Appendix G

Sewerage Impact Assessment

Sewerage Impact Assessment (SIA)

S16 Planning Application for Proposed Residential Institution (Elderly Home) Development at Various Lots in D.D. 101 76 S.G. & 76 S.H., Tam Kon Chau Road, Mai Po, N.T.

Date: 09 Sept 2024

Revision 1

Quality Management

Issue/revision	0	1	
Remarks			
Date	08 Mar. 2024	09 Sept. 2024	
Prepared by	Chun Sing Leung	Chun Sing Leung	
Signature			
Checked by	Alex Cheung	Alex Cheung	
Signature			
Authorised by	Kau, Paul	Kau, Paul	
Signature			

Signatures

Prepared by

Chun Sing Leung
Assistant Consultant

Reviewed by

Alex Cheung

Technical Director

CONTENTS

LIST OF TABLES

1 INTRODUCTION

1.1 WSP (Asia) Limited was commissioned by Gotland Enterprises Ltd to conduct a Sewerage Impact Assessment (SIA) for a Proposed Residential Institution (Elderly Home) Development at Various Lots in D.D. 101 76 S.G. & 76 S.H. (thereafter referred to as "the Application Site") by assessing the impact of the sewage generated due to the proposed residential development.

1.2 The Application Site is located at Mai Po, Yuen Long. It is generally bounded by Castle Peak Road – San Tin and Tam Kon Chau Road. There are fishponds to the northwest, residential developments, namely Mai Po Lo Wai Village to the south, and Hop Shing Wai Village to the northeast.

1.3 This proposed residential institutional development comprises of comprehensive elderly care home facilities, landscaped open spaces, sewerage treatment plant, and car parks. The Application Site is located by the side of Castle Peak Road – San Tin, as shown in **Figure 1**. The tentative completion date for this proposed development is 2028.

1.4 A sewage treatment facility consisting of an on-site Membrane Bioreactor Plant (MBR) and an effluent reuse facility is proposed. The proposed location for the MBR plant is shown in the Site Layout Plan in **Figure 2**.

2 OUTLINE OF APPLICATION SITE AND PLANNED SEWERAGE CONDITIONS

2.1 The Application Site is classified as unsewered area with respect to the Yuen Long and Kam Tin Sewerage Master Plan (YLKT SMP). In addition, there is no proposed trunk sewer to direct the sewage from the Application Site to Yuen Long Sewage Treatment Work (YLSTW) for treatment, thus, a long-term on-site sewage treatment facility will be constructed to treat the sewage from the Application Site and reuse the treated water for local flushing and irrigation, with any excess discharge to stormwater drainage pipe.

3 STANDARDS AND REGULATIONS ON WATER QUALITY

3.1 Water quality in Hong Kong is subject to the provisions of the Water Pollution Control Ordinance (Cap 358), 1980 (WPCO). Territorial Water has been subdivided into ten Water Control Zones (WCZ) and four supplementary water control zones. The Application Site is located in the Deep Bay Control Zone. As such, the sewage disposal scheme would have to comply with the Zero Discharge Policy in accordance to Town Planning Board Guidelines (i.e. TPB PG-No. 12C) that there will be no net increase in the pollution loads into the Deep Bay Water Control Zone.

4 ASSESSMENT METHODOLOGY

4.1 The assessment has been carried out in accordance with the guidelines set out in EPD Report No. EPD/TP 1/05 Guidelines for Estimating Sewage Flows (GESF) for Sewerage Infrastructure Planning Version 1.0 ("GESF").

4.2 The projected demand for the sewerage system was identified to estimate the potential sewerage impact on the on-site sewerage system serving the amended comprehensive residential development of this application. The on-site sewerage system consists of an on-site sewerage treatment plant and an effluent reuse facility.

4.3 With reference to Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF), the Global Unit Flow Factors indicated in **Table 4.1** and the Global Peaking factors shown in **Table 4.2** are adopted for calculation.

Table 4.1 Global Unit Flow Factor (UFF)

Type	**Units Flow Factors (m^3/person/day)**
Domestic (Institutional and Special Class)	0.19
Staff (General)	0.28

Table 4.2 Global Peaking Factor

Population	**Peaking Factor**
More than 50000	$\text{Max}(\frac{3.9}{N^{0.065}}, 2.4)$
25,000 – 50,000	3
10,000 – 25,000	3.5
Less than 10,000	4

5 POPULATION AND SEWAGE FLOW PROJECTION

5.1 The expected amount of sewage generated from the proposed residential institutional development of this application is summarized in **Table 5.1** below.

Table 5.1 Sewage Flow Projection of the Proposed Residential Institution Development

	Design Population		Usage Type	UFF [(i)] (m^3/head/day)	ADWF (m^3/day)	Total ADWF (m^3/day)	Peaking Factor	Design Peak Flow (m^3/day)
Proposed Development	Resident	715 [(ii)]	Domestic (Institutional)	0.19	135.88	157.97	3	473.91
	Staff	79 [(iii)]	Commercial J11	0.28	22.12			

Note:

(i) The Unit Flow Factor for the resident and staff are extracted from GESF. The Unit Flow Factor for commercial activities type J11, community, social & personal services are adopted for estimating the flow generated by the staff.
(ii) Number of residents provided by Architect.
(iii) Estimate for number of staff follow the Code of Practice for Residential Care Homes (Elderly Persons).

5.2 The estimation on the number of staff followed the Code of Practice for Residential Care Homes (Elderly Persons) published by the Social Welfare Department. The calculations are summarized in **Table 5.2** below.

Table 5.2 Estimation of the Number of Staff

Staff Requirements [(i)]	Ratio	Nos. of Staff	Total
Home Manager	-	1	79 [(iv)]
Ancillary Worker	1 per 40 residents	18	
Care Worker	1 per 20 residents	36	
Health Worker [(ii)]	1 per 30 residents	24	
Nurse [(iii)]	1 per 60 residents	12	

Note:

(i) The type of Residential Care Home is assumed to be a Care and Attention Home as it is one with the most nos. of staff requirements as a conservative approach.
(ii) Health Worker required unless nurse is present.
(iii) Nurse required unless Health Worker is present.
(iv) As more health workers are required over nurses, they are considered in the total over nurses as a conservative approach.

6 SEWERAGE IMPACT ASSESSMENT

6.1 The on-site sewage treatment plant will utilize an MBR treatment process to treat the effluent generated by the proposed development for reclaimed water use**.** It refers to the reuse water quality standards as recommended in the "Water Supplies Department (WSD) Inter-departmental Working Group on the Implementation of Reclaimed Water Supply in Sheung Shui and Fanling" for non-portable uses and the USEPA Guidelines for Water Reuse (2012). **Table 6.1** below has summarized the above water reuse standards:

Table 6.1 Summary of WSD Reuse Water Quality Standards and USEPA Unrestricted Urban Reuse Water Quality Standards

Water Quality Parameters	Unit	WSD Criteria (ii)	USEPA Criteria (iii)	
		Irrigation & Non-Potable Uses	Toilet Flushing	Irrigation
pH	--	6 – 9	6 – 9	6 – 9
Turbidity	NTU	=< 5	=< 2	=< 2
TSS	Mg/L	=< 5	N.S.(i)	=< 30
BOD_5	Mg/L	=< 10	=< 10	=< 30
E. Coli	cfu / 100mL	Non – Detectable	Non – Detectable	=< 200
Total Residual Chlorine	Mg/L	>= 1/L (out of treatment system); >= 0.2 (at point-of-use)	>= 1	>= 1
Dissolved Oxygen	Mg/L	>= 2	N.S.(i)	N.S.(i)
Colour	Hazen Unit	=< 20	N.S.(i)	N.S.(i)
Threshold Odour Number	TON	=< 100	N.S.(i)	N.S.(i)
Ammonia Nitrogen	Mg/L	=< 1	N.S.(i)	N.S.(i)
Synthetic Detergents	Mg/L	=< 5	N.S.(i)	N.S.(i)
Note: Apart from Total Residual Chlorine which has been specified, the water quality standards for all parameters shall be applied at the point-of-use of the system.				

Note:

(i) N.S. – Not Specified.
(ii) Standard of effluent reuse from WSD Inter-Departmental Working Group on the implementation of Reclaimed Water Supply to Sheung Shui and Fanling
(iii) From Table 4-4 of USEPA (2012) Guidelines for Water Reuse

6.2 The MBR is a combined system of biological treatment and microfiltration process, which can generate high quality effluent. The MBR process operates at a higher biomass concentration than conventional activated sludge system. The pores on the membrane surface have a diameter of 0.04 micrometres, separating bacteria, solid and *E. Coli* in accordance with WSD's reuse water quality standards. The MBR process will be operated at optimum conditions with sufficient retention time to reduce BOD_5 and ammonia nitrogen to the reuse standards.

6.3 Effluent that has gone through the MBR process will undergo ultraviolet (UV) disinfection, which serves as the second disinfection barrier to reduce *E. Coli* level in the effluent to non-detectable level. Subsequently, sodium hypochlorite solution will be added to the effluent to maintain the total residual chorine level above 1 mg/L to prevent microbial contamination.

6.4 Furthermore, operation conditions and quality of the effluent including pH, turbidity, total residual chlorine, and dissolved oxygen will also be real-time monitored. Immediate maintenance will be carried out if any parameter is found to approach or exceed its pre-set limits. Samples of reclaimed water will also be taken regularly and tested to ensure compliance with the reuse criteria.

6.5 This on-site MBR plant shall be designed in accordance with EPD's "Guidelines for the Design of Small Sewage Treatment Plant". The design peak flow arriving at the sewerage treatment plant shall be taken as 3 times of DWF (i.e. 473.91 m^3/day), with the excess flow over 3 times of DWF being equalized in an equalization tank of adequate volume to store up at least 2 hours (i.e. 39.49 m^3).

6.6 Based on WSD's Departmental Instruction No. 1309 (DI1309), the estimated toilet flushing water demand for the residential institutional development is shown in **Table 6.2** below.

Table 6.2 Estimation of Reclaimed Water Demand for Toilet Flushing

	Units	Toilet Flushing	
		Resident	Staff
Design Population	Head	715	79
Unit Flow Factor (i)	m^3/head/day	0.13	0.07
Average Daily Demand	m^3/day	98	

Note:

(i) Quantity of toilet flushing is estimated in accordance to WSD's Departmental Instruction No. 1309 (DI1309).

6.7 The quantity of treated effluent from the MBR plant is 157.97 m^3/day from **Table 5.1**.

It will supply toilet flushing for the comprehensive residential development, with a surplus of 59.97 m^3/day catering for the irrigation at the application site.

6.8 Approximately 1,685.8 m^2 landscape areas within the proposed comprehensive residential institution development will be maintained, adopting the remaining reclaimed effluent for irrigation. In accordance to the approved Water Supply Impact Assessment of the Project "CE35/2006 (CE) – Kai Tak Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction" and the approved EIA report of the project "Sludge Treatment Facilities" (EIA-155/2008), an average irrigation rate of 10 L/m^2/day is adopted in our estimation. This rate has made allowance for rainy days, means a higher irrigation demand would be required during non-rainy days.

6.9 **Table 6.3** below shows the estimated demand of reclaimed water for landscape irrigation.

Table 6.3 Estimation of Reclaimed Water Demand for Landscape Irrigation

	Units	Landscape Irrigation (i)	Total
Area	m^2	1685.8	
Irrigation Rate	L/m^2/day	10 (ii)	
Average Daily Demand	m^3/day	-	17

Note:

(i) Figures in the table are approximate and subject to detailed design.
(ii) The irrigation rate is an average rate with allowance for rainy days, and an average water demand of 10 L/m^2/day would be required.

The total flushing and landscape irrigation demand (i.e. 115 m^3/day) is less than the amount of treated effluent (164.79 m^3/day) there would be an excess of 42.97 m^3/day of treated effluent that would be stored in a reclaimed water storage tank which would be discharged via stormwater pipe.

7 EMERGENCY DISCHARGE OF UNTREATED SEWAGE EFFLUENT FROM THE ON-SITE SEWAGE TREATMENT FACILITY

7.1 During emergency situations, such as loss of power supply at the on-site sewage treatment facility, or mechanical faults / equipment failures, untreated sewage effluent may overflow and cause potential adverse impacts. With the “no net increase of pollution load” requirement as stipulated in the Town Planning Board Guideline, any discharge of sewage leading to a net increase in pollution load is not environmentally acceptable. To minimize the risk of untreated sewage effluent discharge due to emergency events, a number of contingencies will be provided at the on-site sewage treatment facility, such as equalization tank, dual or standby power supply, standby sewage treatment units, flow sensors and alarm systems. As a last resort and in case operation of the on-site sewage treatment facility cannot be resumed after all these contingency measures have been exhausted, any surplus raw sewage will be tanked away to the public Sewage Treatment Work, such as YLSTW. With these contingency measures in place, the risk of untreated sewage effluent discharge to Deep Bay WCZ due to emergency events is negligible.

8 MAINTENANCE RESPONSIBILITIES

8.1 The Applicant will be responsible for the maintenance of all sewers and the on-site sewage treatment facility within the Application Site. The applicant will be responsible for the implementation, operation and maintenance of the proposed sewage treatment plant.

9 CONCLUSION

9.1 The sewerage system within the Application Site includes an on-site sewage treatment facility to treat the sewage from the Application Site. A sewerage impact assessment has been conducted for the proposed residential institutional development at Wo Shang Wai to assess the impact of additional flow and load from the Application Site.

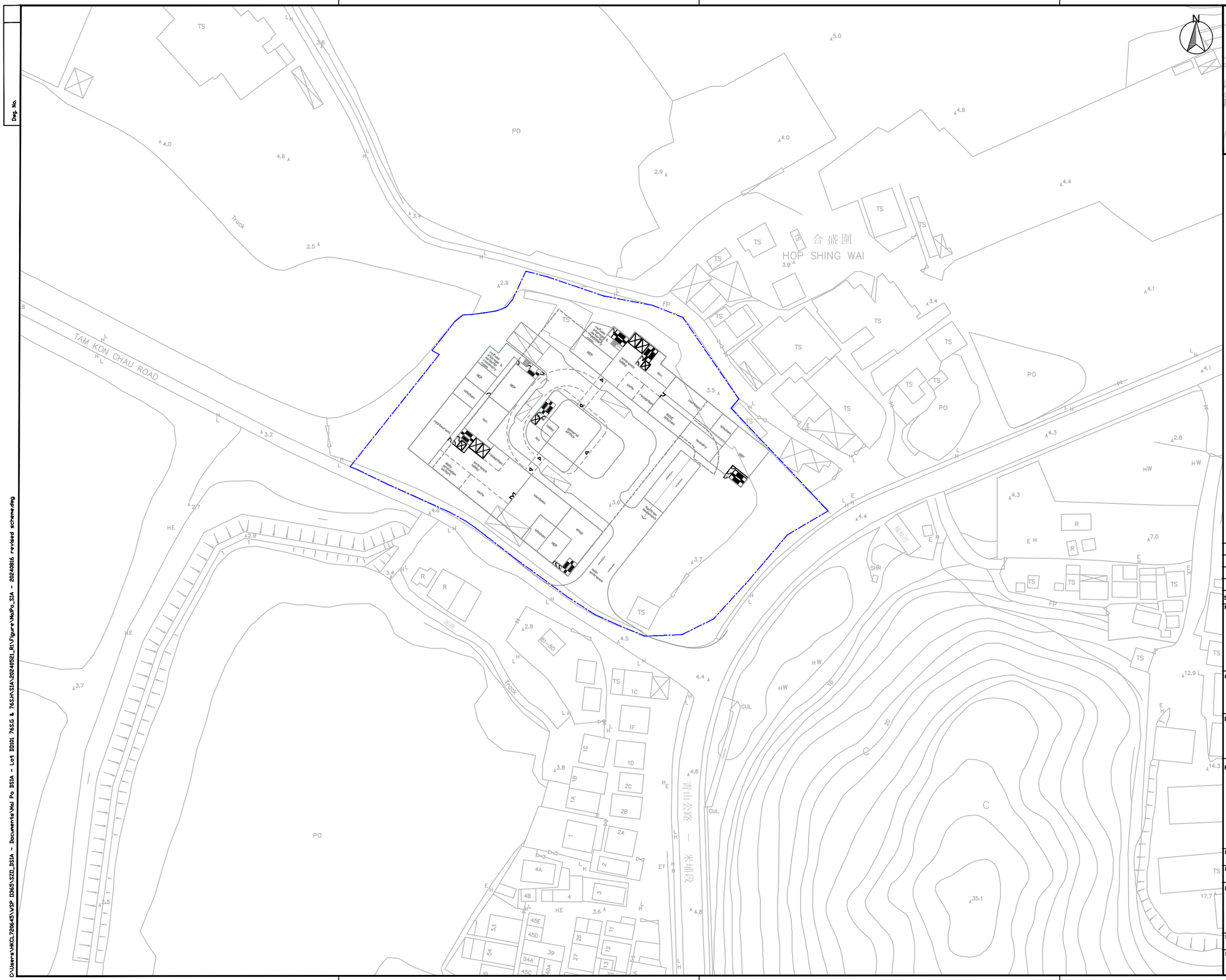
9.2 The on-site sewage treatment facility with the enhanced tertiary treatment process of MBR with UV disinfection system will treat the 157.97 m^3/day sewage from the development to achieve effluent quality to meet the standard for on-site effluent reuse for toilet flushing and irrigation for landscape areas within the Application Site. It would also meet the effluent quality standard for discharge to stormwater drainage system and any excess treated effluent would be stored in a reclaimed water storage tank and discharged via stormwater pipes.

9.3 Several contingencies will be provided, such as equalization tank, dual or standby power supply, standby sewage treatment units, flow sensors, alarm systems and tanker, for emergency discharge of untreated sewage effluent from the on-site sewage treatment facility.

9.4 The Applicant will be responsible for the maintenance of all sewers and the on-site sewage treatment facility within the Application Site.

9.5 Adverse environmental impacts in respect of water quality, health and safety arising from the sewerage generated from the proposed development are not anticipated. As a result, no adverse sewerage impact will be incurred.

Figures



LEGEND

Site Boundary

Suffix	Date	Revision	Drawn	Checked
–	–	–	–	–

NOTES:
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4. All Pipe Sizes refers to inner diameter in millimeters.

CLIENT
GOTLAND ENTERPRISES LIMITED

DESIGN CONSULTANT
wsp

PROJECT
PROPOSED RESIDENTIAL INSITUTION (ELDERLY HOME) DEVELOPMENT AT VARIOUS LOTS IN D.D. 101 76 S.G. & 76 S.H., MAI PO, N.T.

DESIGNED BY	DATE	CHECKED BY	DATE
–	–	AC	March 2024
DRAWN BY	DATE	APPROVED BY	DATE
CSL	March 2024	AC	March 2024

DRAWING TITLE
SITE LAYOUT PLAN
TYPICAL GROUND FLOOR LAYOUT

SCALE	STATUS	FILE NAME
–		

DRAWING NO.
Figure 1

REV.

Dwg. No.

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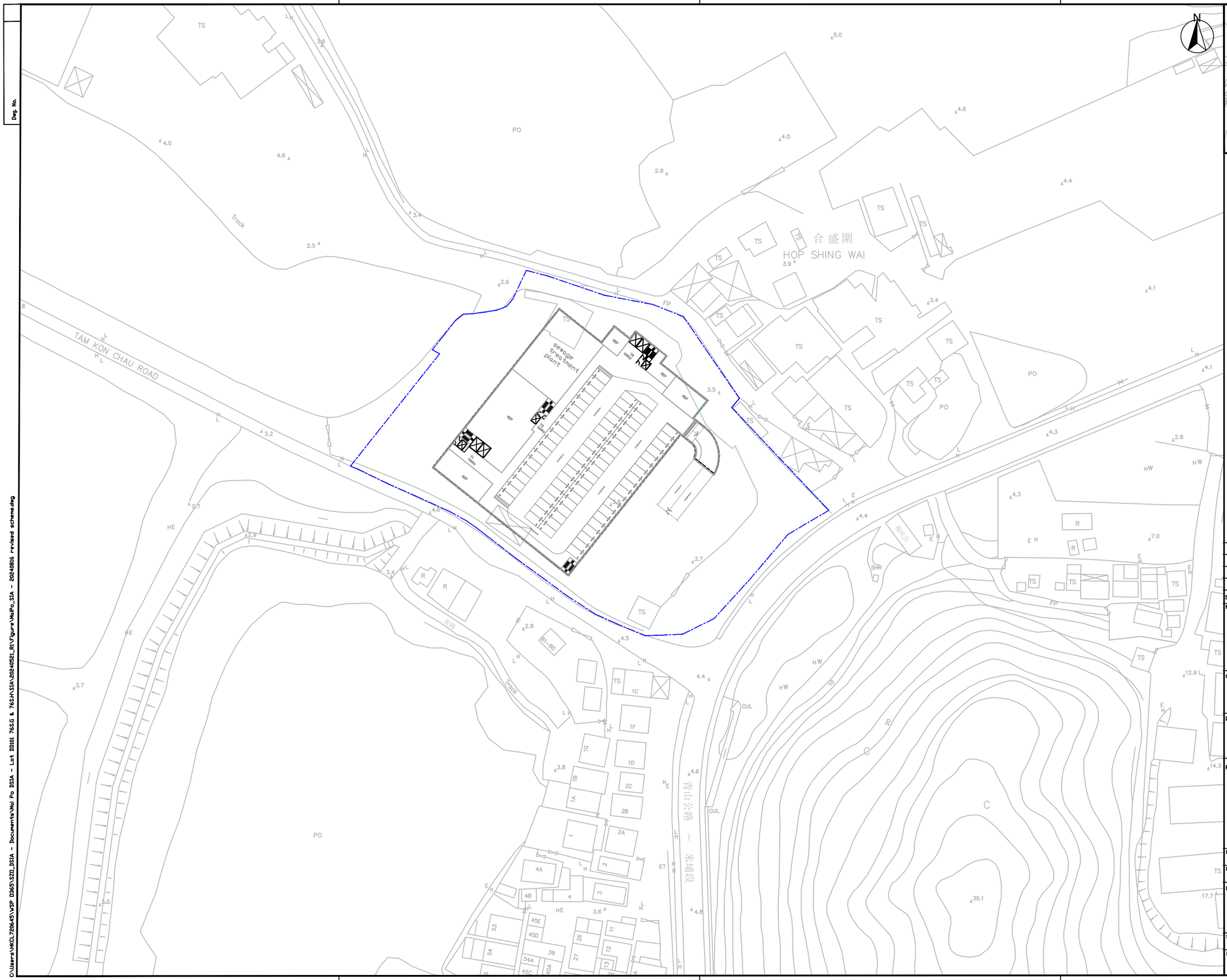

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DESIGNED BY	DATE	CHECKED BY	DATE
–	–	AC	March 2024
DRAWN BY	DATE	APPROVED BY	DATE
CSL	March 2024	AC	March 2024

DRAWING TITLE
SITE LAYOUT PLAN
TYPICAL BASEMENT FLOOR LAYOUT

SCALE	STATUS	FILE NAME
–		

DRAWING NO. Figure 2 REV.

Dwg. No.

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