1. Drainage Proposal

1.1 Site Particulars

1.1.1 The application site is abutting a local vehicular access leading to Kong Nga Po Road. possesses an area of approximately 2,145m^2.

1.1.2 There is a natural open stream directly to the northeast of the application site, and an underground drainage direction to the west of the application site. The application site is currently vacant.

1.2 Level and gradient of the subject site & proposed surface channel

1.2.1 The application site is mostly paved, an area of approximately 2,145m^2. The paved area will have a gradient sloping from southeast to northwest from about +29.7mPD to +29.5mPD.

1.2.2 In order to follow the topography of the application site, the proposed surface channel will be constructed following the gradient of the site. As demonstrated in the calculation in Annex 1.3 hereunder, 300mm surface U-channel will be capable to drain the surface runoff accrued at the subject site.

1.3 Catchment area of the proposed drainage provision at the subject site.

1.3.1 It is noted that the land to the South of the application site commands a higher level whereas the land to the north and west command a lower level. There is existing drainage abutting to the east and south of the site. As such, no external catchment is identified.

1.3.2 The intercepted stormwater will then be discharged to the existing open streamcourse to the Northwest of the Site via a proposed 300mm surface U-channel.

2 Runoff Estimation and Proposed Drainage Facilities

2.1 Proposed Drainage Facilities

2.1.1 Subject to the below calculations, it is determined that 300mm surface U-channel which is made of concrete along the site periphery is adequate to intercept storm water passing through and generated at the application site.

2.1.2 The intercepted stormwater will then be discharged to the existing natural stream to the northwest of the application site as shown in Figure 1.

2.1.3 The flow capacities of the proposed U-channel are calculated using the Chart for the Rapid Design of Channels. Runoff from corresponding Site Catchments (calculated based on a return period of 50 years), the capacity estimation are included below.

2.1.4 The calculations below shows that the proposed 300mm U-channel has adequate capacity to cater for the surface runoff generated at the application site and the external catchment. A sand trap is proposed at the terminal catchpit.

2.1.5 All the proposed drainage facilities, including the section of surface channel proposed in between the subject site to the streamcourse will be provided and maintained at the applicant's own expense. Also, surface U-channel will be cleaned at regular interval to avoid the accumulation of rubbish/debris which would affect the dissipation of storm water.

2.1.6 Prior to the commencement of drainage works, the applicant will seek the consent of the District Lands Office/North District and the registered land owner for any drainage works outside the application site or outside the jurisdiction of the applicant.

2.1.7 The provision of the proposed surface U-channel will follow the gradient of the application site. All the proposed drainage facilities will be constructed and maintained at the expense of the applicant.

2.1.8 All proposed works at the site periphery would not obstruct the flow of surface runoff from the adjacent areas, the provision of trees and surface U-channel at the site boundary is detailed hereunder:

a) Soil excavation at the site periphery, although at minimal scale, is inevitably for the provision of surface U-channel and landscaping. In the reason that the accumulation of excavated soil at the site periphery would obstruct the free flow of the surface runoff from the surroundings, the soil will be cleared at the soonest possible after the completion of the excavation process.
b) No levelling work will be carried at the site periphery. The level of the site periphery will be maintained during and after the works. As such, the works at the site periphery would not either alter or obstruct the flow of the surface runoff from adjacent areas.
c) Some holes will be provided at the toe of hoarding so as to allow unobstructed flow of surface runoff to and from adjacent areas.

3 Drainage Calculation for the proposed Provision of Drainage Facilities at the Application Site

3.1 Runoff Estimation

3.1.1 Rational method is adopted for estimating the designed run-off

$$Q=0.278\ C \times I \times A$$

Table 1: Runoff Coefficients

Surface Characteristics	Runoff Coefficient
Asphalt	0.70-0.95
Concrete	0.80-0.95
Brick	0.70-0.85
Grassland (Heavy Soil)	
Flat	0.13-0.25
Steep	0.25-0.35
Grassland (Sandy Soil)	
Flat	0.05-0.15
Steep	0.15-0.2

Assuming that:

I. The total catchment area from the application site is about 2,145 m^2;
II. Approximately 2,145 m^2 is hard paved, and therefore the value of run-off co-efficient (k) is taken as 0.95.

Difference in Land Datum	=	29.7m –29.5m = 0.2m
L	=	71.6m
Average fall	=	0.28m in 100m

According to the Brandsby-Williams Equation adopted from the “Stormwater Drainage Manual – Planning, Design and management” published by the Drainage Services Department (DSD),

$$\text{Time of Concentration } (t_c) = 0.14465[L/(H^{0.2} \times A^{0.1})]$$

t_c = $0.14465[71.6/(0.28^{0.2}\times 2{,}145^{0.1})]$

t_c = 6.20 minutes

The rainfall intensity *i* is determined by using the Gumbel Solution:

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

Where *I* = Extreme mean intensity in mm/hr

td = Duration in minutes (td≤240)

a, b, c = Storm constants given in the table below

Table 2: Storm Constants for Different Return Periods of North District Area

Return Period T(years)	2	5	10	20	50
a	1004.5	1112.2	1157.7	1178.6	1167.6
b	17.24	18.86	19.04	18.49	16.76
c	0.644	0.614	0.597	0.582	0.561

i = $1167.6/[6.2+16.76]^{0.561}$

i = 201.2mm/hr

By Rational Method, Q = $0.95\times$ 201.2mm/hr × 2,145/3600

Q = 114l/s = $0.114 m^3/s$ = 6,835 l/min

In accordance with the Chart of the Rapid Design of Channels in "Geotechnical Manual for Slopes", 450mm surface U-channel in 1:100 gradient is considered adequate to dissipate all the stormwater accrued by the application site. The intercepted stormwater will then be discharged to the existing natural stream to the north of the application site as shown in Figure 2.

3.2 Checking the Capacity of the Natural Stream

Manning Equation

$$V = R^{2/3} \times S_f^{0.5}/n$$

$$R = \frac{L\times D}{2D+L}$$

L = 2.5m

D = 1.8m

R = [2.5×1.8]/[2×1.8+2.5]

R = 0.738m

n = 0.035 $s/m^{1/3}$

(Table 13 of Stormwater Drainage Manual)

V = $[0.738^{2/3}]\times[0.01^{0.5}]/0.035$

V = 2.33m/sec

Maximum Capacity Q_{Max} = V × A

A = L × D

A = 2.5 × 1.8

A	=	$4.5m^2$
Q_{Max}	=	$2.33m/sec \times 4.5m^2$
Q_{Max}	=	$10.5m^3/sec$
$10.5m^3/sec$	>	$0.114m^3/sec$
Q_{Max}	>	Q

The runoff estimation is only a small fraction of the existing streamcourse's capacity

4 Conclusion

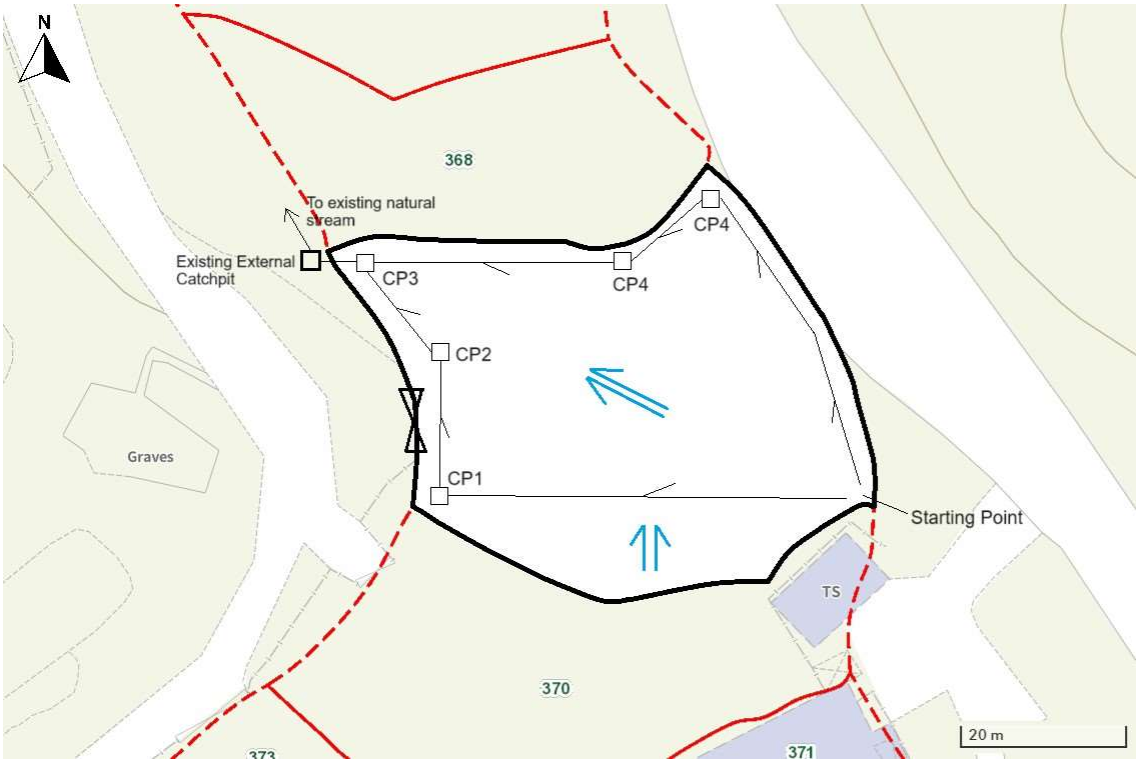
4.1 The applicant will be responsible for the construction and ongoing maintenance of the drainage facilities.

4.2 Potential drainage impacts that may arise from the Site after construction of the Proposed Development have been assessed. Thus, existing stormwater system will have sufficient capacity to receive stormwater runoff from the Proposed Development and surrounding catchments.

4.3 Adequate measures are provided at the resources of the applicant to prevent the site from being eroded and flooded

4.4 External catchment is taken into account such that flooding susceptibility of the adjoining areas would not be adversely affected by the proposed development.

Figure 1 Drainage Plan



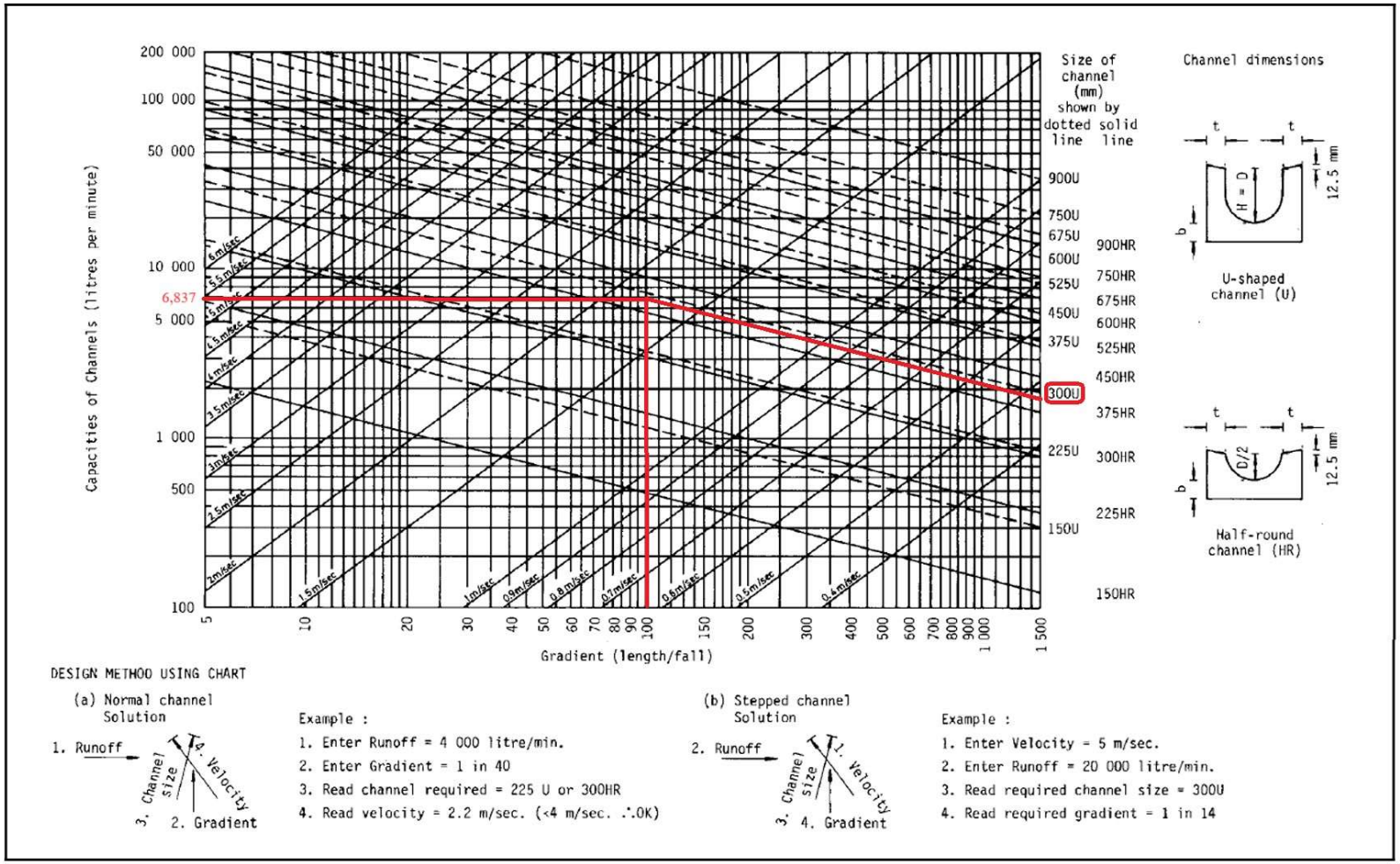


Figure 2

Chart for the Rapid Design of Channels in the Geotechnical Manual for Slopes (Second Edition) (GCO, 1984)