1. Drainage Proposal

1.1 Site Particulars

1.1.1 The application site is abutting the Man Kam To Food control office, and possesses an area of approximately 4,364m^2.

1.1.2 There is a natural open stream directly to the north of the application site.

1.1.3 The application site is vacant and unpaved

1.1.4 The application site is in close proximity to the Man Kam To Boundary Control Point and a number of open storage yards and warehouse. The land in close proximity is mainly vacant soil land.

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

1.2.1 The application site is entirely vacant and unpaved. It can be separated into two areas; the western portion has a very gentle gradient sloping from South to North from about +8.6mPD to +8.4mPD, and the central portion which is separated by a steep slope from the western portion, has a very gentle gradient sloping from South to North from about 7.2mPD to 7.0mPD. While the Southern portion has a higher gradient sloping from South to North from +10.2mPD to +7.2mPD.

1.2.2 An area of approximately 4,364m^2 is proposed to be filled and paved. The proposed paved area will have a gradient sloping from Southwest to Northeast from about +8.7mPD to +8.2mPD, spanning the majority of the site, and only the entrance at the Southern portion of the site will have a greater gradient sloping from South to North from about +10.2mPD to 8.3mPD

1.2.3 The proposed surface channel will be constructed following the proposed gradient of 1:100. As demonstrated in the calculation in Annex 2.3 hereunder, 450mm 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. The land to the East of the application site is occupied by temporary open storage with its own drainage facilities. There is an existing open channel abutting to the north of the site. As such, an external catchment is found to the South of the application site (Figure 1).

1.3.2 The Site currently receives runoff from the external catchment to the South of the site and this will continue after the proposed development. The runoff is expected to be widespread (rather than at discrete locations), U-channels will be proposed to collect the internal and external drainage.

1.3.3 The intercepted stormwater will then be discharged to the existing open streamcourse to the North of the Site via a proposed 450mm surface U-channel.

1.3.4 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 Runoff Estimation

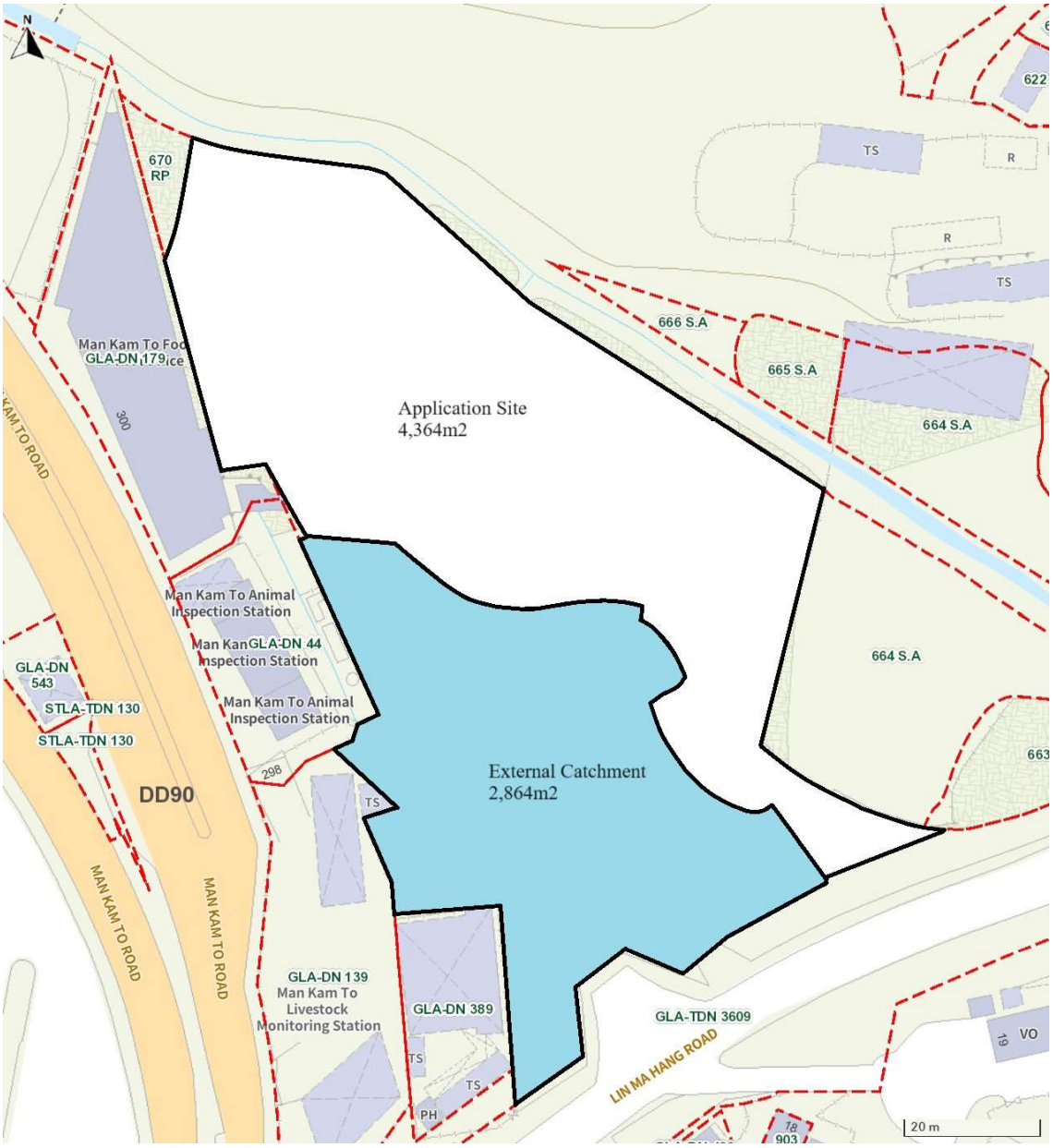
2.1 Proposed Drainage Facilities

2.1.1 Subject to the below calculations, it is determined that 450mm 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 north of the application site as shown in Figure 3 via a proposed 450mm surface U-channel leading to the natural stream.

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.

Figure 1: Catchment Area



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 is about 7,228m^2, including the area of external catchment of approximately 2,864m^2 and the existing site area of about 4,364 m^2;

II. Approximately 4,642 m^2 is hard paved, and therefore the value of run-off co-efficient (k) is taken as 0.95.

III. Approximately 2,586 m^2 is unpaved and covered in heavy soil, and therefore the value of run-off co-efficient (k) is taken at 0.25.

Difference in Land Datum	=	10.2m –8.3m = 1.9m
L	=	118.5m
Average fall	=	1.60m 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),

Time of Concentration (t_c)	=	$0.14465[L/(H^{0.2}\times A^{0.1})]$
t_c	=	$0.14465[118.5/(1.6^{0.2}\times 7{,}228^{0.1})]$
t_c	=	6.446 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

$$i = 1167.6/[6.446+16.76]^{0.561}$$
$$i = 200.1\text{mm/hr}$$

By Rational Method, Q = 0.95× 200.1mm/hr × 4,642 /3600
+0.25× 200.1mm/hr × 2,586/3600

Q = 281l/s = 0.281m^3/s = 16,861 l/min

In accordance with the Chart of the Rapid Design of Channels in "Geotechnical Manual for Slopes" (Figure 2), 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 3.

Figure 2

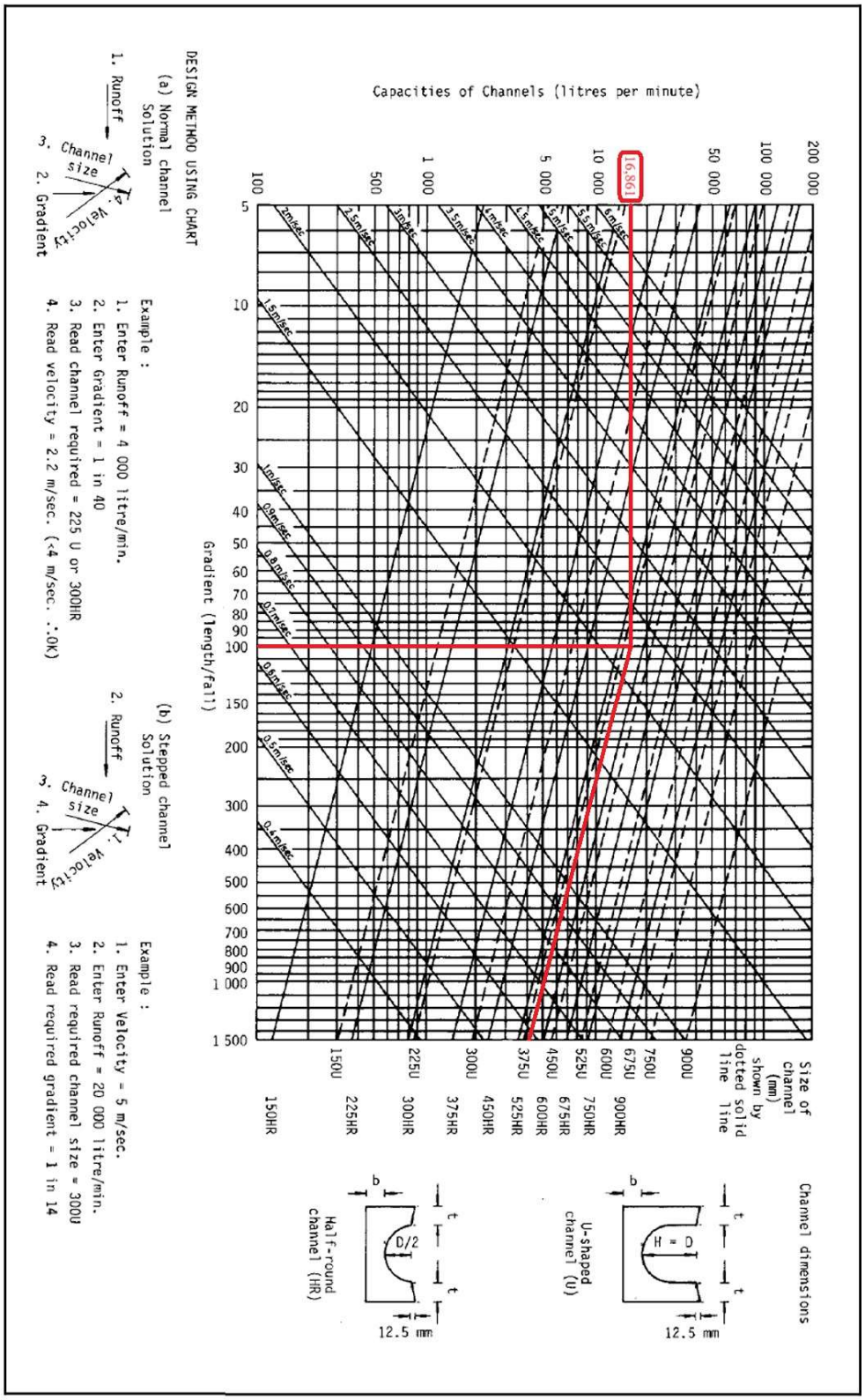
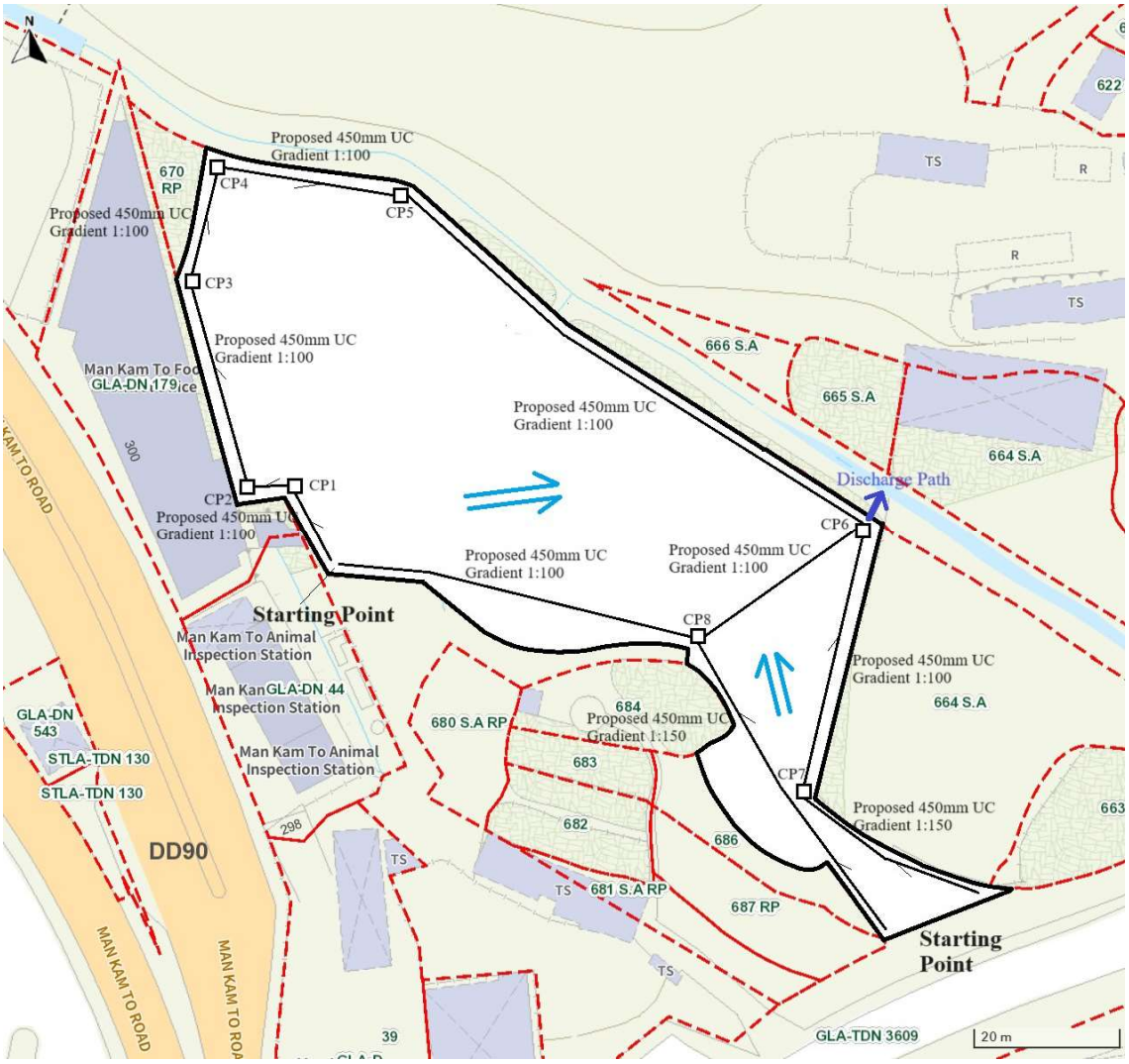


Chart for the Rapid Design of Channels in the Geotechnical Manual for Slopes (Second Edition) (GCO, 1984)

Figure 3: Drainage Plan



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	=	2.8m
D	=	1.5m
R	=	[2.8×1.5]/[2×1.5+2.8]
R	=	0.72m
n	=	0.035 s/m$^{1/3}$
		(Table 13 of Stormwater Drainage Manual)
V	=	[$0.72^{2/3}$]×[$0.01^{0.5}$]/0.035
V	=	2.30m/sec

Maximum Capacity $Q_{Max} = V \times A$

A	=	L × D
A	=	2.8 × 1.5
A	=	$4.2m^2$
Q_{Max}	=	$2.3m/sec \times 4.2m^2$
Q_{Max}	=	$9.68m^3/sec$
$9.68m^3/sec$	>	$0.281m^3/sec$
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.