GoldRich PLANNERS & SURVEYORS LTD.
金 潤 規 劃 測 量 師 行 有 限 公 司

Your Ref.: A/YL-KTN/1012 Our Ref.: P22096/TL24299 12 June 2024

The Secretary
Town Planning Board
15/F., North Point Government Offices
333 Java Road, North Point, Hong Kong

By Post and E-mail
tpbpd@pland.gov.hk

Dear Sir,

Submission of Further Information (FI)

Proposed Temporary Warehouse (excluding Dangerous Goods Godown) with Ancillary Office for a Period of 3 Years and Associated Filling of Land in "Agriculture" Zone, Lots 1046, 1047 S.A, 1047 RP, 1049 S.A, 1049 S.B RP(Part), 1049 RP(Part) and 1054 in D.D. 109, Kam Tin, Yuen Long, New Territories
(S.16 Planning Application No. A/YL-KTN/1012)

We would like to submit a Drainage Impact Assessment to respond to the comment from the Drainage Services Department dated 27.5.2024.

Yours faithfully,
For and on behalf of
Goldrich Planners & Surveyors Ltd.

Francis Lau

Encl.

c.c.
DPO/FSYLE, PlanD (Attn.: Ms. Andrea YAN / Ms. Olivia NG) *By E-mail only*

Planning Application No. A/YL-KTN/1012

Drainage Impact Assessment Report

Date: June 2024

1 Introduction

1.1 Background

Warehouse use is proposed on the application site, Lots 1046, 1047 S.A, 1047 RP, 1049 S.A, 1049 S.BRP (Part), 1049 RP (Part) and 1054 in D.D. 109, Yuen Long, New Territories.

Owing to concerns on possible drainage impact arising from the proposed redevelopment, a Drainage Impact Assessment (DIA) has been conducted to demonstrate the acceptability of drainage impact upon the surrounding environment.

1.2 Study Objectives

The objectives of this DIA are to assess the possible drainage impacts may be caused by the Proposed Development and to recommend the mitigation measures to alleviate such impacts if necessary.

2 Site Context

2.1 Site Location and Its Environs

The site is on Lots 1046, 1047 S.A, 1047 RP, 1049 S.A, 1049 S.BRP (Part), 1049 RP (Part) and 1054 in D.D. 109, Yuen Long, New Territories. It is located at Tai Kong Po. The eastern side of the site is immediately adjacent to a nullah (Kam Tin River). The norther side of the site is a small hill. The western and southern side of the site are some farmlands.

2.2 Proposed Use

The proposed use is for warehouses use. Warehouses are proposed on site.

2.3 Existing Drainage Condition

The Site is not currently served by any form of DSD's drainage facility. However, one existing nullah (Kam Tin River) is at the east of the Site. The surface runoff from the Site may be discharged this nullah via u-channels. (Refer to **Plan 7.1**)

Drainage Analysis

2.4 Assessment Methodology and Assumptions

This DIA has adopted the Rational Method for runoff estimation:

$$Q_p = 0.278\ i \sum C_j A_j$$

Where

Q_p is peak runoff (m^3/s);

i is rainfall intensity (mm/hr);

A_j is the j^{th} catchment (m^2);

C_j is the runoff coefficient of the j^{th} catchment (dimensionless).

The details of the Rational Method can be referred to the Stormwater Drainage Manual (SDM) (DSD, 2018).

The storm constant in Table 3d has been referred to Corrigendum No. 1/2024.

Based on a 1:50 year flood protection standard in the SDM and the estimated time of concentration, the appropriate rainfall intensities (i) were calculated based on linear interpolation of the intermediate table values.

The assumptions of this DIA are summarised below:

- Rainstorm return period – 1 in 50 years
- Runoff coefficient for developed (paved) area – 0.95
- Runoff coefficient for steep grassland (heavysoil) – 0.35
- Manning's roughness coefficient for the proposed U-channels – 0.016

The capacities of the proposed concrete lined U-channels were checked by comparing with magnitudes of different combinations of the catchments. The Manning's roughness coefficient of 0.016 for surface channel (fair condition) as stated in Table 13 of SDM was assumed for the u-channels as referred in the SDM.

2.5 Assessment Results

Runoffs and capacities at the concerned location of the proposed U-channels was estimated in attached drainage calculations.

With the provision of the proposed drainage system for discharging into the existing nullah as shown in **Plan 7.1**, the Proposed Development would not cause adverse drainage impacts or increase in the flooding susceptibility of the surrounding areas.

3 Conclusion

For collecting surface runoff within the Site, a series of U-channels have been designed.

The drainage analysis has demonstrated that subject to the implementation of the proposed drainage systems, the Proposed Development would not cause adverse drainage impacts or increase in the flooding susceptibility of the adjacent areas.

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Application Site

Site Area (about): 10,723 m²

Proposed 450mm UC 1:200

Proposed 500mm UC 1:200

Proposed 300mm UC 1:200

Proposed 450mm UC 1:200

Proposed 300mm UC 1:200

Proposed 300mm UC 1:200

Proposed 500mm UC 1:200

Proposed 500mm UC with C.I. cover 1:200

Proposed covered 700mm UC 1:200

Proposed 300mm UC 1:200

Proposed 300mm UC 1:200

Fall

CP1	G.L 10.3	I.L 10.53
CP2	G.L 11.0	I.L 10.1
CP3	G.L 11.0	I.L 10.05
CP4	G.L 11.0	I.L 9.68
CP5	G.L 11.0	I.L 9.63
CP6	G.L 10.9	I.L 9.32
CP7	G.L 11.0	I.L 10.13
CP8	G.L 11.0	I.L 9.73
CP9	G.L 10.9	I.L 9.53
CP10	G.L 10.9	I.L 9.19
CP11	G.L 10.9	I.L 9.01
CP12	G.L 10.7	I.L 8.91
Outfall	G.L 10.4	I.L 8.86

G.L 11.0
I.L 10.55

G.L 11.0
I.L 10.55

A

A1

B

B1

CUL

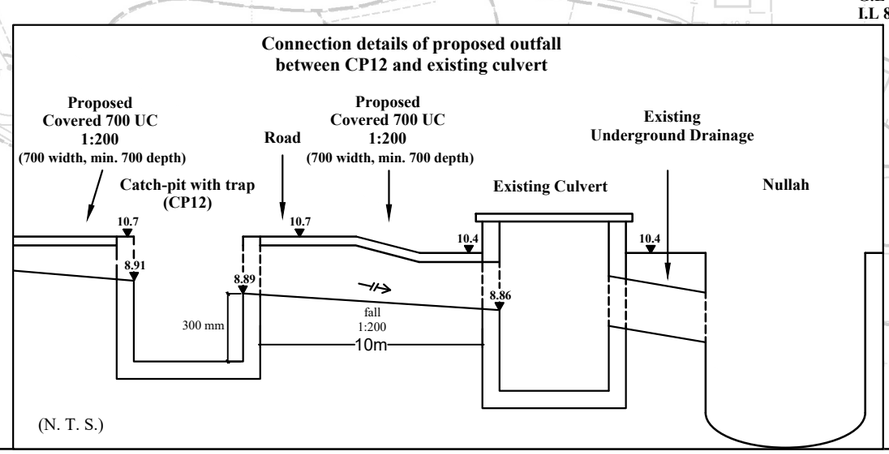
排水口 Outfall

KAM TIN RIVER

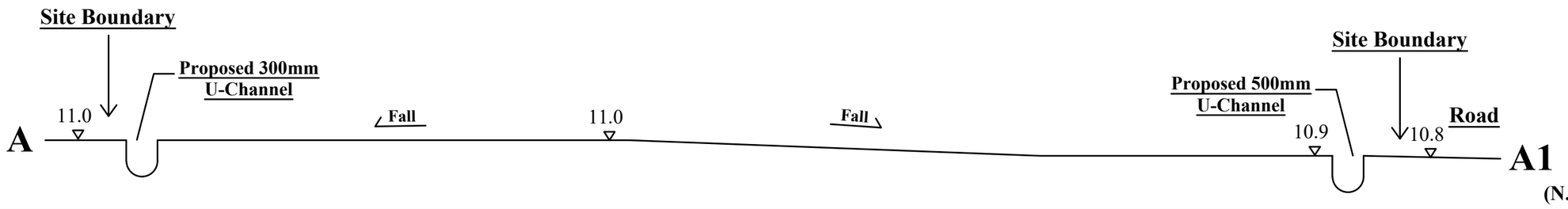
Legend

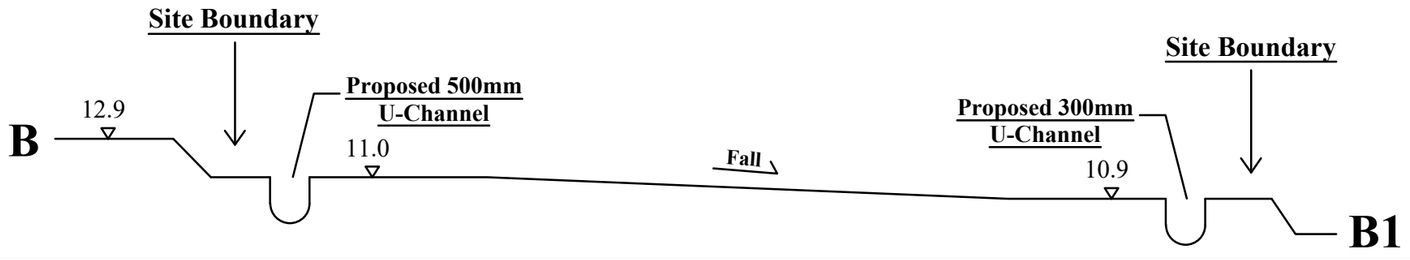
- Proposed Catch-pit with trap
- Proposed Catch-pit
- Proposed U-Channel
- Proposed U-Channel with C.I. cover
- Proposed Covered U-Channel
- Vehicular Ingress / Egress

Connection details of proposed outfall between CP12 and existing culvert



(N. T. S.)





1:1000 (A3)	**Drainage Proposal**	Goldrich Planners & Surveyors Ltd.
June 2024	Lots 1046, 1047 S.A, 1047 RP, 1049 S.A, 1049 S.B RP (part), 1049 RP (part) and 1054 in D.D. 109 Kam Tin, Yuen Long	Plan 7.1 (P 22096)

N

Catchment Area A

Steep Grassland Area:	5,896m²(about)
Concrete Paving Area:	2,014m²(about)
Total Catchment Area:	7,910m²(about)

Catchment Area B

Steep Grassland Area:	5,409m²(about)
Concrete Paving Area:	2,581m²(about)
Total Catchment Area:	7,990m²(about)

Catchment Area C

Steep Grassland Area:	3,569m²(about)
Concrete Paving Area:	1,551m²(about)
Total Catchment Area:	5,120m²(about)

Catchment Area D

Steep Grassland Area:	3,390m²(about)
Concrete Paving Area:	3,650m²(about)
Total Catchment Area:	7,040m²(about)

Catchment Area E
Area(about): 1,856m²

Fall

A B C D E F G H

Application Site

Catchment Area F
Area(about): 1,823m²

Catchment Area G
Area(about): 1,203m²

Catchment Area H
Area(about): 2,223m²

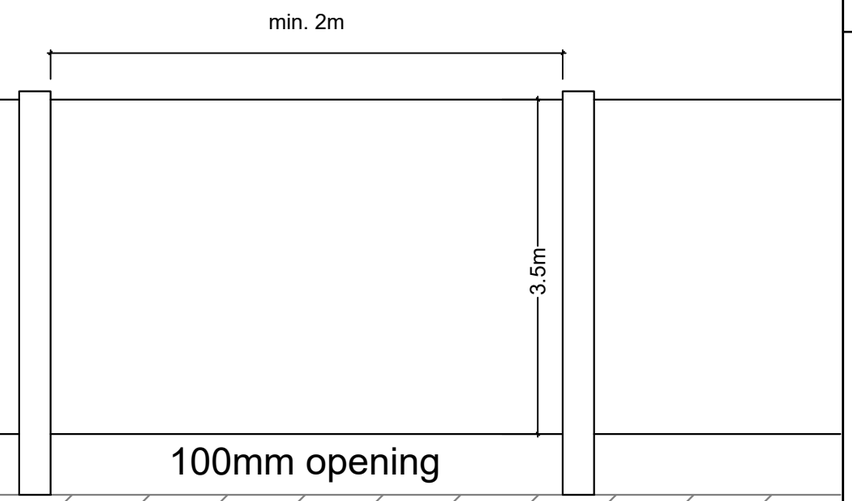
Steep Grassland

Concrete Paving

Catchment Area

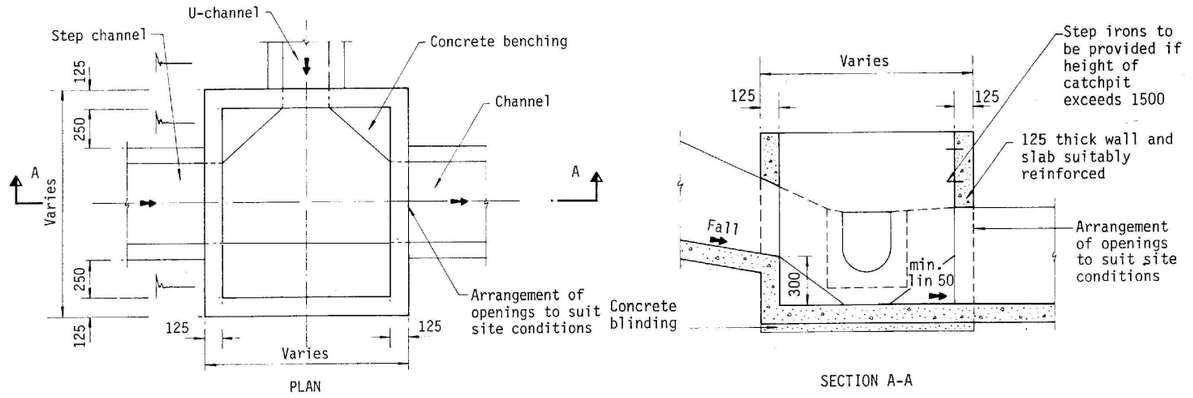
AREA OF CATCHMENT

1:1000 (A3)	**Drainage Proposal** Lots 1046, 1047 S.A, 1047 RP, 1049 S.A, 1049 S.B RP (part), 1049 RP (part) and 1054 in D.D. 109 Kam Tin, Yuen Long	Goldrich Planners & Surveyors Ltd.
June 2024		Plan 7.2 (P 22096)

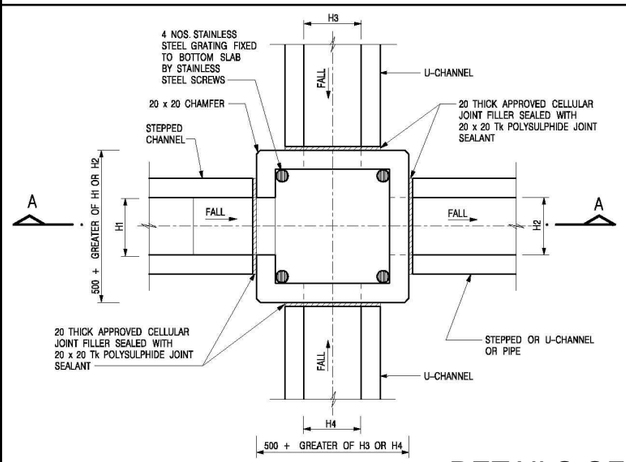


Details of hoarding with 100mm opening

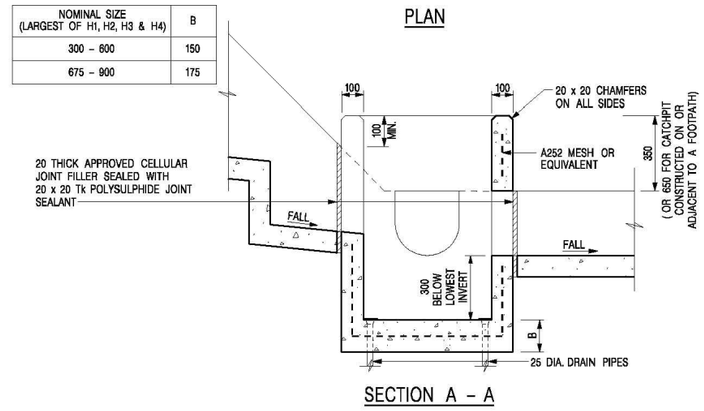
(N. T. S.)



TYPICAL DETAILS OF CATCHPIT

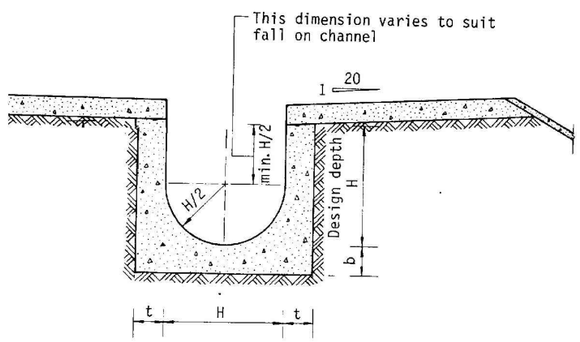


NOMINAL SIZE (LARGEST OF H1, H2, H3 & H4)	B
300 – 600	150
675 – 900	175

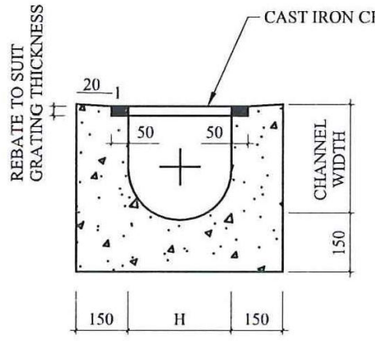


DETAILS OF CATCHPIT WITH TRAP

(REFER TO CEDD'S STANDARD DWG. C2406/1)

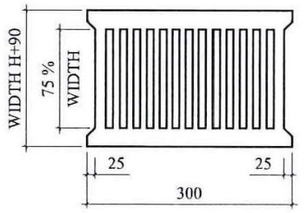


TYPICAL DETAILS OF U CHANNEL



TYPICAL SECTION OF U-CHANNEL WITH COVER

(N.T.S.)



CAST IRON CRATING (HEAVY DUTY)

N.T.S	**Drainage Proposal** **Lots 1046, 1047 S.A, 1047 RP, 1049 S.A, 1049 S.B RP (part), 1049 RP (part) and 1054 in D.D. 109 Kam Tin, Yuen Long**	**Goldrich Planners & Surveyors Ltd.**
June 2024		**Plan 7.3 (P 22096)**

1 For Catchment Area A

Ref.

Area, A = 7910 m^2
Average slope, H = 21.4 m per 100m
Distance on the line of natural flow, L = 90 m

Time of concentration, t_o = 0.14465L / ($H^{0.2}A^{0.1}$) = 0.14465 (90) / (21.4^0.2*7910^0.1) — SDM 7.5.2 (d)
= 2.9 min

2 For Proposed U-Channel in catchment area A

	From	To
Ground level (mPD)	11.00	11.00
Invert level (mPD)	10.55	10.13

Width of u-channel, w = 450 mm
Length of u-channel, L_c = 85 m
Depth of vertical part of u-channel, d = 645 mm
Gradient of u-channel, S_f =).55-10.13)/85 = 0.005

Cross-Section Area, a = 0.5 πr^2 + w d = 0.5 x 3.14 x 225^2 + 450 x 645
= 0.370 m^2
Wetted Perimeter, p = π r + 2 d = 3.14 x 225 + 2 x 645
= 1.997 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.185 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6}$x $(RS_f)^{1/2}$/n = (0.185)^1/6 x (0.185 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.43 m/s
Time of flow, t_f = 1.0 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = a / (t_o + t_f +b)^c — SDM 4.3.2
= 474.6 / (2.9+1+2.9)^0.42 for return period T = 50 years — SDM Table 3(d)
= 286

SDM 7.5.2 (b)

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	5896.0	2063.6
Concrete Paving	0.95	2014.0	1913.3
		SUM =	3976.9

Upstream flow, Q_u = 0 m^3/s

Design flow, Q_d = 0.278i Σ C_jA_j + Q_u where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 286 x 3976.9 / 1000000 + 0
= 0.316 m^3/s

Allowable flow, Q_a = a x v
= 0.37 x 1.43
= 0.528 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

Scale: NA	**Drainage Calculation**	Goldrich Planners & Surveyors Ltd.
June 2024	Lots 1046, 1047 S.A, 1047 R.P., 1049 S.A, 1049 S.B RP (Part), 1049 RP (Part) and 1054 in D.D. 109, Kam Tin, Yuen Long	Page 1 (P22096)

1 For Catchment Area B

Ref.

Area, A = 7990 m^2
Average slope, H = 42.4 m per 100m
Distance on the line of natural flow, L = 80 m

Time of concentration, t_o = 0.14465L / ($H^{0.2}A^{0.1}$) = 0.14465 (80) / (42.4^0.2*7990^0.1) — SDM 7.5.2 (d)
= 2.2 min

2 For Proposed U-Channel in catchment area B

	From	To
Ground level (mPD)	11.00	11.00
Invert level (mPD)	10.13	9.73

Width of u-channel, w = 450 mm
Length of u-channel, L_c = 81 m
Depth of vertical part of u-channel, d = 1050 mm
Gradient of u-channel, S_f = |0.13-9.73)/81 = 0.005

Cross-Section Area, a = 0.5 πr^2 + w d = 0.5 x 3.14 x 225^2 + 450 x 1050
= 0.552 m^2
Wetted Perimeter, p = π r + 2 d = 3.14 x 225 + 2 x 1050
= 2.807 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.197 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6}$x $(RS_f)^{1/2}$/n = (0.197)^1/6 x (0.197 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.49 m/s
Time of flow, t_f = 0.9 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = a / (t_o + t_f +b)^c — SDM 4.3.2
= 474.6 / (2.2+0.9+2.9)^0.4 for return period T = 50 years — SDM Table 3(d)
= 298

SDM 7.5.2 (b)

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	5409.0	1893.2
Concrete Paving	0.95	2581.0	2452.0
		SUM =	4345.1

Upstream flow, Q_u = 0.316 m^3/s

Design flow, Q_d = 0.278i Σ C_jA_j + Q_u where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 298 x 4345.1 / 1000000 + 0.316
= 0.675 m^3/s

Allowable flow, Q_a = a x v
= 0.552 x 1.49
= 0.825 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

1 For Catchment Area C

Ref.

Area, A = 5120 m^2
Average slope, H = 23 m per 100m
Distance on the line of natural flow, L = 92 m

Time of concentraction, t_o = $0.14465L / (H^{0.2}A^{0.1})$ = 0.14465 (92) / (23^0.2*5120^0.1) — SDM 7.5.2 (d)
= 3.0 min

2 For Proposed U-Channel in catchment area C

	From	To
Ground level (mPD)	11.00	10.90
Invert level (mPD)	9.73	9.53

Width of u-channel, w = 500 mm
Length of u-channel, L_c = 41 m
Depth of vertical part of u-channel, d = 1125 mm
Gradient of u-channel, S_f = (9.73-9.53)/41 = 0.005

Cross-Section Area, a = 0.5 πr^2 + w d = 0.5 x 3.14 x 250^2 + 500 x 1125
= 0.661 m^2
Wetted Perimeter, p = π r + 2 d = 3.14 x 250 + 2 x 1125
= 3.035 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.218 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6}x (RS_f)^{1/2}/n$ = (0.218)^1/6 x (0.218 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.60 m/s
Time of flow, t_f = 0.4 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = $a / (t_o + t_f + b)^c$ — SDM 4.3.2
= 474.6 / (3+0.4+2.9)^0.42 for return period T = 50 years — SDM Table 3(d)
= 292

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	3569.0	1249.2
Concrete Paving	0.95	1551.0	1473.5
		SUM =	2722.6

— SDM 7.5.2 (b)

Upstream flow, Q_u = 0.675 m^3/s

Design flow, Q_d = $0.278i \Sigma C_jA_j + Q_u$ where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 292 x 2722.6 / 1000000 + 0.675
= 0.896 m^3/s

Allowable flow, Q_a = a x v
= 0.661 x 1.6
= 1.056 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

1 For Catchment Area D

Ref.

Area, A = 7040 m^2
Average slope, H = 18.8 m per 100m
Distance on the line of natural flow, L = 110 m

Time of concentration, t_o = $0.14465L / (H^{0.2}A^{0.1})$ = 0.14465 (110) / (18.8^0.2*7040^0.1) — SDM 7.5.2 (d)
= 3.6 min

2 For Proposed U-Channel in catchment area D

	From	To
Ground level (mPD)	10.90	10.90
Invert level (mPD)	9.53	9.20

Width of u-channel, w = 500 mm
Length of u-channel, L_c = 70 m
Depth of vertical part of u-channel, d = 1450 mm
Gradient of u-channel, S_f = (9.53-9.2)/70 = 0.005

Cross-Section Area, a = $0.5 \pi r^2 + w d$ = 0.5 x 3.14 x 250^2 + 500 x 1450
= 0.823 m^2
Wetted Perimeter, p = $\pi r + 2 d$ = 3.14 x 250 + 2 x 1450
= 3.685 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.223 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6} x (RS_f)^{1/2}/n$ = (0.223)^1/6 x (0.223 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.58 m/s
Time of flow, t_f = 0.7 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = $a / (t_o + t_f + b)^c$ — SDM 4.3.2
= 474.6 / (3.6+0.7+2.9)^0.4 for return period T = 50 years — SDM Table 3(d)
= 278

SDM 7.5.2 (b)

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	3390.0	1186.5
Concrete Paving	0.95	3650.0	3467.5
		SUM =	4654.0

Upstream flow, Q_u = 0.896 m^3/s

Design flow, Q_d = $0.278i \Sigma C_j A_j + Q_u$ where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 278 x 4654 / 1000000 + 0.896
= 1.256 m^3/s

Allowable flow, Q_a = a x v
= 0.823 x 1.58
= 1.300 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

1 For Catchment Area E

Ref.

Area, A = 1856 m^2
Average slope, H = 2.28 m per 100m
Distance on the line of natural flow, L = 69 m

Time of concentration, t_o = $0.14465L / (H^{0.2}A^{0.1})$ = 0.14465 (69) / (2.28^0.2*1856^0.1) — SDM 7.5.2 (d)
= 4.0 min

2 For Proposed U-Channel in catchment area E

	From	To
Ground level (mPD)	10.90	10.90
Invert level (mPD)	9.20	9.01

Width of u-channel, w = 500 mm
Length of u-channel, L_c = 35 m
Depth of vertical part of u-channel, d = 1645 mm
Gradient of u-channel, S_f = (9.2-9.01)/35 = 0.006

Cross-Section Area, a = 0.5 πr^2 + w d = 0.5 x 3.14 x 250^2 + 500 x 1645
= 0.921 m^2
Wetted Perimeter, p = π r + 2 d = 3.14 x 250 + 2 x 1645
= 4.075 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.226 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6}x (RS_f)^{1/2}/n$ = (0.226)^1/6 x (0.226 x 0.006)^1/2 / 0.016 — SDM Table 12
= 1.73 m/s
Time of flow, t_f = 0.3 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = $a / (t_o + t_f + b)^c$ — SDM 4.3.2
= 474.6 / (4+0.3+2.9)^0.42 for return period T = 50 years — SDM Table 3(d)
= 279

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	0.0	0.0
Concrete Paving	0.95	1856.0	1763.2
		SUM =	1763.2

— SDM 7.5.2 (b)

Upstream flow, Q_u = 1.256 m^3/s

Design flow, Q_d = $0.278i \Sigma C_j A_j + Q_u$ where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 279 x 1763.2 / 1000000 + 1.256
= 1.393 m^3/s

Allowable flow, Q_a = a x v
= 0.921 x 1.73
= 1.593 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

1 For Catchment Area F

Ref.

Area, A = 1823 m^2
Average slope, H = 0.1 m per 100m
Distance on the line of natural flow, L = 27 m

Time of concentraction, t_o = 0.14465L / ($H^{0.2}A^{0.1}$) = 0.14465 (27) / (0.1^0.2*1823^0.1) — SDM 7.5.2 (d)
= 2.9 min

2 For Propsed U-Channel in catchment area F

	From	To
Ground level (mPD)	11.00	11.00
Invert level (mPD)	10.55	10.05

Width of u-channel, w = 300 mm
Length of u-channel, L_c = 95 m
Depth of vertical part of u-channel, d = 800 mm
Gradient of u-channel, S_f =).55-10.05)/95 = 0.005

Cross-Section Area, a = 0.5 πr^2 + w d = 0.5 x 3.14 x 150^2 + 300 x 800
= 0.275 m^2
Wetted Perimeter, p = π r + 2 d = 3.14 x 150 + 2 x 800
= 2.071 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.133 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6}$x $(RS_f)^{1/2}$/n = (0.133)^1/6 x (0.133 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.18 m/s
Time of flow, t_f = 1.3 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = a / (t_o + t_f +b)^c — SDM 4.3.2
= 474.6 / (2.9+1.3+2.9)^0.4 for return period T = 50 years — SDM Table 3(d)
= 280

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	0.0	0.0
Concrete Paving	0.95	1823.0	1731.9
		SUM =	1731.9

— SDM 7.5.2 (b)

Upstream flow, Q_u = 0 m^3/s

Design flow, Q_d = 0.278i Σ C_jA_j + Q_u where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 280 x 1731.85 / 1000000 + 0
= 0.135 m^3/s

Allowable flow, Q_a = a x v
= 0.275 x 1.18
= 0.325 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

1 For Catchment Area G

Ref.

Area, A = 1203 m^2
Average slope, H = 0.1 m per 100m
Distance on the line of natural flow, L = 23 m

Time of concentration, t_o = 0.14465L / ($H^{0.2}A^{0.1}$) = 0.14465 (23) / (0.1^0.2*1203^0.1) — SDM 7.5.2 (d)
= 2.6 min

2 For Proposed U-Channel in catchment area G

	From	To
Ground level (mPD)	11.00	11.00
Invert level (mPD)	10.05	9.63

Width of u-channel, w = 300 mm
Length of u-channel, L_c = 83 m
Depth of vertical part of u-channel, d = 1220 mm
Gradient of u-channel, S_f = |0.05-9.63)/83 = 0.005

Cross-Section Area, a = 0.5 πr^2 + w d = 0.5 x 3.14 x 150^2 + 300 x 1220
= 0.401 m^2
Wetted Perimeter, p = π r + 2 d = 3.14 x 150 + 2 x 1220
= 2.911 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.138 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6}$x $(RS_f)^{1/2}$/n = (0.138)^1/6 x (0.138 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.18 m/s
Time of flow, t_f = 1.2 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = a / (t_o + t_f +b)^c — SDM 4.3.2
= 474.6 / (2.6+1.2+2.9)^0.4 for return period T = 50 years — SDM Table 3(d)
= 287

SDM 7.5.2 (b)

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	0.0	0.0
Concrete Paving	0.95	1203.0	1142.9
		SUM =	1142.9

Upstream flow, Q_u = 0.135 m^3/s

Design flow, Q_d = 0.278i Σ C_jA_j + Q_u where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 287 x 1142.85 / 1000000 + 0.135
= 0.226 m^3/s

Allowable flow, Q_a = a x v
= 0.401 x 1.18
= 0.473 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

1 For Catchment Area F

Ref.

Area, A = 2223 m^2
Average slope, H = 0.1 m per 100m
Distance on the line of natural flow, L = 22 m

Time of concentration, t_o = 0.14465L / ($H^{0.2}A^{0.1}$) = 0.14465 (22) / (0.1^0.2*2223^0.1) — SDM 7.5.2 (d)
= 2.3 min

2 For Proposed U-Channel in catchment area F

	From	To
Ground level (mPD)	11.00	10.90
Invert level (mPD)	9.63	9.01

Width of u-channel, w = 300 mm
Length of u-channel, L_c = 123 m
Depth of vertical part of u-channel, d = 1740 mm
Gradient of u-channel, S_f = 9.63-9.01)/123 = 0.005

Cross-Section Area, a = 0.5 πr^2 + w d = 0.5 x 3.14 x 150^2 + 300 x 1740
= 0.557 m^2
Wetted Perimeter, p = π r + 2 d = 3.14 x 150 + 2 x 1740
= 3.951 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.141 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6}$x $(RS_f)^{1/2}$/n = (0.141)^1/6 x (0.141 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.20 m/s
Time of flow, t_f = 1.7 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = a / (t_o + t_f +b)^c — SDM 4.3.2
= 474.6 / (2.3+1.7+2.9)^0.4 for return period T = 50 years — SDM Table 3(d)
= 283

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.35	0.0	0.0
Concrete Paving	0.95	2223.0	2111.9
		SUM =	2111.9

SDM 7.5.2 (b)

Upstream flow, Q_u = 0.226 m^3/s

Design flow, Q_d = 0.278i Σ C_jA_j + Q_u where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 283 x 2111.85 / 1000000 + 0.226
= 0.392 m^3/s

Allowable flow, Q_a = a x v
= 0.557 x 1.2
= 0.667 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD

1 For Connection between CP12 and Existing Culvert

Ref.

Area, A = 0 m^2
Average slope, H = 0.1 m per 100m
Distance on the line of natural flow, L = 0 m

Time of concentration, t_o = $0.14465L / (H^{0.2}A^{0.1})$ = 0.14465 (0) / (0.1^0.2*0^0.1) — SDM 7.5.2 (d)
= 0.0 min

2 For Proposed U-Channel between CP12 and Existing Culvert

	From	To
Ground level (mPD)	10.90	10.40
Invert level (mPD)	9.01	8.86

Width of u-channel, w = 700 mm
Length of u-channel, L_c = 30 m
Depth of vertical part of u-channel, d = 1190 mm
Gradient of u-channel, S_f = (9.01-8.86)/30 = 0.005

Cross-Section Area, a = $0.5 \pi r^2 + w d$ = 0.5 x 3.14 x 350^2 + 700 x 1190
= 1.025 m^2
Wetted Perimeter, p = $\pi r + 2 d$ = 3.14 x 350 + 2 x 1190
= 3.480 m
Hydralic radius, R = a / p — SDM 8.2.1
= 0.295 m

3 Use Manning Equation for estimating velocity of stormwater

Take n = 0.016 for concrete lined channels:- — SDM Table 13
Allowable velocity, v = $R^{1/6} x (RS_f)^{1/2}/n$ = (0.295)^1/6 x (0.295 x 0.005)^1/2 / 0.016 — SDM Table 12
= 1.96 m/s
Time of flow, t_f = 0.26 min

4 Use "Rational Method" for calculation of design flow

Design intensity, i = $a / (t_o + t_f + b)^c$ — SDM 4.3.2
= 687 / (0+0.26+4.2)^0.42 for return period T = 50 years — SDM Table 3(d)
= 367

Type of surface	Runoff Coefficient C	Catchment Area A (m^2)	C x A
Steep Glassland(heavy soil)	0.25	0.0	0.0
Concrete Paving	0.95	0.0	0.0
		SUM =	0.0

— SDM 7.5.2 (b)

Upstream flow, Q_u = 1.785 m^3/s

Design flow, Q_d = $0.278i \Sigma C_j A_j + Q_u$ where A_j is in km^2 — SDM 7.5.2 (a)
= 0.278 x 367 x 0 / 1000000 + 1.785
= 1.785 m^3/s

Allowable flow, Q_a = a x v
= 1.025 x 1.96
= 2.007 m^3/s

> Q_d (O.K.)

Reference was made to Stormwater Drainage Manual (SDM) by DSD