

Annex G

A Drainage Impact Assessment in response to DSD's Comment

**DRAINAGE IMPACT ASSESSMENT FOR
PROPOSED RESIDENTIAL DEVELOPMENT AT
LOT 1109 RP IN D.D. 253,8 KA SHUE ROAD,
SAI KUNG, NEW TERRITORIES
DRAINAGE IMPACT ASSESSMENT
REPORT**

OCTOBER 31, 2024

CONFIDENTIAL





**DRAINAGE IMPACT ASSESSMENT FOR
Proposed Residential Development at Lot
1109 RP in D.D. 253,8 Ka Shue Road, Sai
Kung, New Territories**

CONFIDENTIAL







DRAINAGE IMPACT ASSESSMENT REPORT

DATE: OCTOBER 31, 2024

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1 INTRODUCTION

1.1 BACKGROUND

- 1.1.1 The applicant proposes to redevelop the Application Site at Lot 1109 RP in D.D. 253,8 Ka Shue Road, Sai Kung, New Territories with minor relaxation of building height and site coverage restrictions. The Application Site falls within “Residential (Group C) 1” and “Green Belt” zones on the approved Tseng Lan Shue Outline Zoning Plan (OZP) No. S/SK-TLS/10.
- 1.1.2 The Applicants commissioned WSP (Asia) Limited (WSP) as the Consultant to carry out a Drainage Impact Assessment (DIA) for the proposed development under this planning application.

1.2 APPLICATION SITE AND ITS ENVIRONS

- 1.2.1 The Application Site covers an area of approximately 1,719m² and is situated in Sai Kung, New Territories. The proposed development site is bounded by Ka Shue Road.
- 1.2.2 The existing topography of the Project Site is predominantly flat, with a slight slope. The highest point is located in the middle of the site at +228.8mPD, gently sloping down to approximately +228.7mPD near Clear Water Bay Apartments Blocks F and E, and further descending to +220mPD at the northern edge of the site. The Application Site is surrounded by existing old buildings and areas of greenery. For the location of subject site, please refer to **Figure 1**.

1.3 PROJECT DESCRIPTION

- 1.3.1 The proposed development consists of two residential towers with soft landscape.
- 1.3.2 The proposed development's ground level will feature a combination of greenery and concrete paving. The ratio of paved to unpaved areas will remain largely consistent with the existing site layout.
- 1.3.3 The master layout plan is shown in **Appendix A**.

2 ASSESSMENT CRITERIA AND METHODOLOGY

2.1 GENERAL

- 2.1.1 The aim of this study is to assess the changes to runoff from the Application Site as a result of the proposed development and the potential impacts on the existing drainage system.
-

2.2 METHODOLOGY

Catchment Area

- 2.2.1 The catchment areas for the purpose of this DIA have been defined and details could be referred to Sections 3.

Storm Return Period

- 2.2.2 According to DSD's "*Stormwater Drainage Manual – Fifth Edition January 2018 (SDM)*", the category of stormwater drainage system of the site is classified as "Urban Drainage Branch Systems", so 1 in 50-year storm return period was adopted in this assessment. Effect of rainfall increase and sea level rise due to climate change by end of 21st Century are taken into account by adding 16% and 12.1% to the surface runoff from the proposed development in accordance with the Table 28 and Table 31 SDM Corrigendum No. 1/2022, respectively.

Sea Tidal Effect

- 2.2.3 The proposed project site is not subject to sea tidal effect and therefore sea level is not considered in the DIA.

Basic Formulation of Rational Method

- 2.2.4 Rational method is used for calculation of the peak runoff. The formula is extracted from Section 7.5.2(a) of SDM which is to estimate the stormwater runoff as shown below:

$$Q_p = 0.278CiA$$

| | | |
|-------|-------|--------------------------------------|
| 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 |

Time of Concentration

- 2.2.5 The time of concentration of urban area is assumed as 5 minutes as a conservative approach.

Runoff Intensity

- 2.2.6 The rainfall intensity is referenced from the Section 4.3.2 of SDM (Fifth Edition) and its Corrigendum 1/2024 which is to estimate the Intensity-Duration-Frequency (IDF) Relationship. The design storm return period is 50 years, the values of a, b and c are 505.5, 3.29 and 0.355, respectively.

$$i = \frac{a}{(t_d + b)^c}$$

| | | |
|-------|-----|-----------------------------------|
| where | i | = Extreme mean intensity in mm/hr |
|-------|-----|-----------------------------------|

t_d = Duration in minutes ($t_d < 240$)
 a, b, c = Storm constants given in SDM Table 3a.

- **Runoff Coefficient**

2.2.7 According to surface characteristics of the catchments, the runoff coefficient for paved area and unpaved area is 0.95 and 0.30 respectively.

-

2.2.8 Colebrook-White Equation is used in hydraulic design for pipe flow.

$$V = -\sqrt{32gRs} \log \left(\frac{k_s}{14.8R} + \frac{1.255v}{R\sqrt{32gRs}} \right)$$

where V = Mean velocity (m/s)
 g = Gravitational acceleration (m/s²)
 R = Hydraulic radius (m)
 D = Pipe diameter (m)
 k_s = Equivalent sand roughness (m)
 v = Kinematic viscosity of fluid (m²/s)
 s = Frictional slope (energy gradient due to frictional loss)

2.2.9 Manning's Equation is used in hydraulic design for open channel flow.

$$V = \frac{Ar^{1/6}(rs)^{1/2}}{n}$$

where V = Mean velocity (m/s)
 A = Cross sectional area of flow (m²)
 s = Frictional slope (Energy gradient due to frictional loss)
 r = Hydraulic radius (m)
 n = Manning coefficient of roughness

3 DRAINAGE IMPACT ASSESSMENT

3.1 BEFORE DEVELOPMENT

- 3.1.1 The Application Site is currently occupied by a residential building and characterized by a combination of concrete surfaces and greenery area.
- 3.1.2 The Application Site has been divided into Catchment A (including A1 to A3) and Catchment B (B1 to B4) based on their unique boundaries and topographical features. The characteristics of the Catchment A and Catchment B are shown in **Figure 2** and summarised in **Table 3-1**.
- 3.1.3 According to the site observations, the existing drainage system for the Application Site will be collected by the on-site U-channels and eventually discharge to two stepped channels as shown in **Figure 3**. The runoff from Catchment A would be discharged to the Stepped Channel 1, whereas the runoff from Catchment B will be discharged into Stepped Channel 2.

Table 3-1 Summary of Catchment Characteristics Before Development

| Catchment | Sub-Catchment | Runoff coefficient (C) | Total Area (m ²) | Estimated Runoff ^[1] (m ³ /s) | Receiving Stepped Channel |
|-----------|---------------|------------------------|------------------------------|---|----------------------------|
| A | A1 | 0.95 | 317.9 | 0.049 | Existing Stepped Channel 1 |
| | A2 | 0.30 | 143.8 | | |
| | A3 | 0.95 | 302.7 | | |
| B | B1 | 0.95 | 642.41 | 0.054 | Existing Stepped Channel 2 |
| | B2 | 0.30 | 56.78 | | |
| | B3 | 0.30 | 221.88 | | |
| | B4 | 0.30 | 15.46 | | |

Note[1] :The estimated runoff would be included 16% climate change factor as conservative.

3.2 AFTER DEVELOPMENT

- 3.2.1 After development, there is no major change on the landscape characteristic (i.e. combination of concrete surface and greenery area).
- 3.2.2 The catchment of the Application Site has been re-defined into Catchment P-A (including P-A1 to P-A6) and Catchment P-B (P-B1 to P-B9).The characteristics of the Catchment P-A and Catchment P-B are shown in **Figure 4** and summarised in **Table 3-2**.
- 3.2.3 The Application Site will follow the existing drainage system. The collected surface runoff would be discharged to the existing stepped channels as shown in **Figure 5**. The runoff from Catchment P-A would be discharged to the Stepped Channel 1, whereas the runoff from Catchment P-B will be discharged into Stepped Channel 2.

Table 3-2 Summary of Catchment Characteristics After Development

| Catchment | Sub-Catchment | Runoff coefficient (C) | Total Area (m ²) | Estimated Runoff [1] (m ³ /s) | Receiving Stepped-Channel |
|-----------|---------------|------------------------|------------------------------|--|----------------------------|
| P-A1 | P-A1 | 0.30 | 144.6 | 0.048 | Existing Stepped Channel 1 |
| | P-A2 | 0.30 | 74.1 | | |
| | P-A3 | 0.30 | 8.4 | | |
| | P-A4 | 0.95 | 264.9 | | |
| | P-A5 | 0.30 | 1.9 | | |
| | P-A6 | 0.95 | 314.8 | | |
| P-B1 | P-B1 | 0.30 | 28.4 | 0.053 | Existing Stepped Channel 2 |
| | P-B2 | 0.30 | 42.9 | | |
| | P-B3 | 0.95 | 55.2 | | |
| | P-B4 | 0.30 | 24.9 | | |
| | P-B5 | 0.95 | 249.0 | | |
| | P-B6 | 0.30 | 131.3 | | |
| | P-B7 | 0.30 | 3.7 | | |
| | P-B8 | 0.95 | 343.7 | | |
| | P-B9 | 0.30 | 1.6 | | |

Note[1] :The estimated runoff would be included 16% climate change factor as conservative.

3.3 ASSESSMENT FINDINGS

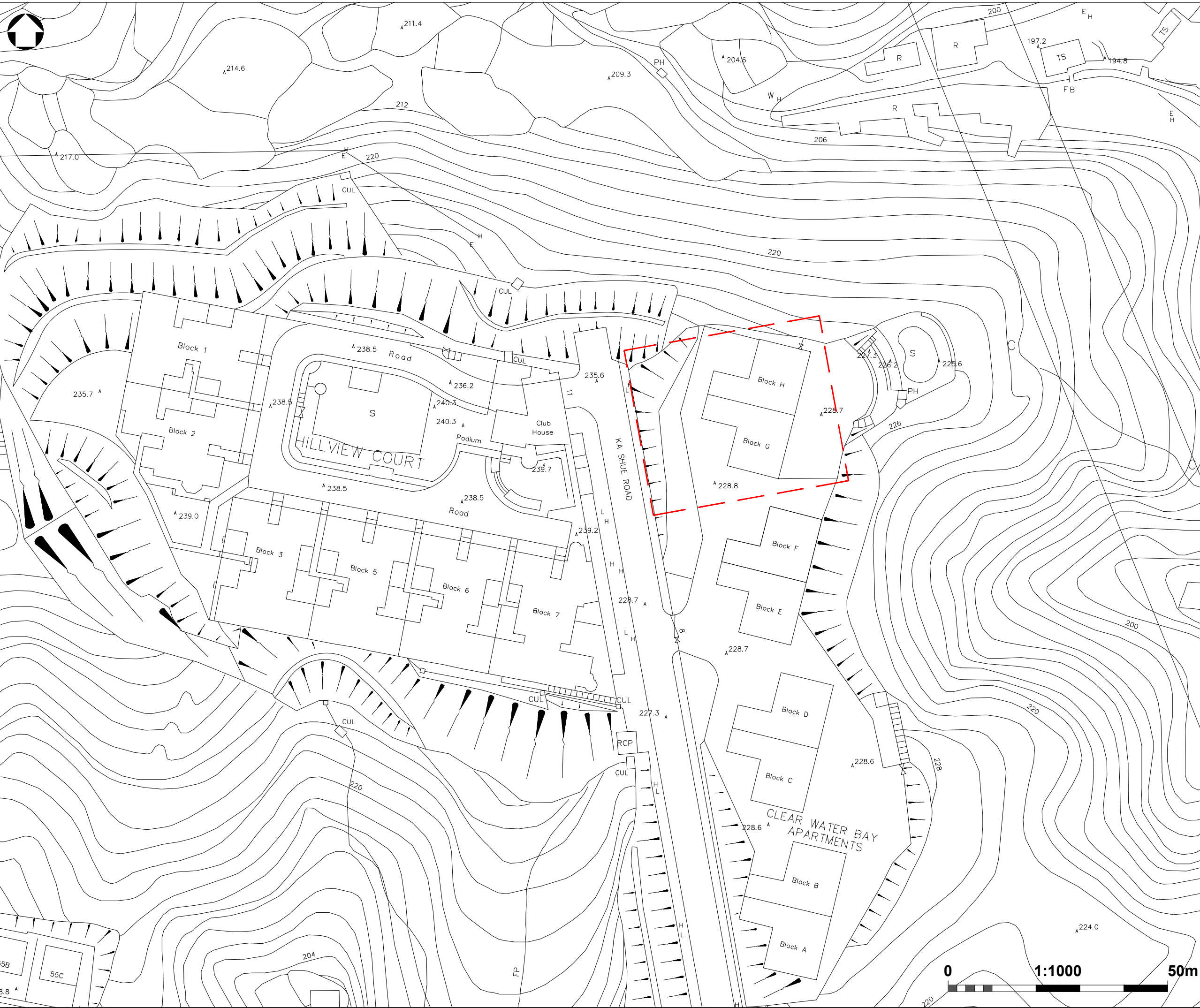
- 3.3.1 Base on the catchment area as mentioned in **Table 3-1** and **Table 3-2**, the runoff from the proposed development before and after development was estimated based on the return periods of 50 years as detailed in **Appendix B**.
- 3.3.2 **Table 3-3** presents a comparative analysis of the estimated peak runoff under existing and proposed development conditions. For Existing Stepped Channel 1, the peak runoff is projected to decrease marginally from **0.049m³/s to 0.048m³/s**, while for Existing Stepped Channel 2, it is expected to reduce slightly from **0.054m³/s to 0.053m³/s**. These calculations, based on a 50-year return period, demonstrate that the proposed development will not lead to an increase in peak runoff. Hence, no significant adverse impact is anticipated due to the proposed development on the existing drainage system.

Table 3-3 Estimated Peak Runoff of the Existing Condition and Propose Development


| | Estimate Peak Runoff (m ³ /s) | | |
|----------------------------|--|-------------------|------------|
| | Existing Condition | After Development | Increase ? |
| Existing Stepped Channel 1 | 0.049 | 0.048 | No |
| Existing Stepped Channel 2 | 0.054 | 0.053 | No |

Figures

Date : 2024/09/24
 Filename : \\hkwr200dat16\SD\EN\7 - Projects\Project_H321_ENV\Wyn int Spectacle Theatre\B. Other Proposal\Exx (2024.09.03) Ka Shue Rd DIA 4.Ka Shue Road Project Folder\6. Working\2. Calculation\20240920_KSR_DIA_existing Site_For PPT.dwg



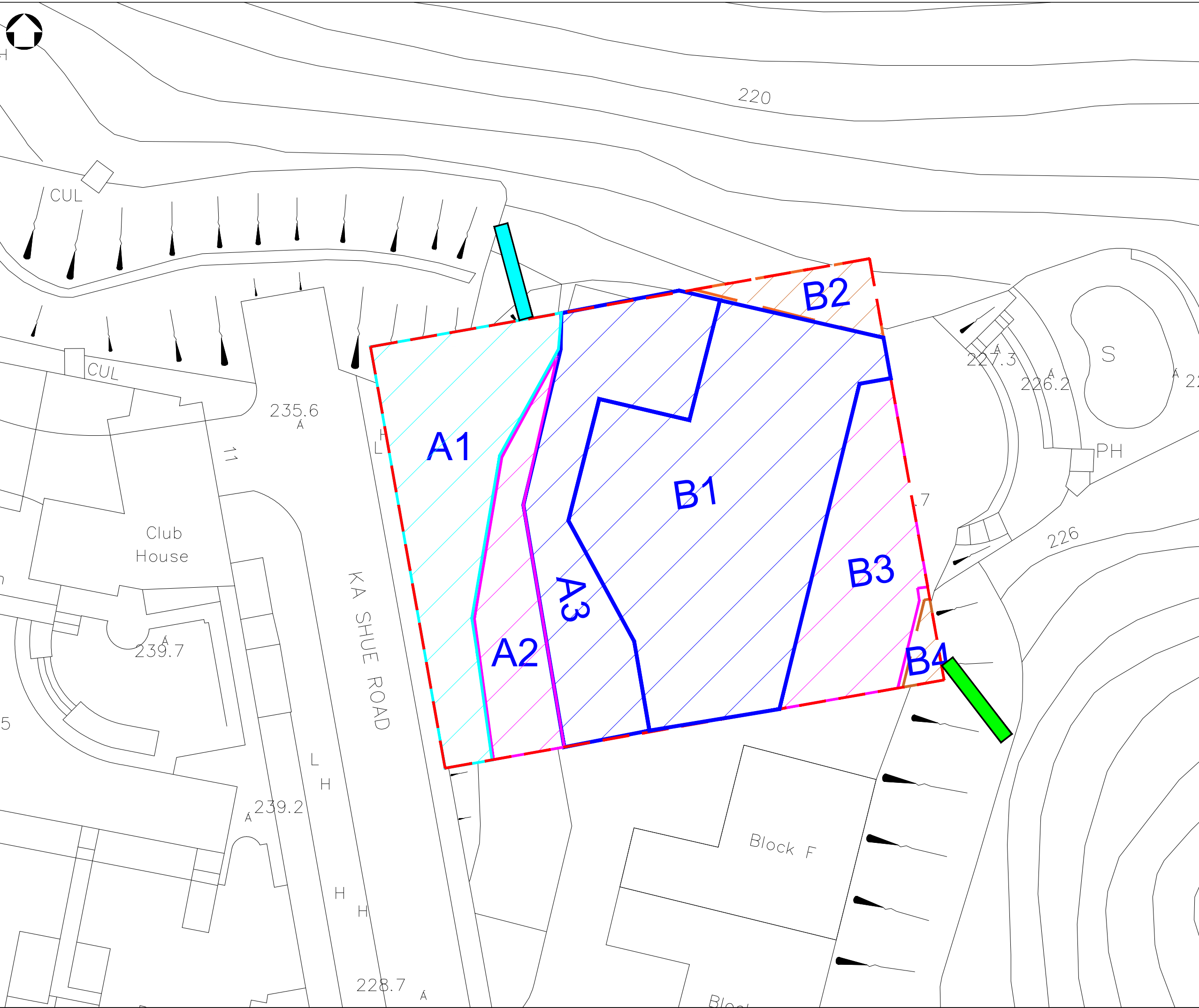
LEGEND :
 --- SITE BOUNDARY

| Rev | Description | By | Date |
|---|------------------------|----------------------|-----------------------|
|  | | | |
| Project title Proposed Residential Development at Lot 1109 RP in D.D. 253,8 Ka Shue Road, Sai Kung, New Territories | | | |
| Drawing title LOCATION OF THE PROJECT | | | |
| Drawing no. FIGURE 1 | | Rev. 0 | |
| Drawn SC | Date AUG2024 | Checked AC | Approved FN |
| Scale 1:200@A3 | | Status - | |



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Date : 2024/09/26
 Filename : \\hkwr200dat16\SD\ENNV=7: Projects\Project_H321_ENV\Wynn Intl Spectacle Theatre\8: Other Proposal\Ex (2024.09.03) Ka Shue Rd DIA\4:Ka Shue Road Project Folder\6: Working\2: Calculation\20240920_KSR_DIA_existing Site_For PPT.dwg

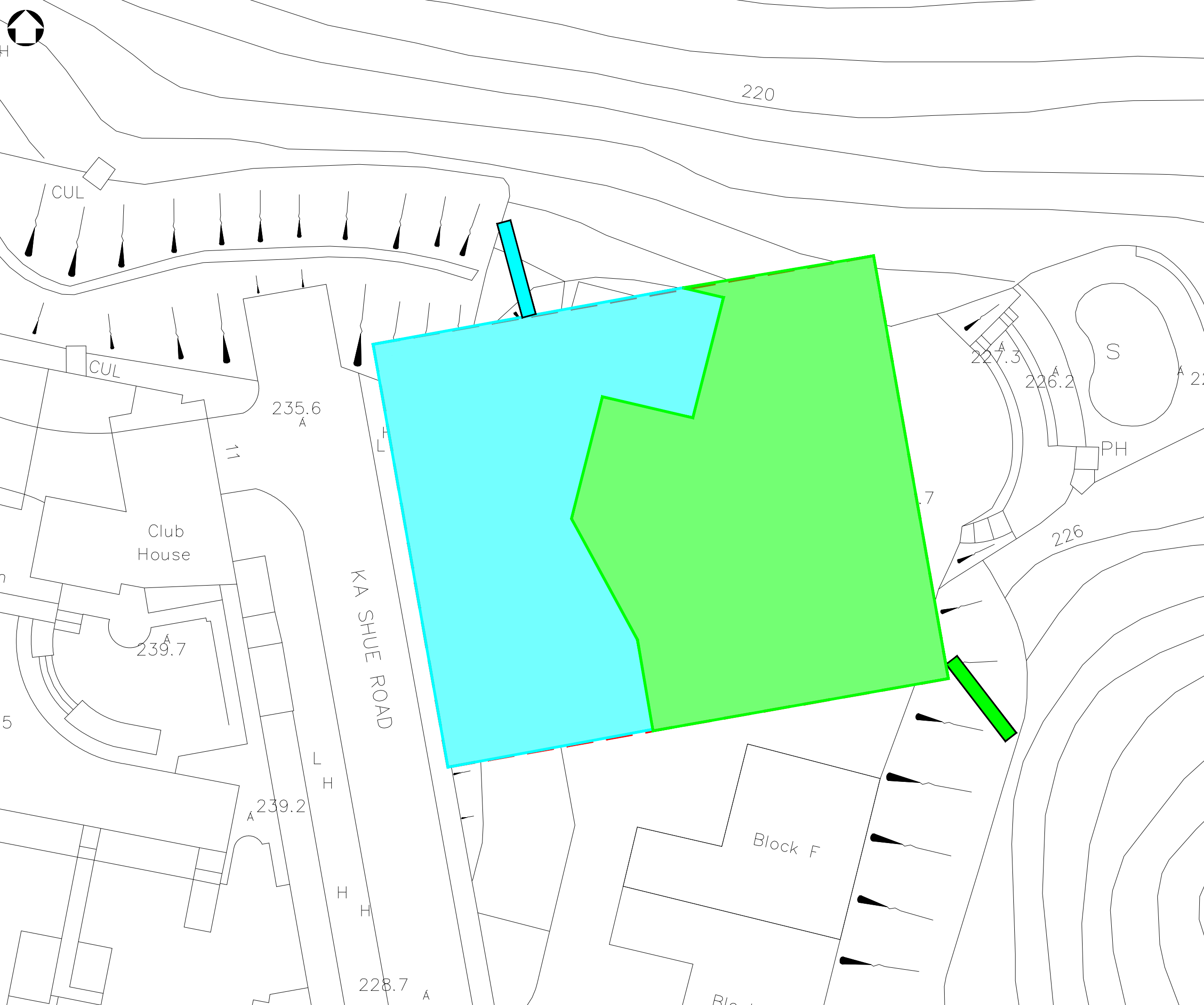


LEGEND :


- - - SITE BOUNDARY
- ▨ NATURAL SLOPE
- ▨ LAWN
- ▨ PAVED AREA
- ▨ FILLING SLOPE
- ▬ EXISTING STEPPED CHANNEL 1
- ▬ EXISTING STEPPED CHANNEL 2

| Rev | Description | By | Date |
|---|------------------------|----------------------|-----------------------|
| <div style="font-size: 2em; font-weight: bold; color: red; margin: 0;">WSP</div> | | | |
| Project title Proposed Residential Development at Lot 1109 RP in D.D. 253,8 Ka Shue Road, Sai Kung, New Territories | | | |
| Drawing title Existing Catchment at Subject Site Layout Plan | | | |
| Drawing no. FIGURE 2 | | | Rev. 0 |
| Drawn SC | Date AUG2024 | Checked AC | Approved FN |
| Scale 1:200@A3 | Status - | | |

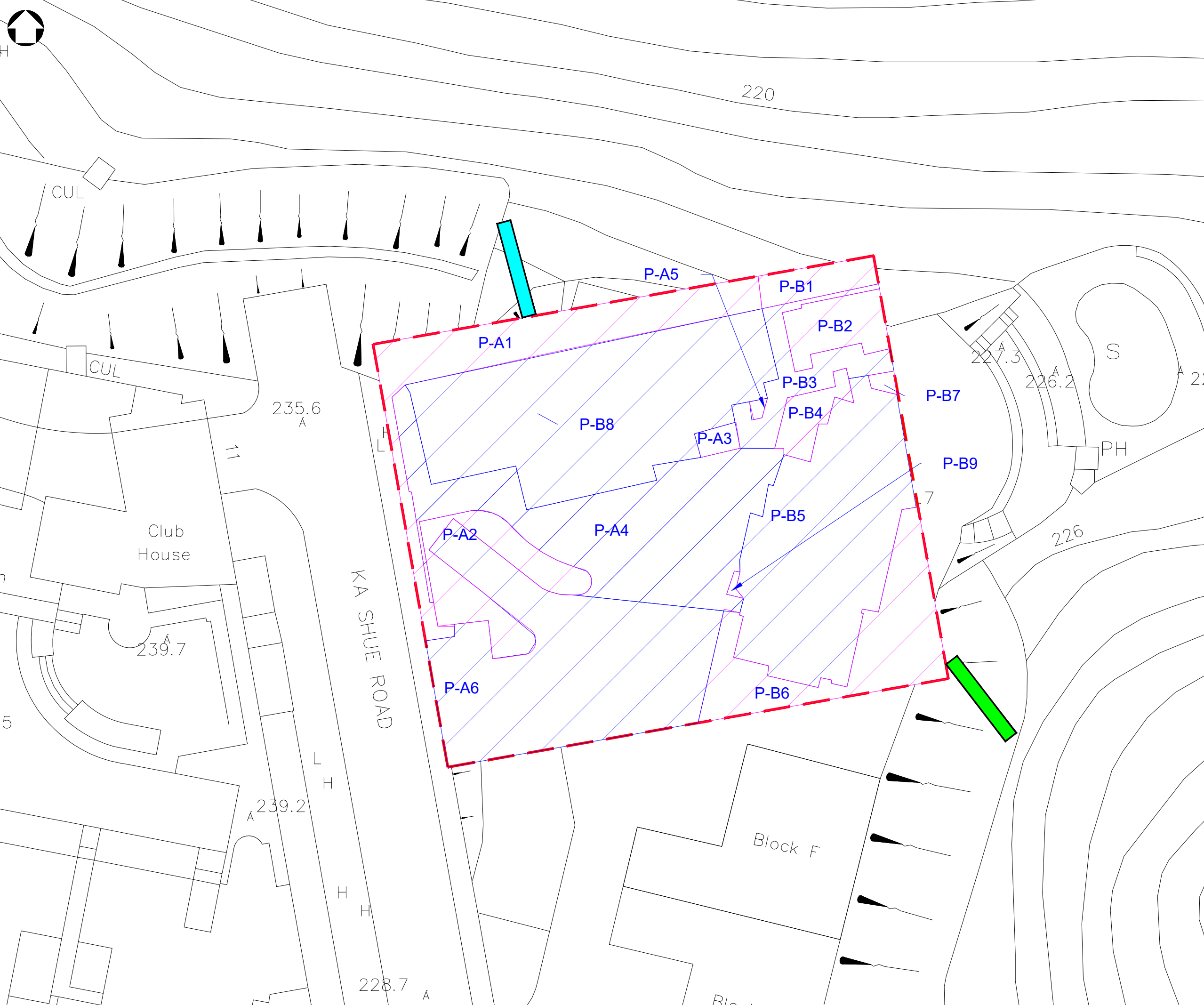
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- LEGEND :
- SITE BOUNDARY
 - ANTICIPATED STORMWATER AREA FLOW TO EXISTING STEP CHANNEL 1
 - ANTICIPATED STORMWATER AREA FLOW TO EXISTING STEP CHANNEL 2
 - EXISTING STEPPED CHANNEL 1
 - EXISTING STEPPED CHANNEL 2


| Rev | Description | By | Date |
|---|--------------|------------|-------------|
| Consultant | | | |
|  | | | |
| Project title | | | |
| Proposed Residential Development at Lot 1109 RP in D.D. 253,8 Ka Shue Road, Sai Kung, New Territories | | | |
| Drawing title | | | |
| Locations of Existing Catchment Areas and Stepped Channel in Existing Condition | | | |
| Drawing no. FIGURE 3 | | | Rev. 0 |
| Drawn SC | Date AUG2024 | Checked AC | Approved FN |
| Scale 1:200@A3 | | Status | - |

Date : 2024/11/01
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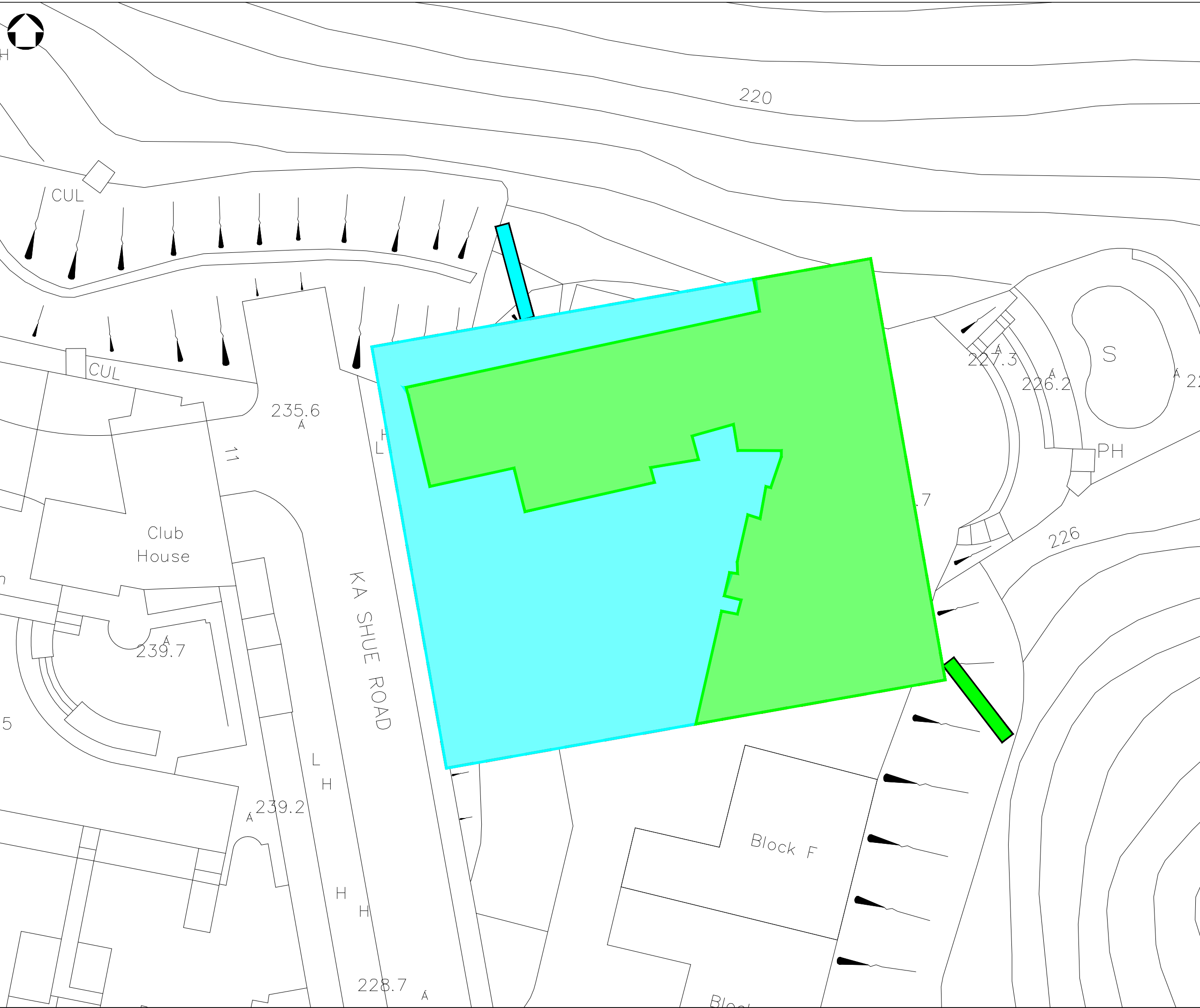


LEGEND :

- SITE BOUNDARY
- ▨ LAWN
- ▨ PAVED AREA
- ▨ EXISTING STEPPED CHANNEL 1
- ▨ EXISTING STEPPED CHANNEL 2


| Rev | Description | By | Date |
|---|------------------------|----------------------|-----------------------|
|  | | | |
| Project title Proposed Residential Development at Lot 1109 RP in D.D. 253,8 Ka Shue Road, Sai Kung, New Territories | | | |
| Drawing title Propose Catchment at Subject Site Layout Plan in Existing Condition | | | |
| Drawing no. FIGURE 4 | | | Rev. 1 |
| Drawn SC | Date AUG2024 | Checked AC | Approved FN |
| Scale 1:200@A3 | Status - | | |

Date : 2024/09/26
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LEGEND :

- SITE BOUNDARY
- ANTICIPATED STORMWATER AREA FLOW TO EXISTING STEP CHANNEL 1
- ANTICIPATED STORMWATER AREA FLOW TO EXISTING STEP CHANNEL 2
- ▬ EXISTING STEPPED CHANNEL 1
- ▬ EXISTING STEPPED CHANNEL 2

| Rev | Description | By | Date |
|---|------------------------|----------------------|-----------------------|
|  | | | |
| Project title Proposed Residential Development at Lot 1109 RP in D.D. 253,8 Ka Shue Road, Sai Kung, New Territories | | | |
| Drawing title Locations of Catchment Areas and Stepped Channel After Development | | | |
| Drawing no. FIGURE 5 | | | Rev. 0 |
| Drawn SC | Date AUG2024 | Checked AC | Approved FN |
| Scale 1:200@A3 | | Status | Rev. - |

Appendix A Master Layout Plan of Proposed Development



BD REF : 2/9414/23
 FSD REF : FP 8/31908
 BIM REF :

| NO. | DATE | REVISION | APP. |
|-----|------------|-----------------|------|
| A | 2024-08-15 | BD RESUBMISSION | JC |
| | 2024-03-27 | BD SUBMISSION | JC |

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PROJECT
 PROPOSED RESIDENTIAL DEVELOPMENT
 AT KA SHUE ROAD
 LOT 1109RP IN D.D.253
 SAI KUNG, NEW TERRITORIES

DRAWING TITLE
 2/F-5/F FLOOR PLAN
 (4/F OMITTED)

| DRAWING NO. | REV. NO. | PROJECT NO. |
|-------------|----------|-------------|
| A-05 | A | 23-546 |

| DESIGNED | CHECKED | SCALE |
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| JC | JC | 1:100 |

| DRAWN | APPROVED | DATE |
|-------|----------|-----------|
| LWH | KC | MAR, 2024 |

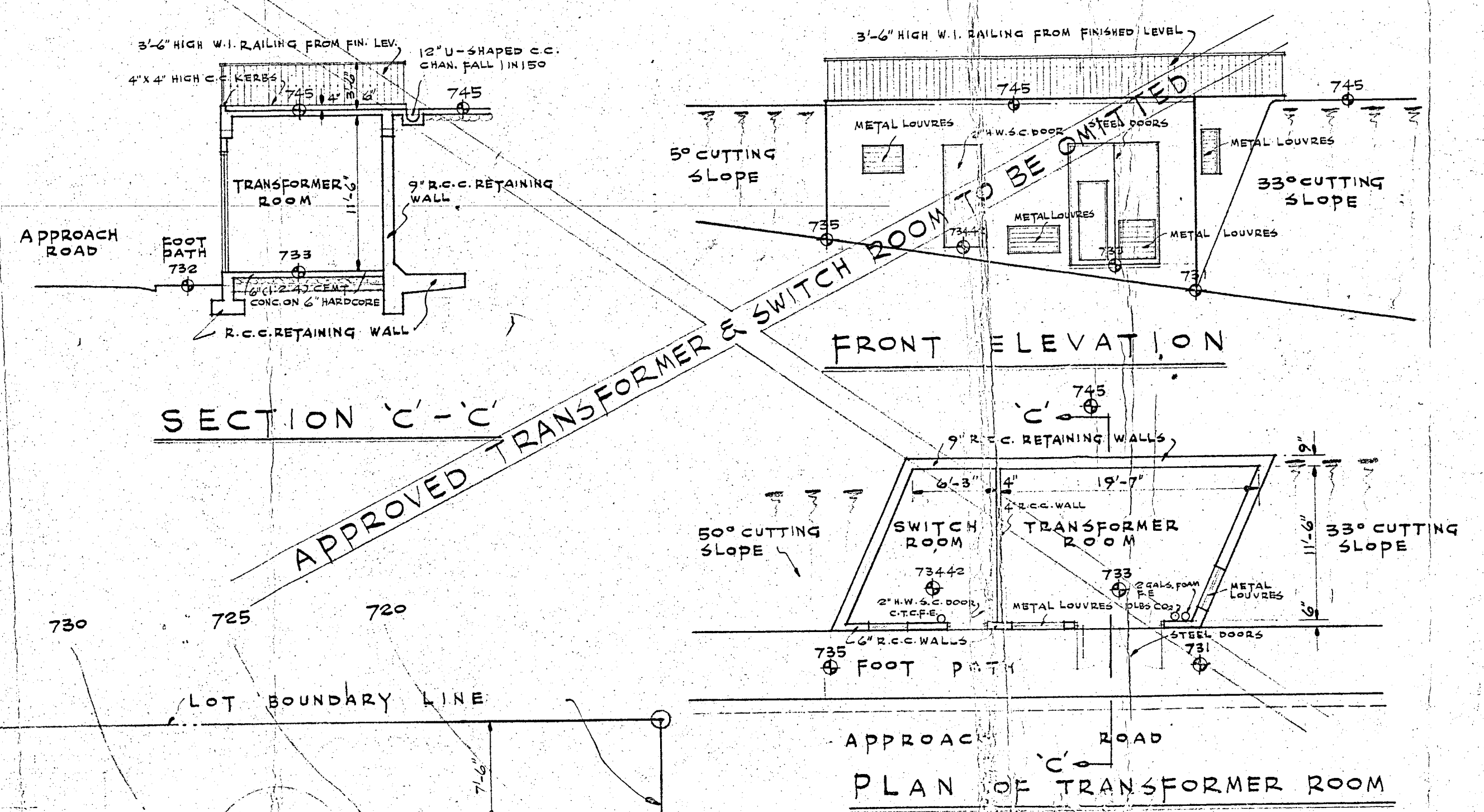
CAD REF :
 V:\CSD\23-546 Ka Shue Road Sai Kung\05A\046_OF-RF

C Y S Associates (H K) Ltd.
 Architects & Urban Designers.

B.D. SUBMISSION
 15 AUG 2024

* ARCHITECTURAL FEATURE COMPLY WITH APPENDIX B OF PNAP APP-93

Appendix B Drainage Impact Assessment Calculations



Indicative Site Boundary

BLOCK B, C AND D, ALL DIMENSIONS & MATERIALS TO BE SAME AS BLOCK A

GROUND FLOOR PLAN

APPROVED BY
DATE
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PROJECT NO.

APPROVED BY
DATE
SCALE
PROJECT NO.

NG CHUN MAN ARCH

DATE
SCALE
PROJECT NO.

Appendix B - Drainage Impact Assessment Calculations

| Scenario | Catchment Location | Catchment Area (A), m ² | Time of Concentration (mins) | Storm Constants | | | Runoff intensity (i), mm/hr | Runoff coefficient (C) | C x A | Climate Change Factor | Peak runoff, m ³ /s |
|--|--------------------|------------------------------------|------------------------------|-----------------|------|-------|-----------------------------|------------------------|-------|-----------------------|--------------------------------|
| | | | | a | b | c | | | | | |
| Existing - Catchment A | A1 | 317.9 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 302.0 | 16% | 0.023 |
| - | A2 | 143.8 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 43.2 | 16% | 0.003 |
| - | A3 | 302.7 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 287.6 | 16% | 0.022 |
| Total Runoff of Existing condition to Existing Stepped-Channel 1 | | | | | | | | | | | 0.049 |

| | | | | | | | | | | | |
|---|------|-------|---|-------|------|-------|-------|------|-------|-----|--------------|
| Proposed - Catchment A | P-A1 | 144.6 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 43.4 | 16% | 0.003 |
| - | P-A2 | 74.1 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 22.2 | 16% | 0.002 |
| - | P-A3 | 8.4 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 2.5 | 16% | 0.000 |
| - | P-A4 | 264.9 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 251.7 | 16% | 0.019 |
| - | P-A5 | 1.9 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 0.6 | 16% | 0.000 |
| - | P-A6 | 314.8 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 299.0 | 16% | 0.023 |
| Total Runoff of After Development to Existing Stepped-Channel 1 | | | | | | | | | | | 0.048 |

| Scenario | Catchment Location | Catchment Area (A), m ² | Time of Concentration (mins) | Storm Constants | | | Runoff intensity (i), mm/hr | Runoff coefficient (C) | C x A | Climate Change Factor | Peak runoff, m ³ /s |
|--|--------------------|------------------------------------|------------------------------|-----------------|------|-------|-----------------------------|------------------------|-------|-----------------------|--------------------------------|
| | | | | a | b | c | | | | | |
| Existing - Catchment B | B1 | 642.4 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 610.3 | 16% | 0.047 |
| - | B2 | 56.8 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 17.0 | 16% | 0.001 |
| - | B3 | 221.9 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 66.6 | 16% | 0.005 |
| - | B4 | 15.5 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 4.6 | 16% | 0.000 |
| Total Runoff of Existing condition to Existing Stepped-Channel 2 | | | | | | | | | | | 0.054 |

| | | | | | | | | | | | |
|--|------|-------|---|-------|------|-------|-------|------|-------|-----|--------------|
| Proposed - Catchment B | P-B1 | 28.4 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 8.5 | 16% | 0.001 |
| - | P-B2 | 42.9 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 12.9 | 16% | 0.001 |
| - | P-B3 | 55.2 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 52.5 | 16% | 0.004 |
| - | P-B4 | 24.9 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 7.5 | 16% | 0.001 |
| - | P-B5 | 249.0 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 236.6 | 16% | 0.018 |
| - | P-B6 | 131.3 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 39.4 | 16% | 0.003 |
| - | P-B7 | 3.7 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 1.1 | 16% | 0.000 |
| - | P-B8 | 343.7 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.95 | 326.5 | 16% | 0.025 |
| - | P-B9 | 1.6 | 5 | 505.5 | 3.29 | 0.355 | 238.6 | 0.30 | 0.5 | 16% | 0.000 |
| Total Runoff of After Development to Stepped U-Channel 2 | | | | | | | | | | | 0.053 |