Prepared for

Great Huge Limited

Prepared by

Ramboll Hong Kong Limited

PROPOSED PRIVATE RESIDENTIAL DEVELOPMENT AT LOT 409 RP, 409S.AA, 409S.AB, 409S.AC, 409S.AD, 409S.AE, 409S.AF, 409S.AG, 409S.AH,409S.AI, 409S.AJ, 409S.AK, 409S.AL, 409S.AM, 409S.AN, 409S.AO, 409S.AP, 409S.AQ,409S.AR, 409S.AS, 409S.AT, 409S.AU, 409S.AV, 409S.AW, 409S.AX, 409S.AY, 409S.AZ, 409S.BA, 409S.BB, 409S.BC, 409S.BD, 409S.BE, 409S.BF, 409S.BG, 409S.BH, 409S.BI,409S.BJ, 409S.BK, 409S.BL, 409S.BM, 409S.BN, 409S.BO,4 09S.BP,409S.BQ, 409S.BR, 409S.BS, 409S.BT, 409 S.F. RP, 409 S.F.SS.1, 409 S.F.SS.2, 409 S.F.SS.3, 409 S.F.SS.4, 409 S.F.SS.5, 409 S.F.SS.6, 409 S.F.SS.7, 409 S.F.SS.8, 409 S.F.SS.9, 409 S.F.SS.10, 409 S.F.SS.11, 409 S.F.SS.12, 409 S.F.SS.13, 409 S.F.SS.14, 409 S.F.SS.15, 409 S.F.SS.16, 409 S.F.SS.17, 409 S.F.SS.18, 409 S.F.SS.19, 409 S.F.SS.20, 409 S.F.SS.21, 409S.G, 409S.H, 409S.I, 409S.J, 409S.K, 409S.L, 409S.M, 409S.N, 409S.O, 409S.P, 409S.Q, 409S.R, 409S.S, 409S.T, 409S.U, 409S.V, 409S.W, 409S.X, 409S.Y, 409S.Z IN D.D 94, KWU TUNG SOUTH, N.T.

SEWERAGE AND DRAINAGE IMPACT ASSESSMENT

Date	**January 2023**
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CHAPTERS

Page

1. INTRODUCTION 3

1.1 Background and Objectives 3
1.2 Subject Site and its Environs 3
1.3 Proposed Development Scheme 3

2. SEWERAGE IMPACT ASSESSMENT 4

2.1 Scope of Work 4
2.2 Assessment Criteria and Methodology 4
2.3 Existing Sewerage System 4
2.4 Wastewater Generated by the Proposed Development 4
2.5 Sewerage Impact 5
2.6 Conclusion 6

3. DRAINAGE IMPACT ASSESSMENT 7

3.1 Scope of Work 7
3.2 Assessment Criteria and Methodology 7
3.3 Site Condition 7
3.4 Proposed Development 7
3.5 Discussion 8

4. OVERALL CONCLUSION 9

4.1 Conclusion 9

TABLES

Table 1 Estimated Peak Flow for Application Site (onsite STP) 4
Table 2 Summary of Surface Runoff under Proposed Conditions 8

FIGURES

Figure 1 Location of the Application Site and its Environs
Figure 2 Proposed Drainage System

APPENDICES

Appendix 1 Master Layout Plan
Appendix 2 Detailed Sewerage Analysis
Appendix 3 Detailed Drainage Analysis

1. INTRODUCTION

1.1 Background and Objectives

1.1.1 A residential development (the Proposed Development) has been proposed at Kwu Tung South, New Territories (the Application Site).

1.1.2 The Application Site falls within the "Residential (Group D)" ("R(D)") zone under the Approved Kwu Tung South Outline Zoning Plan (OZP) No. S/NE-KTS/18.

1.1.3 Ramboll Hong Kong Limited is commissioned by the Applicant to provide consultancy services to prepare this drainage and sewerage impact assessment (DSIA) report with respect to the Application Site.

1.1.4 The design of the master layout plan (MLP) and other technical information on the Proposed Development are provided by the Project Architect (CHIH Design Ltd).

1.2 Subject Site and its Environs

1.2.1 The Application Site is approximately 12,100 m^2. It is bounded by a village access road on the west in Hang Tau Village.

1.2.2 To the immediate east and southeast of the Application Site is existing village houses development (Serenity Garden and Richmond Villa). To the immediate south and north are scattered village houses. To the further west of the site is Sheung Yue River.

1.2.3 The Application Site is currently used as warehouse, open storage and machinery storage & repair.

1.2.4 **Figure 1** shows the location of the Application Site and its environ.

1.3 Proposed Development Scheme

1.3.1 The Proposed Development consists of 42 houses (i.e. House 1 to House 42). E&M rooms, clubhouse, onsite sewage treatment plant are proposed underneath House 36 to House 42, which are located at the northwest corner of the Application Site.

1.3.2 The tentative occupation year is 2028.

1.3.3 The MLP, floor plans and sections of the Proposed Development are shown in **Appendix 1**.

2. SEWERAGE IMPACT ASSESSMENT

2.1 Scope of Work

2.1.1 The aim of this sewerage impact assessment (SIA) is to assess whether sewage generation from the Proposed Development would impose any significant impact and whether the capacity of the existing sewerage network serving the Application Site, if any, is sufficient to cope with the sewage flow from the Proposed Development.

2.2 Assessment Criteria and Methodology

2.2.1 Environmental Protection Department's (EPD's) Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, Version 1 (GESF) has been referred to for the purposes of estimating the quantity of the sewage generated from the Proposed Development and the existing catchment area. Sewage flow parameters and global peaking factors in this document have been adopted for this SIA.

2.2.2 Based on the building type in the area, the following unit flow factor is used in the SIA calculation:

- Private Domestic R4: 0.37 m^3/day

2.3 Existing Sewerage System

2.3.1 There is no existing sewerage system serving the Application Site. The nearest manhole is around 415m away from the Application Site and various private lots are situated in between. Therefore, it is considered not practicable to connect with the existing sewerage system.

2.4 Wastewater Generated by the Proposed Development

2.4.1 Wastewater arising from the Proposed Development will be primarily contributed by the residents.

2.4.2 Based on the constraints as mentioned in **Section 2.3**, onsite sewage treatment plant (STP) is proposed. The treated effluent will be discharged to the stormwater system.

2.4.3 Detailed calculation for the Proposed Development is given in **Table 1** below and **Appendix 2**.

Table 1 Estimated Peak Flow for Application Site (onsite STP)

Development Parameters	Proposed Development	
	Residential	Clubhouse
Area (m^2)	-	232
Units	42	-
Assumed Population	118 (1)	8 (2)
Design Flow (m^3/person/day)	0.37 (3)	0.28 (4)
Flow Rate (m^3/day)	**43.7**	**2.1**
Total Flow Rate (m^3/day)	**45.8**	
Peak Flow (L/s)	**3.2**	

(1) Refer to 2021 Population Census: Average Household Size of 2.8 in Sheung Shui Rural District
(2) Based on Table 8 of CIFSUS – Community, Social & Personal Services - 30m^2 per worker
(3) Refer to Table T-1 of GESF – Private R4
(4) Refer to Table T-2 of GESF – J11

2.5 Sewerage Impact

2.5.1 It is currently technically infeasible to discharge wastewater generated from the Proposed Development to public sewerage system. Therefore, onsite STP is proposed to cater for sewage discharge based on design capacity of 3.2 L/s.

2.5.2 The exact treatment process would be subject to later detailed design and submissions. It will be necessary for the treatment facilities to achieve the necessary discharge standards, as set out in EPD's Technical Memorandum – Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.

2.5.3 Membrane bioreactor (MBR) is recommended to achieve required effluent discharge standard and sludge dewatering system will be provided and designed in accordance with the requirement in the "Guidelines for the Design of Small Sewage Treatments Plants" issued by EPD. Sludge storage tank with deodorisation facilities will be provided. The sludge after having been dewatered and thickened will be tanked away to the landfill for disposal subject to confirmation with future licensed collector/contractor. As good practice for sewage treatment facilities, measures will be incorporated into the design to minimize the risk of emergency overflow from the treatment plant. These measures will include standby pumps, secure power supplies and appropriate alarms, as well as comprehensive Operation and Maintenance procedures, to keep the facilities in good working order. Holding tank for emergency storage/retention will be included with adequate capacity (e.g. to store 6-hours of ADWF discharge) to minimise need of emergency discharge. In the event of any emergency overflow, on-call crews will follow the overflow emergency response plan and proceed with the best response to correct the problem immediately. For example, the alarm system will be activated once overflow occurs. The on-call crews will provide instant response by acknowledging the alarm, to investigate the cause of overflow and correct the problem. The alarm system will repeat until it is acknowledged. In addition, the on-call crews will ensure the standby pump is switched on and contain the overflowed sewage using temporary weirs or vacuum trucks, where applicable.

2.5.4 The STP will also be subject to regular maintenance to ensure that it functions in designed condition and optimal performance, and can minimise any emergency situation. In addition, regular self-monitoring will be conducted to ensure the quality of the treated effluent shall meet the applicable standard before discharge. Monitoring programme will be devised for T&C of the system. A discharge licence will be applied prior the development commencement and monitoring requirement under the licence would be strictly followed as per Water Pollution Control Ordinance (WPCO). Necessary discharge standards, as set out in EPD's Technical Memorandum – Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters will be adopted.

2.5.5 The treated effluent will be discharged to the terminal stormwater manhole onsite and discharged to Sheung Yue River eventually (see next Chapter). Discharge from STP is also accounted in the Drainage Impact Assessment. No unacceptable impacts are expected from the proposed discharge of the treated effluent. With the proposed onsite STP in place, there is no sewerage connection to the public sewerage system.

2.6 Conclusion

2.6.1 A Sewerage Impact Assessment (SIA) has been conducted to evaluate the potential impacts due to the sewage generation from the Proposed Development.

2.6.2 The estimated sewage generations from the Proposed Development will be approximately 3.2L/s.

2.6.3 The nearest public foulwater manhole is located 415m from the Application Site, while various private lots are situated in between. Therefore, onsite STP is proposed to treat effluent before discharge to public drain. Details of the proposed STP including emergency discharge, emergency storage/retention arrangement and the sludge disposal arrangement will be provided after specialist contractor and licensed collector are engaged. The proposal will be submitted to relevant departments for approval.

3. DRAINAGE IMPACT ASSESSMENT

3.1 Scope of Work

3.1.1 The aim of this Drainage Impact Assessment (DIA) is to assess whether there is any unacceptable impact on existing drainage network serving the Application Site after development.

3.2 Assessment Criteria and Methodology

3.2.1 The assessment standard complies with Drainage Services Department (DSD) Stormwater Drainage Manual (SDM) (2018 Edition). The Application Site is situated in rural area, therefore, a 1 in 50 year return storm has been adopted for the DIA.

3.2.2 The catchment runoff has been calculated using the "Rational Method", as outlined in the DSD SDM:

$$Q = 0.278\ C\ i\ A$$

Where	Q	=	peak runoff in m^3/s
	C	=	runoff coefficient (dimensionless)
	i	=	rainfall intensity in mm/hr
	A	=	catchment area in km

3.2.3 The Proposed Development will be for residential use. An overall runoff coefficient of 0.95 is adopted for the future paved areas, and 0.20 for the greenery areas.

3.2.4 The rainfall intensity parameter "i" is dependent on the return period, rainfall duration and the time of concentration of the catchment under consideration. For the future upstream catchment containing the Site, there is no significant change to the flow path and the same time of concentration has been adopted as for the existing scenario. Runoff calculations are included in **Appendix 3**.

3.3 Site Condition

3.3.1 Based on site observations, the Application Site consists of warehouse, open storage and machinery storage & repair. The area is generally paved.

3.3.2 There are no existing flooding blackspots or known drainage problems in the vicinity of the Application Site.

3.4 Proposed Development

3.4.1 It is recommended that the drainage system of the Proposed Development to be discharged through the proposed drainage system (T1 to Outfall) as shown in **Figure 2**. The new underground pipes (525mm in diameter) connecting to the site's terminal manhole and the proposed outfall are proposed to discharge the surface runoff from the Application Site. The surface runoff from the Application Site have been estimated and presented in **Appendix 3**.

3.4.2 After development, the proposed green coverage of the Proposed Development will be no less than 20%. In other words, the surface runoff will decrease.

3.4.3 The surface runoff after development is summarized below in **Table 2**.

Table 2 Summary of Surface Runoff under Proposed Conditions

Catchment	Area (m^2)	Runoff (m^3/s) under 1 in 50 years scenario
Site	12,100	0.609
	Total	**0.609**

3.4.4 The treated effluent from the STP of 3.2 L/s (i.e. 0.00032m^3/s) has been considered in this DIA. The total discharge volume (i.e. future surface runoff + effluent from STP) is considered to be 0.612m^3/s.

3.5 Discussion

3.5.1 A DIA has been conducted to evaluate the potential impacts due to the surface runoff from the Proposed Development.

3.5.2 It is noted that the Proposed Development will be equipped with onsite sewage treatment plant (STP) to treat the effluent before discharging to the proposed drainage system. The estimated flow from the STP would have a peak discharge rate of 3.2 L/s (i.e. 0.0032m^3/s).

3.5.3 Hence, the total discharge volume (i.e. future surface runoff + effluent from STP) after development is 0.612m^3/s.

3.5.4 The surface runoff and treated effluent will discharge to the proposed connection via the site terminal manhole and new 525mm diameter drainage pipes to the proposed outfall of Sheung Yue River. Detailed capacity calculations of the proposed pipes are included in **Appendix 3**.

4. OVERALL CONCLUSION

4.1 Conclusion

4.1.1 A residential development is proposed at the Application Site at Kwu Tung South, N.T. The potential sewerage and drainage impact have been assessed.

4.1.2 Given that the long separation distance and inaccessible private lots between the Application Site and public foulwater manholes, it is considered not practicable to connect the Application Site with existing sewerage network. Therefore, onsite sewage treatment plant (STP) is proposed and the treated effluent (i.e. 3.2L/s) will be discharged through the proposed drainage system.

4.1.3 The STP will be subject to later detailed design and the proposal will be submitted to relevant departments for approval. The project proponent will be responsible to apply for the discharge license.

4.1.4 According to the findings in DIA, the total discharge volume will be 0.63m^3/s (with the treated effluent from the STP included). With the proposed 525mm diameter drainage pipes in place, no adverse sewerage and drainage impact due to the Proposed Development is anticipated.

Figures

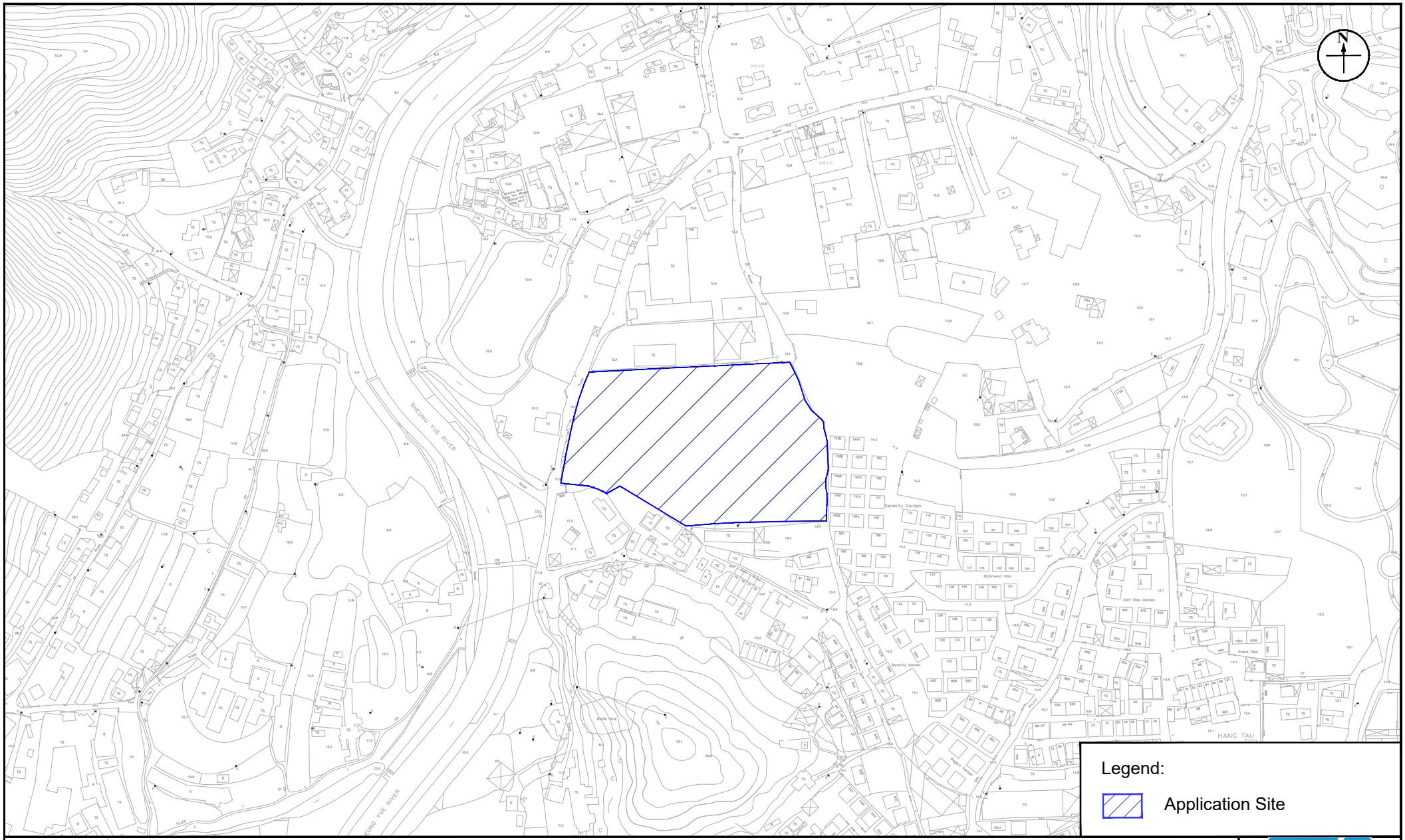

Figure: 1	RAMBOLL
Title: Location of the Application Site and its Environs	Drawn by: MW
Project: Proposed Residential Development at Lot 409 RP, 409S.AA, 409S.AB, 409S.AC, 409S.AD, 409S.AE, 409S.AF, 409S.AG, 409S.AH,409S.AI, 409S.AJ, 409S.AK, 409S.AL, 409S.AM, 409S.AN, 409S.AO, 409S.AP, 409S.AQ,409S.AR, 409S.AS, 409S.AT, 409S.AU, 409S.AV, 409S.AW, 409S.AX, 409S.AY, 409S.AZ, 409S.BA, 409S.BB, 409S.BC, 409S.BD, 409S.BE, 409S.BF, 409S.BG, 409S.BH, 409S.BI,409S.BJ, 409S.BK, 409S.BL, 409S.BM, 409S.BN, 409S.BO,4 09S.BP,409S.BQ, 409S.BR, 409S.BS, 409S.BT, 409 S.F. RP, 409 S.F.ss.1, 409 S.F.ss.2, 409 S.F.ss.3, 409 S.F.ss.4, 409 S.F.ss.5, 409 S.F.ss.6, 409 S.F.ss.7, 409 S.F.ss.8, 409 S.F.ss.9, 409 S.F.ss.10, 409 S.F.ss.11, 409 S.F.ss.12, 409 S.F.ss.13, 409 S.F.ss.14, 409 S.F.ss.15, 409 S.F.ss.16, 409 S.F.ss.17, 409 S.F.ss.18, 409 S.F.ss.19, 409 S.F.ss.20, 409 S.F.ss.21, 409S.G, 409S.H, 409S.I, 409S.J, 409S.K, 409S.L, 409S.M, 409S.N, 409S.O, 409S.P, 409S.Q, 409S.R, 409S.S, 409S.T, 409S.U, 409S.V, 409S.W, 409S.X, 409S.Y, 409S.Z in D.D 94, Kwu Tung South, N.T.	Checked by: CC
	Rev.: 1.0
	Date: Jan 2023

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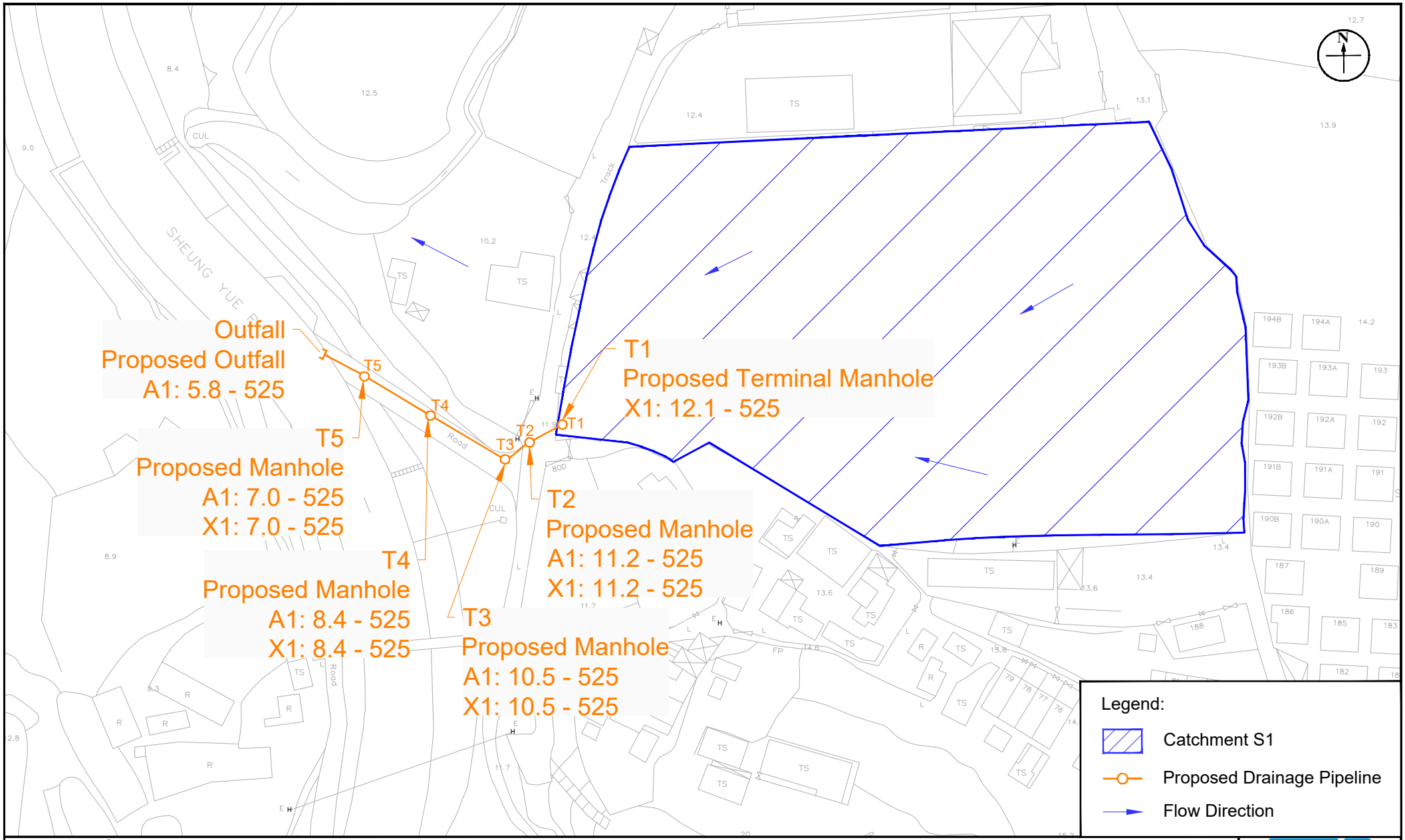

Figure:	2
Title:	Proposed Drainage System
Project:	Proposed Residential Development at Lot 409 RP, 409S.AA, 409S.AB, 409S.AC, 409S.AD, 409S.AE, 409S.AF, 409S.AG, 409S.AH,409S.AI, 409S.AJ, 409S.AK, 409S.AL, 409S.AM, 409S.AN, 409S.AO, 409S.AP, 409S.AQ,409S.AR, 409S.AS, 409S.AT, 409S.AU, 409S.AV, 409S.AW, 409S.AX, 409S.AY, 409S.AZ, 409S.BA, 409S.BB, 409S.BC, 409S.BD, 409S.BE, 409S.BF, 409S.BG, 409S.BH, 409S.BI,409S.BJ, 409S.BK, 409S.BL, 409S.BM, 409S.BN, 409S.BO,4 09S.BP,409S.BQ, 409S.BR, 409S.BS, 409S.BT, 409 S.F. RP, 409 S.F.ss.1, 409 S.F.ss.2, 409 S.F.ss.3, 409 S.F.ss.4, 409 S.F.ss.5, 409 S.F.ss.6, 409 S.F.ss.7, 409 S.F.ss.8, 409 S.F.ss.9, 409 S.F.ss.10, 409 S.F.ss.11, 409 S.F.ss.12, 409 S.F.ss.13, 409 S.F.ss.14, 409 S.F.ss.15, 409 S.F.ss.16, 409 S.F.ss.17, 409 S.F.ss.18, 409 S.F.ss.19, 409 S.F.ss.20, 409 S.F.ss.21, 409S.G, 409S.H, 409S.I, 409S.J, 409S.K, 409S.L, 409S.M, 409S.N, 409S.O, 409S.P, 409S.Q, 409S.R, 409S.S, 409S.T, 409S.U, 409S.V, 409S.W, 409S.X, 409S.Y, 409S.Z in D.D 94, Kwu Tung South, N.T.

RAMBOLL

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Checked by:	CC
Rev.:	1.0
Date:	Jan 2023

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Appendix 1 Master Layout Plan

PLAN 5 MASTER LAYOUT PLAN

PROPOSED PRIVATE RESIDENTIAL DEVELOPMENT at
Lot 409 RP, 409S.AA, 409S.AB, 409S.AC, 409S.AD, 409S.AE, 409S.AF, 409S.AG, 409S.AH,409S.AI, 409S.AJ, 409S.AK, 409S.AL, 409S.AM, 409S.AN, 409S.AO, 409S.AP, 409S.AQ,409S.AR, 409S.AS, 409S.AT, 409S.AU, 409S.AV, 409S.AW, 409S.AX, 409S.AY, 409S.AZ, 409S.BA, 409S.BB, 409S.BC, 409S.BD, 409S.BE, 409S.BF, 409S.BG, 409S.BH, 409S.BI,409S.BJ, 409S.BK, 409S.BL, 409S.BM, 409S.BN, 409S.BO,4 09S.BP,409S.BQ, 409S.BR, 409S.BS, 409S.BT, 409 S.F. RP, 409 S.F.ss.1, 409 S.F.ss.2, 409 S.F.ss.3, 409 S.F.ss.4, 409 S.F.ss.5, 409 S.F.ss.6, 409 S.F.ss.7, 409 S.F.ss.8, 409 S.F.ss.9, 409 S.F.ss.10, 409 S.F.ss.11, 409 S.F.ss.12, 409 S.F.ss.13, 409 S.F.ss.14, 409 S.F.ss.15, 409 S.F.ss.16, 409 S.F.ss.17, 409 S.F.ss.18, 409 S.F.ss.19, 409 S.F.ss.20, 409 S.F.ss.21, 409S.G, 409S.H, 409S.I, 409S.J, 409S.K, 409S.L, 409S.M, 409S.N, 409S.O, 409S.P, 409S.Q, 409S.R, 409S.S, 409S.T, 409S.U, 409S.V, 409S.W, 409S.X, 409S.Y, 409S.Z in D.D 94, Kwu Tung South, N.T.

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LEGEND:

E.M.C.	= ELECTRICAL METER CABINET
G.M.&W.M.	= GAS METER & WATER METER
KIT.	= KITCHEN
P.R.	= POWER ROOM
P.W.&F.W. T.&P.	= PORTABLE WATER & FLUSHING WATER TANK & PUMP
T.G.	= TOWN GAS
TBE RM.	= TELECOMMUNICATIONS & BROADCASTING EQUIPMENT ROOM

PLAN 6 GROUND FLOOR PLAN

PROPOSED PRIVATE RESIDENTIAL DEVELOPMENT at
Lot 409 RP, 409S.AA, 409S.AB, 409S.AC, 409S.AD, 409S.AE, 409S.AF, 409S.AG, 409S.AH,409S.AI, 409S.AJ, 409S.AK, 409S.AL, 409S.AM, 409S.AN, 409S.AO, 409S.AP, 409S.AQ,409S.AR, 409S.AS, 409S.AT, 409S.AU, 409S.AV, 409S.AW, 409S.AX, 409S.AY, 409S.AZ, 409S.BA, 409S.BB, 409S.BC, 409S.BD, 409S.BE, 409S.BF, 409S.BG, 409S.BH, 409S.BI,409S.BJ, 409S.BK, 409S.BL, 409S.BM, 409S.BN, 409S.BO,4 09S.BP,409S.BQ, 409S.BR, 409S.BS, 409S.BT, 409 S.F. RP, 409 S.F.ss.1, 409 S.F.ss.2, 409 S.F.ss.3, 409 S.F.ss.4, 409 S.F.ss.5, 409 S.F.ss.6, 409 S.F.ss.7, 409 S.F.ss.8, 409 S.F.ss.9, 409 S.F.ss.10, 409 S.F.ss.11, 409 S.F.ss.12, 409 S.F.ss.13, 409 S.F.ss.14, 409 S.F.ss.15, 409 S.F.ss.16, 409 S.F.ss.17, 409 S.F.ss.18, 409 S.F.ss.19, 409 S.F.ss.20, 409 S.F.ss.21, 409S.G, 409S.H, 409S.I, 409S.J, 409S.K, 409S.L, 409S.M, 409S.N, 409S.O, 409S.P, 409S.Q, 409S.R, 409S.S, 409S.T, 409S.U, 409S.V, 409S.W, 409S.X, 409S.Y, 409S.Z in D.D 94, Kwu Tung South, N.T.

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DATE : 19 - 01 - 2023
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PLAN 7 FIRST FLOOR PLAN

PROPOSED PRIVATE RESIDENTIAL DEVELOPMENT at
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PLAN 8 SECOND FLOOR PLAN

PROPOSED PRIVATE RESIDENTIAL DEVELOPMENT at

Lot 409 RP, 409S.AA, 409S.AB, 409S.AC, 409S.AD, 409S.AE, 409S.AF, 409S.AG, 409S.AH,409S.AI, 409S.AJ, 409S.AK, 409S.AL, 409S.AM, 409S.AN, 409S.AO, 409S.AP, 409S.AQ,409S.AR, 409S.AS, 409S.AT, 409S.AU, 409S.AV, 409S.AW, 409S.AX, 409S.AY, 409S.AZ, 409S.BA, 409S.BB, 409S.BC, 409S.BD, 409S.BE, 409S.BF, 409S.BG, 409S.BH, 409S.BI,409S.BJ, 409S.BK, 409S.BL, 409S.BM, 409S.BN, 409S.BO,4 09S.BP,409S.BQ, 409S.BR, 409S.BS, 409S.BT, 409 S.F. RP, 409 S.F.ss.1, 409 S.F.ss.2, 409 S.F.ss.3, 409 S.F.ss.4, 409 S.F.ss.5, 409 S.F.ss.6, 409 S.F.ss.7, 409 S.F.ss.8, 409 S.F.ss.9, 409 S.F.ss.10, 409 S.F.ss.11, 409 S.F.ss.12, 409 S.F.ss.13, 409 S.F.ss.14, 409 S.F.ss.15, 409 S.F.ss.16, 409 S.F.ss.17, 409 S.F.ss.18, 409 S.F.ss.19, 409 S.F.ss.20, 409 S.F.ss.21, 409S.G, 409S.H, 409S.I, 409S.J, 409S.K, 409S.L, 409S.M, 409S.N, 409S.O, 409S.P, 409S.Q, 409S.R, 409S.S, 409S.T, 409S.U, 409S.V, 409S.W, 409S.X, 409S.Y, 409S.Z in D.D 94, Kwu Tung South, N.T.

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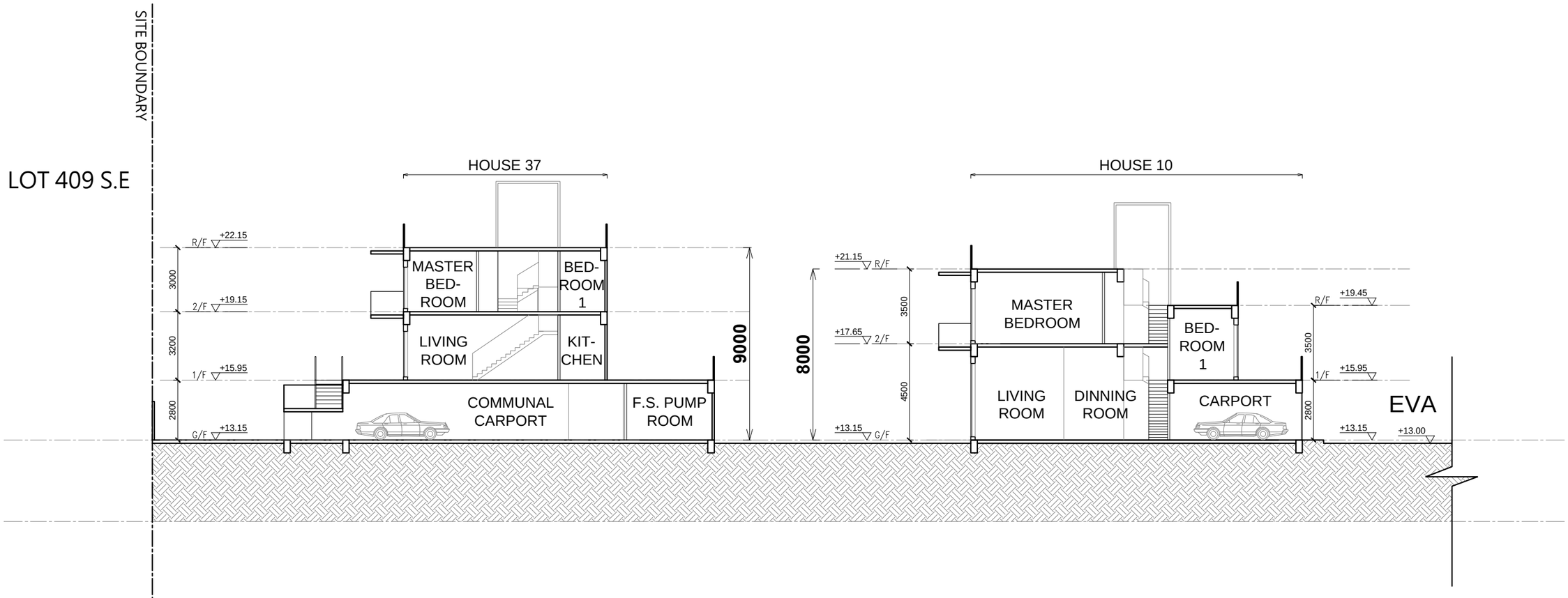
JOB NO.: 2105PA
DATE : 19 - 01 - 2023
SCALE : 1:500 @A3



PLAN 9

SECTION AA'

PROPOSED PRIVATE RESIDENTIAL DEVELOPMENT at
Lot 409 RP, 409S.AA, 409S.AB, 409S.AC, 409S.AD, 409S.AE, 409S.AF, 409S.AG, 409S.AH,409S.AI, 409S.AJ, 409S.AK, 409S.AL, 409S.AM, 409S.AN, 409S.AO, 409S.AP, 409S.AQ,409S.AR, 409S.AS, 409S.AT, 409S.AU, 409S.AV, 409S.AW, 409S.AX, 409S.AY, 409S.AZ, 409S.BA, 409S.BB, 409S.BC, 409S.BD, 409S.BE, 409S.BF, 409S.BG, 409S.BH, 409S.BI,409S.BJ, 409S.BK, 409S.BL, 409S.BM, 409S.BN, 409S.BO,4 09S.BP,409S.BQ, 409S.BR, 409S.BS, 409S.BT, 409 S.F. RP, 409 S.F.ss.1, 409 S.F.ss.2, 409 S.F.ss.3, 409 S.F.ss.4, 409 S.F.ss.5, 409 S.F.ss.6, 409 S.F.ss.7, 409 S.F.ss.8, 409 S.F.ss.9, 409 S.F.ss.10, 409 S.F.ss.11, 409 S.F.ss.12, 409 S.F.ss.13, 409 S.F.ss.14, 409 S.F.ss.15, 409 S.F.ss.16, 409 S.F.ss.17, 409 S.F.ss.18, 409 S.F.ss.19, 409 S.F.ss.20, 409 S.F.ss.21, 409S.G, 409S.H, 409S.I, 409S.J, 409S.K, 409S.L, 409S.M, 409S.N, 409S.O, 409S.P, 409S.Q, 409S.R, 409S.S, 409S.T, 409S.U, 409S.V, 409S.W, 409S.X, 409S.Y, 409S.Z in D.D 94, Kwu Tung South, N.T.

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DATE : 19 - 01 - 2023
SCALE : 1:200 @A3

Appendix 2 Detailed Sewerage Analysis

Table 1 Calculation for Sewage Generation Rate of the Proposed Development at the Application Site

1. Residential Tower

1a. Total number of residential units	=	42 units
1b. Total number of residents	=	118 people -- (2021 Population Census: Average Household Size of 2.8 in Sheung Shui Rural District)
1c. Design flow	=	0.37 m^3/person/day -- (Private R4 in Table T-1 of GESF)
1d. Sewage Generation rate	=	**43.7** m^3/day

2. Clubhouse

2a. Assumed Area	=	232 m^2
2b. Assumed floor area per employee	=	30.3 m^2 per worker -- (refer to Table 8 of CIFSUS - Community, Social & Personal Services)
2c. Total number of employees	=	8 employees
2d. Design flow for commercial activities	=	0.28 m^3/employee/day -- (refer to Table T-2 of GESF - J11)
2e. Sewage Generation rate	=	**2.1** m^3/day

Total Flow from Proposed Development

Flow Rate (without Catchmnet Inflow Factor)	=	**45.8** m^3/day
Contributing Population	=	170 people
Peaking factor	=	6 Refer to Guidelines for the Design of Small Sewage Treatment Plants
Peak Flow	=	**3.2** litre/sec

Appendix 3 Detailed Drainage Analysis

Kwu Tung South, Various Lots D.D. 94
Table 1 - Proposed Catchment Areas and Run-off (1 in 50 year)

$$Q_p = 0.278\ C\ i\ A$$

where Q_p = peak runoff in m^3/s
C = runoff coefficient (dimensionless)
i = rainfall intensity in mm/hr
A = catchment area in km^2

Notes:

Site Area 12,100 m^2

Catchments are small, so Rational Method is appropriate

1 in 50-year (according to Table 3 of DSD Manual)
a= 451.3
b= 2.46
c= 0.337

Surface Characteristics	*Runoff coefficient, C**
Asphalt	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85
Grassland (heavy soil**)	
Flat	0.13 - 0.25
Steep	0.25 - 0.35
Grassland (sandy soil)	
Flat	0.05 - 0.15
Steep	0.15 - 0.20

	Catchment	Discharge Manhole	Paved	Unpaved	Run-off at	Area	Levels (mPD)		Fall	Overland, L	Fall, H	Overland t_c	t_0	Total t_f[1]	Total t_c[2]	Intensity	Weighted Runoff Coefficient	Run-off
						(m^2)	Upstream	Downstream	(m)	(m)	(m/100m)	(min)	(min)	(min)	(min)	(mm/h)		(m^3/s)
Future	**Application Site**																	
	S1	T1	80%	20%	T1	12,100							5.0	0.00	5.00	229	0.79	0.609
					T2									0.09	5.09	228	0.79	0.607
					T3									0.07	5.07	229	0.79	0.607
					T4									0.00	5.07	229	0.79	0.607
					T5									0.00	5.07	229	0.79	0.607
					Outfall									0.00	5.07	229	0.79	0.607

Remarks:
1. Assumed Time of Concentration through stream flow
2. Assumed Time of Concentration

Kwu Tung South, Various Lots D.D. 94
Hydraulic Calculations of Existing and Proposed Drainage System

Table 2a - 1 in 50 year Runoff of Future Catchments (m^3/s)

Runoff at	Catchment	
	S1	Total
T1	0.609	**0.61**
T2	0.607	**0.61**
T3	0.607	**0.61**
T4	0.607	**0.61**
T5	0.607	**0.61**

Table 2b - Treated Effluent from the proposed on-site STP

Estimated Peak Sewage Generation Rate, m^3/s	Estimated Peak Effluent from Proposed On-Site STP, m^3/s
0.003	0.003

Table 3 - Hydraulic Capacities for Proposed Drainage System

Segment	Manhole Reference	Manhole Reference	Type of Channel	Pipe Dia.	Pipe Length	Invert Level 1	Invert Level 2	g	k_s	s	Gradient	v	V	Area	Q	Q_{silt} [1]
				mm	m	mPD	mPD	m/s^2	m		1 in	m^2/s	m/s	m^2	m^3/s	m^3/s
T1 - T2	-	-	Circular	525	8.4	12.10	11.20	9.81	0.0030	0.107	9	0.000001	5.89	0.22	1.28	1.21
T2 - T3	-	-	Circular	525	6.7	11.20	10.50	9.81	0.0030	0.105	10	0.000001	5.83	0.22	1.26	1.20
T3 - T4	-	-	Circular	525	19.5	10.50	8.40	9.81	0.0030	0.108	9	0.000001	5.92	0.22	1.28	1.22
T4 - T5	-	-	Circular	525	17.3	8.40	7.00	9.81	0.0030	0.081	12	0.000001	5.13	0.22	1.11	1.05
T5 - Outfall	-	Outfall	Circular	525	10.2	7.00	5.80	9.81	0.0030	0.117	9	0.000001	6.17	0.22	1.34	1.27

Table 4 - Comparison of Runoff from Proposed Catchments and Hydraulic Capacities of Existing Drainage System

Segment	Manhole Reference	Manhole Reference	Pipe Dia.	Q_{silt} [1]	Catchment Involved	Runoff	Occupancy	Sufficient Capacity?	Runoff [2]	Occupancy	Sufficient Capacity?	Runoff [3]	Occupancy	Sufficient Capacity?
			mm	m^3/s		m^3/s			m^3/s			m^3/s		
T1 - T2	-	-	525	1.21	S1	0.612	50.5%	YES	0.68	56.1%	YES	0.71	58.6%	YES
T2 - T3	-	-	525	1.20	S1	0.610	50.8%	YES	0.68	56.5%	YES	0.71	59.0%	YES
T3 - T4	-	-	525	1.22	S1	0.610	50.1%	YES	0.68	55.7%	YES	0.71	58.2%	YES
T4 - T5	-	-	525	1.05	S1	0.610	57.9%	YES	0.68	64.3%	YES	0.71	67.2%	YES
T5 - Outfall	-	Outfall	525	1.27	S1	0.610	48.1%	YES	0.68	53.4%	YES	0.71	55.8%	YES

Remarks:

1. Qsilt: 10% reduction in flow for gradient is not greater than 1 in 25, 5% reduction in flow for gradient greater than 1 in 25.
2. Cross Section Area of Circular Pipe: D^2 × PI / 4
3. Perimeter of Circular Pipe: (D × 2 × PI) / 2

Runoff [2] represents the situation in Mid 21st Century
Runoff [3] represents the situation in Late 21st Century