Appendix E

Drainage Impact Assessment

Hong Kong International Innovation and Technology Hub Limited

Section 12A Planning Application for Proposed Innovation and Technology Hub at Various Lots in D.D. 82 and D.D. 86 and Adjoining Government Land, Man Kam To, New Territories

Drainage Impact Assessment

Aug 2023

Job number

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ARUP

Contents

1 Introduction

1.1 Background

The Applicant proposes amendments to the Approved Man Kam To Outline Zoning Plan No. S/NE-MKT/4 ("the OZP") by rezoning the Application Site from "Agriculture" ("AGR"), "Green Belt" ("GB") and "Government, Institution or Community" ("G/IC") to a tailor-made "Other Specified Uses" ("OU") annotated "Innovation and Technology Hub", with a maximum non-domestic gross floor area (GFA) of 365,180m^2 and a maximum domestic GFA of 170,400m^2 (including dormitory) and maximum building heights (BH) of 80, 90, 110 and 120 meters above principal datum (mPD) for four sub-areas respectively, to facilitate the development of the proposed Innovation and Technology (I&T) Hub.

Currently, the Application Site is largely vacant with vegetation and inactive farmland, and covers a portion of the access road from Lin Ma Hang Road leading to the existing River Ganges Pumping Station.

The Application Site, with a site area of about 125,863m^2, is located at Man Kam To in the North District. It is on a gentle sloping from site level of about 6mPD near Ping Yuen River to 25mPD near the eastern foot of Lo Shue Ling. The Application Site includes the Development Site (of an area about 102,461m^2) and remaining land parcels adjoining the Development Site for better rationalisation of boundary and land use zoning.

1.2 Objectives

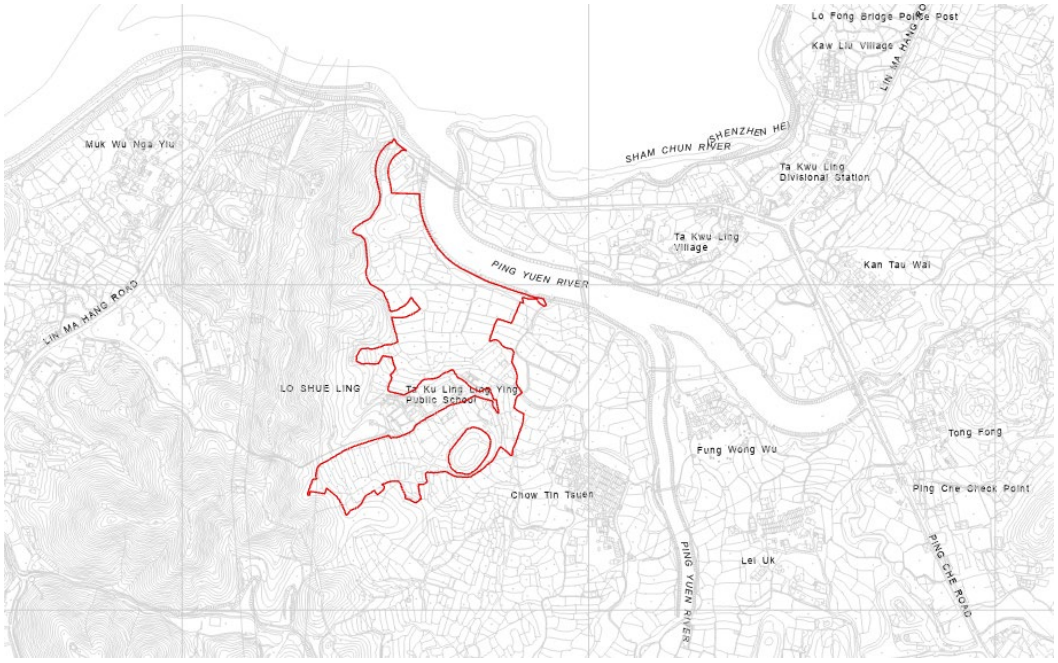
The objective of this report is to provide an assessment of the impact of storm water flow generation as a result of the proposed development at the Application Site on the connecting public drainage system adjacent to the Application Site and to propose mitigation measures (if any).

2 Project Outline

2.1 Subject Development

The Application Site is located in Man Kam To, New Territories, bounded by Ping Yuen River to the northeast, Lo Shue Ling to the west and Chow Tin Tsuen to the east. There is an existing public school surrounded by the site, as shown in **Figure 2.1**. In the vicinity of the Site there are mainly scattered village houses and agricultural land. A master layout plan of Indicative Scheme in the Development Site is enclosed in **Appendix A**.

Figure 2.1: Location Plan of the Development Site



2.2.1 The development parameters of the Indicative Scheme are presented in **Table 2.1**:

Table 2.1: Key Development Parameters Table

		Indicative Scheme
Application Site Area (1)		About 125,863 m^2
Development Site Area		About 102,461 m^2
Total Plot Ratio (2)		5.23
- Non-Domestic PR		3.57
- Domestic PR		1.66
Total Gross Floor Area		535,580 m^2
- **Non-Domestic GFA**		365,180 m^2
R&D Centre		*268,780 m^2*
Data Centre		*86,400 m^2*
Commercial Centre		*9,276 m^2*
Kindergarten (3)		*724 m^2*
- **Domestic GFA**		170,400 m^2
Ancillary Dormitories		*63,900 m^2*
Other Residential Uses		*106,500 m^2*
- **Clubhouse GFA** (4)		3,500 m^2
Building Height		
1. *R&D Centre*	Building Height	83m
	mPD	90mPD
	No. of Storeys (5)	16
2. *Data Centre*	Building Height	73m
	mPD	80mPD
	No. of Storeys (5)	12
3. *Commercial Centre*	Building Height	30m
	mPD	37mPD

	No. of Storeys [5]	6
4. *Ancillary Dormitories*	Building Height	99-102.15m
	mPD	110mPD
	No. of Storeys [6]	30-31
5. *Other Residential Uses*	Building Height	99-105.3m
	mPD	120mPD
	No. of Storeys [6]	30-32
Anticipated No. of Working Population		6,207
6. *R&D Centre* [7]		*5,375*
7. Data Centre [8]		*432*
8. Commercial [9]		*400*
No. of Units		3,712
9. *Ancillary Dormitories*		*1,392*
10. *Other Residential uses*		*2,320*
Average Flat Size [10]		35.5 m^2
Anticipated Population [11]		10,022
11. *No. of Tenants of Ancillary Dormitories*		*3,758*
12. No. of Population of Other Residential Uses		*6,264*
Local Open Space		Not less than 13,126 m^2
13. For *Workers*		*Not less than 3,104 m^2*
14. For *Residents*		*Not less than 10,022 m^2*
Target Completion Year		2028

Remarks:
[1] Application Site includes the Development Site and remaining land parcels adjoining the Development Site for better rationalisation of boundary and land use zoning.
[2] PR calculations are based on the area of Development Site. May not add up due to rounding.
[3] The kindergarten with 6-classroom of about 724m^2 GFA fulfils the minimum floor space requirement specified in the EBD's Operation Manual for Pre-primary Institute. Indicative only, subject to detailed design.
[4] According to APP-104, a maximum area of 3,500m^2 can be applied for GFA concession for a development with domestic GFA of >100,000m^2 to 125,000m^2. The clubhouse GFA (intended for use by residents of Other Residential Uses) is proposed to be exempted from GFA calculation.
[5] The no. of storeys excludes basement carparks.
[6] The no. of storeys excludes 1-storey lobby and basement carparks.
[7] An assumption of 50m^2 per worker is assumed for R&D Centre, with reference to Employment Density Guide (3rd Ed.) in the UK.
[8] An assumption of 200m^2 per worker is assumed for Data Centre, with reference to Employment Density Guide (3rd Ed.) in the UK.
[9] An assumption of 25m^2 per worker is assumed for commercial uses (retail, F&B), with reference to HKPSG Chapter 5.
[10] Average flat size is assumed as 35.5m^2 which has excluded area required for corridor, lift shaft, lobby, staircase, etc.
[11] A person per flat (PFF) ratio of 2.7 is assumed, according to the average household size of the Territory and North District in 2021 Census.

2.2 Project Interface

No foreseeable interaction or conflict with other development projects in the vicinity of the Application Site was identified when this DIA was conducted.

3 Existing Drainage

3.1 Existing Drainage Network

The Application Site locates at the east flank of Lo Shue Ling. Surface run-off from Lo Shue Ling runs freely through the application site and discharges to the U channel along the west bank of Ping Yuen River. There is no existing drainage pipe within the application site.

Based on the preliminary calculation of the catchment area, the capacity of the outlet (SSP1004585) of catchment B2 is not sufficient.

Detailed existing drainage network information is found on GEOINFO MAP in **Appendix B**.

The catchment associated with the existing drainage system were identified based on the existing topography. Catchment Plans of existing Site and proposed development are shown in **Appendix C**.

The capacity checking of existing drainage system is presented in **Appendix E**.

4 Assumptions and References

4.1 Climate Change

Climate change is taken into account in existing drainage system capacity check calculation. 16.0% Rainfall intensity increase for end of 21st century (2081-2100) is included referring to Stormwater Drainage Manual CORRIGENDUM No. 1/2022, Table 28.

4.2 Desilting

Referring to SDM 2018 section 9.3(a), 10% reduction in flow area is adopted in capacity checking of pipe/channel for taking into account of the effects to flow capacity due to materials deposited on the pipe/channel bed.

5 Drainage Impact Assessment for the Proposed Development

5.1 Catchment Area Changes

Comparing the existing and the proposed catchment area, it can be found that:

a) The existing catchment areas within Site is almost 100% unpaved. The proposed catchment areas within Site will be 25% unpaved and 75% hard-paved referring to Mater Layout Plan.

b) The rest of the catchment area will remain the same as before.

Table 5.1 Summary of Development Parameters

Development Parameters	Existing Site	Development Site
Area (m^2)	About 102,461 m^2	About 102,461 m^2
% of Hard-paved Area/ Unpaved Area	Hard-paved Area: 0% Unpaved Area: 100%	Hard-paved Area: 75% Unpaved Area: 25%
Statutory Land Use Zoning	AGR / GB / G/IC	OU

5.2 Assessment Results

Referring to the summary of catchment area changes in **Table 5.1**, the proposed catchment area of surface run-off discharging to the existing drainage pipe is increased and some catchment areas are changed from unpaved to hard-paved. The sub-catchment is changed due to the development. the original outlet of sub-catchment B is now abandoned. Both sub-catchment A2 and A3 is now discharged to box culvert SBP1007222. As a result, the hydraulic capacity of east drainage system has been checked and the result shows that there is no adverse impact caused by the catchment area change. The capacity checking of east drainage system is presented in **Appendix E**.

It is worth noting that Ta Ku Ling Ling Ying Public School (TKLLYPS) and Chow Tin Tsuen (CTT) are adjacent to the Development Site. However, the Development Site locates in the upstream of the TKLLYPS and CTT. Therefore the increase of runoff caused by the Development Site will not effect TKLLYPS and CTT.

In addition, the capacity of Ping Yuen River is roughly estimated as $311m^3/s$[1]. The increased stormwater runoff is about 1% of the Ping Yuen River capacity, which is negligible.

5.3 Proposed Drainage Diversion

To suit the arrangement of proposed development, the existing drainage system adjacent to the Application Site are required to be diverted:

Sub-catchment A1

As there is no existing drainage pipe within the sub-catchment A1. In order to prevent the runoff from Lo Shue Ling, 2 u-channels are proposed along the west boundary of the site. UC01 is 1000mm wide and will be discharged to the north. UC02 is 700mm wide and will be discharged to the south. The stormwater collected by UC02 will be transferred through the site via the drainage pipes and eventually

[1] Due to the lack of information, the capacity is calculated under the following assumption: Width: 53m; Side slope: 1/2; Bottom slope: 0.003; Roughness: 0.02. The assumption is made based on GEOINFO MAP and River Tour photo found on DSD website.
https://www.dsd.gov.hk/EcoDMS/EN/River_Channels/Ping_Yuen_River/River_Tour.html

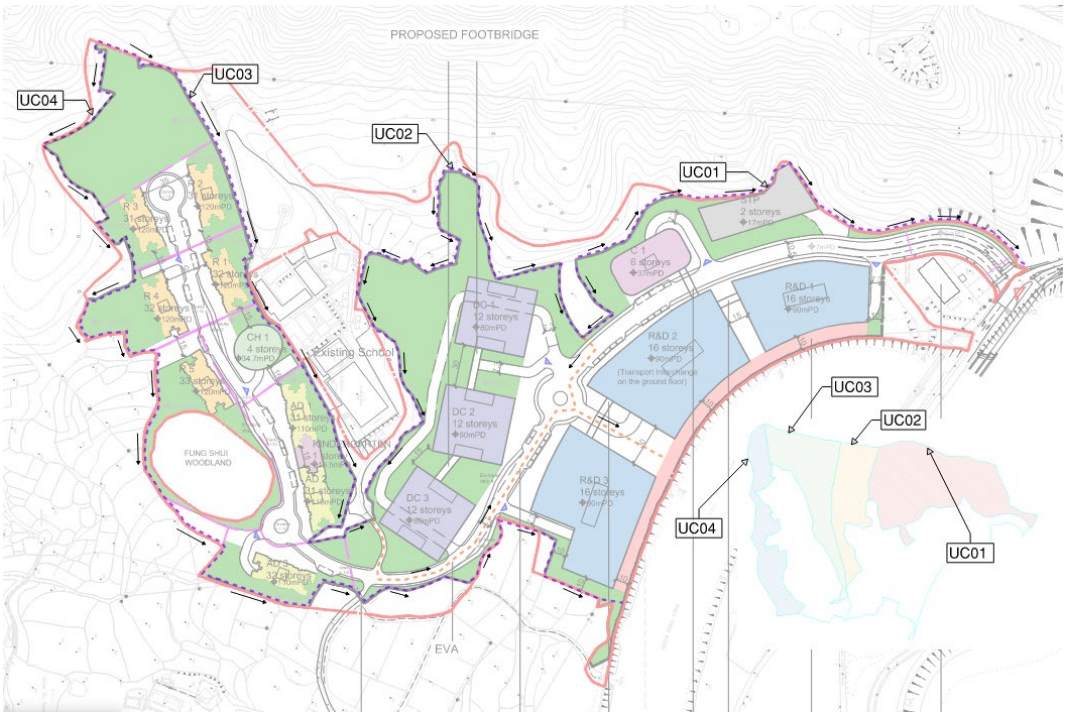
discharged to the Ping Yuen River. Access to the u-channel and the drains will be provided to DSD for future operation and maintenance.

Sub-catchment A4

As there is no existing drainage pipe within the sub-catchment A4. In order to prevent the runoff from Lo Shue Ling, 2 u-channels are proposed along the west and south boundary of the site. UC03 is 800mm wide and the stormwater collected by UC03 will be transferred to the drainage pipe within the site and eventually discharged to the Ping Yuen River. UC04 along the south boundary is 700mm wide and will be discharged to Ping Yuen River. Access to the u-channel and the drains will be provided to DSD for future operation and maintenance.

The proposed u-channels are indicated in **Figure 5.1**. The drainage calculation of the proposed u-channels is shown in **Appendix F**.

Figure 5.1: Location Plan of the Proposed u-channels



The catchment associated with the proposed drainage diversion were identified based on the existing topography and proposed development plan. Catchment Plan of Application Site is shown in **Appendix C**.

The catchment plan after development and drainage diversion Scheme is illustrated in **Appendix D**.

5.4 Proposed Stormwater Manhole

The proposed stormwater terminal manhole STMH-01 is located at the northeast corner of the Site to receive stormwater flow from the Application Site. It will be connected to a proposed public manhole MH-01 next to the Application Site boundary via a proposed 1500ø pre-cast concrete pipe. Stormwater from MH-01 will discharge to the existing 1950ø drain.

The catchment plan after development is presented in **Appendix D**.

5.5 Flooding Susceptibility

The proposed site ground level is varying from around +7.0mPD to + 24.0mPD which is higher than the design extreme sea level of 1 in 200 return period which is 5.10mPD referring to DSD storm drainage manual Table 8. On the other hand, there is no record of flood blackspot found for the Application Site or adjacent area. In general, foreseeing there is slim chance of the Application Site been affected by backwater effect under extreme weather.

6 Conclusion

Capacity of the existing public drainage system adjacent to the proposed development has been checked. The hydraulic capacity of the existing 1950ø public drain along Ping Yuen River on the east of the Application Site is sufficient.

U-channels are proposed along the Site boundary for diverting the stormwater running from Lo Shue Ling.

In general, there is no adverse drainage impact caused by the Application Site on the surrounding.

Appendix A

Master Layout Plan

LEGEND

- APPLICATION SITE BOUNDARY
- DEVELOPMENT SITE BOUNDARY
- SITE FORMATION LEVEL
- SITE RUN-IN/OUT
- ACCESS TO BASEMENT CARPARK
- R&D CENTRE
- DATA CENTRE
- RESIDENTIAL
- COMMERCIAL
- ANCILLARY DORMITORIES
- CLUBHOUSE
- LANDSCAPE AREA
- SEWAGE TREATMENT PLANT
- PROMENADE

N

PROPOSED FOOTBRIDGE

R 1 32 storeys ◆120mPD
R 2 31 storeys ◆120mPD
R 3 31 storeys ◆120mPD
R 4 32 storeys ◆120mPD
R 5 33 storeys ◆120mPD
CH 1 4 storeys ◆34.7mPD
Existing School
AD 1 31 storeys ◆110mPD
KINDERGARTEN 1 storey ◆15.5mPD
AD 2 31 storeys ◆110mPD
AD 3 32 storeys ◆110mPD
FUNG SHUI WOODLAND
DC 1 12 storeys ◆80mPD
DC 2 12 storeys ◆80mPD
DC 3 12 storeys ◆80mPD
C 1 6 storeys ◆37mPD
STP 2 storeys ◆17mPD
R&D 1 16 storeys ◆90mPD
R&D 2 16 storeys ◆90mPD (Transport Interchange on the ground floor)
R&D 3 16 storeys ◆90mPD
EVA

ACCESS ROAD TO EXISTING SCHOOL
DRIVEWAY / EVA
PROPOSED FOOTBRIDGE
10M PROMENADE
EXISTING PUMPING STATION

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Rev.	Date	Description

Notes
1. Do not scale drawings. Dimensions govern.
2. Verify dimensions in field. Notify WCWP of discrepancies.
3. Dimensions in mm unless otherwise noted.
4. Not for construction unless expressly certified.

Key Plan

Client
Hong Kong International Innovation Tech Hub

Consultants

Issue
Planning Application

BD Ref: BD 2/9188/10 (PT. II)
FSD Ref: FP 8/9584/VII <131>

Authorized Person

Project
The Nexus

Project Number: 20027
Date: 20230629
Scale: 1:3000 at A3
Drawn/Approved: CL/TL

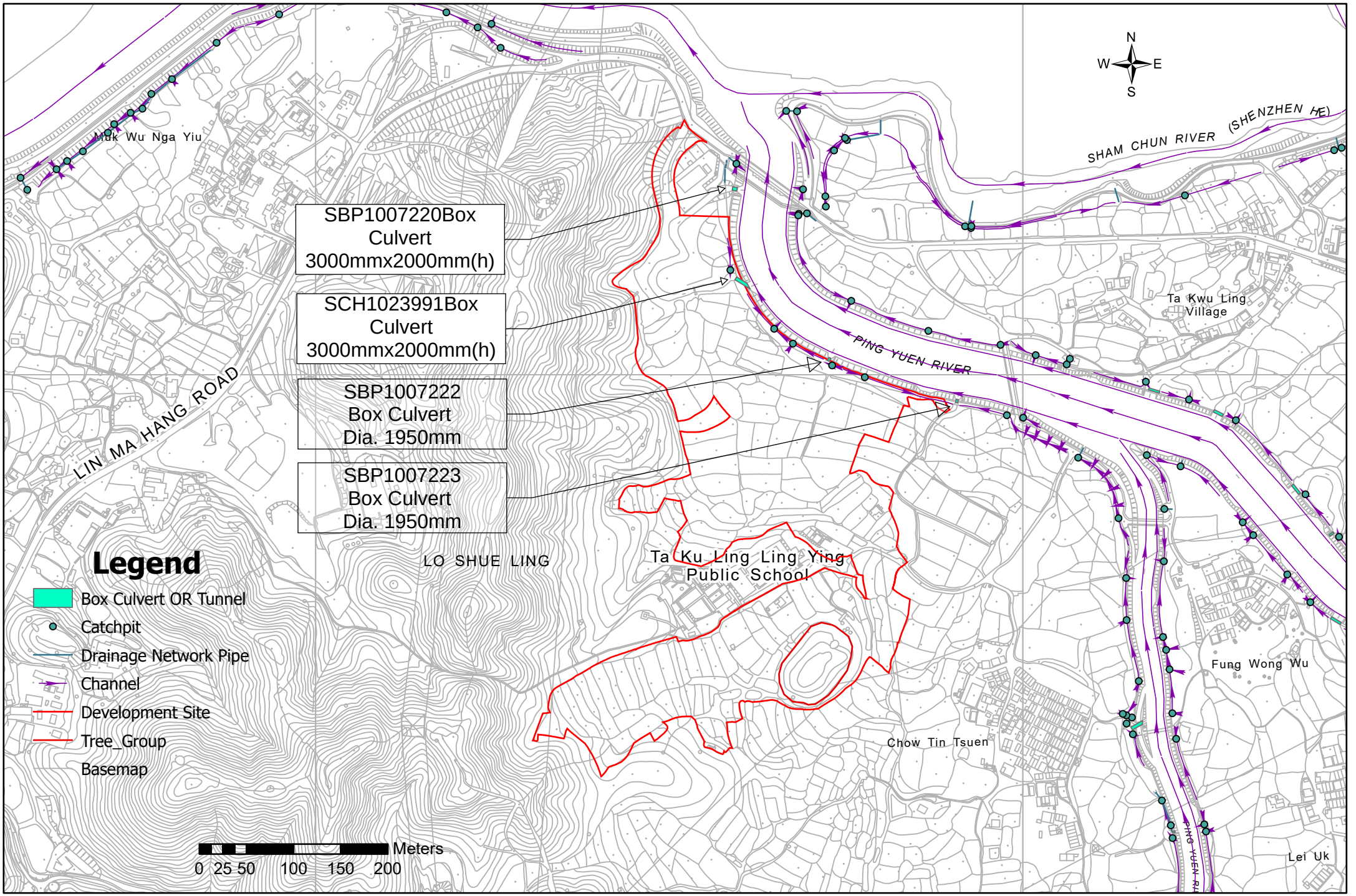
Title
Master Layout Plan

Number: MLP-001
Revision: -

Appendix B

Existing Drainage Network Information

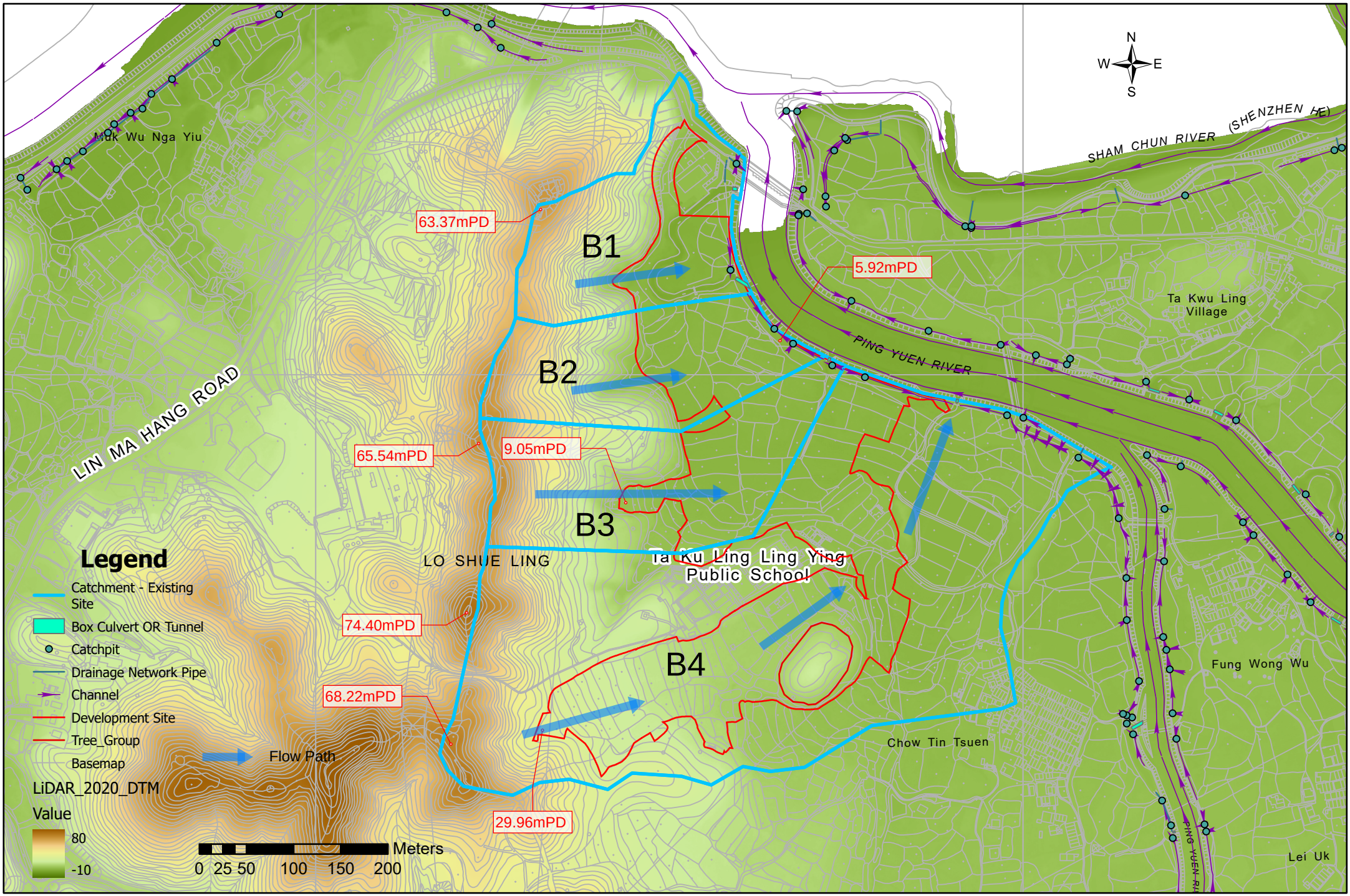
Appendix B - Detailed Existing Drainage Network Information



Appendix C

Catchment Plans of Existing Site

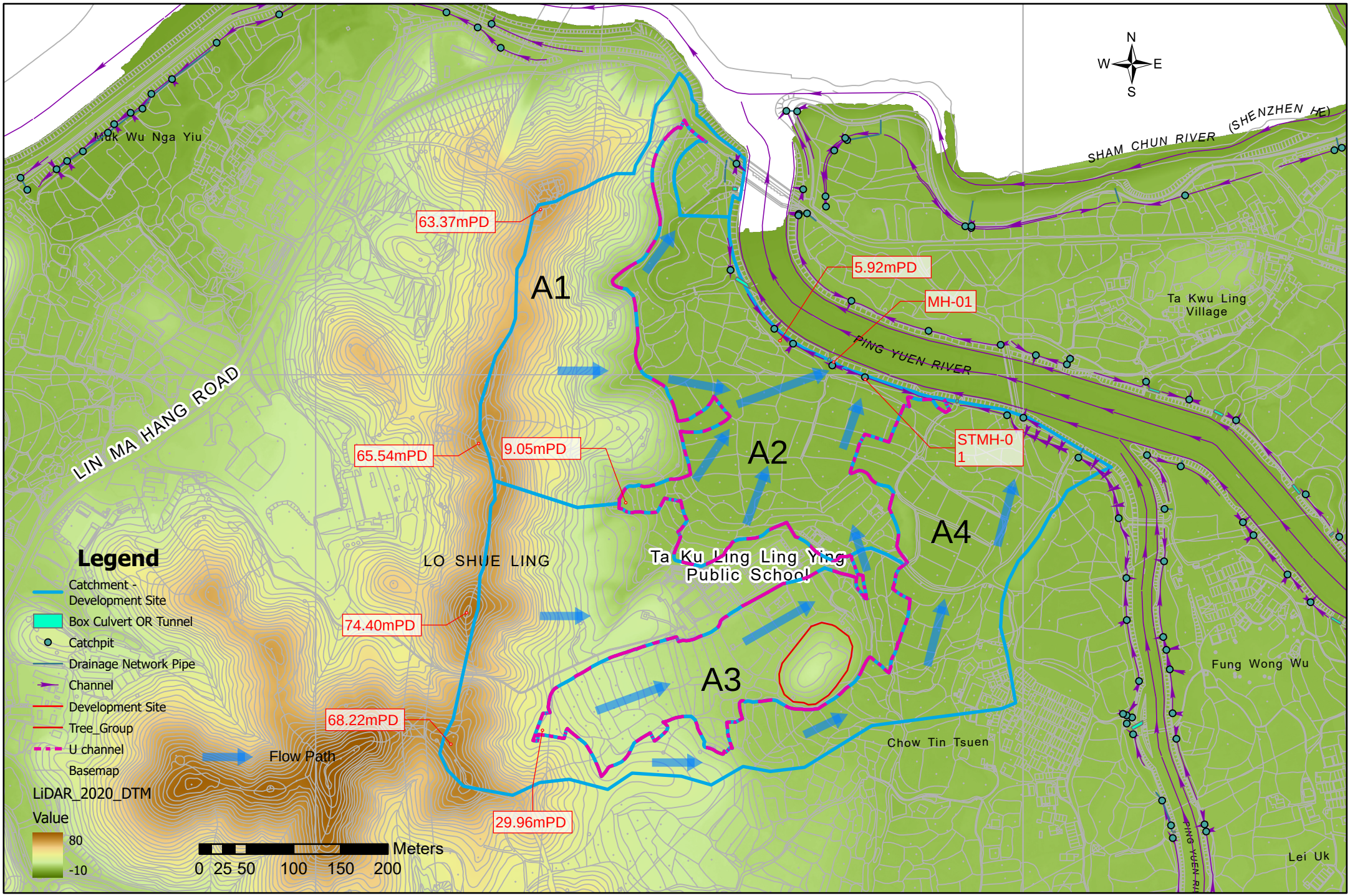
Appendix C - Catchment Plan of Existing Site



Appendix D

Catchment Plans of Indicative Scheme in the Development Site

Appendix D - Catchment Plan of Development Site



Appendix E

Drainage Capacity Checking Calculation

ARUP Arup Hong Kong Limited Calculation Sheet

Job Title: Proposed Development at Various Lots in D.D. 82 and D.D. 86 Man Kam To, New Territories

Job No. : Sheet : 1

Made by : BX Date : 7-Jul-2023

Drainage Impact Assessment

Capacity Checking for Existing Drainage

Runoff Coeff., C = 0.95 (Paved)
0.15 (Flat Grassland)
0.35 (Steep natural slope)

Return Period = 50 years Urban Drainage Branch Systems
200 years Urban Drainage Trunk Systems

Rainfall Intensity, $I = a / (T_c + b)^c$ (Gumbel solution)
T = 50 years
where : a = 1167.6 (Table 3d, Stormwater Drainage Manual, Fifth Edition)
b = 16.76
c = 0.561

Inlet Time, $T_0 = 0.14465\ L / H^{0.2} / A^{0.1}$ (Bransby Williams Equation)
where : L = Longest distance measured on the line of natural flow between the submit and the point under consideration (m)
H = Average slope (m per 100m)
A = Sub-catchment area (m2)

Peak Runoff ,Q = IA

Pipe Capacity Q_p=VA

$$\overline{V} = -\sqrt{32gRS_f}\,\log\left[\frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{32gRS_f}}\right]$$

(By Colebrook-White Equation)

Roughness Coeff., Ks = 0.60 mm (Circular Box culvert / pre-cast concrete pipe)

Ks = 3.30 mm (channel, Trowel finish)

Kinematic Viscosity, u = 0.0000012 m^2/s

Acceleration due to gravity g = 9.81 m/s^2

Calculation for Inlet Time for Natural Catchment plus WSD Catchwater Catchment

Catchment	L (m)	U/S G/L (mPD)	D/S G/L (mPD)	H (m/100m)	A (m^2)	T_o (min)
B1	318	63.37	5.17	18.30	37,866	8.96
B2	305	64.60	5.85	19.26	35,414	8.57
B3	417	65.27	4.50	14.57	45,887	12.07
B4	668	72.38	4.72	10.13	176,604	18.17

Climate Change Factor (%) = 16.00% (Table 28, Stormwater Drainage Manual CORRIGENDUM No. 1/2022, for rainfall increase at End of 21st Century 2081 – 2100)

Table 1 Capacity Checking of Existing Pipe & Box Culvert (T = 50 years) for Existing Drainage

Contributing Catchment	Area (m^2)			Accumulated Factored Area A, (m^2)	L (m)	H (m/100m)	T_o (min.)	T_f (min.)	T_c (min.)	I (mm/hr)	I (mm/hr) incl. Climate C	Q (m^3/s) incl. Climate C	Existing Downstream Drainage														Flow %
	steep natural slope	flat grassland	Paved										Upstream Stormwater Manhole Ref	Downstream Stormwater Manhole Ref	size of channel / culvert / pipe width (m)	height (m)	Length (m)	US GL (mPD)	Invert Level US (mPD)	Invert Level DS (mPD)	Slope (S_f)	A (m^2)	P (m)	R = A/P (m)	$32gRS_f$ m^2/s^2	Capacity (m^3/s)	Velocity (m/s)	
B1	18,035	14,756		8525	-	-	8.96	0.02	9.44	186.89	216.80	0.51		SBP1007220	3.00	2.00	4.78	4.980	2.21	-	0.0040	6.00	10.00	0.60	0.75	21.62	3.60	21%
B2	16,405	16,405		8203			8.57	0.09	0.09	239.41	277.71	0.63		SCH1023991	0.60	-	8.49	5.610	-	-	0.0040	0.28	1.88	0.15	0.19	0.43	1.53	146%
B3	18,624	18,624		9312			12.07	0.02	9.47	186.80	216.69	0.56		SBP1007222	1.95	-	3.62	4.760	-	-	0.0040	2.99	6.13	0.49	0.61	7.79	2.61	7%
B4	57,678	57,678		28839			18.17	0.02	0.11	239.25	277.54	2.22		SBP1007223	1.95	-	3.67	5.150	-	-	0.0040	2.99	6.13	0.49	0.61	9.49	3.18	23%
												3.93														39.34		10%

Drainage Impact Assessment

Capacity Checking for Proposed Drainage

Runoff Coeff., C = 0.95 (Paved)
0.15 (Flat Grassland)
0.35 (Steep natural slope)

Return Period = 50 years Urban Drainage Branch Systems
200 years Urban Drainage Trunk Systems

Rainfall Intensity, $I = a / (T_c + b)^c$ (Gumbel solution)
T = 50 years
where : a = 1167.6 (Table 3, Stormwater Drainage Manual, Fifth Edition)
b = 16.76
c = 0.561

Inlet Time, $T_0 = 0.14465\ L / H^{0.2} / A^{0.1}$ (Bransby Williams Equation)
where : L = Longest distance measured on the line of natural flow between the submit and the point under consideration (m)
H = Average slope (m per 100m)
A = Sub-catchment area (m2)

Peak Runoff ,Q = IA

Pipe Capacity Q_p=VA

$$\overline{V} = -\sqrt{32gRS_f}\,\log\left[\frac{k_s}{14.8R} + \frac{1.255v}{R\sqrt{32gRS_f}}\right]$$

(By Colebrook-White Equation)

Roughness Coeff., Ks = 0.60 mm (Circular Box culvert / pre-cast concrete pipe)
Ks = 0.15 mm (D.I. pipe with epoxy lining, poor condition)
Ks = 3.30 mm (channel, Trowel finish)

Kinematic Viscosity, u = 0.0000012 m^2/s

Acceleration due to gravity g = 9.81 m/s^2

Calculation for Inlet Time for Natural Catchment plus WSD Catchwater Catchment

Catchment	L (m)	U/S G/L (mPD)	D/S G/L (mPD)	H (m/100m)	A (m^2)	T_o (min)
A1	318	63.37	5.17	18.30	62,119	8.53
A2	253	10.81	5.85	1.96	66,017	10.54
A3	426	29.74	3.79	6.09	41,899	14.81
A4	668	72.38	3.15	10.36	125,735	18.71

Climate Change Factor (%) = 16.00% (Table 28, Stormwater Drainage Manual CORRIGENDUM No. 1/2022, for rainfall increase at End of 21st Century 2081 – 2100)

Table 2 Capacity Checking of Existing Pipe & Box Culvert (T = 50 years) for Proposed Drainage

Contributing Catchment	Area (m^2) steep natural slope	flat grassland	Paved	Accumulated Factored Area A, (m^2)	L (m)	H (m/100m)	T_o (min.)	T_f (min.)	T_c (min.)	I (mm/hr)	I (mm/hr) incl. Climate C	Q (m^3/s) incl. Climate C	Existing Downstream Drainage: Upstream Stormwater Manhole Ref	Downstream Stormwater Manhole Ref	size of channel / culvert / pipe: width (m)	height (m)	Length (m)	US GL (mPD)	Invert Level: US (mPD)	Invert Level: DS (mPD)	Slope (S_f)	A (m^2)	P (m)	R = A/P (m)	$32gRS_f$ m^2/s^2	Capacity (m^3/s)	Velocity (m/s)	Flow %
A1	55,907		6,212	25469	-	-	8.53	0.02	8.55	190.56	221.05	1.56		SBP1007220	3.00	2.00	4.78	4.980	2.21	-	0.0040	6.00	10.00	0.60	0.75	21.62	3.60	7%
A2		17,461	48,556	48747	-	-	10.54	0.02	10.56	182.56	211.77	2.87		SBP1007222	1.95	-	3.62	4.760	-	-	0.0040	2.99	6.13	0.49	0.61	9.49	3.18	50%
A3	7,272		34,627	35441	-	-	14.81	0.02	14.83	168.29	195.21	1.92			1.95	-	3.62	4.760	-	-	0.0040	2.99	6.13	0.49	0.61	9.49	3.18	
A4	62,868	62,868		31434	-	-	18.71	0.02	18.73	157.65	182.88	1.60		SBP1007223	1.95	-	3.67	5.150	-	-	0.0040	2.99	6.13	0.49	0.61	9.49	3.18	17%
												7.95																20%

Appendix F

Drainage Calculation of the Proposed U-channels

Drainage Impact Assessment

Capacity Checking for Proposed Drainage

Runoff Coeff., C = 0.95 (Paved)
0.15 (Flat Grassland)
0.35 (Steep natural slope)

Return Period = 50 years Urban Drainage Branch Systems
200 years Urban Drainage Trunk Systems

Rainfall Intensity, $I = a / (T_c + b)^c$ (Gumbel solution)
T = 50 years
where : a = 1167.6 (Table 3, Stormwater Drainage Manual, Fifth Edition)
b = 16.76
c = 0.561

Inlet Time, $T_0 = 0.14465 L / H^{0.2} / A^{0.1}$ (Bransby Williams Equation)
where : L = Longest distance measured on the line of natural flow between the submit and the point under consideration (m)
H = Average slope (m per 100m)
A = Sub-catchment area (m2)

Peak Runoff ,Q = IA

Pipe Capacity Q_p=VA

$$\overline{V} = -\sqrt{32gRS_f}\,\log\left[\frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{32gRS_f}}\right]$$

(By Colebrook-White Equation)

Roughness Coeff., Ks = 0.60 mm (Circular Box culvert / pre-cast concrete pipe)
Ks = 0.15 mm (D.I. pipe with epoxy lining, poor condition)
Ks = 3.30 mm (channel, Trowel finish)

Kinematic Viscosity, u = 0.0000012 m^2/s

Acceleration due to gravity g = 9.81 m/s^2

Calculation for Inlet Time for Natural Catchment plus WSD Catchwater Catchment

Catchment	L (m)	U/S G/L (mPD)	D/S G/L (mPD)	H (m/100m)	A (m^2)	T_o (min)
UC01	202	65.54	7.00	28.98	54,156	5.01
UC02	198	74.40	7.24	33.92	23,392	5.18
UC03	116	74.40	14.70	51.47	31,046	2.71
UC04	89	63.37	29.96	37.54	23394	2.28

Climate Change Factor (%) = 16.00% (Table 28, Stormwater Drainage Manual CORRIGENDUM No. 1/2022, for rainfall increase at End of 21st Century 2081 – 2100)

Table 3 Drainage Calculation of the Proposed U Channels

Contributing Catchment	Area (m^2)			Accumulated Factored Area A, (m^2)	L (m)	H (m/100m)	T_o (min.)	T_f (min.)	T_c (min.)	I (mm/hr)	I (mm/hr) incl. Climate C	Q (m^3/s) incl. Climate C	Existing Downstream Drainage														Flow %
	steep natural slope	flat grassland	Paved										Upstream Stormwater Manhole Ref	Downstream Stormwater Manhole Ref	size of channel / culvert / pipe width (m)	height (m)	Length (m)	US GL (mPD)	Invert Level US (mPD)	Invert Level DS (mPD)	Slope (S_0)	A (m^2)	P (m)	R = A/P (m)	$32gRS_f$ m^2/s^2	Capacity (m^3/s)	Velocity (m/s)	
UC04	48,740			17059	-	-	5.01	6.00	11.01	180.92	209.86	0.99	-	-	1.00	1.00	656.00	24.000	-	-	0.0030	1.00	4.00	0.25	0.24	1.82	1.82	0.55
UC03	21,053			7368	-	-	5.18	4.03	9.20	187.86	217.91	0.45	-	-	0.70	0.70	353.00	24.000	-	-	0.0030	0.49	2.80	0.18	0.16	0.72	1.46	0.62
UC02	27,941			9779	-	-	2.71	4.11	6.82	198.30	230.03	0.62	-	-	0.80	0.80	391.00	7.000	-	-	0.0030	0.64	3.20	0.20	0.19	1.02	1.59	0.62
UC01	21,055			7369	-	-	2.28	6.37	8.65	190.15	220.58	0.45	-	-	0.70	0.70	558.00	7.000	-	-	0.0030	0.49	2.80	0.18	0.16	0.72	1.46	0.63
												2.52																77%