Annex C
Revised Drainage Impact Assessment

MOTT MACDONALD

Rezoning from “Residential (Group C)2” and “Open Space” zones to “Residential (Group C)4” zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.

Drainage Impact Assessment

March 2026

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Drainage Impact Assessment

March 2026

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Contents

1 Introduction

1.1 General

1.1.1 Mott MacDonald Hong Kong Limited (hereinafter as “MMHK) was commissioned by the Applicant to prepare a Drainage Impact Assessment (DIA) for supporting the proposed residential development at Shek Kong, Yuen Long (the Site). The location of the proposed residential development is shown in **Appendix A1**. This Drainage Impact Assessment (DIA) is prepared to support the planning application under Section 12A of the Town Planning Ordinance to rezone the Site from "Residential (Group C)2" and "Open Space" to "Residential (Group C)4" zone to enable the proposed residential development at the Site.

1.1.2 This report forms part of the application document and will demonstrate that the proposed residential project at the Site is feasible in terms of its impact on the drainage system.

1.2 Objectives of the Assignment

1.2.1 The DIA focuses on the potential drainage impacts due to the implementation of the residential project at the Site. The objective of the DIA is to identify, assess and mitigate potential adverse drainage impacts which may arise from the Site.

1.3 Structure of the Report

1.3.1 This DIA Report contains the following sections in addition to this introduction (Section 1):-

Section 2 – Methodology and Design Parameters for Drainage Impact Assessment

Discuss the methodology adopted and the design parameters used in the drainage impact assessment.

Section 3 – Existing Drainage System

Describe the drainage conditions and catchment characteristics of the existing drainage system.

Section 4 – Drainage Impact Assessment and Proposed Drainage System

Briefly discuss the catchment characteristics of the Proposed Development and neighbouring area, assess the potential drainage impacts arising from the Proposed Development, and propose the necessary drainage mitigation works as necessary.

Section 5 – Conclusion

Summarise the findings and conclude the drainage impact arising from the Development.

2 Methodology and Design Parameters for Drainage Impact Assessment

2.1 General Approach

2.1.1 The DIA is conducted by comparing the existing drainage condition (Baseline Condition) against the drainage condition after the implementation of the Proposed Development (Proposed Condition) to identify potential drainage impacts to the existing drainage system near the site. Appropriate mitigation measures will be proposed to reduce potential drainage impacts, if necessary.

2.1.2 Potential drainage impacts are identified by comparing the baseline drainage condition against the proposed drainage condition after the implementation of the Proposed Development in respect of the water levels.

2.2 Assessment Methodology

Assessment Method

2.2.1 As discussed in the above section, potential drainage impacts are identified by comparing the baseline drainage condition against the proposed drainage condition. The existing drainage systems and its catchments likely to be affected by the Proposed Development are presented in **Appendix B1** and **Appendix C1** respectively.

2.2.2 The following approach and methodology will be adopted in the drainage impact assessment:-

- Carry out desktop study to collect the relevant information for the assessment, relevant information collected included drainage record plans and boundary information from Drainage Services Department (DSD), topographical information from basemap and Topographic Survey received from the Applicant in **Appendix G**;
- Based on desktop information, identify the existing drainage systems in the vicinity of the Site;
- Estimate the change in runoff generated from the Proposed Development; and
- Assess the drainage impacts arising from the Proposed Development.

2.2.3 Due to the implementation of the Proposed Development site, the catchment characteristic within the Site will be changed to partly paved areas and partly landscaped areas. It is anticipated that the surface runoff shall be varied after the implementation of the Proposed Development. For analysing the implications of the proposed condition, hydraulic model software “InfoWorks ICM” was adopted in the assessment.

2.2.4 To perform the drainage impact assessment, a localised model (Baseline model, the extent of model refers to **Appendix E**) is developed for existing drainage condition under

this assessment. The baseline model of the existing drainage system is then used to establish hydraulic model for Proposed Development under proposed condition.

2.3 Assessment Criteria, Design Parameters and Assumptions

Assessment Criteria

2.3.1 The assessment criteria are based on the recommendations set out in the Stormwater Drainage Manual (SDM) – 5th Edition, Corrigendum No.1/2022 and Corrigendum No.1/2024 issued by DSD. Flood event of 1 in 10 years return period, 1 in 50 years return period and 1 in 200 years return period for village drainage, branch and trunk drains respectively as recommended in Table 10 of SDM has been adopted in the design and assessment of drainage system for the Site. This DIA has also taken the Corrigendum No. 2/2024 of SDM into account for the formulation of proposed drainage mitigation measures.

2.3.2 The following flood combinations in accordance with Section 6.4 and Table 11 of the SDM and repeated in **Table 2.1** are adopted to assess the existing and proposed drainage systems.

Table 2.1: Flood combinations

Flood Level Return Period (Years)	Rainfall Return Period (Years)	Sea Level Return Period (Years)	Flood Return Event Case
10	10	2	a
	2	10	b
50	50	10	a
	10	50	b
200	200	10	a
	10	200	b

Design Parameters and Assumptions for modelling

Modelling Approach

2.3.3 As mentioned above, the hydraulic performance of the drainage system near the Site has been assessed using InfoWorks ICM software. The assumptions and various parameters used in the modelling are presented in this section.

Baseline Model Scenario

2.3.4 To perform the DIA, a localised baseline model for the existing drainage system where the Site located has been developed based on the boundary information provided by DSD, topographical information from basemap and Topographic Survey received from the Applicant. The extent of baseline model is showed in **Appendix E**. Design rainfall in

accordance with SDM and its corrigenda, and downstream water boundary condition based on the collected boundary from DSD have been applied in the localised model.

2.3.5 The localised baseline model has also been incorporated the following:-

- catchment delineation and discharge points for catchments adjacent to the Site have been reviewed according to topographic data shown in basemap. The existing catchment plan can be referred to **Appendix C1**; and
- Detailed survey along the existing stream course near the Site has been carried out and incorporated into model. Details can be referred to **Appendix G**.

2.3.6 SCS-Curve Number method has been used to calculate the runoff from the assessed upland, urban and rural catchments respectively. In order to assess any drainage impact caused by the Development for streams in the vicinity of the Site, a one-dimensional (1D) hydraulic model covering the concerned area has been used. Drainage system including the conduits, river reaches and channels are modelled through the 1D network.

Proposed Model Scenario

2.3.7 Based on the localised model under baseline condition, a localised model under proposed condition was established. The changes incorporated in the model under proposed condition with reference to the latest master layout plan in **Appendix A2** are:

- a change of CN for the Site due to the Proposed Development;
- a stormwater storage tank with capacity of about 5,000m^3 is built within the Development to store additional runoff from the Site; and
- the Development area is set to its formation level of about 10.4mPD.

2.3.8 The extent of the proposed model will be same as the baseline model and can be referred to **Appendix E**. A set of hydraulic models including baseline and proposed models used in this assessment is included in **Appendix H**.

Design Rainfall

2.3.9 A 4-hour duration rainfall profile has been used in model simulation and the rainfall profile is determined based on the equation as mentioned in Clause 4.3.5 of SDM where storm constants for different return period of HKO Headquarters (a, b, c) are given in Table 3a of SDM corrigendum No. 1/2024 and repeated in **Table 2.2**.

$$F(t) = \begin{cases} \dfrac{a[b + 2(1-c)t]}{(2t+b)^{c+1}} & , \quad 0 \le t \le \dfrac{t_d}{2} \\ F(-t) & , \quad -\dfrac{t_d}{2} \le t \le 0 \end{cases}$$

where

F(t) = rate of rainfall or instantaneous intensity in mm/hr at time t (in minutes)

t_d = rainstorm duration (in minutes) (td <= 240)

a, b, c = storm constants given in Table 3a of SDM corrigendum No. 1/2024 and repeated in the following table.

Table 2.2: Storm constants for different return periods

Return Period T (years)	10	50	200
a	485.0	505.5	508.8
b	3.11	3.29	3.46
c	0.397	0.355	0.322

2.3.10 Rainfall duration of 240 minutes has been adopted for the assessment.

Design Modification due to Climate Change

2.3.11 According to SDM, climate change effect will be considered in this assessment. To take account of climate change effect, the rainfall increases percentage and mean sea level rise projected to end of 21st Century (2081 – 2100) as recommended in SDM Corrigendum No.1/2022 presented in **Table 2.3** have been adopted in this assessment for proposing the required drainage works for the development. Besides, storm surge increase due to climate change at Tsim Bei Tsui and design allowance as recommended in SDM Corrigendum No.1/2022 presented in **Table 2.4** and **Table 2.5** are also adopted in this assessment.

Table 2.3: Percentage of rainfall increase and sea level rise due to climate change

	Rainfall Increase	Sea Level Rise (m)
End of 21st Century (2081 – 2100)	16.0%	0.47

Table 2.4: Storm surge increase due to climate change in End of 21st Century

Return Period (Years)	Storm Surge Increase (m)
2	0.09
10	0.15
50	0.20
200	0.26

Table 2.5: Design allowance in End of 21st Century

Return Period (Years)	Extreme Sea Level Rise (m)	Rainfall Increase
2	0.20	12.1%
10	0.23	
50	0.25	
200	0.27	

Design Inflow from upstream

2.3.12 In order to assess the hydraulic performance of the existing drainage system, the upstream inflow boundary conditions obtained from DSD (**Appendix F**) has been adopted. To take account of the rainfall increase, the upstream inflow boundary has been increased by 28.1% in End of 21st Century. The upstream inflow boundary

conditions received by DSD and adopted in the model are summarised in **Table 2.6**. The location of the boundary is presented in the model extent in **Appendix E**.

Table 2.6: Inflow boundary adopted in the localised model with climate change in End of 21st Century

Return Period T (years)	Flood Return Event Case	Inflow Boundary received from DSD (m^3/s)	End of 21st Century: Inflow with Climate Change (m^3/s), see model ID: KT001
10	A	231.827	296.970
	B	138.460	177.367
50	A	306.148	392.175
	B	231.843	296.991
200	A	363.374	465.482
	B	231.839	296.986

Design Water Level for Downstream Boundary

2.3.13 In order to assess the hydraulic performance of the existing drainage system, the downstream water level boundary conditions obtained from DSD (**Appendix F**) has been adopted. To take account of the sea level rise, the downstream water level boundary has been increased for mean sea level rise, storm surge increase due to climate change and design allowance recommended in SDM Corrigendum No.1/2022. The downstream boundary conditions received by DSD and adopted in the model are summarised in **Table 2.7**. The location of the boundary is presented in the model extent in **Appendix E**.

Table 2.7: Design water levels for different return periods

Return Period T (years)	Flood Return Event Case	Water Level Boundary received from DSD (mPD)	End of 21st Century: Water Level with Climate Change (mPD) for Model, see model ID: KT012
10	A	5.456	6.216
	B	4.760	5.610
50	A	5.958	6.808
	B	5.565	6.485
200	A	6.215	7.065
	B	5.817	6.817

2.3.14 As shown in **Table 2.6** and **Table 2.7**, the upstream inflow boundary and downstream flood level of flood return event case A in 10-year, 50-year and 200-year return period are the worst-case scenarios. Therefore, hydraulic assessment will be conducted for

10A, 50A and 200A scenarios with the worst-case downstream water level boundary and upstream flow boundary.

Runoff Estimation

2.3.15 The Soil Conservation Services (SCS) Curve Number method of InfoWorks ICM rainfall runoff module has been used to compute the runoff hydrograph. The SCS Curve Number (CN) is a characteristic of the soil type, land use and the initial degree of saturation. In this assessment, weighed average SCS curve numbers is estimated based on the existing land use. The CN values for the corresponding land uses adopted in this DIA have been presented in **Table 2.8**.

Table 2.8: Curve numbers adopted for each land use

Land use	CN
Agriculture	70
Upland	65
Grassed	70
Barracks	75
Village	90
Open Storage	90
Residential	95
Commercial	95
Rail	100
Roads / Footpath	100
River	100

2.3.16 For the Proposed Development, a weighted CN value of 90 has been assumed for the proposed Site under the proposed condition, assuming a 20% of the landscaping area (grassed area) for the proposed site and 80% of paved area for residential area.

Roughness

2.3.17 There are two approaches available in the ICM which can be used in modelling hydraulic roughness of the drainage system, i.e. Colebrook-White equation (ks) for underground drains or the Manning formula (n) for open channel or river.

2.3.18 For existing drainage system, the following roughness values have been adopted:-

- Colebrook-White ks value of 3mm has been adopted for pipelines and box culverts; and Manning’s n value of 0.04 has been adopted for existing watercourse and 0.016 has been adopted for existing engineering channel.

2.3.19 For proposed drainage system, concrete pipes have been provided for the proposed new pipes, Colebrook-White ks value of 3mm has been adopted for concrete pipes.

Sediment

2.3.20 For existing pipeline system and proposed pipeline system, siltation follows the recommendation given in SDM, which suggests allowing for 5% reduction in flow area if the gradient is greater than 1 in 25 or 10% reduction in flow area in other areas.

3 Existing Drainage System

3.1 Site Condition

3.1.1 The Development Site covers a total site area of about 8,580 square meters and is located in Kam Tin North. The Site abuts Kam Tin Road to its immediate south. A low-rise, low-density residential developments, namely Seasons Villa, are located to the immediate north-east. In general, the existing ground level of the Site is ranging from approximately 9 to 10 mPD and the nearby road levels of about 13.5 mPD. The Site is found to be composed mostly trees and grass based on desktop study and site inspections. The location of the Site is shown in **Appendix A1**. An existing watercourse connecting to Kam Tin River is identified at the west of the Site. Three existing watercourse crossing structures connecting the north and south side of the steam have been identified from site inspections and survey, and the details are given in **Appendix G**.

3.2 Existing Drainage System and Catchment

3.2.1 The surface runoff generated from the existing Development Site is currently discharged to the watercourse at the west of the Site. The watercourse is then discharged to an engineering channel (Kam Tin River) via a 2-cell box culvert.

3.2.2 Based on site inspections and collected information, the existing watercourse originated at the northwest side of the Site and conveys runoff from nearby villages, vegetative areas, part of barrack and the existing Development Site to Kam Tin River via the watercourse and a 2-cell box culvert. Location of the existing watercourse and Kam Tin River refers to **Appendix B1**.

3.3 Existing Land Use Surface Characteristics

3.3.1 The existing watercourse and Kam Tin River currently conveys runoff to downstream drainage system from several catchments. Based on the topographic data in basemap, the delineation of local catchments has been carried out. The local catchments of the existing drainage system and its catchment properties have been summarised in **Table 3.1**. The existing catchment plan and their discharge points is shown in **Appendix C1**.

3.3.2 The CN values for the corresponding land uses are summarised in **Table 2.8** and are used to calculate the weighted CN for the following sub-catchments.

Table 3.1: Catchment properties of existing catchment

Model ID	Area (ha)	Weighted CN
Cat_001	8.190	84.26
Cat_002	0.321	78.03
Cat_003	10.626	85.74
Cat_004	20.189	75.35
Cat_005	8.501	87.40

Model ID	Area (ha)	Weighted CN
Cat_006	2.792	80.88
Cat_007A	0.081	83.79
Cat_007B	0.462	90.00
Cat_007C	0.433	77.22
Cat_008	0.897	78.65
Cat_009A	1.289	81.65
Cat_009B	0.734	75.40
Cat_010A	1.187	75.00
Cat_010B	0.393	83.83
Cat_011A	0.176	77.91
Cat_011B	0.288	75.51
Cat_012A	0.092	70.00
Cat_012B	0.048	83.57
Cat_012C	0.858	70.00
Cat_013A	0.182	82.30
Cat_013B	0.318	82.2
Cat_014	0.222	70.94
Cat_015	0.025	71.12
Cat_017	56.851	65.00
Cat_018	16.467	65.00
Cat_019	39.24	74.61
Cat_020	55.316	75.33
Cat_021	31.806	75.28
Cat_022	74.009	65.21
Cat_023	1.527	76.86
Cat_024	2.189	75.00
Cat_025	6.569	87.93
Cat_026	27.003	75.09

3.3.3 The existing catchments of the Development Site (as indicated with Model ID: Cat_012C) have weighted CNs of 70 based on existing topography and land use. The runoff of all the existing catchments of the Development Site is discharged to the existing watercourse.

3.3.4 For other sub-catchments, weighted average CN values are ranging from about 65 to 90.

3.4 Hydraulic Performance of Existing Drainage System

3.4.1 The hydraulic performance of the existing channels has been assessed by the model with the network containing the existing watercourse and Kam Tin River. The results

indicated that the predicted 200 years flood event water levels for the assessed section of Kam Tin River will generally be within riverbank with a freeboard of about 300mm, except for the few cross sections near to the upstream and midstream of the modelled Kam Tin River. For the existing watercourse, due to the climate change effect at end of Century, downstream of the watercourse will be flooded under the 10 years flood event. Details of hydraulic model results can be referred to **Table 4.3** and the hydraulic model included in **Appendix H**.

4 Drainage Impact Assessment and Proposed Drainage System

4.1 The Development

4.1.1 The Development Site will be developed as a residential area with paved condition and some landscaping area. In view of the increase of paved area in the Development Site, additional runoff from the Site is anticipated. Runoff from the Development Site will be collected by 750mm diameter pipes. To cope with the increase of paved area in the Site, a storage tank with a size of about 5,000m^3 will be provided to temporarily store the additional runoff and the stored runoff will be discharged to a new pipeline of size from 750 to 900mm connecting to the existing watercourse via a 450mm pipe after the peak of storm. Based on the design arrangement, the proposed stormwater storage tank, with a storage depth of 2m, will have an inflow level of 8.3mPD and an outflow level of 7.4mPD. The design will be further refined and developed, if needed, in subsequent design and construction phases of the project. The typical drainage outlet details connecting the proposed discharge pipe to existing watercourse is shown in **Appendix B2**. The design of the drainage outlet will be subject to be confirmed at the later design and construction stage.

4.1.2 For the surrounding areas, according to the topography, the runoff arising from the areas at the west and south of the proposed development are currently directly discharged to the existing watercourse through overland flow. As a conservative approach, a 600mm peripheral channel, as spare drain, will be provided to collect the runoff generated from the area between the east bank of the existing watercourse and the proposed Development Site boundary. For the existing development at the north and east of the proposed Development Site, the existing development has their own boundary channels and internal drainages which collect and convey the runoff from the development to Kam Tin River. Besides, the runoff generated from the adjacent lands between the east bank of the existing watercourse and the proposed Development Site boundary is expected to be directly discharged into existing drainage system. In this connection, as a conservative approach, peripheral channels of 300mm at the boundaries of the proposed Development Site, as spare drains, are provided to collect the runoff generated from the local area (i.e. Cat_012A-1) between the east bank of the existing watercourse and the proposed Development Site boundary. The capacity check calculations for the set of 300mm and 600mm channel are provided in **Appendix I**. Both the 600mm and 300mm peripheral channels are connected to the proposed stormwater terminal manhole via the associated pipes (i.e. 600mm pipe for 600mm peripheral channel and 450mm pipe for 300mm peripheral channel), then to the existing watercourse via the proposed 900mm diameter pipe. The proposed drainage arrangement is also shown in **Appendix B2**. The layout of the Proposed Development is shown in **Appendix A1**.

4.1.3 The proposed drainage system shown in **Appendix B2**, including the proposed stormwater storage tank, proposed pipes and manholes, peripheral channels and

associated sand traps and catchpit, will be maintained and managed by the owner/ management office of the Proposed Development.

4.2 Changes in Catchment and Existing Drainage Network due to the Proposed Development

4.2.1 As discussed in **Section 3**, the runoff generated from the Site under the existing condition is discharged to the existing watercourse. The runoff from the Development Site will be discharged to the existing watercourse via 750mm and 900mm diameter pipes. With the stormwater stage tank in place, no additional runoff is anticipated from the proposed development.

4.2.2 Under the proposed condition, a CN value of 90 has been assigned for the Development Site (Model ID: Cat_012C) due to the paved condition of the Proposed Development and details given in **Table 4.1**.

Table 4.1: Catchment properties of proposed condition

Model ID	Area (ha)	Weighted CN
Cat_012C	0.858	90.00
Cat_011A-1	0.141	77.91
Cat_011A-2	0.035	77.91
Cat_012A-1	0.083	70.00
Cat_012A-2	0.009	70.00
Cat_013B-1	0.035	82.20
Cat_013B-2	0.283	82.20
Cat_023A	0.060	76.86
Cat_023B	1.466	76.86

4.2.3 Despite that the runoff arising from the areas at the west and south of the proposed development are currently directly discharged to the existing watercourse through overland flow, it is assumed that the proposed 300mm and 600mm peripheral channels would act as spare drains and has the capacity to collect those runoffs. Several existing catchments (i.e. Cat_011A, Cat_012A, Cat_013B and Cat_023) are further delineated to suit with the proposed 300mm and 600mm peripheral channels. Some catchments, including Cat_011A-1, Cat_012B, Cat_013A, Cat_013B-1 and Cat_023A, would be served by the proposed 600mm peripheral channel and catchment Cat_012A-1 would be served by the proposed 300mm peripheral channel. The remaining catchments (i.e. Cat_011B, Cat_013B-2, Cat_012A-2 and Cat_023B) would be discharged to the existing watercourse. As there is no change to other catchments served by the assessed drainage system, apart from those catchments discussed above, the catchment properties for other catchments in **Table 3.1** are also applicable to the proposed condition.

4.2.4 The localised model under the proposed condition has incorporated the change in CN value arising from additional paved condition.

4.3 Drainage Impact Assessment

4.3.1 To mitigate the increase of runoff from the proposed development due to the increase of paved area in the Development Site, a storage tank with a size of about 5,000m^3 will be provided to temporarily store the additional runoff and the stored runoff will be discharged after the peak of storm. Thus, the Proposed Development would lead to no increase to the hydraulic at the discharge point (i.e. Control point 5) under the 10 years, 50 years and 200 years flood return period as shown in **Table 4.2**. With the storage tank to mitigate the additional runoff, the peak runoff discharged from the Proposed Development will be reduced as compared with the baseline condition under 1 in 10 years, 1 in 50 years and 1 in 200 years flood event.

Table 4.2: Change in peak flow at the existing streamcourse with mitigation measure (control point 5)

Return period (Years)	Flow (Existing) (m^3/s)	Flow (Proposed) (m^3/s)	Change (m^3/s)	Change (%)
10	1.2	0.9	0.3	-27%
50	1.5	1.1	0.4	-25%
200	1.7	1.1	0.5	-33%

4.3.2 The stormwater inside the Development Site will be collected by internal drainage and is proposed to be discharged to existing watercourse at the west of the Development Site via the proposed 750 mm and 900mm diameter pipes.

4.3.3 To assess the effectiveness of the proposed drainage mitigation works, a hydraulic model has been developed under the proposed condition to incorporate the aforesaid proposed drainage system including the stormwater storage tank, the 450mm, 750mm and 900mm pipes using InfoWorks ICM. The predicated water levels under the 10 years, 50 years and 200 years flood return period under the proposed Mitigation Measures are presented in **Table 4.3**.

Table 4.3: Predicted peak water levels and freeboard of stream near the Site under 10-, 50- and 200-years flood events with climate change in End of 21st century

Case	Control Points	Cross Section line ID	Existing Condition			Proposed Condition with mitigation			Change in Water Level (m) (i.e. Proposed Condition - Existing Condition)
			Bank Level (mPD)	Water Level (mPD)	Freeboard (m)	Bank Level (mPD)	Water Level (mPD)	Freeboard (m)	Water level (m)
200A	1	KT-10	8.590	8.176	0.414	8.590	8.176	0.414	0.000
	2	KT-12	8.494	7.840	0.654	8.494	7.839	0.655	-0.001
	3	KT-17	7.557	7.243	0.314	7.557	7.242	0.315	-0.001
	4	S13-2	8.810	7.862	0.948	8.810	7.859	0.951	-0.003
	5	S13-2-S12	8.607	7.862	0.745	8.607	7.859	0.748	-0.003
	6	S4	6.480	7.858	-1.378	6.480	7.856	-1.376	-0.002
50A	1	KT-10	8.590	7.820	0.770	8.590	7.820	0.770	0.000
	2	KT-12	8.494	7.519	0.975	8.494	7.519	0.975	0.000
	3	KT-17	7.557	6.964	0.593	7.557	6.964	0.593	0.000
	4	S13-2	8.810	7.537	1.273	8.810	7.536	1.274	-0.001
	5	S13-2-S12	8.607	7.537	1.070	8.607	7.536	1.071	-0.001
	6	S4	6.480	7.533	-1.053	6.480	7.532	-1.052	-0.001
10A	1	KT-10	8.590	7.252	1.338	8.590	7.252	1.338	0.000
	2	KT-12	8.494	6.942	1.552	8.494	6.942	1.552	0.000
	3	KT-17	7.557	6.375	1.182	7.557	6.375	1.182	0.000
	4	S13-2	8.810	6.957	1.853	8.810	6.957	1.853	0.000
	5	S13-2-S12	8.607	6.957	1.650	8.607	6.956	1.651	-0.001
	6	S4	6.480	6.951	-0.471	6.480	6.950	-0.470	-0.001

Remarks:-

1. Location of control points refers to **Appendix D.**
2. The bank levels refer to the low bank level.
3. -ve freeboard means water level will be above channel bank level, +ve freeboard means water level below channel bank level.
4. -ve in change in water level means the water level is lower under the proposed condition as compared with the existing condition.

4.3.4 With reference to results in **Table 4.3**, the predicted peak water levels of the Kam Tin River generally remain unchanged under 1 in 10 years, 1 in 50 years and 1 in 200 years rainfall event compared with the Existing Condition after adopting the proposed Mitigation Measure. For all the control points of Kam Tin River (i.e. Control Points 1 to 3), there are at least 300mm freeboard under 1 in 10 years, 1 in 50 years and 1 in 200 years rainfall event. For the control points along the existing watercourse (i.e. Control Points 4 to 6), the predicted peak water levels remain unchanged or slightly decrease under 1 in 10 years, 1 in 50 years and 1 in 200 years rainfall event compared with the Existing Condition after adopting the proposed Mitigation Measure.

4.3.5 All the proposed pipeline of the proposed development, including the proposed 750mm pipes connected to the storage tank, the proposed 450mm pipe from storage tank, the proposed 750mm to 900mm outlet pipes, will have more than 300mm freeboard under 1 in 10 years, 1 in 50 years and 1 in 200 years flood event. Also, based on the results of the hydraulic model under the proposed condition, with the presence of the stormwater storage tank, the peak flow discharging from the proposed development will be reduced from 0.59m^3/s to 0.29m^3/s under the assessed scenario of 1 in 200 years rainfall event. With the flow collected by the proposed peripheral channels (as a conservation approach, it has assumed the 300mm and 600mm channel will collect all runoff generated from the area between the east bank of the existing watercourse and the proposed Development Site boundary, about 0.478m^3/s as shown in **Appendix I**), the proposed 900mm discharge pipe which collect a total flow of 0.768m^3/s connecting the existing watercourse will have a full-bore capacity of about 1.03m^3/s and the utilization of pipe is about 76%.

4.3.6 Based on the assessment, there are no changes or slightly improvement in the predicted peak water levels for the 10 years, 50 years and 200 years flood event for all the control points. Therefore, it is concluded that there is no significant adverse impact from the Proposed Development with proposed drainage system and storage tank.

5 Conclusion

5.1.1 The surface runoff generated from the existing Development Site is currently discharged to the watercourse at the west of the Site. The watercourse is then discharged to an engineering channel (Kam Tin River) via a 2-cell box culvert.

5.1.2 The Development Site will be developed as a residential area with paved condition and some landscaping area. In view of the increase of paved area in the Development Site, additional runoff from the Site is anticipated. Runoff from the Development Site will be collected by 750mm diameter pipes. To cope with the increase of paved area in the Site, a storage tank with a size of about 5,000m^3 will be provided to temporarily store the additional runoff and the stored runoff will be discharged to a new pipeline of size from 750mm to 900mm connecting to the existing watercourse via a 450mm pipe after the peak of storm. Based on the design arrangement, the proposed stormwater storage tank, with a storage depth of 2m, will have an inflow level of 8.3mPD and an outflow level of 7.4mPD. The design will be further refined and developed, if needed, in subsequent design and construction phases of the project.

5.1.3 With the storage tank to mitigate the additional runoff, the peak runoff discharged from the Proposed Development will be reduced as compared with the baseline condition under 1 in 10 years, 1 in 50 years and 1 in 200 years flood event.

5.1.4 With reference to results of the hydraulic assessment, the predicted peak water levels of the Kam Tin River generally remain unchanged under 1 in 10 years, 1 in 50 years and 1 in 200 years rainfall event compared with the Existing Condition after adopting the proposed Mitigation Measure. For all the control points of Kam Tin River (i.e. Control Points 1 to 3), there are at least 300mm freeboard under 1 in 10 years, 1 in 50 years and 1 in 200 years rainfall event. For the control points along the existing watercourse (i.e. Control Points 4 to 6), the predicted peak water levels remain unchanged or slightly decrease under 1 in 10 years, 1 in 50 years and 1 in 200 years rainfall event compared with the Existing Condition after adopting the proposed Mitigation Measure.

5.1.5 All the proposed pipeline of the proposed development, including the proposed 750mm pipes connected to the storage tank, the proposed 450mm pipe from the storage tank, the proposed 750mm and 900mm pipes, will have more than 300mm freeboard under 1 in 10 years, 1 in 50 years and 1 in 200 years flood event. Also, based on the results of the hydraulic model under the proposed condition, with the presence of the stormwater storage tank, the peak flow discharging from the proposed development will be reduced from 0.59m^3/s to 0.29m^3/s under the assessed scenario of 1 in 200 years rainfall event. With the flow collected by the proposed peripheral channels (as a conservation approach, it has assumed the 300mm and 600mm channel will collect all runoff generated from the area between the east bank of the existing watercourse and the proposed Development Site boundary, about 0.478m^3/s), the proposed 900mm discharge pipe connecting the existing watercourse will have a full-bore capacity of about 1.03m^3/s and the utilization of pipe is about 76%.

5.1.6 Based on the assessment, there are no changes or slightly improvement in the predicted peak water levels for the 10 years, 50 years and 200 years flood event for all the control

points. Therefore, it is concluded that there is no significant adverse impact from the Proposed Development with proposed drainage system and storage tank.

6 Appendices

Appendix A1 Location Plan of the Proposed Residential Development

Appendix A2 Master Layout Plan of the Proposed Residential Development

Appendix B1 Existing Drainage System

Appendix B2 Proposed Drainage System

Appendix C1 Existing Catchment Plan

Appendix C2 Proposed Catchment Plan

Appendix D Location of Control Points in the Model

Appendix E Existing Model Extent

Appendix F Downstream Boundary Conditions Obtained from DSD

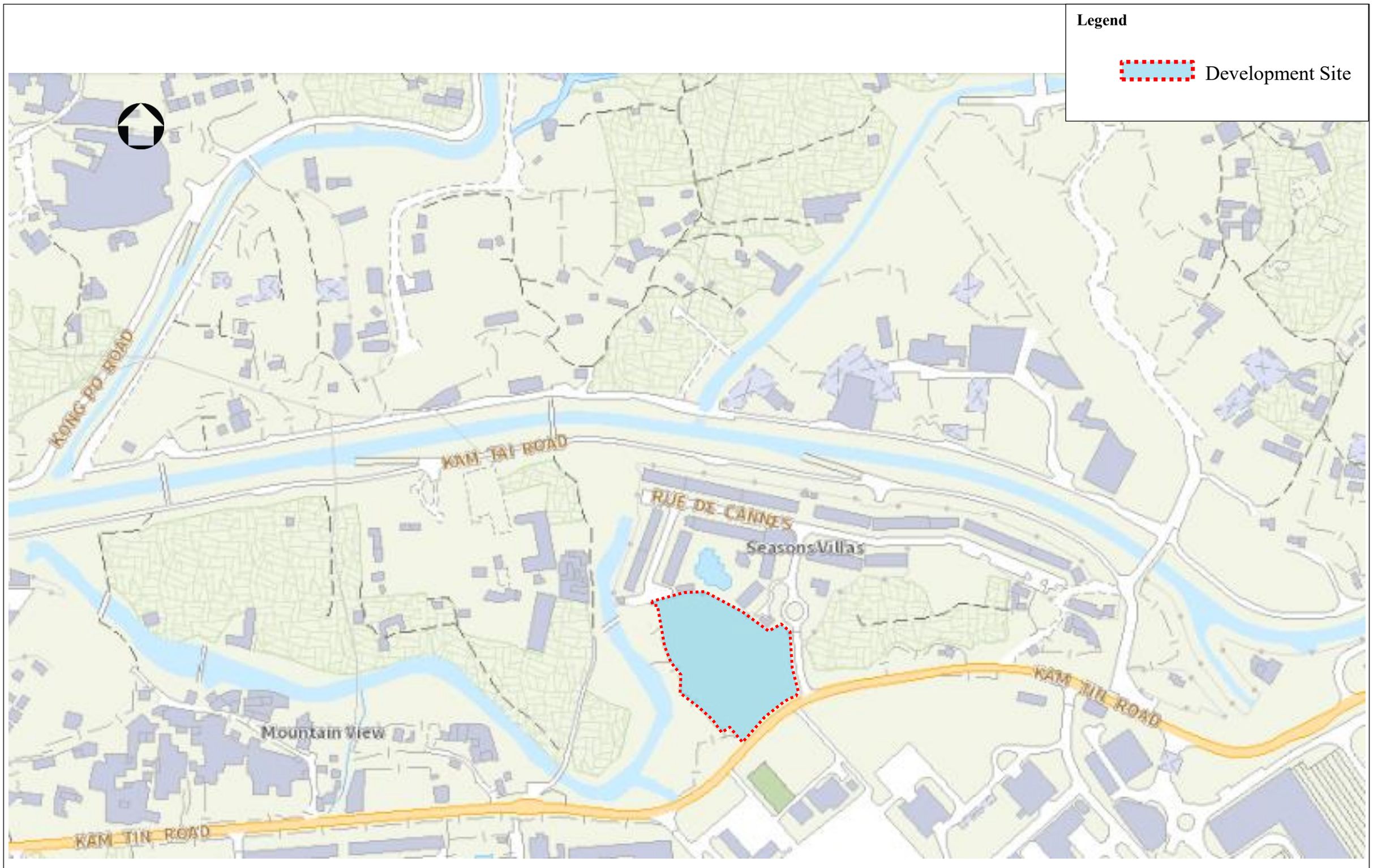
Appendix G Topographic Survey received from the Applicant

Appendix H InfoWorks ICM Hydraulic Model

Appendix I Capacity Check for Peripheral Channels

Appendix A1

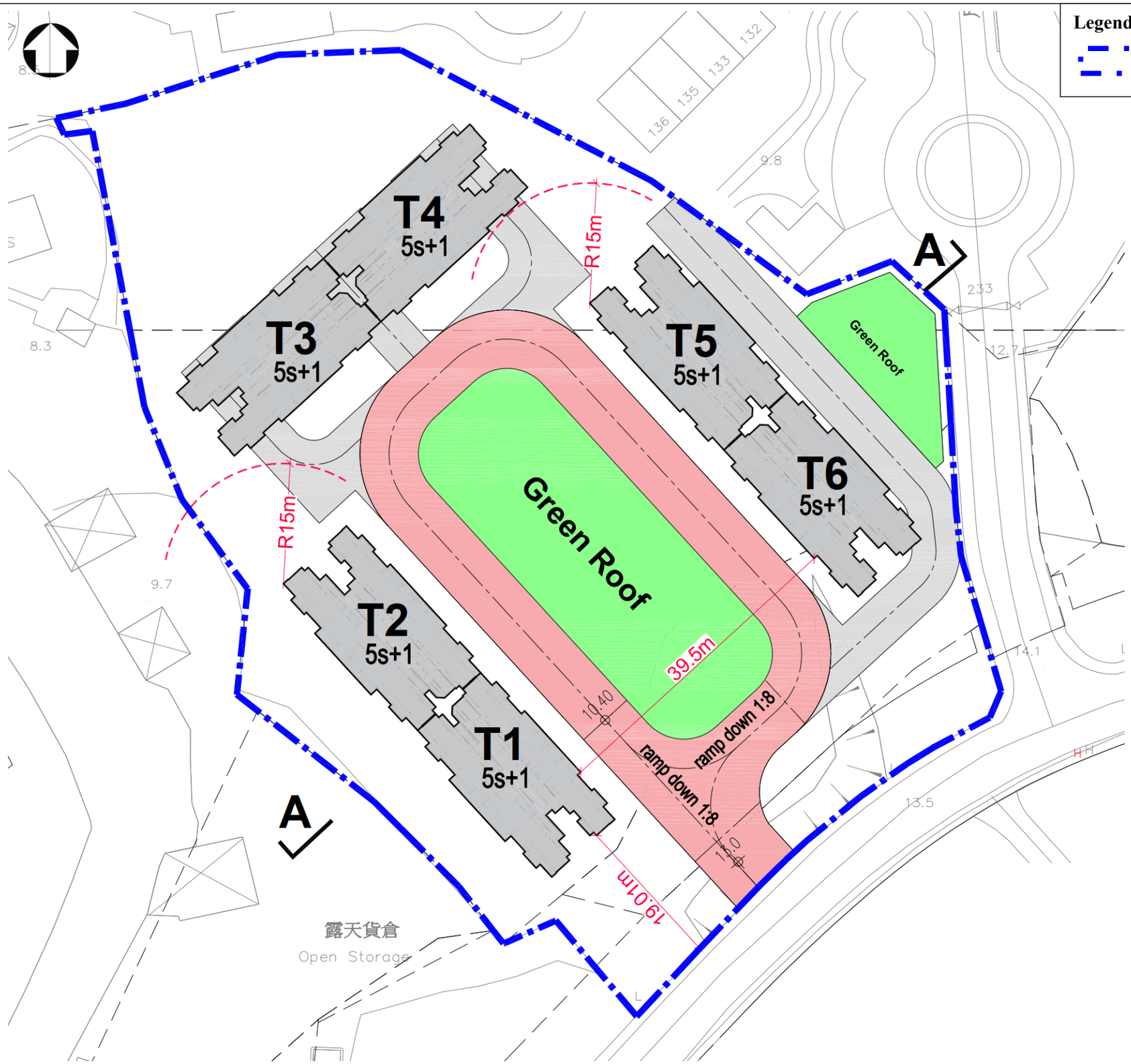
Location Plan of the Proposed Residential Development



Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**	MOTT MACDONALD
Title	**Location Plan of the Proposed Residential Development**	**Appendix A1**
Date Aug 2025	**Scale** N.T.S.	**File**

Appendix A2

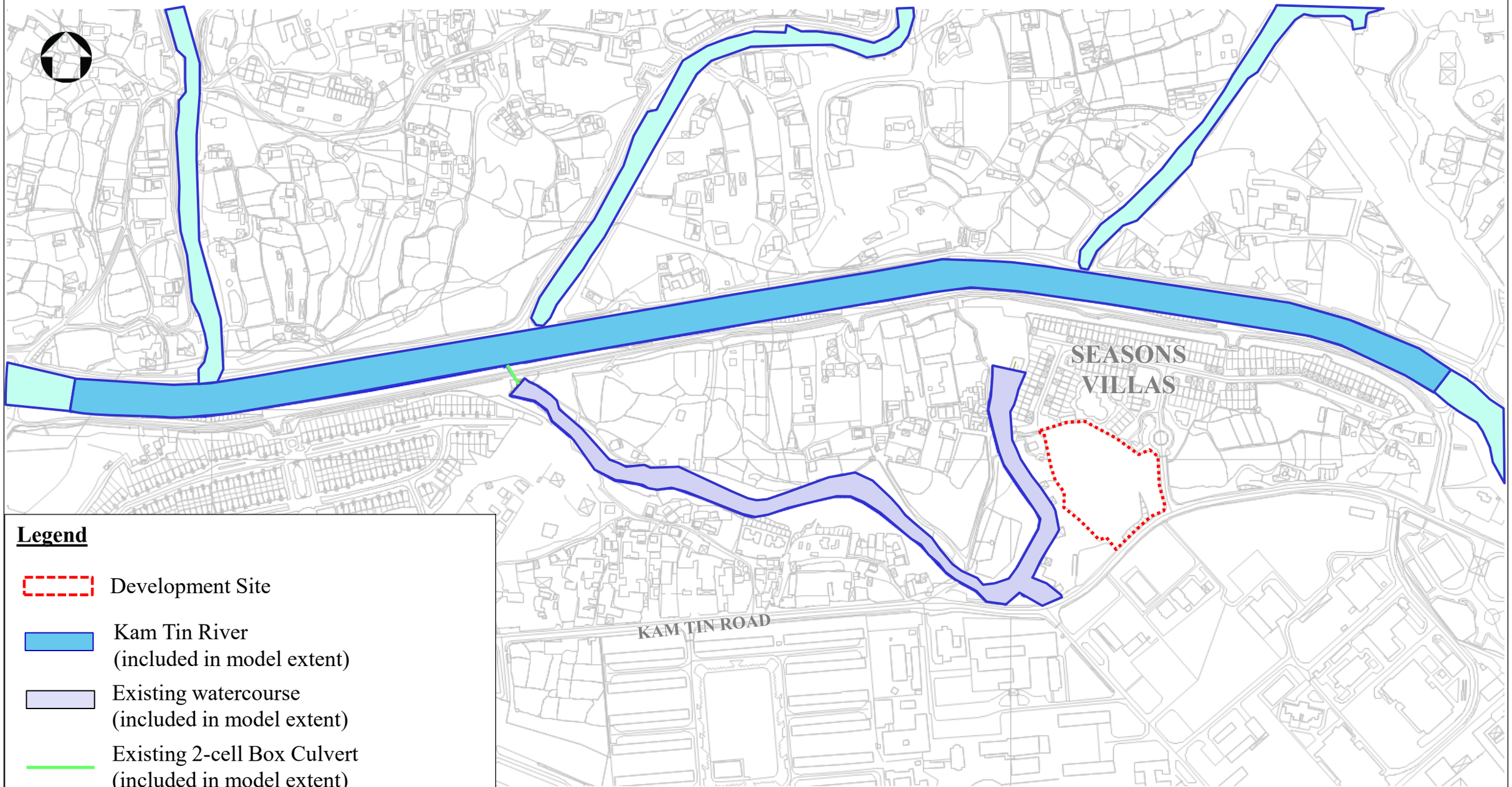
Master Layout Plan of the Proposed Residential Development



Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**	MOTT MACDONALD
Title	**Master Layout Plan of the Proposed Residential Development**	**Appendix A2**
Date Aug 2025	**Scale** N.T.S.	**File**

Appendix B1

Existing Drainage System



Legend

- Development Site
- Kam Tin River (included in model extent)
- Existing watercourse (included in model extent)
- Existing 2-cell Box Culvert (included in model extent)
- Kam Tin River (not included in model extent)

Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**
Title	**Existing Drainage System**

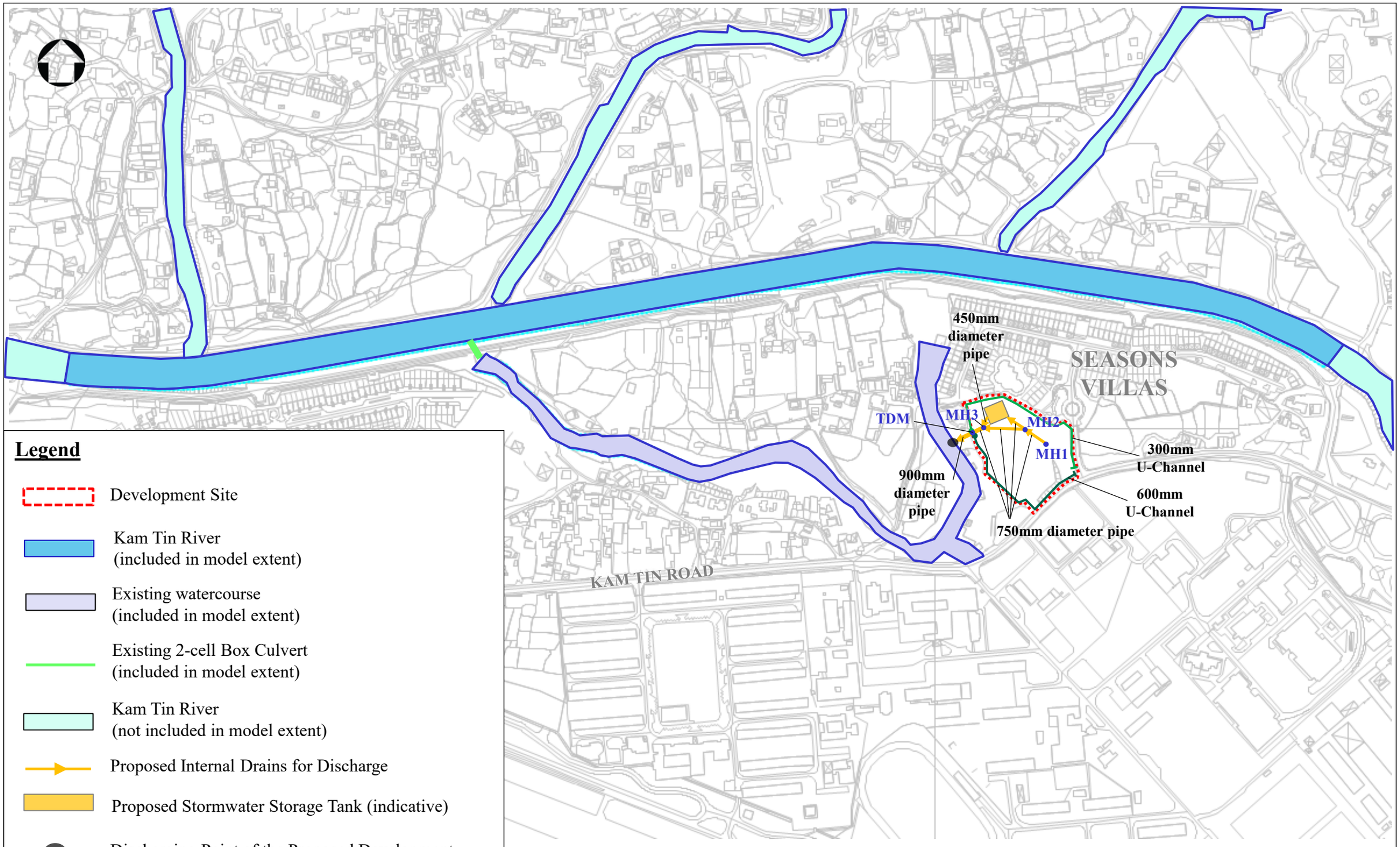
Date Aug 2025	**Scale** N.T.S.	**File**

MOTT MACDONALD

Appendix B1

Appendix B2

Proposed Drainage System



Legend

- Development Site
- Kam Tin River (included in model extent)
- Existing watercourse (included in model extent)
- Existing 2-cell Box Culvert (included in model extent)
- Kam Tin River (not included in model extent)
- Proposed Internal Drains for Discharge
- Proposed Stormwater Storage Tank (indicative)
- Discharging Point of the Proposed Development
- Proposed Boundary Channels with Grading Cover

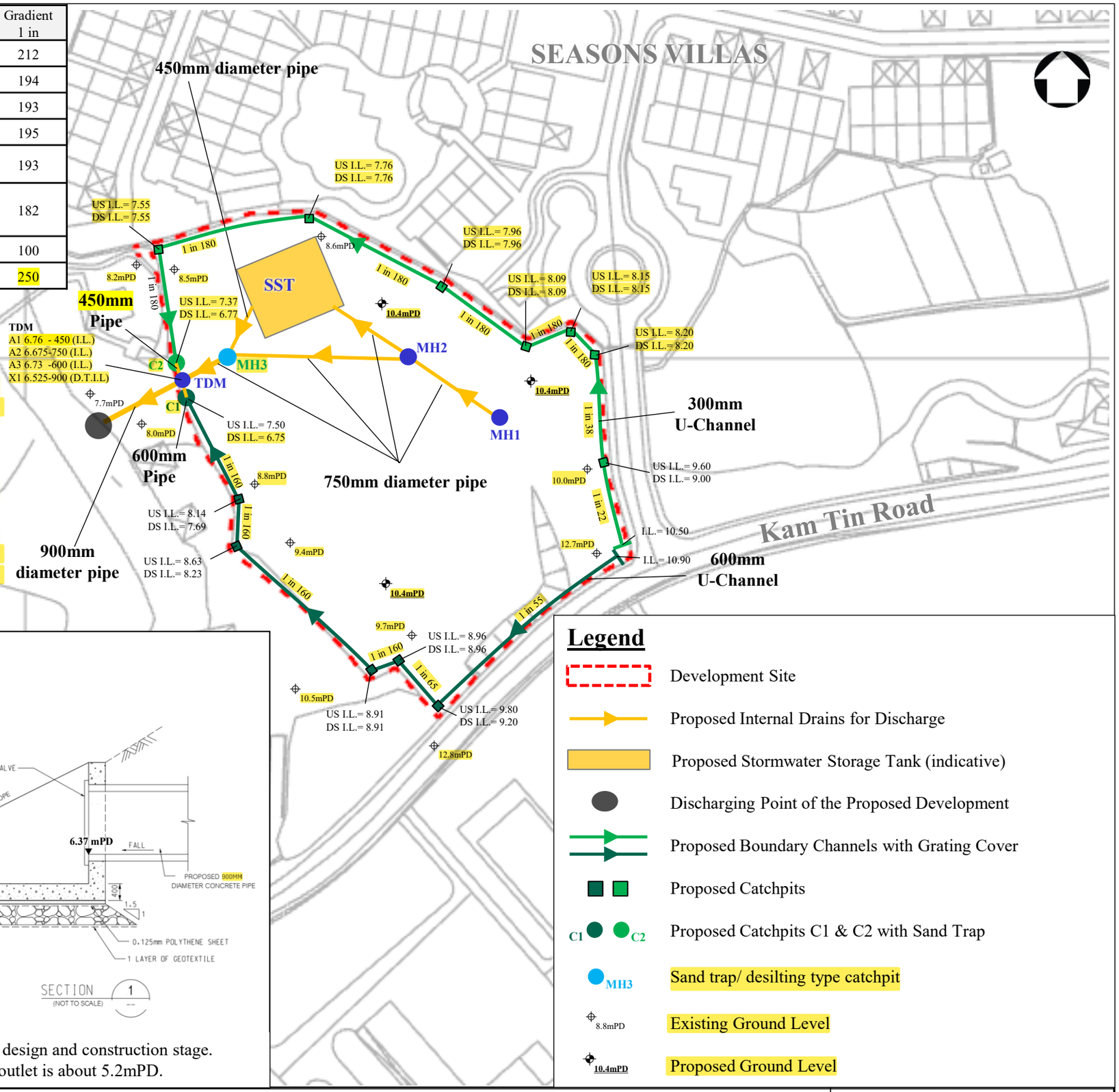
Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**
Title	**Proposed Drainage System**

Date	Scale	File	
Jan 2026	N.T.S.		**Appendix B2**

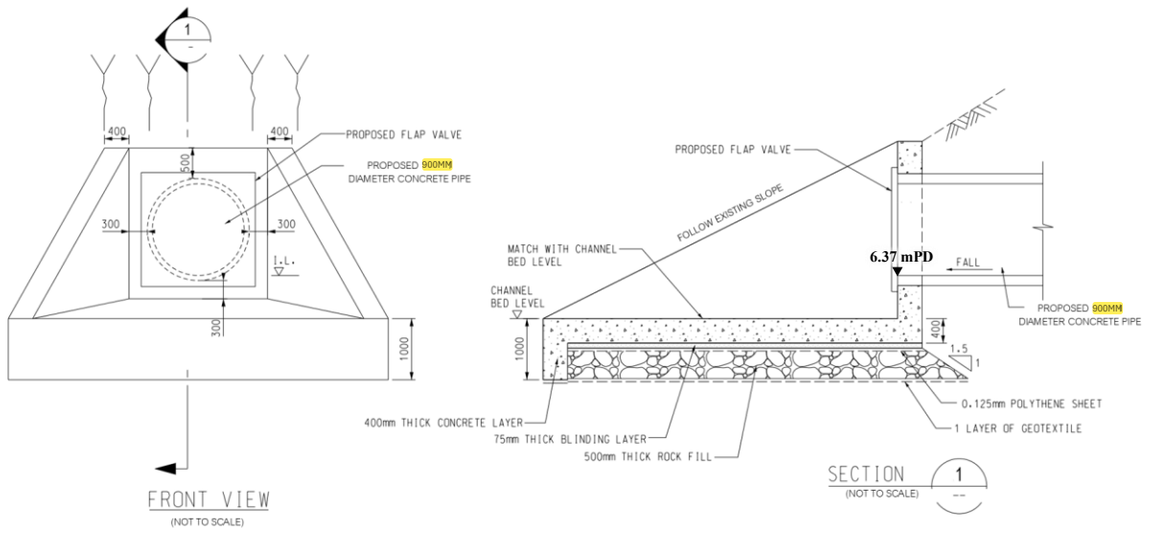
From	To	Size (mm)	US I.L. (mPD)	DS I.L. (mPD)	Gradient 1 in
MH1	MH2	750	8.870	8.800	212
MH2	SST	750	8.400	8.300	194
SST	MH3	450	7.400	7.320	193
MH2	MH3	750	8.800	8.660	195
MH3	TDM	750	6.720	6.675 (I.L. of TDM)	193
TDM	watercourse	900	6.525 (D.T.I.L. of TDM)	6.370	182
C1	TDM	600	6.750	6.730	100
C2	TDM	450	6.770	6.760	250

Note:

- US I.L. = Upstream Invert Level
  DS I.L. = Downstream Invert Level
- TDM = Terminal manhole. The proposed stormwater terminal manhole will comply with the current Government standard. The Type T2_1 terminal manhole will be adopted, subject to detailed design, and DSD standard drawings will be referenced in later detailed design stage.
- C1 & C2 details will be made reference to DSD Standard Drawing No. DS1025.
- MH3 details will be made reference to CEDD standard drawing No. C2406/1.
- Subject to the future drainage plan approval at construction stage, sand trap/desilting type catchpit or alternative design will be provided for drainage prior to connection to the proposed stormwater terminal manhole.



Typical Drainage Outlet



* The design of the drainage outlet will be subject to be confirmed at later design and construction stage.
** The invert level of the existing watercourse at the location of drainage outlet is about 5.2mPD.

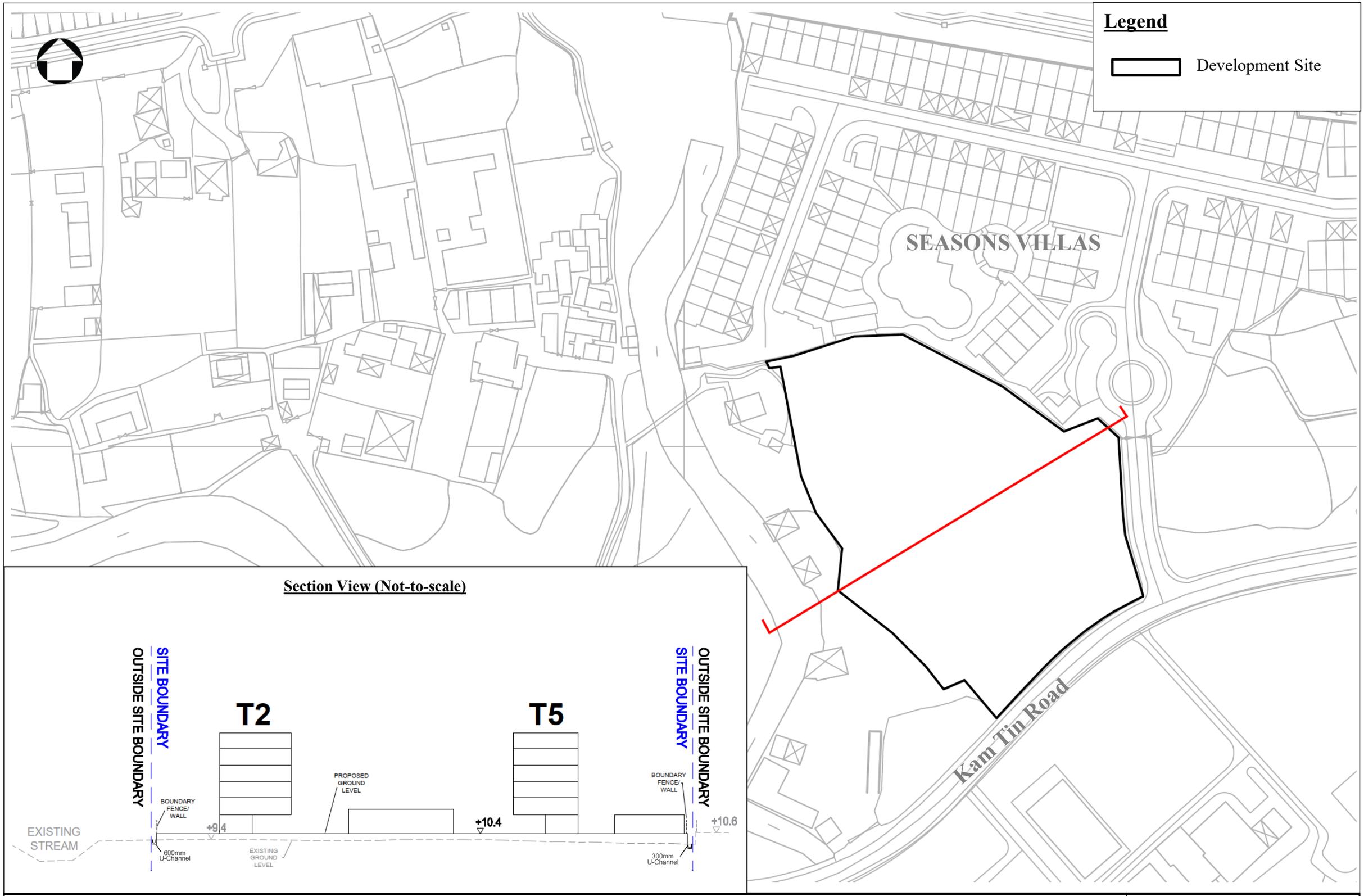
Legend

- Development Site
- Proposed Internal Drains for Discharge
- Proposed Stormwater Storage Tank (indicative)
- Discharging Point of the Proposed Development
- Proposed Boundary Channels with Grating Cover
- Proposed Catchpits
- C1 C2 — Proposed Catchpits C1 & C2 with Sand Trap
- MH3 — Sand trap/ desilting type catchpit
- 8.8mPD — Existing Ground Level
- 10.4mPD — Proposed Ground Level

Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**
Title	**Proposed Drainage System (Enlarged)**
Date Mar 2026	**Scale** N.T.S. **File**

MOTT MACDONALD

Appendix B2



Section View (Not-to-scale)

Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**
Title	**Proposed Drainage System**

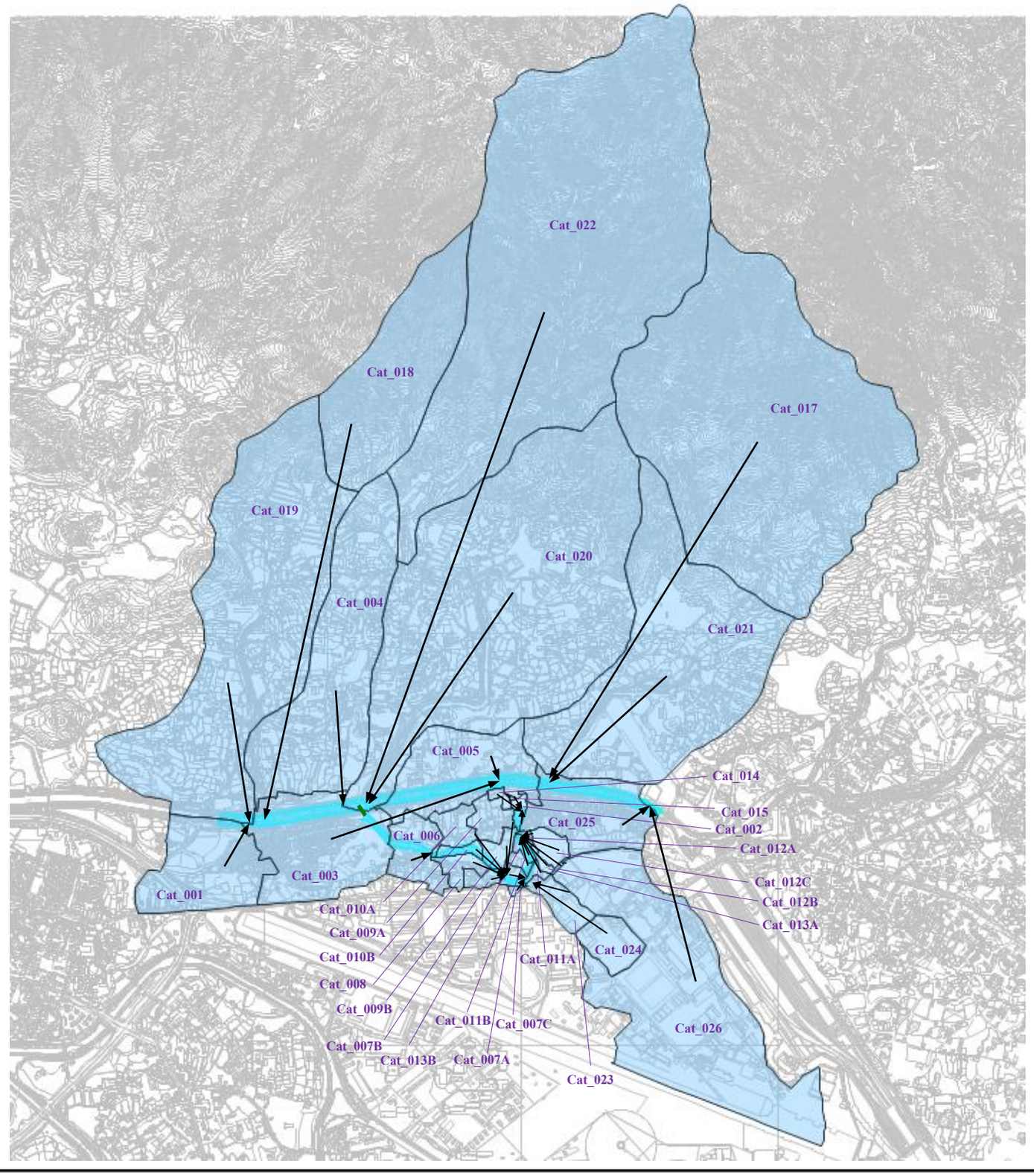
Date Oct 2025	**Scale** N.T.S.	**File**

MOTT MACDONALD

Appendix B2

Appendix C1

Existing Catchment Plan



Legend

- Existing Channel Modelled
- Existing Box Culvert Modelled
- Sub-catchments
- Catchment Distribution

Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**
Title	**Existing Catchment Plan**

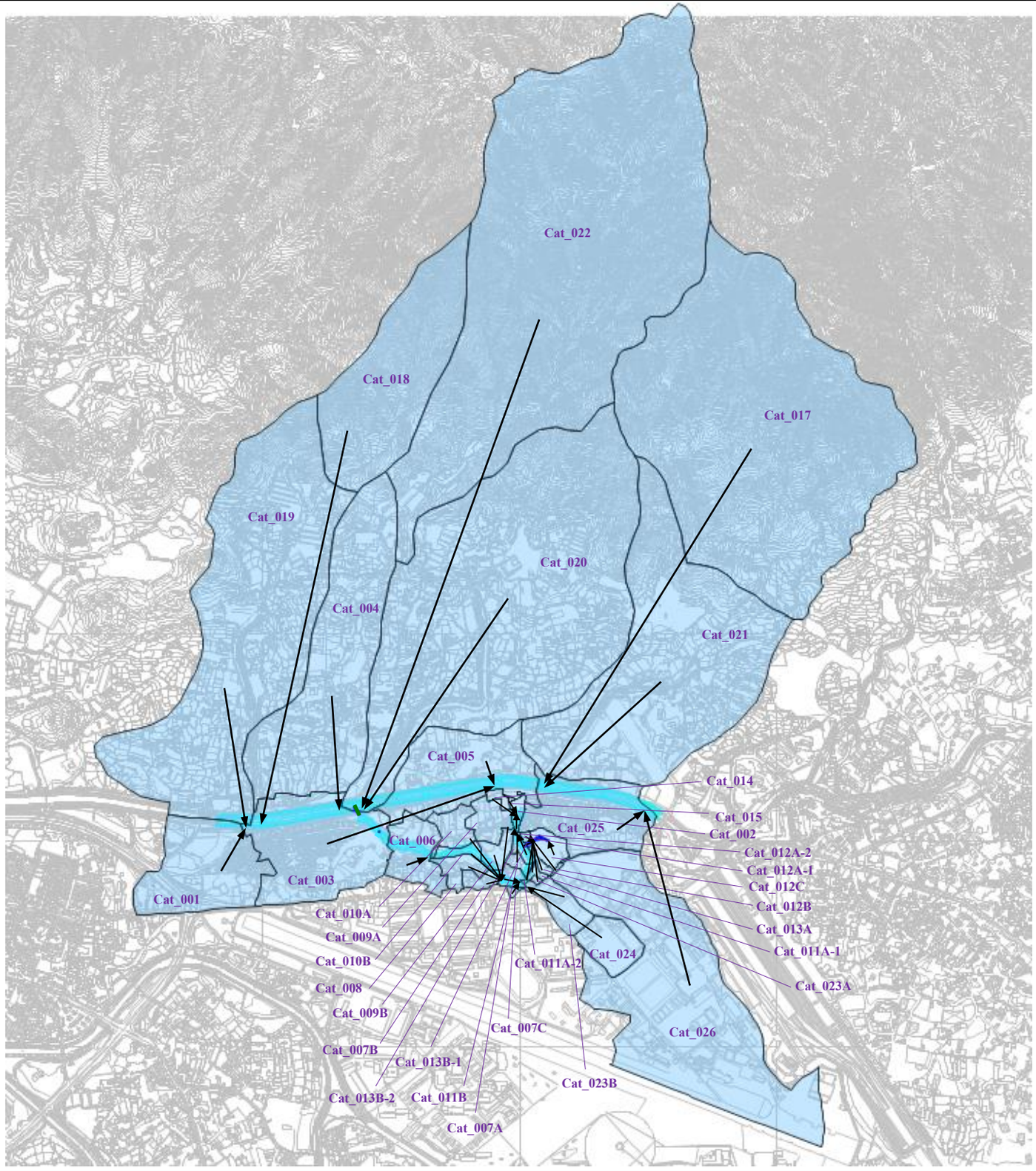
Date	Scale	File
Jan 2026	N.T.S.	

MOTT MACDONALD

Appendix C1

Appendix C2

Proposed Catchment Plan



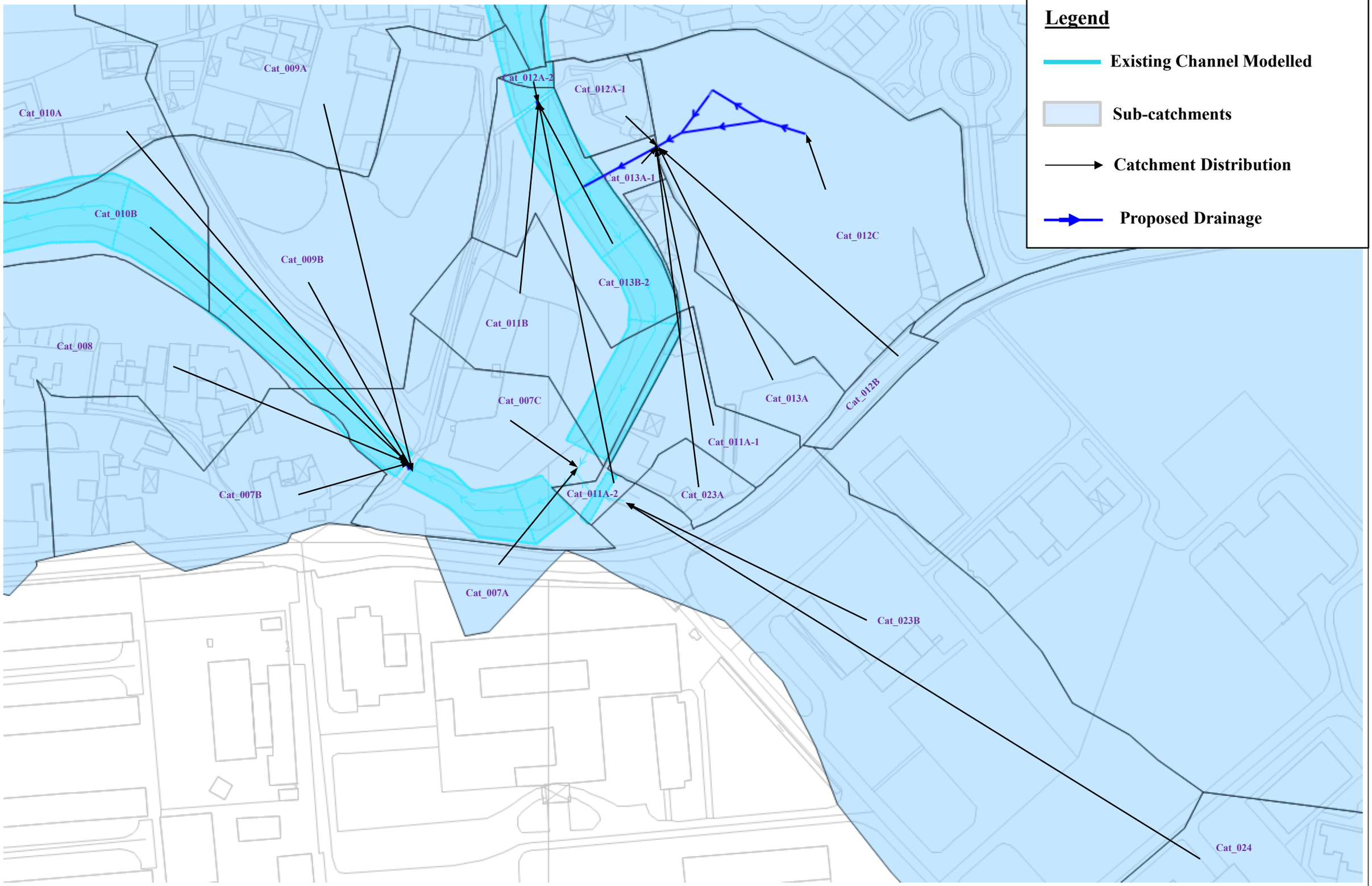
Legend

- Existing Channel Modelled
- Existing Box Culvert Modelled
- Sub-catchments
- Catchment Distribution
- Proposed Drainage

Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**
Title	**Proposed Catchment Plan**
Date Jan 2026	**Scale** N.T.S. **File**

MOTT MACDONALD

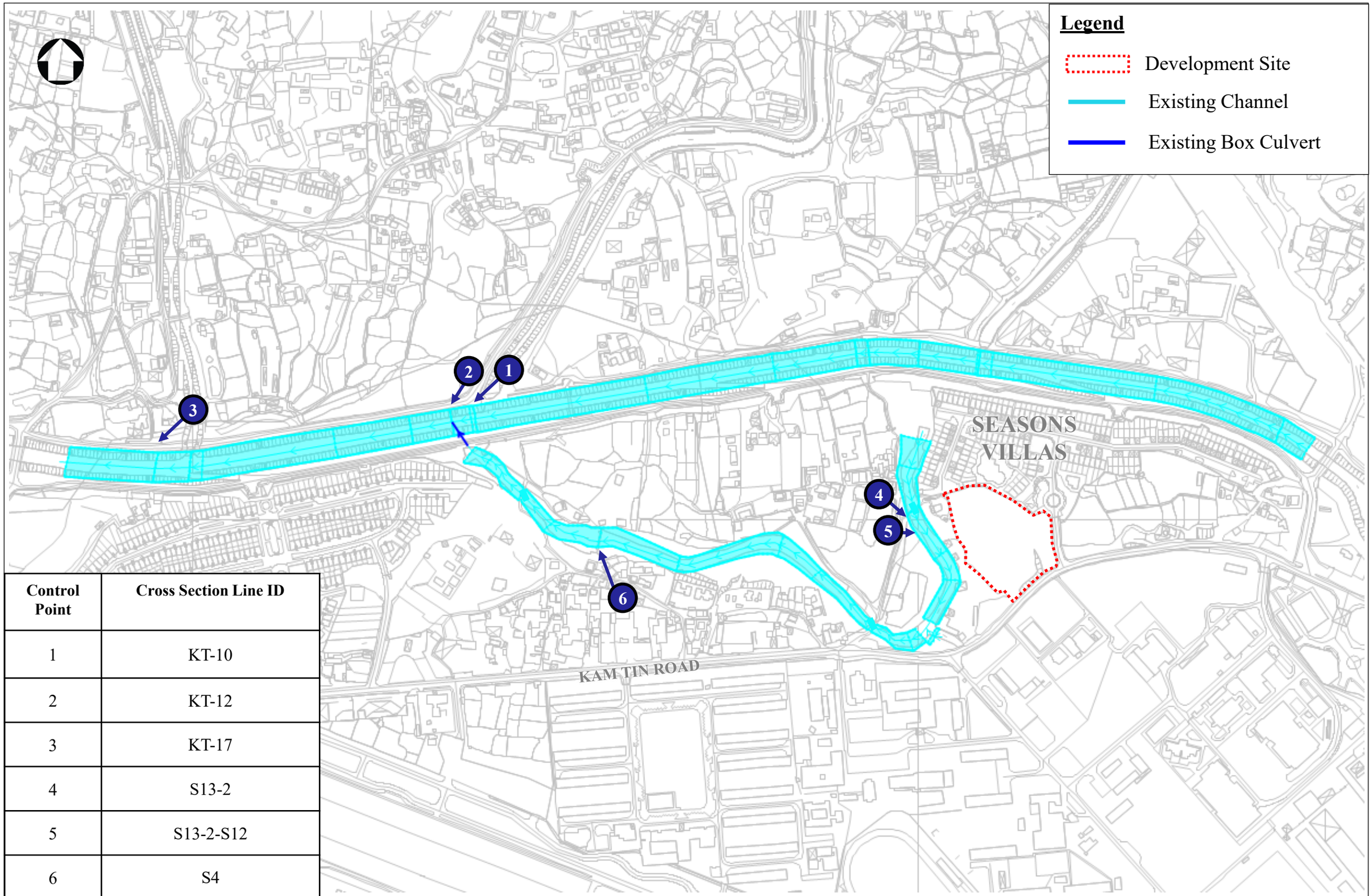
Appendix C2



Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**	MOTT MACDONALD
Title	**Proposed Catchment Plan (Enlarged)**	**Appendix C2**
Date Jan 2026	**Scale** N.T.S.	**File**

Appendix D

Location of Control Points in the Model

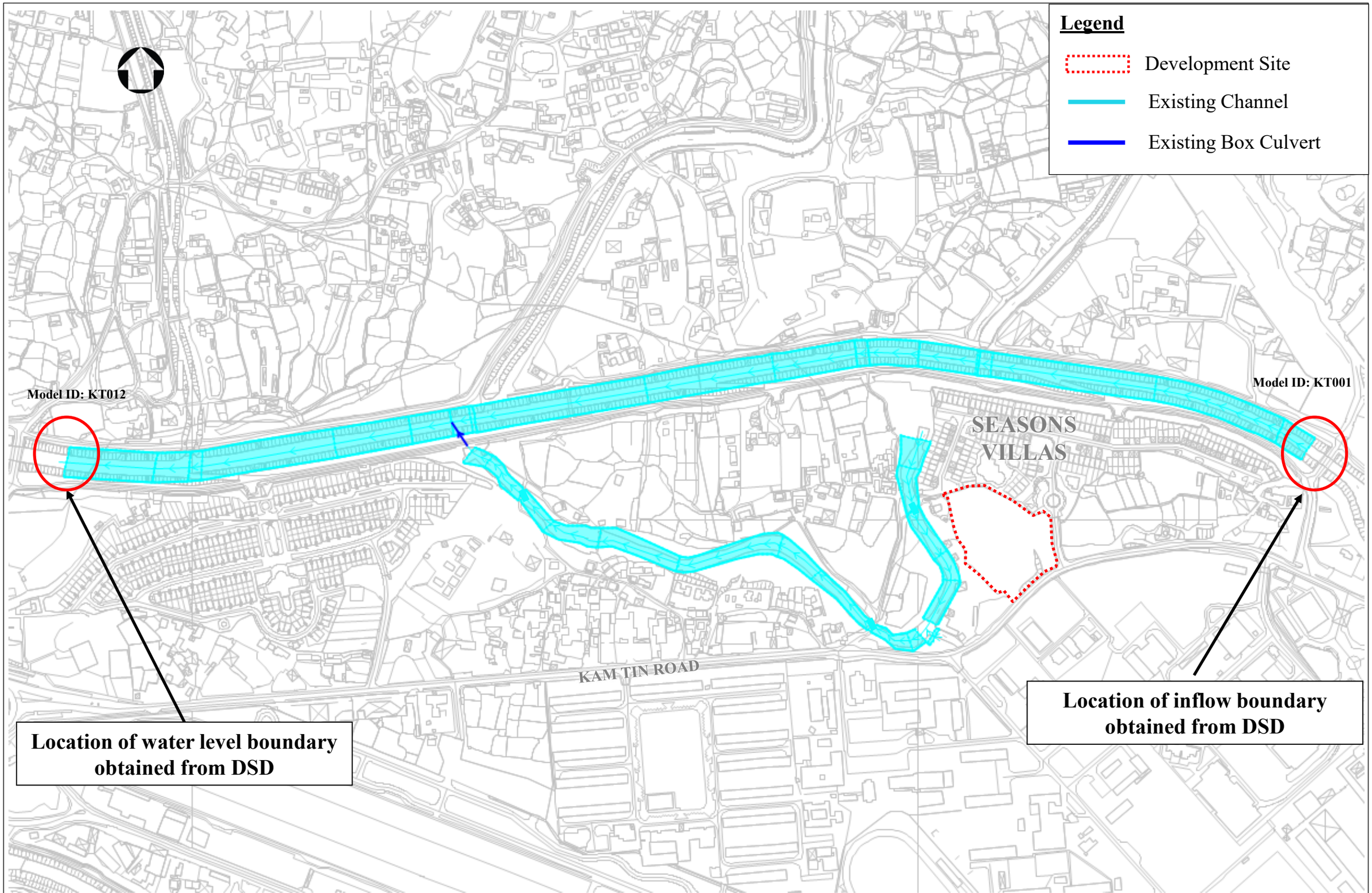


Control Point	Cross Section Line ID
1	KT-10
2	KT-12
3	KT-17
4	S13-2
5	S13-2-S12
6	S4

Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**	MOTT MACDONALD
Title	**Location of Control Points in the Model**	**Appendix D**
Date Aug 2025	**Scale** N.T.S.	**File**

Appendix E

Existing Model Extent



Project	**Rezoning from "Residential (Group C)2" and "Open Space" zones to "Residential (Group C)4" zone for a Proposed Residential Development at Lot Nos. 519 RP (part) and 520 RP in D.D. 110 and the Adjoining Government land, Shek Kong, Yuen Long, N.T.**	MOTT MACDONALD
Title	**Existing Model Extent**	**Appendix E**
Date Aug 2025	**Scale** N.T.S.	**File**

Appendix F

Downstream Boundary Conditions Obtained from DSD

IC0014

Drainage Services Department
Mainland North Division
11/F, Kowloon Government Offices,
405 Nathan Road, Kowloon

渠務署
新界北渠務部
九龍彌敦道 405 號
九龍政府合署 11 樓

本署檔號 Our Ref : (00RPNA) in MN 10/YL/DD110
來函檔號 Your Ref : EC/MT/426076/L-0004
電 話 Tel : (852) 2781 4107
傳 真 Fax : (852) 2770 4761

By Post

15 November 2021

MOTT MACDONALD HONG KONG LIMITED
3/F, International Trade Tower,
348 Kwun Tong Road,
Kowloon,
Hong Kong
(Attn.: May TSE)

	To	Action	Informan	Copy	Sign	Date
1						
2						
Rec'd	19 NOV 2021					
3						
4						
File No. 426076						

Dear Sir/Madam,

S12A Planning Application for Proposed Residential Development at Various Lots in DD110 Shek Kong, Kam Tin, Yuen Long, New Territories
Request for Information

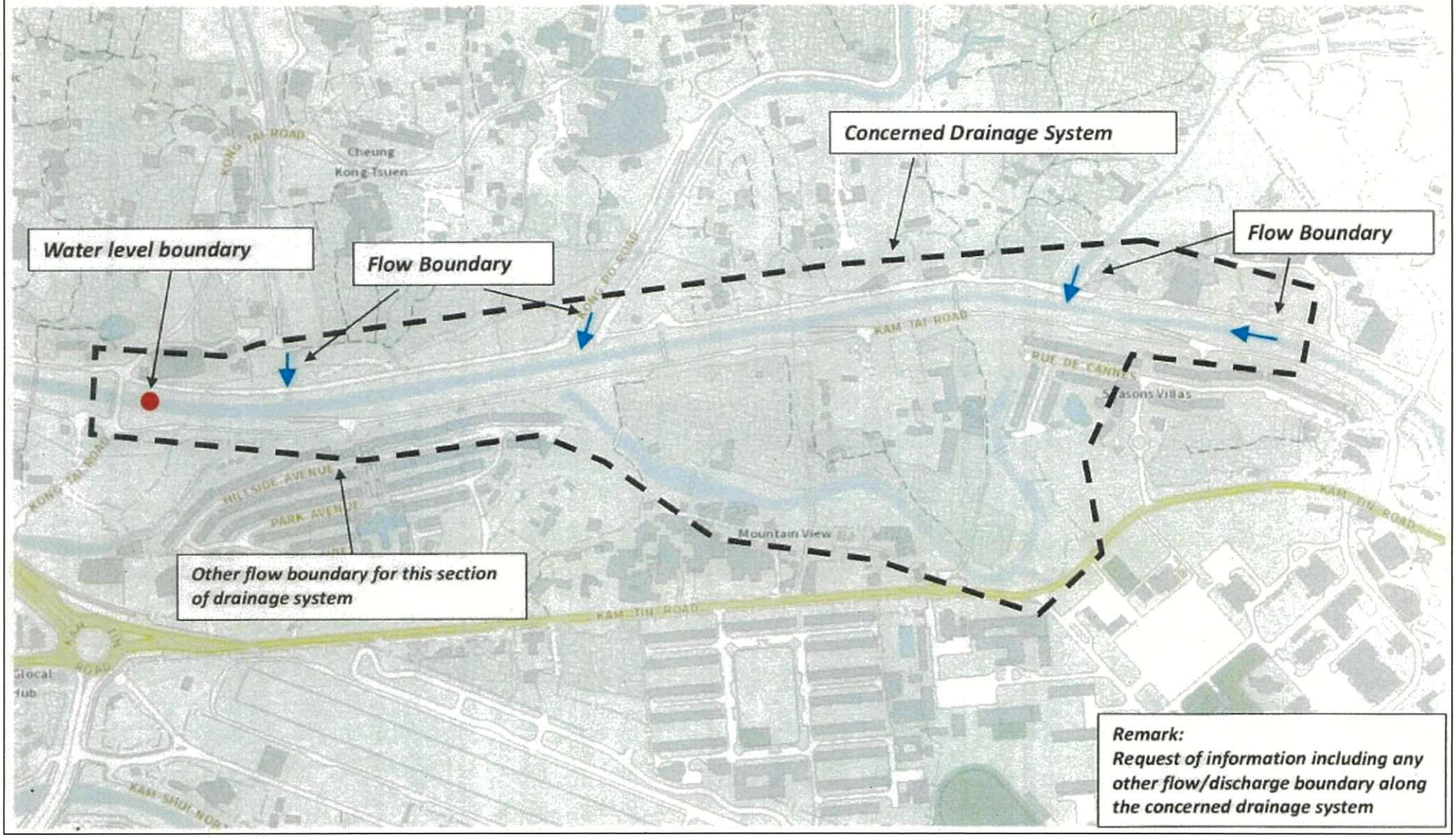
I refer to your letter dated 28 October 2021 requesting for drainage information.

The requested information is enclosed for your reference.

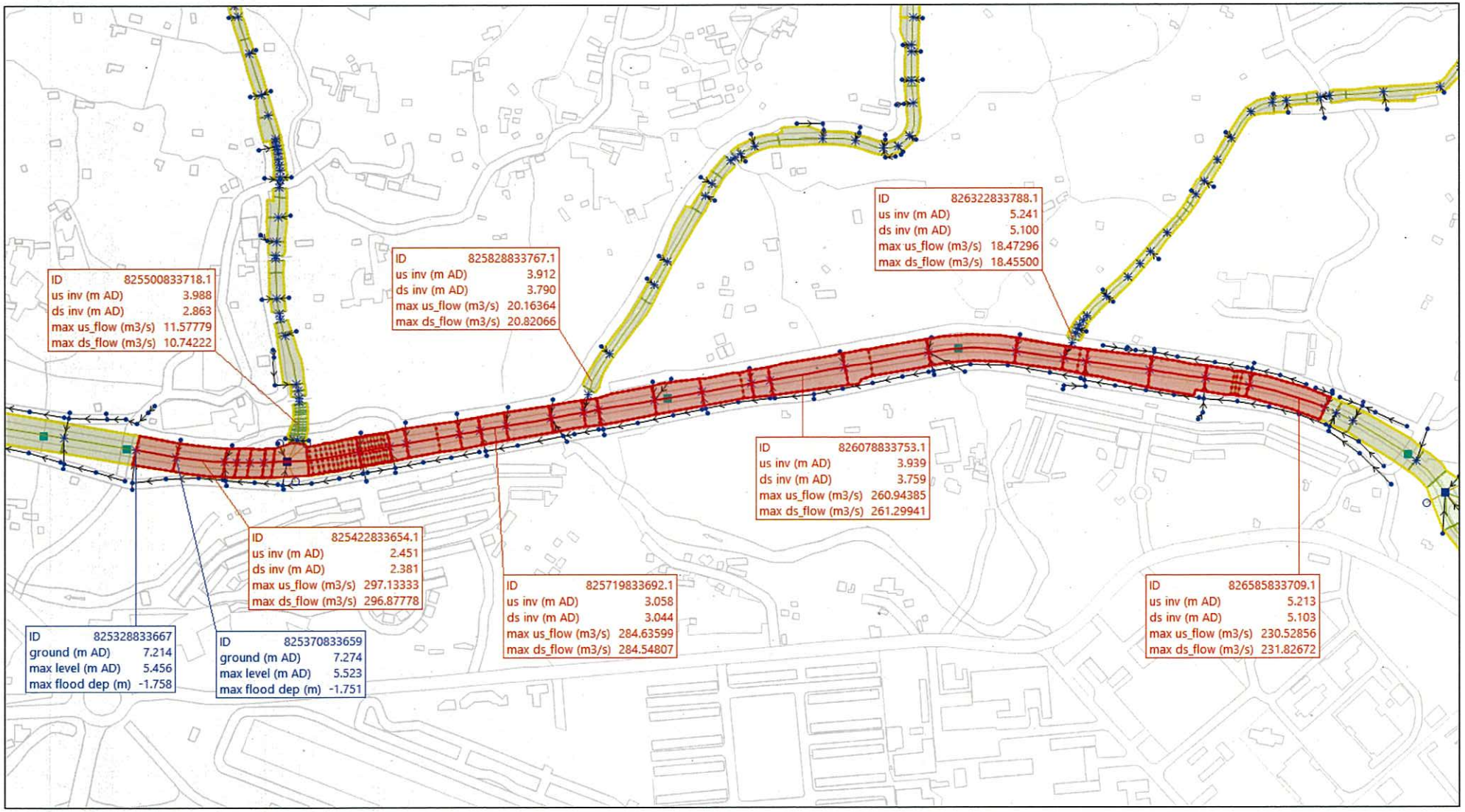
Yours faithfully,

(Bill C H CHAN)
for Chief Engineer / Mainland North
Drainage Services Department

Sketch 1 - Request for Information



Location of Request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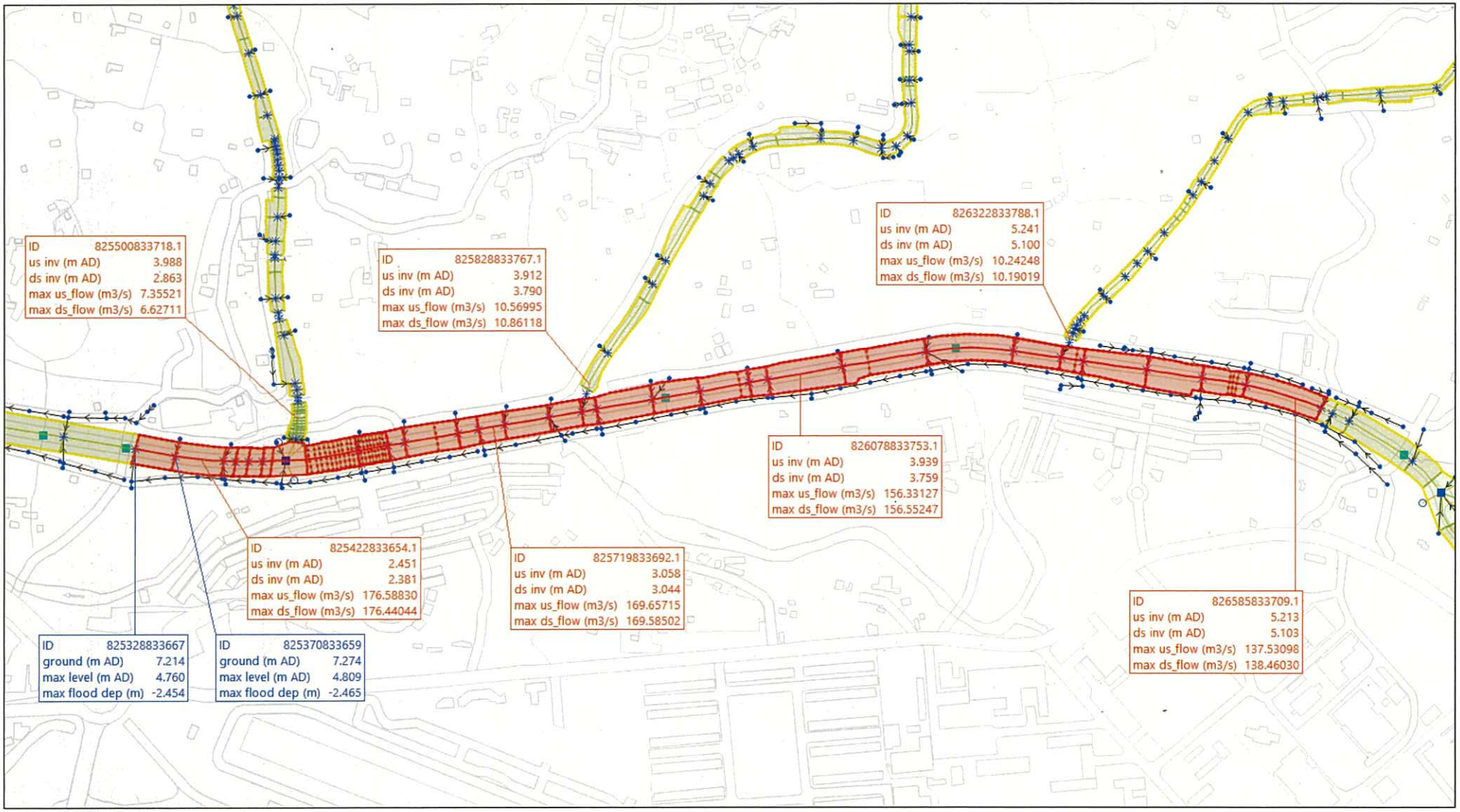
10A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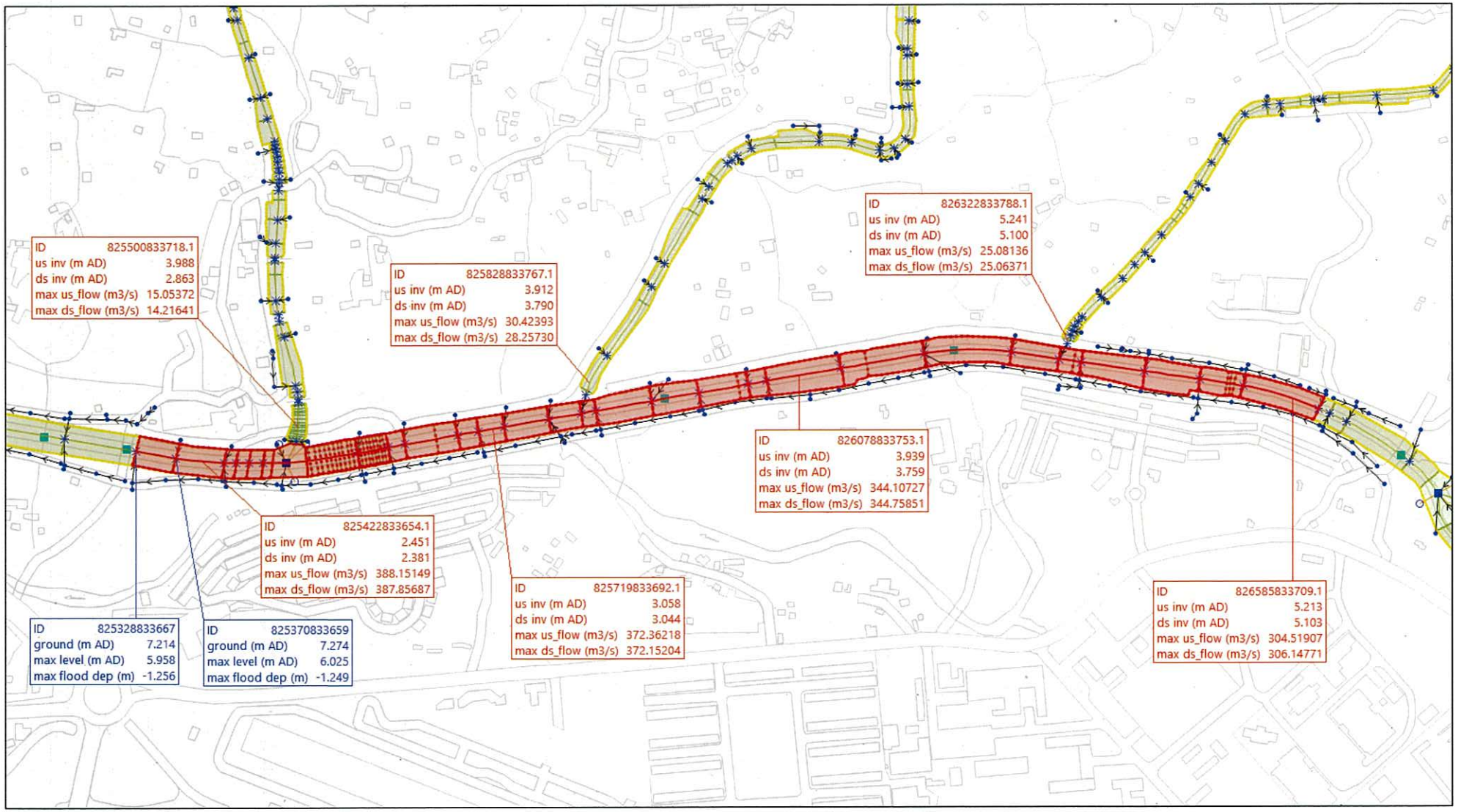
10B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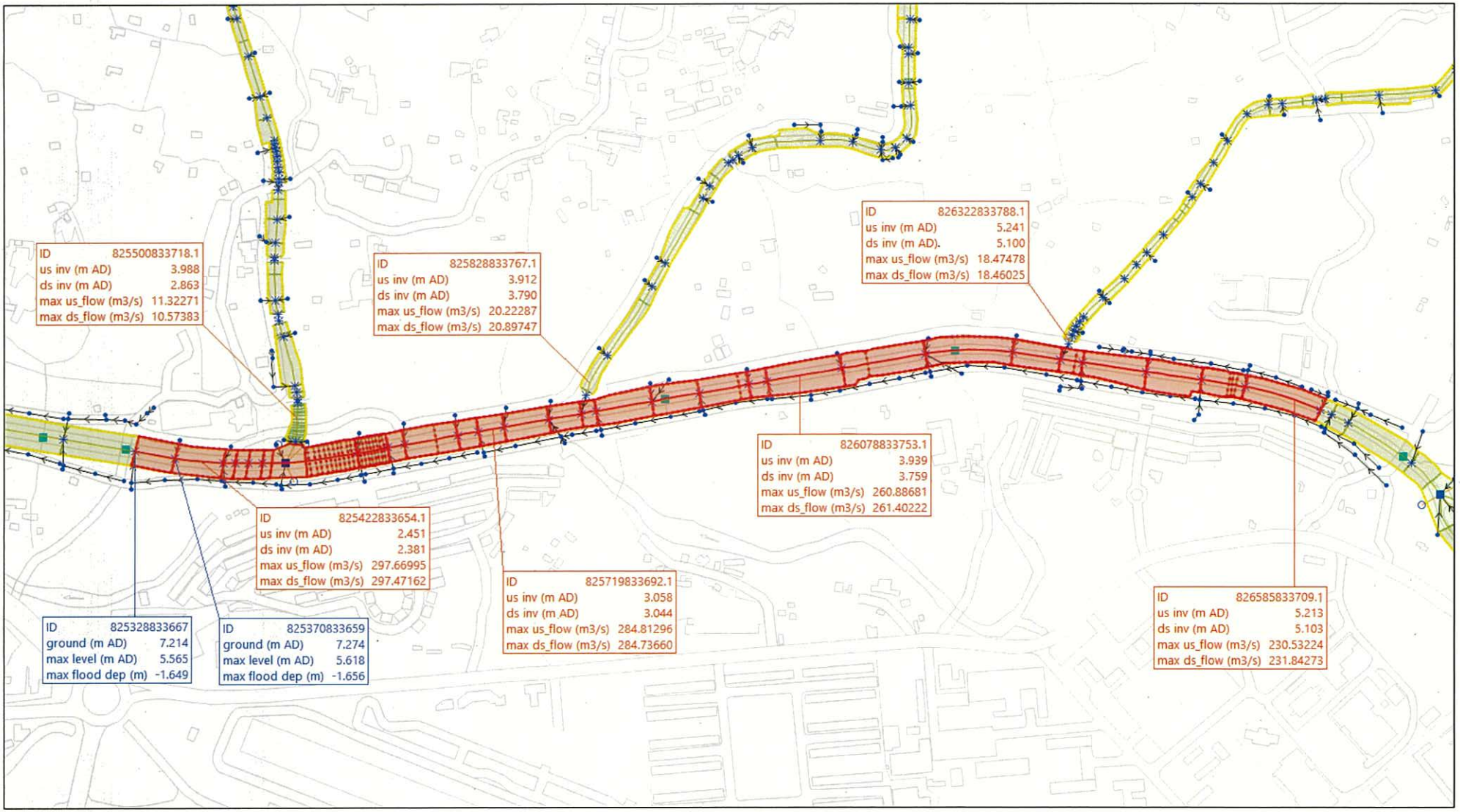
50A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ds inv (m AD) 3.044
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ground (m AD) 7.214
max level (m AD) 5.565
max flood dep (m) -1.649
ID 825370833659
ground (m AD) 7.274
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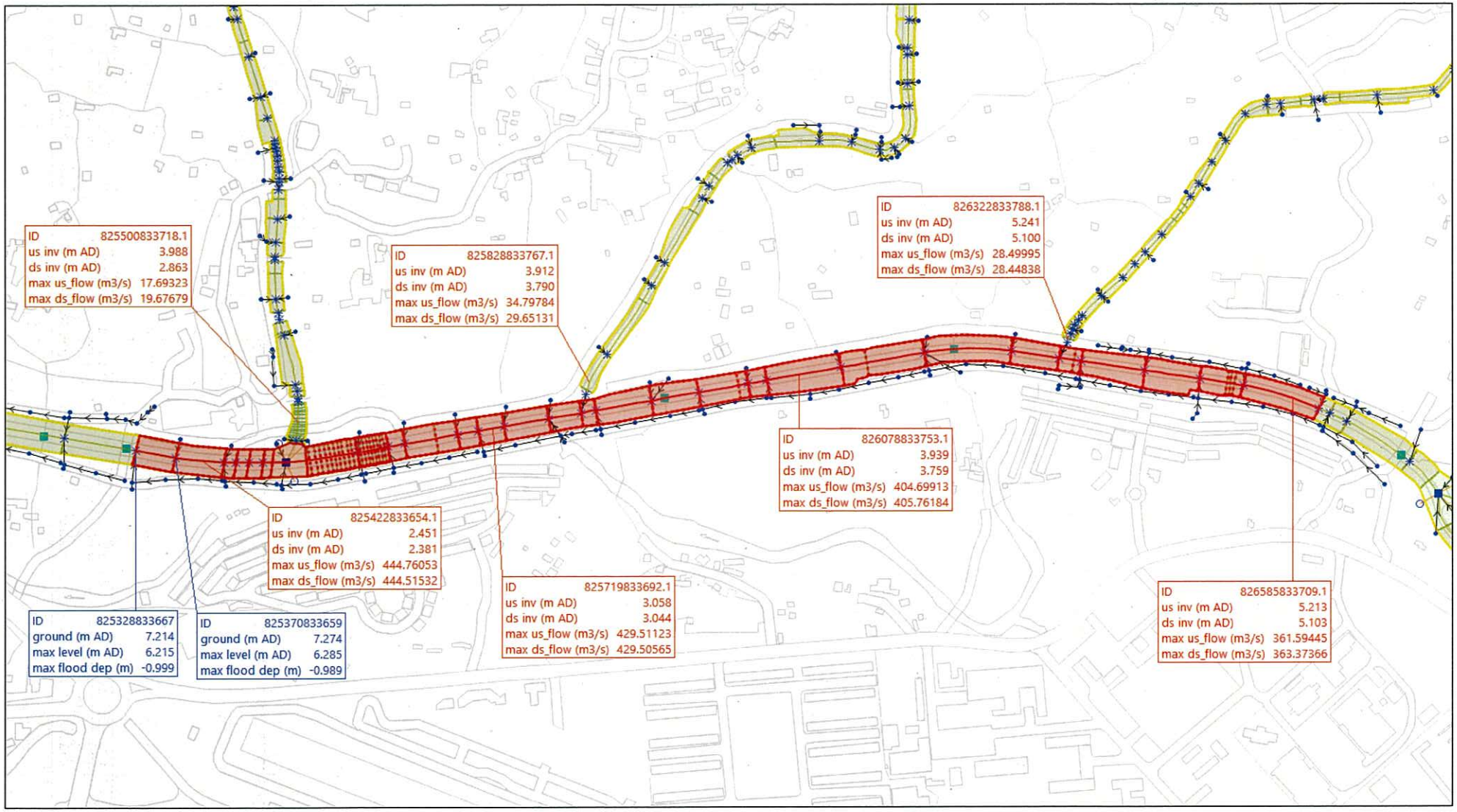
50B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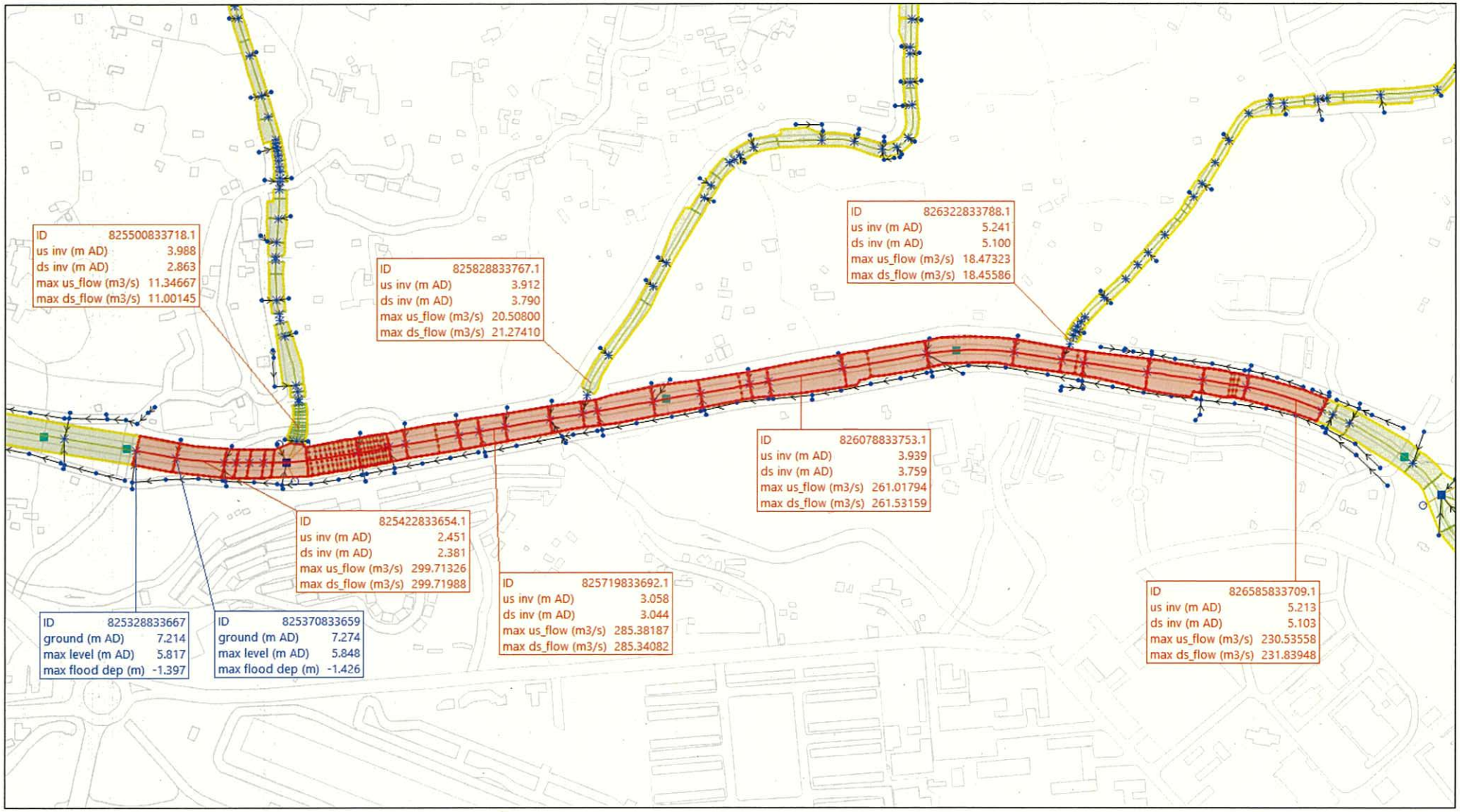
200A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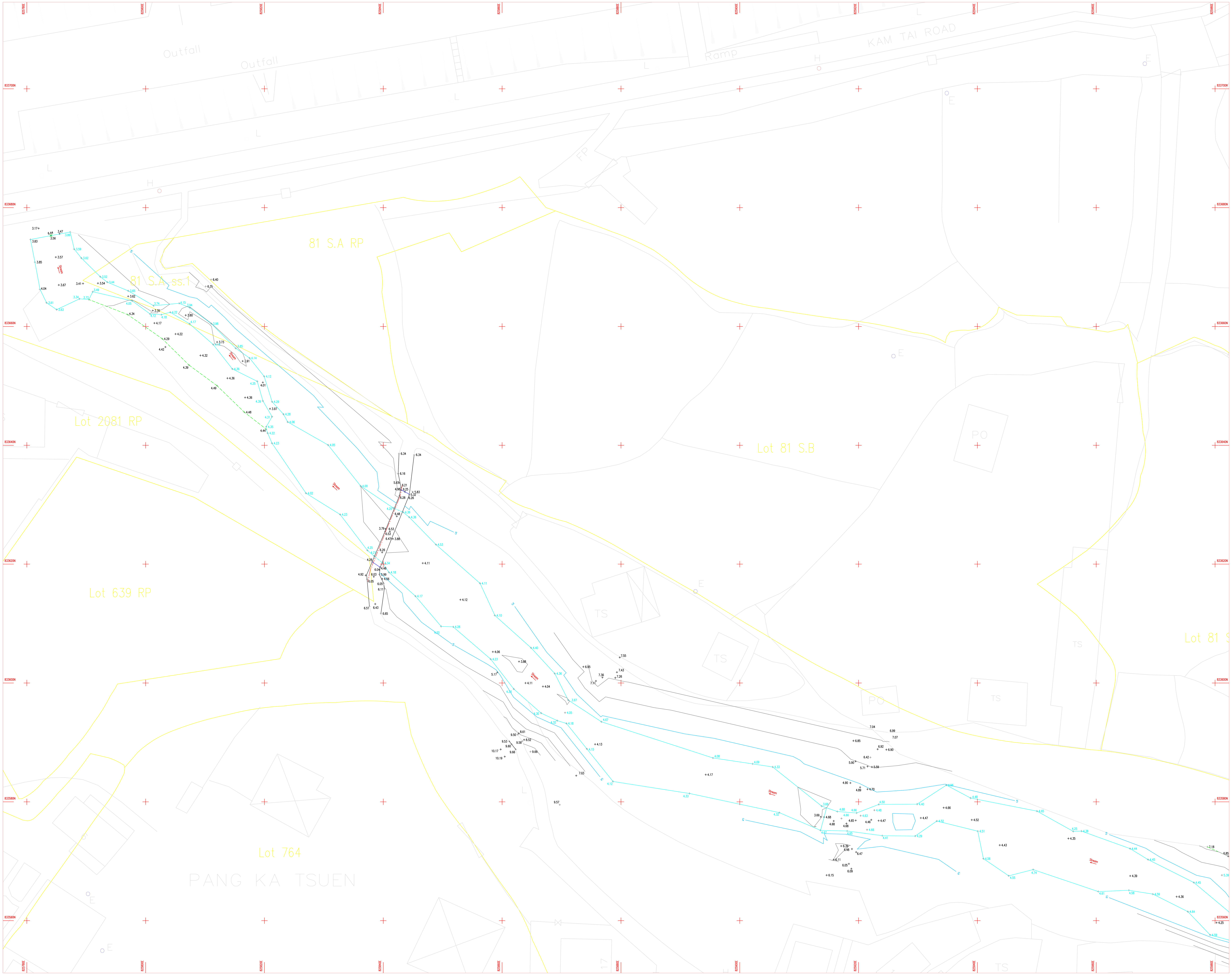
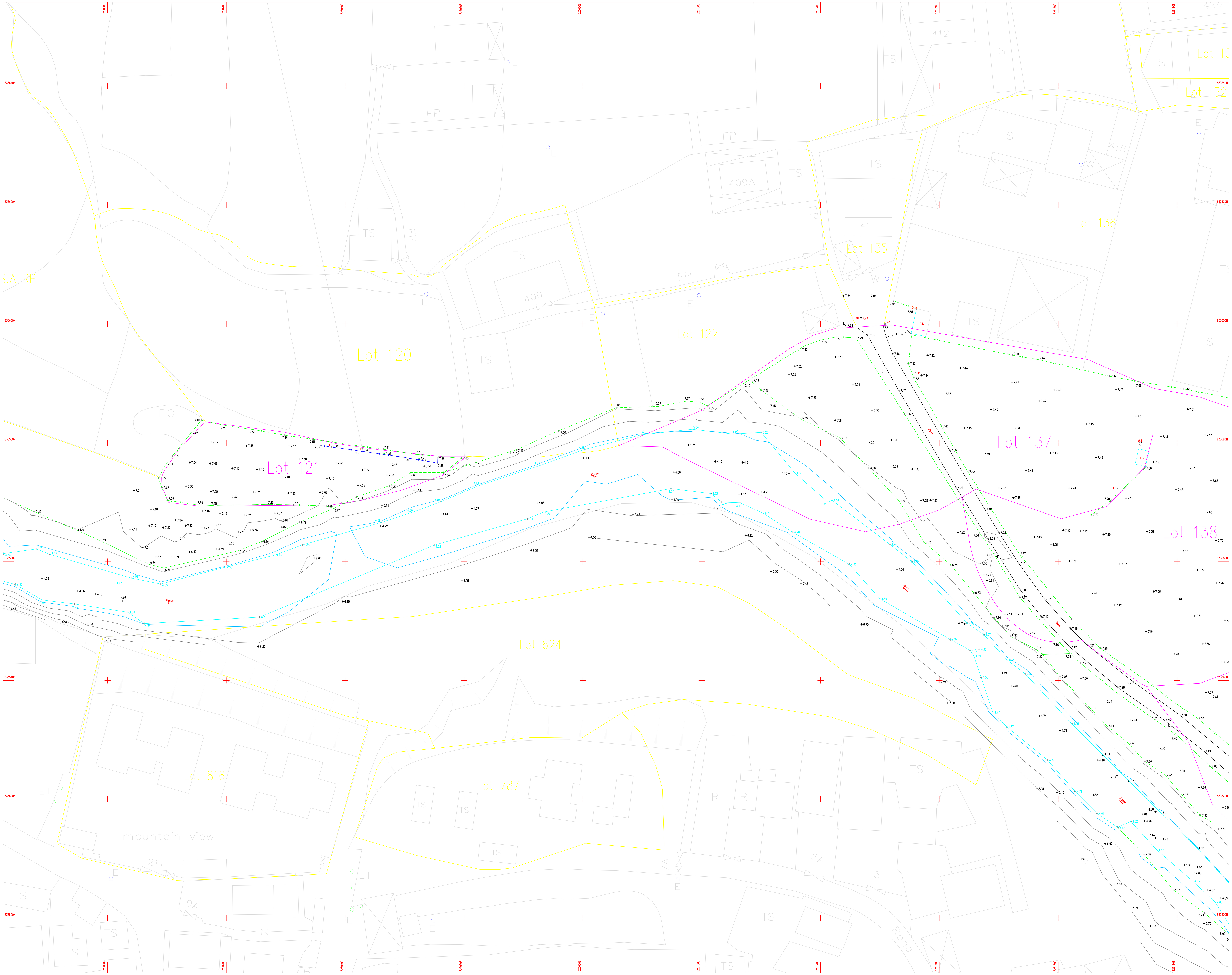
max flood dep (m) -1.426

200B

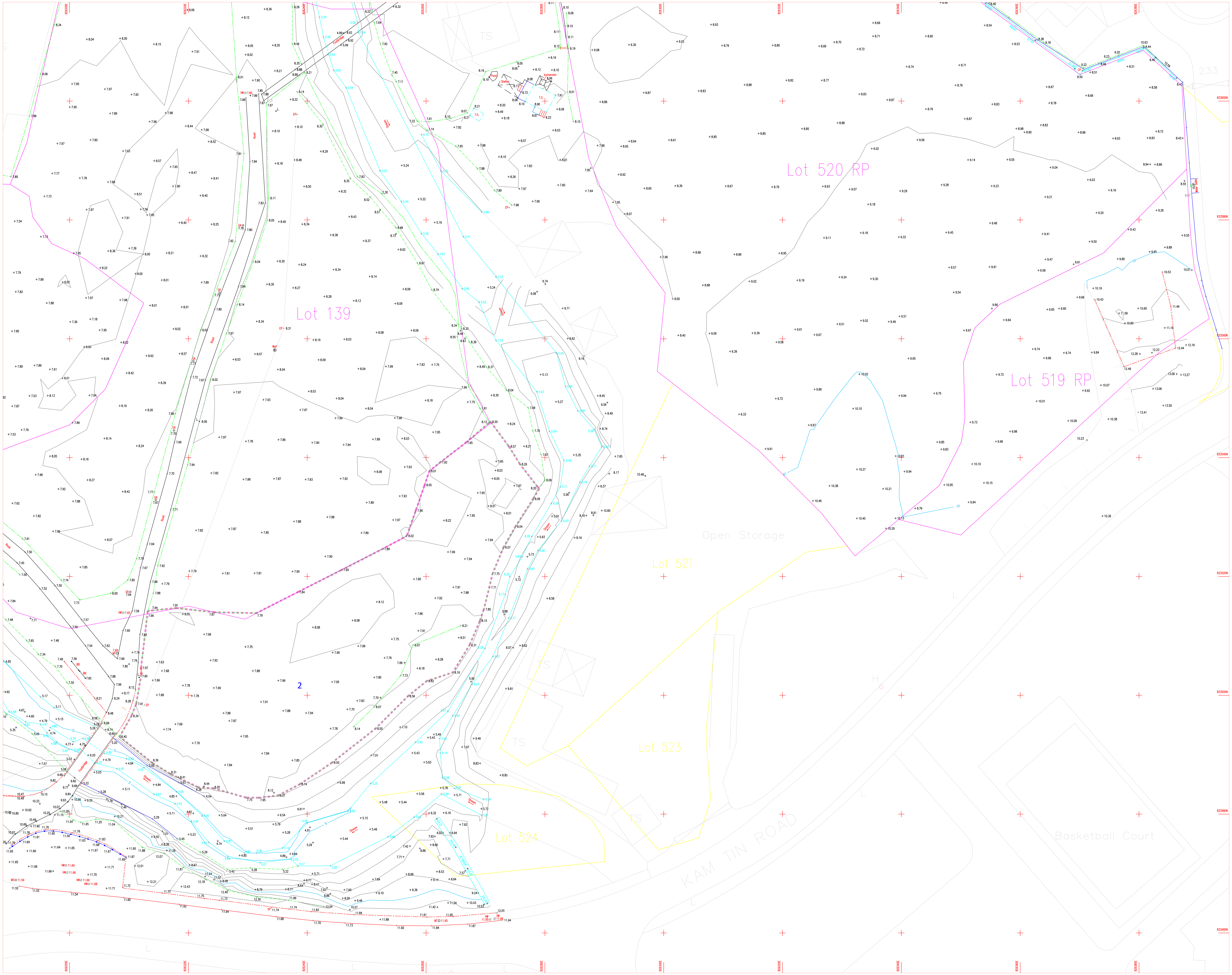
Appendix G

Topographic Survey received from the Applicant


Outfall
Outfall
KAM TAI ROAD
Ramp
81 S.A RP
81 S.A ss.1
Lot 2081 RP
Lot 639 RP
Lot 81 S.B
PO
TS
Lot 764
PANG KA TSUEN



Lot 120
Lot 121
Lot 122
Lot 135
Lot 136
Lot 137
Lot 138
Lot 624
Lot 816
Lot 787
PO
mountain view
Stream
Road
409
409A
411
412
415
211
TS
FP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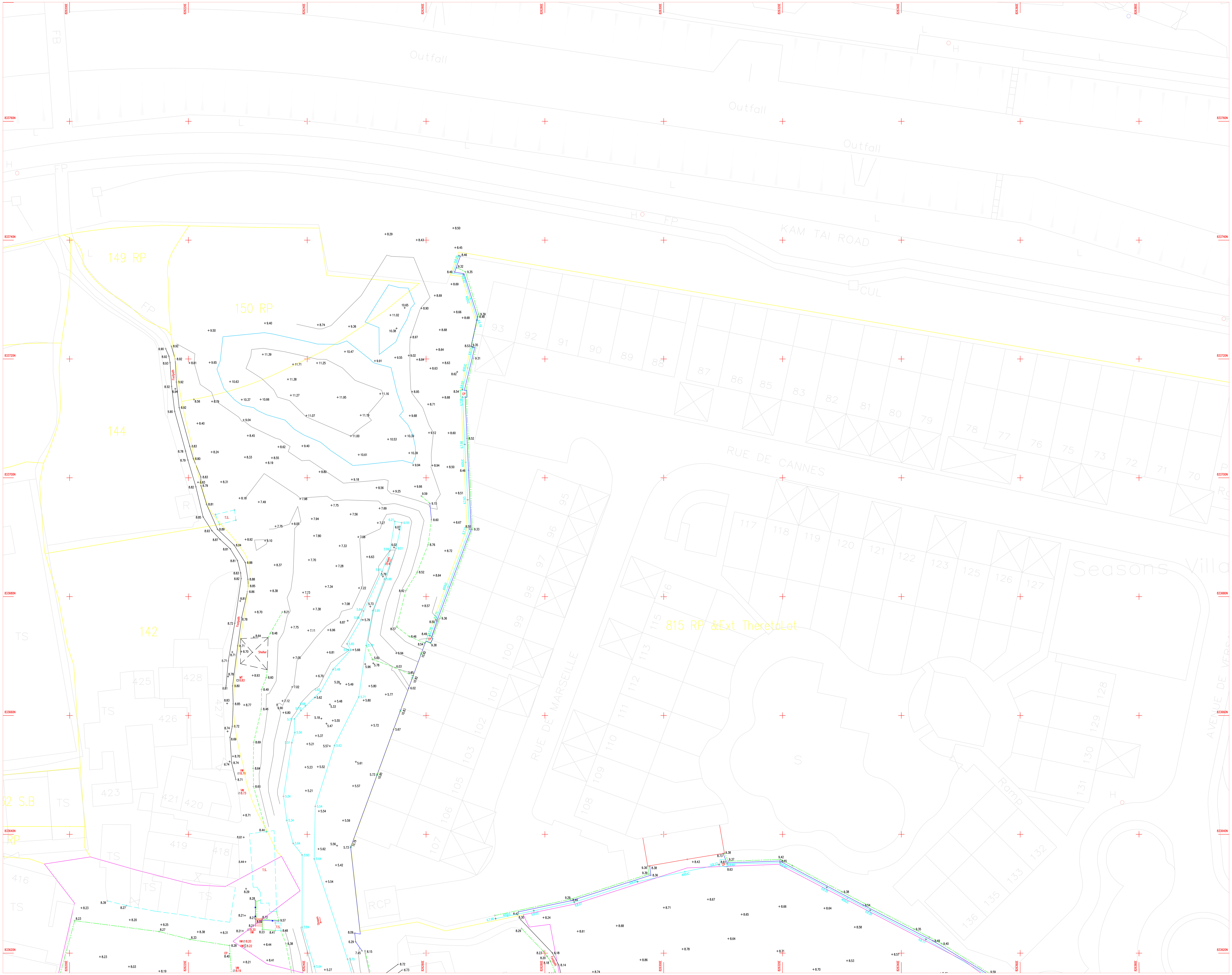
Lot 520 RP
Lot 519 RP
Lot 521
Lot 523
Lot 524
Open Storage
KAM TIN ROAD
Basketball Court
TS
2


Outfall
Outfall
Outfall
KAM TAI ROAD
CUL
FP
149 RP
150 RP
144
142
815 RP &Ext Thereto Lot
RUE DE CANNES
RUE DE MARSEILLE
Ramp
RCP
Shelter

Appendix H

InfoWorks ICM Hydraulic Model

Appendix I

Capacity Check for Peripheral Channels

Appendix I - Capacity Check for Peripheral Channels

Ref.	Calculation

Objective Determine the runoff of the adjacent areas that will be collected by the proposed peripheral channels.

Methodology

1. Determine the runoff from subcatchments by extracting from the results of hydraulic model
2. Use Manning Equation to determine the capacity of the proposed open channel and check against the design flow
3. The capacity of proposed boundary channels has been checked for 200-year rainfall event.

1. Runoff from Nearby Catchments Extracted from the Hydraulic Model

-Refer to Appendix C2 for the catchment plan.
-Runoff is extracted from hydraulic model as attached in Appendix H of this DIA Report.
-According to the topography, the runoff arising from the areas at the west and south of the proposed development are currently directly discharged to the existing watercourse through overland flow. As a conservative approach, the peripheral channel, namely Channel A, is sized to cater for the runoff generated from the area between the east bank of the existing watercourse and the proposed Development Site boundary.
-For the existing development at the north and east of the proposed Development Site, the existing development has their own boundary channels and internal drainages which collect and convey the runoff from the development to Kam Tin River. A set of 300mm peripheral channels, Channel B, and associated 300mm pipe will be provided along the site boundaries at the north and east side of the proposed Development Site boundary. As a conservative approach, the peripheral channel, namely Channel B, is sized to cater for the runoff generated from the area between the east bank of the existing watercourse and the proposed Development Site boundary.

Sub Catchment ID	Total Catchment Areas(m^2)	200-year rainfall event	Collected By Proposed Drainage System
Cat_012A-1	829	0.0724	According to topography, the runoff from Cat_012A-1 is directly discharged to the existing watercourse. As conservative approach for sizing the peripheral channel (Channel B), it is assumed that the peripheral channel have sufficient capacity to collect the runoff from Cat_012A-1. The peripheral channel is connected to Pipe PC-2 then to the proposed stormwater terminal manhole.
Cat_013B-1	351	0.0335	According to topography, the runoff from Cat_013B-1 is directly discharged to the existing watercourse. As conservative approach for sizing the peripheral channel (Channel A), it is assumed that the peripheral channel have sufficient capacity to collect the runoff from Cat_013B-1. The peripheral channel is connected to Pipe PC-1 then to the proposed stormwater terminal manhole.
Cat_013A	1,820	0.1616	According to topography, the runoff from Cat_013A is directly discharged to the existing watercourse. As conservative approach for sizing the peripheral channel (Channel A), it is assumed that the peripheral channel have sufficient capacity to collect the runoff from Cat_013A. The peripheral channel is connected to Pipe PC-1 then to the proposed stormwater terminal manhole.
Cat_011A-1	1,410	0.1249	According to topography, the runoff from Cat_011A-1 is directly discharged to the existing watercourse. As conservative approach for sizing the peripheral channel (Channel A), it is assumed that the peripheral channel have sufficient capacity to collect the runoff from Cat_011A-1. The peripheral channel is connected to Pipe PC-1 then to the proposed stormwater terminal manhole.
Cat_023A	605	0.0461	According to topography, the runoff from Cat_023A is directly discharged to the existing watercourse. As conservative approach for sizing the peripheral channel (Channel A), it is assumed that the peripheral channel have sufficient capacity to collect the runoff from Cat_023A. The peripheral channel is connected to Pipe PC-1 then to the proposed stormwater terminal manhole.
Cat_012B	483	0.0390	According to topography, the runoff from Cat_012B is directly discharged to the existing watercourse. As conservative approach for sizing the peripheral channel (Channel A), it is assumed that the peripheral channel have sufficient capacity to collect the runoff from Cat_012B. The peripheral channel is connected to Pipe PC-1 then to the proposed stormwater terminal manhole.

2. Determine the size of proposed peripheral channels

Using Manning equation for calculate the channel Free Flow Full Bore Capacity

SDM Table 12

$$\bar{V} = \frac{R^{1/6}}{n}\sqrt{RS_f}$$

where

$\bar{V}$ = Velocity (m/s)
R = Hydraulic Radius (m)
S_f = Slope (m/m)
n = Manning's Coefficient of Roughness (Dimensionless)

Assumptions:
1 Surface roughness coefficient (n) = 0.016 (refer to Concrete-lined Channel under Fair condition in Stormwater Drainage Manual Part 1 - Table 13)

Proposed open channels

For Rainfall Return Period 200 years

Channel Name	U-Channel / Rectangular Channel Size m	Area m^2	Wet Perimeter m	Channel Length m	Hydraulic Radius m	Upstream Ground Level mPD	Downstream Ground Level mPD	Upstream Invert mPD	Downstream Invert mPD	Min. slope of the channel bed (So)	Flow from Catchment m^3/s	Free Flow Full-bore Capacity m^3/s	Full-bore Velocity m/s	Utilization %	Flow Capacity Check
Channel A.1	0.6	0.32	1.54	60	0.21	12.7	11.6	10.90	9.80	55	0.405	0.956	2.97	42.4	OK
Channel A.2	0.6	0.32	1.54	16	0.21	11.7	9.7	9.20	8.96	65	0.405	0.876	2.72	46.3	OK
Channel A.3	0.6	0.32	1.54	8	0.21	9.7	10.5	8.96	8.91	160	0.405	0.558	1.74	72.6	OK
Channel A.4	0.6	0.32	1.54	46	0.21	10.5	9.5	8.91	8.63	160	0.405	0.558	1.74	72.6	OK
Channel A.5	0.6	0.32	1.54	14	0.21	9.5	8.8	8.23	8.14	160	0.405	0.558	1.74	72.6	OK
Channel A.6	0.6	0.32	1.54	30	0.21	8.8	8.1	7.69	7.50	160	0.405	0.558	1.74	72.6	OK
Channel B.1	0.3	0.08	0.77	19	0.10	12.7	10.0	10.50	9.60	22	0.072	0.239	2.98	30.2	OK
Channel B.2	0.3	0.08	0.77	30	0.10	10.0	8.6	9.00	8.20	38	0.072	0.182	2.26	39.9	OK
Channel B.3	0.3	0.08	0.77	9	0.10	8.6	8.5	8.20	8.15	180	0.072	0.083	1.03	87.3	OK
Channel B.4	0.3	0.08	0.77	11	0.10	8.5	8.5	8.15	8.09	180	0.072	0.083	1.03	87.3	OK
Channel B.5	0.3	0.08	0.77	24	0.10	8.5	8.4	8.09	7.96	180	0.072	0.083	1.03	87.3	OK
Channel B.6	0.3	0.08	0.77	36	0.10	8.4	8.6	7.96	7.76	180	0.072	0.083	1.03	87.3	OK
Channel B.7	0.3	0.08	0.77	39	0.10	8.6	8.2	7.76	7.55	180	0.072	0.083	1.03	87.3	OK
Channel B.8	0.3	0.08	0.77	32	0.10	8.2	8.1	7.55	7.37	180	0.072	0.083	1.03	87.3	OK

Ref.	Calculation

3. Determine the Size of the Proposed Pipes

New proposed pipes will be proposed to divert the surface runoff collected from the development to the existing drainage network.

$$V = -\sqrt{32gRSf}\log\left[\frac{ks}{14.8R} + \frac{1.255v}{R\sqrt{32gRSf}}\right]$$

Use the Colebrook-White Equation to Determine the Drainage Capacity

Assumptions:
1. Pipe Roughness is 3.00 mm
2. Transitional flow and water at 15 degree Celsius, i.e. kinematic viscosity is 1.14 x 10-6 m2/s.

Full-bore capacity for Proposed Pipe PC-1:

Pipe Diameter	600	mm
Pipe Roughness	3	mm
Thickness of Pipe	0.2	m
Cover	1.2	m
Length of Pipe	2	m
Upstream Invert	6.75	mPD
Downstream Invert	6.73	mPD
Hydraulic Gradient, Sf	0.010	
Gradient 1 in	100	
Full-bore capacity	0.56	m^3/s

and velocity of 1.97 m/s

The future flow of	0.41	m^3/s	is	72.9%	of the full-bore capacity of	0.56	m^3/s	**OK!**

The proposed Pipe PC-1 is capable of conveying the future flow while maintaining 10% flow capacity allowance for siltation under 1 in 200 years storm event.

Full-bore capacity for Proposed Pipe PC-2:

Pipe Diameter	450	mm
Pipe Roughness	3	mm
Thickness of Pipe	0.2	m
Cover	1.2	m
Length of Pipe	2	m
Upstream Invert	6.77	mPD
Downstream Invert	6.76	mPD
Hydraulic Gradient, Sf	0.004	
Gradient 1 in	250	
Full-bore capacity	0.16	m^3/s

and velocity of 1.03 m/s

The future flow of	0.07	m^3/s	is	44.2%	of the full-bore capacity of	0.16	m^3/s	**OK!**

The proposed Pipe PC-2 is capable of conveying the future flow while maintaining 10% flow capacity allowance for siltation under 1 in 200 years storm event.

3. Conclusion

(1) The proposed peripheral channels and associated pipe have sufficient capacity to collect the peak flow from catchments.