIA)
Unit Demand (UDD) for Service Trade: 45 L/head/day (By WSIA Assumed, Development Type: Clubhouse; Flow Type: Service Trades)

Domestic Fresh Water Daily Demand : Domestic Population X Unit Demand (UDD) for Fresh Water Demand
= 432 X 300
= 129600 L/day
= **130** m3/day

Clubhouse Fresh Water Daily Demand: No. of Employees (Clubhouse) X Unit Demand (UDD) for Service Trade:
= 39 X 45
= 1762.56 L/day
= **1.8** m3/day

Total Fresh Water Daily Demand: Domestic Fresh Water Daily Demand + Clubhouse Fresh Water Daily Demand
= 130 + 1.8
= **131.4** m3/day

2) Salt Water Daily Demand (Excluding Fire-fighting)

Unit Demand (UDD) for Flush Water Demand: 80 L/head/day (By GESF, Table III(c), Development Type: Domestic; Flow Type: Private Residential -R2)
Take **70** L/head/day (By WSIA)

Salt Water Daily Demand: Domestic Population + Unit Demand (UDD) for Flush Water Demand:
= 432 X 70
= 30240 L/day
= **30.2** m3/day

3) Firefighting Fresh Water Daily Water Demand

Min. Fresh Water Supply: 6000 m3/day (By WSIA)
Discharge Pressure: 17 m (By WSIA)
Fire Hydrant: Standard Pattern with Min. Output Pressure of Not Less Than 25psi (By WSIA)
Min. Output of fire hydrant not less than 25 psi: 4000 L/min to last for 60mins (By WSIA)

Assuming the FS water supply of the proposed development would be supplied by the fresh water main.

(F) Calculations for Water Incoming Distribution Main Size

1) Fresh Water

a) Verification of the Existing Water Main Size

Nominal Diameter of Existing Fresh Water Main: **250** mm (By WSIA & WSD Record Plan)
Internal Diameter of Existing Fresh Water Main: 233 mm
= 0.233 m
Pipe Area: 0.043 m2
Assuming that the Velocity of Watermain: 1.5 m/s (By WSIA)
The Flow Capacity of Watermain **0.064** m3/s

Estimated Fresh Water Demand for Proposed Development: 131.4 m3/day (By Calculation in Part (E)(1))
= **0.0015** m3/s

The Water Demand of the Proposed Development is Equivalent to **2.378** % of the Existing Water Main

b) Water Distribution Main Sizing

Estimated Fresh Water Demand for Proposed Development: 131.4 m3/day (By Calculation in Part (E)(1))
= 0.0015 m3/s
Peaking Factor for Fresh Water Distribution Main: 3 (By WSIA)
Required Peak Flow Rate for Proposed Development: **0.0046**

To Supply Water for the Proposed Development:
Nominal Diameter of the Proposed Pipe Size: **150** mm
Internal Diameter of Proposed Pipe Size: 138 mm
= 0.138 m
Pipe Area: 0.015 m2
Assuming that the Velocity of Water Distribution Main: 0.9 m/s (By WSIA)
The Flow Capacity of Water Distribution Main **0.013** m3/s

Factor of Safety:

$$= \frac{\text{The Flow Capacity of Watermain}}{\text{Required Peak Flow Rate for Proposed Developmen}} = \frac{0.013}{0.0046}$$

= **2.95** > **1**
=> **OK**

2) Flush Water

a) Verification of the Existing Water Main Size

Nominal Diameter of Existing Fresh Water Main:		**150**	mm	(By WSIA & WSD Record Plan)
Internal Diameter of Existing Fresh Water Main:		138	mm	
	=	0.138	m	
Pipe Area:		0.015	m2	
Assuming that the Velocity of Watermain:		1.5	m/s	(By WSIA)
The Flow Capacity of Watermain		**0.022**	m3/s	
Estimated Fresh Water Demand for Proposed Development:		30.2	m3/day	(By Calculation in Part (E)(1))
	=	**0.0004**	m3/s	
The Water Demand of the Proposed Development is Equivalent to		**1.561**	% of the Existing Water Main	

b) Water Distribution Main Sizing

Estimated Fresh Water Demand for Proposed Development:		30.2	m3/day	(By Calculation in Part (E)(2))
	=	0.0004	m3/s	
Peaking Factor for Fresh Water Distribution Main:		2		(By WSIA)
Required Peak Flow Rate for Proposed Development:		0.0007		
To Supply Water for the Proposed Development:				
Nominal Diameter of the Proposed Pipe Size:		**50**	mm	
Internal Diameter of Proposed Pipe Size:		50	mm	
	=	0.05	m	
Pipe Area:		0.002	m2	
Assuming that the Velocity of Water Distribution Main:		0.9	m/s	(By WSIA)
The Flow Capacity of Water Distribution Main		**0.002**	m3/s	

Factor of Safety:

$$= \frac{\text{The Flow Capacity of Watermain}}{\text{Required Peak Flow Rate for Proposed Developmen}} = \frac{0.002}{0.0007} = \mathbf{2.52} > \mathbf{1}$$

=> **OK**

(G) Check Meter Schedule

	Location	Daily Water Consumption (m3/day)	Size of Check Meter	Classification Code	Water Distribution Main Size (mm dia.)	Water Distribution Main Material (By WSD Manual of Mainlaying Section 1.1)	
						Buried	Exposed
Fresh Water Check Meter Position	G/F of Sump Pump Room	131.4	150	-	150	DI	DI
Flush Water Check Meter Position	G/F of Sump Pump Room	30.2	50	-	50	Blue PE	Black PE

(H) Water Tank Sizing

1) Fresh Water

a) For Domestic Portion:

According to Technical Requirement for Plumbing Works in Buildings (Dec 2021) (WSD TR), Table 6.2.5.3.1:

Total No. of Unit:	160	(From Arch)	
First 10 Required L/point (L):	135	L	(By WSD TR)
Remaining Flat Required L/point (L):	90	L	(By WSD TR)
Required Water Tank Storage:	**14850**	L	

b) For Clubhouse Portion:

According to Technical Requirement for Plumbing Works in Buildings (Dec 2021) (WSD TR), Table 6.2.5.6.1:

i) Kitchen

No. of Unit:			160	(From Arch)		
Person/flat:			2.7	(By C&SD, Average Domestic Household Size)		
Domestic Population:			432			
Clubhouse GFA (m2):			768	(From Arch)		
Worker per 100m2 GFA:			5.1	(By CIFSUS, Industry Group: Restaurant)		
No. of Employees (Clubhouse)			39			
Requied Water Tank Storage:			2.5	L/member		(By WSD TR)
Assuming the No. of Member =		No. of Resident			+	No. of Clubhouse Employees
	=	432			+	39
	=	471				
Requied Water Tank Storage:			**1178**	L		

ii) Changing Room

Requied Water Tank Storage:			90	L/shower (hot and cold combined)		(By WSD TR)
Assuming the No. of Shower =			10			
Requied Water Tank Storage:			**900**	L		

iii) Swimming Pool

Bather Loading			0.1	m3/person		(By ASD Design Guide, min. 0.075 m3/person, take 0.1 m3/person for heavy weight)
Max. no. occupant in swimming-pool:			3	m2/person		(By HK Regulation CAP 132CA Section 6 (2))
Swimming Pool Dimension:			25	m (Length)		(By Arch)
			10	m (Width)		(By Arch)
			1.5	m (Height)		(By Arch)
Swimming Pool Area:			250	m2		
Swimming Pool Volume:			375	m3		
Surge Volume:		Swimming Pool Area x Bather Loading				
		Max. No. of Occupant in Swimming Pool				
	=	8.33		m3		
Surge Volume =			0.5	of Surge Tank Volume		(By ASD Design Guide)
Required Surge Tank Storage:		Surge Volume x 2				
	=	16.67		m3		
	=	**16666.67**		L		

c) For Cleansing Portion:

For storage of cleansing water, the calculation is normally based on 1 day consumption: (By ASD Design Guide)

Required Tank Size for Cleansing =		45	L/no. of water points	(By ASD Design Guide)
Assuming the No. of Cleansing Point for Carpark =		10		
Assuming the No. of Cleansing Point / Sink for Refuse Room =		20		
Assuming the No. of Cleansing Point / Sink for Clubhouse =		10		
Total No. of Cleansing Point		40		
Requied Water Tank Storage:		**1800**	L	

d) For Irrigation Portion:

For storage of irrigation water, the calculation is normally based on 1 day consumption: (By ASD Design Guide)

Site Area:			6150	m2		(From Arch)
Irrigation Water Daily Consumption:			7	L/day/m2		(By ASD Design Guide)
Assuming the Total Planter Area:			30	% of Site Area (m2)		
	=	0.3			x	6150
	=	1845		m2		
Requied Water Tank Storage:			**12915**	L		

e) Summary:

Total Fresh Water Storage Required:		Water Storage for Domestic Portion + Water Storage for Clubhouse Portion + Water Storage for Cleansing + Water Storage for Irrigation				
	=	**48310**		L		
Under WSD TR Clause 6.2.5.1						
The Proportion of Capacity of Sump Tank to Roof Tank=		1		:		3 (By WSD TR)
The Required Water Storage for the Sump Tank of Pump Room:		Total Fresh Water Storage Required for the Proposed Site x 1/4				
	=	12077.40		L		
	=	15700.62		L		(30% safety factor)
	Say	**15700**		L		

2) Flush Water

a) For Domestic Portion:

According to Technical Requirement for Plumbing Works in Buildings (Dec 2021) (WSD TR), Table 6.2.5.2.1:

Requied Water Tank Storage:	30	L/Water Closet (Residential)	(By WSD TR)
Assuming the Average No. of Water Closet per Flat Unit =	1.5		
No. of Unit:	160	(From Arch)	
Total No. of WC:	240		
Requied Water Tank Storage:	**7200**	L	

b) For Clubhouse Portion:

According to Technical Requirement for Plumbing Works in Buildings (Dec 2021) (WSD TR), Table 6.2.5.2.1:

Requied Water Tank Storage:	30	L/Urinal (Commercial)	(By WSD TR)
	45	L/Water Closet (Commercial)	(By WSD TR)
Assuming the total no. of Urinal =	10		
Assuming the total no. of Water Closet =	20		
Requied Water Tank Storage:	**1200**	L	

e) Summary:

Total Flush Water Storage Required: Water Storage for Domestic Portion + Water Storage for Clubhouse Portion

= **8400** L

Under WSD TR Clause 6.2.5.1

The Proportion of Capacity of Sump Tank to Roof Tank= 1 : 3 (By WSD TR)

The Required Water Storage for the Sump Tank of Pump Room: Total Flush Water Storage Required for the Proposed Site x 1/4

=	2100.00	L	
=	2730.00	L	(30% safety factor)
Say	**2800**	L	

3) Summary of Water Tank Schedule

Under WSD TR Clause 6.2.6.2, when the capacity of water cistern exceeds 5,000 litres, adoption of twin-tank system is required:

System	Water Tank Name	Tank Material	Water Tank Arrangement	Water Tank Designation	Location	Storage Capacity (L)		
						Chamber 1 of Twin Tank	**Chamber 2 of Twin Tank**	**Total**
Fresh Water System	Fresh Water Sump Tank	Reinforced Concrete	Twin-Tank	FRWT-01 & 02	G/F Sump Pump Room	**7850**	**7850**	**15700**
Flush Water System	Flush Water Sump Tank	Fibreglass	Twin-Tank	FLWT-01 & 02	G/F Sump Pump Room	**1400**	**1400**	**2800**

(I) Water Pump Sizing

1) Fresh Water

a) Pump Flow

Assuming Pumped Pipe Size = Water Distribution Main Size =	**150**	mm dia.	
Pumped Pipe Material (Exposed):	**DI**	(By WSD Manual of Mainlaying Section 1.1)	
Assuming Requied Pump Flow = Max. Flow Capacity of Pumped Pipe			
Nominal Diameter of the Pumped Pipe Size:	**150**	mm	
Internal Diameter of Proposed Pipe Size:	138	mm	
=	0.138	mm	
Pipe Area:	0.015	m2	
Assuming that the Velocity of Pumped Pipe:	1.5	m/s	(By WSIA)
The Flow Capacity of Pumped Pipe:	0.022	m3/s	
=	22.42	l/s	
=	29.15	l/s	(30% safety factor)
Say	**30.00**	l/s	

b) Pump Head

i) Static Head Loss

Assuming the water would be pumped from the sump pump room to the Master Meter Room of the Proposed Development located at G/F (+80mPD) + 5m head buffer for pumping water to upper floor option:

Sump Pump Room Finsihed Floor Level:	39.6	m	(By Arch)	
Pump Outlet Level:	40.4	m	(Assune Pump Outlet =	0.8 m above sump pump room level
Master Meter Room Level of the Proposed Development located at G/F	80	m	(By Arch)	
Head Buffer for Pumping Water to Upper Floor Option	5	m		

Static Head Loss: = (Master Meter Room Level + Head Buffer for Pump Water to Upper Floor Option) - Pump Outlet Level

44.6 m

ii) Pipe and Pipe Fitting Loss

By Hazen-Williams Formula: (By BS EN 12845)

$$p = \frac{6.05 \times 10^{5}}{C^{1.85} \times d^{4.87}} \times L \times Q^{1.85}$$

where:
p is the pressure loss in the pipe, in bar;
Q is the flow through the pipe, in L/min;
d is the mean internal diameter of the pipe, in mm;
C is a constant for the type and condition of the pipe

Based on BS EN 12845:2004, C values and equivalent length of pipe and fittings shall be referred:

EN 12845:2004 (E)

L is the equivalent length of pipe and fittings, in metres.

The values of *C* indicated in Table 22 shall be used.

Table 22 — C values for various types of pipe

Type of pipe	Value of *C*
cast iron	100
ductile iron	110
mild steel	120
galvanized steel	120
spun cement	130
cement lined cast iron	130
stainless steel	140
copper	140
reinforced glass fibre	140
NOTE The list is not exhaustive	

Table 23 — Equivalent length of fittings and valves

Fittings and valves	Equivalent length of steel straight pipe for a *C* value of 120[a] (m)										
	Nominal diameter (mm)										
	20	25	32	40	50	65	80	100	150	200	250
90° Screwed elbow (standard)	0,76	0,77	1,0	1,2	1,5	1,9	2,4	3,0	4,3	5,7	7,4
90° Welded elbow (r/d = 1,5)	0,30	0,36	0,49	0,56	0,69	0,88	1,1	1,4	2,0	2,6	3,4
45° Screwed elbow (standard)	0,34	0,40	0,55	0,66	0,76	1,0	1,3	1,6	2,3	3,1	3,9
Standard screwed Tee or cross (flow through branch)	1,3	1,5	2,1	2,4	2,9	3,8	4,8	6,1	8,6	11,0	14,0
Gate valve - straight way	-	-	-	-	0,38	0,51	0,63	0,81	1,1	1,5	2,0
Alarm or non-return valve (swinging type)	-	-	-	-	2,4	3,2	3,9	5,1	7,2	9,4	12,0
	-	-	-	-	12,0	19,0	19,7	25,0	35,0	47,0	62,0
Alarm or non-return valve (mushroom type)	-	-	-	-	2,2	2,9	3,6	4,6	6,4	8,6	9,9
Butterfly valve Globe valve	-	-	-	-	16,0	21,0	26,0	34,0	48,0	64,0	84,0

[a] These equivalent lengths may be converted as necessary for pipes with other *C* values by multiplying by the following factors:

C value	100	110	120	130	140
Factor	0,714	0,85	1,00	1,16	1,33

Pumped Pipe Size: **150** mm (By Calculation in Part (I)(1)(a))
Pumped Pipe Material (Exposed): **DI** (By WSD Manual of Mainlaying Section 1.1)
The Flow Capacity of Pumped Pipe: 30.00 L/s (By Calculation in Part (I)(1)(a))
= **1800.00** L/min
C Value **110** (By BS EN 12845:2004, Table 22)
Converted Factor for C Value 0.85

Fitting Loss (By BS EN 12845:2004, Table 23)
From the Sump Pump Room to the Master Meter Room of the Proposed Development located at G/F

Fitting	Quantity	Equivalent Length (fitting) (m) x Converted Factor for C value	Sub-total of Equivalent Length (fitting) (m)
90 deg elbow	30	3.655	109.65
Tee / Cross	6	7.31	43.86
Gate valve	2	0.935	1.87
Alarm / Check valve (swing)	1	6.12	6.12
Alarm / Check valve (mushroom)	0	29.75	0
Butterfly valve	0	5.44	0
Globe valve	0	40.8	0
Flexible Connector (Assumed Equivalent Length = 5m)	1	5	5
Total Equivalent Length for Fitting (m)	-	-	166.5
Total Fitting Loss by Hazen-Williams Formula (m)	-	-	**4.48**

Pipe Loss
From the Sump Pump Room to the Master Meter Room of the Proposed Development located at G/F

Vertical distance From Pump Outlet at Pump Room to Check Meter Cabinet of the Proposed Development (m)	44.6	(By Calculation in Part (I)(1)(b)(i))
Horizontal distance From Pump Outlet at Pump Room to Check Meter Cabinet of the Proposed Development (m)	44.6	(Assume = 100% of Vertical Distance)
Total Pipe Length (m)	89.2	
Total Pipe Loss by Hazen-Williams Formula (m)	**2.40**	

Total Pipe & Fitting Loss
From the Sump Pump Room to the Master Meter Room of the Proposed Development located at G/F

Total Fitting loss (m) and Pipe Loss (m)	**6.88**

iii) Required Residual Head

Required Residual Pressure = Min. Available Residual Pressure by WSD for Fresh Water = **20** m (By WSD TR Clause 4.2.2.3)

iv) Pump Head Required

Requied Pump head (m) = Static Head Loss + Pipe Loss and Fitting Loss + Required Residual Pressure = 71.48 m
= 92.92 m (30% Safety Factor)
Say **95.00** m

c) Pump Power

Required Pump Power: $\frac{\text{Flow Rate (m3/hr) x Density of Water (kg/m3) x Acceleration of Gravity (m/s-2) x Pump Head (m)}}{\text{3.6*10^6 x Pump Efficiency (\%) x Motor Efficiency (\%)}}$

where

Motor efficiency:	80	%	(By Assumption and shall be complied with latest BEC)
Pump efficiency:	60	%	(By Assumption)
Density of Water:	1000	kg/m3	
Acceleration of Gravity:	9.81	m/s2	
Flow Rate:	30.00	L/s	(By Calculation in Part (I)(1)(a))
=	108.00	m3/hr	
Pump Head:	95.00	m	(By Calculation in Part (I)(1)(b))
Required Pump Power:	58.25	kW	
Motor Power:	**75**	**kW**	

2) Flush Water

a) Pump Flow

Assuming Pumped Pipe Size = Water Distribution Main Size =	**50**	mm dia.	
Pumped Pipe Material (Buried and Exposed):	**Black PE**	(By WSD Manual of Mainlaying Section 1.1)	
Assuming Requied Pump Flow = Max. Flow Capacity of Pumped Pipe			
Nominal Diameter of the Pumped Pipe Size:	**50**	mm	
Internal Diameter of Proposed Pipe Size:	50	mm	
=	0.05	mm	
Pipe Area:	0.002	m2	
Assuming that the Velocity of Pumped Pipe:	1.5	m/s	(By WSIA)
The Flow Capacity of Pumped Pipe:	0.003	m3/s	
=	2.94	l/s	
=	3.83	l/s	(30% safety factor)
Say	**4.00**	l/s	

b) Pump Head

i) Static Head Loss

Assuming the water would be pumped from the sump pump room to the Master Meter Room of the Proposed Development located at G/F (+80mPD) + 5m head buffer for pumping water to upper floor option:

Sump Pump Room Finsihed Floor Level:	39.6	m	(By Arch)	
Pump Outlet Level:	40.4	m	(Assune Pump Outlet =	0.8 m above sump pump room level
Master Meter Room Level of the Proposed Development located at G/F	80	m	(By Arch)	
Head Buffer for Pumping Water to Upper Floor Option	5	m		

Static Head Loss: = (Master Meter Room Level + Head Buffer for Pump Water to Upper Floor Option) - Pump Outlet Level

44.6 m

ii) Pipe and Pipe Fitting Loss

By Hazen-Williams Formula: (By BS EN 12845)

$$p = \frac{6.05 \times 10^5}{C^{1.85} \times d^{4.87}} \times L \times Q^{1.85}$$

where:
p is the pressure loss in the pipe, in bar;
Q is the flow through the pipe, in L/min;
d is the mean internal diameter of the pipe, in mm;
C is a constant for the type and condition of the pipe

Based on BS EN 12845:2004, C values and equivalent length of pipe and fittings shall be referred:

EN 12845:2004 (E)

L is the equivalent length of pipe and fittings, in metres.

The values of *C* indicated in Table 22 shall be used.

Table 22 — C values for various types of pipe

Type of pipe	Value of *C*
cast iron	100
ductile iron	110
mild steel	120
galvanized steel	120
spun cement	130
cement lined cast iron	130
stainless steel	140
copper	140
reinforced glass fibre	140
NOTE The list is not exhaustive	

Table 23 — Equivalent length of fittings and valves

Fittings and valves	Equivalent length of steel straight pipe for a *C* value of 120[a] (m)									
	Nominal diameter (mm)									
	20	25	32	40	50	65	80	100	150	200	250
90° Screwed elbow (standard)	0,76	0,77	1,0	1,2	1,5	1,9	2,4	3,0	4,3	5,7	7,4
90° Welded elbow (r/d = 1,5)	0,30	0,36	0,49	0,56	0,69	0,88	1,1	1,4	2,0	2,6	3,4
45° Screwed elbow (standard)	0,34	0,40	0,55	0,66	0,76	1,0	1,3	1,6	2,3	3,1	3,9
Standard screwed Tee or cross (flow through branch)	1,3	1,5	2,1	2,4	2,9	3,8	4,8	6,1	8,6	11,0	14,0
Gate valve - straight way	-	-	-	-	0,38	0,51	0,63	0,81	1,1	1,5	2,0
Alarm or non-return valve (swinging type)	-	-	-	-	2,4	3,2	3,9	5,1	7,2	9,4	12,0
	-	-	-	-	12,0	19,0	19,7	25,0	35,0	47,0	62,0
Alarm or non-return valve (mushroom type)	-	-	-	-	2,2	2,9	3,6	4,6	6,4	8,6	9,9
Butterfly valve Globe valve	-	-	-	-	16,0	21,0	26,0	34,0	48,0	64,0	84,0

[a] These equivalent lengths may be converted as necessary for pipes with other *C* values by multiplying by the following factors:

C value	100	110	120	130	140
Factor	0,714	0,85	1,00	1,16	1,33

Pumped Pipe Size: **50** mm
Pumped Pipe Material (Buried and Exposed): **Black PE** (By WSD Manual of Mainlaying Secti
The Flow Capacity of Pumped Pipe: 4.00 L/s (By Calculation in Part (I)(2)(a))

= **240.00** L/min

C Value **150** (By WSD Installation Notes of Different Types of Corrosion Resistant Pipe Materials as Inside Service in Buildingds)
Converted Factor for C Value 1.51

Fitting Loss (By BS EN 12845:2004, Table 23)
From the Sump Pump Room to the Master Meter Room of the Proposed Development located at G/F

Fitting	Quantity	Equivalent Length (fitting) (m) x Converted Factor for C value	Sub-total of Equivalent Length (fitting) (m)
90 deg elbow	30	2.265	67.95
Tee / Cross	6	4.379	26.274
Gate valve	2	0.5738	1.1476
Alarm / Check valve (swing)	1	3.624	3.624
Alarm / Check valve (mushroom)	0	18.12	0
Butterfly valve	0	3.322	0
Globe valve	0	24.16	0
Flexible Connector (Assumed Equivalent Length = 5m)	1	5	5
Total Equivalent Length for Fitting (m)	-	-	103.9956
Total Fitting Loss by Hazen-Williams Formula (m)	-	-	**2.80**

Pipe Loss
From the Sump Pump Room to the Master Meter Room of the Proposed Development located at G/F

Vertical distance From Pump Outlet at Pump Room to Check Meter Cabinet of the Proposed Development (m)	44.6	(By Calculation in Part (I)(2)(b)(i))
Horizontal distance From Pump Outlet at Pump Room to Check Meter Cabinet of the Proposed Development (m)	44.6	(Assume = 100% of Vertical Distance)
Total Pipe Length (m)	89.2	
Total Pipe Loss by Hazen-Williams Formula (m)	**2.40**	

Total Pipe & Fitting Loss
From the Sump Pump Room to the Master Meter Room of the Proposed Development located at G/F

Total Fitting loss (m) and Pipe Loss (m)	**5.20**

iii) Required Residual Head

Required Residual Pressure = Min. Available Residual Pressure by WSD for Fresh Water = **15** m (By WSD TR Clause 4.2.2.3)

iv) Pump Head Required

Requied Pump head (m) = Static Head Loss + Pipe Loss and Fitting Loss + Required Residual Pressure = 64.80 m
= 84.24 m (30% Safety Factor)
Say **85.00** m

c) Pump Power

Required Pump Power: Flow Rate (m3/hr) x Density of Water (kg/m3) x Acceleration of Gravity (m/s-2) x Pump Head (m) / 3.6*10^6 x Pump Efficiency (%) x Motor Efficiency (%)

where

Motor efficiency:		80 %	(By Assumption and shall be complied with latest BEC)
Pump efficiency:		60 %	(By Assumption)
Density of Water:		1000 kg/m3	
Acceleration of Gravity:		9.81 m/s2	
Flow Rate:		4.00 L/s	(By Calculation in Part (I)(2)(a))
	=	14.40 m3/hr	
Pump Head:		85.00 m	(By Calculation in Part (I)(2)(b))
Required Pump Power:		6.95 kW	
Motor Power:		**7.5 kW**	

3) Summary of Pump Schedule

Pump No.	Pump Servies	Location	Flow Rate (L/s)	Pump Head (m)	Speed (rpm)	Required Pump Power (kW)	Rated Motor Power (kW)	Starting Method	Pump Casing
FRWTP-01&02	Fresh Water Transfer Pump Set (1 Duty & 1 Standby)	G/F Sump Pump Room	30.00	95.00	1450	58.25	75	3-phase, Star-delta	Casted Stainless Steel Grade 316
FLWTP-01&02	Flush Water Transfer Pump Set (1 Duty & 1 Standby)	G/F Sump Pump Room	4.00	85.00	1450	6.95	7.5	3-phase, Star-delta	Close Grain Cast Iron