

Prepared by

**Ramboll Hong Kong Limited**

**PROPOSED SCHOOL AT VARIOUS LOTS IN D.D. 94, 98 & 100  
AND ADJOINING GOVERNMENT LAND, KWU TUNG SOUTH,  
NEW TERRITORIES**

**DRAINAGE IMPACT ASSESSMENT**

Date **February 2026**

Prepared by **Sunny Yeung**  
**Assistant Engineer**

Signed



Approved by **Tony Cheng**  
**Senior Manager**

Signed

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Project Reference **HENKTSISEI00**

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Ramboll Hong Kong Limited

21/F, BEA Harbour View Centre  
56 Gloucester Road, Wan Chai, Hong Kong

Tel: (852) 3465 2888  
Fax: (852) 3465 2899  
Email: hkinfo@ramboll.com

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Annex 3	Design of Drainage System
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## 1. INTRODUCTION

### 1.1 Project Background

- 1.1.1 Ramboll Hong Kong Limited in associated with Binnies Hong Kong Limited (Binnies) has been commissioned to carry out drainage impact assessment (DIA) for the Proposed International School in Kwu Tung South. (Application Site).
- 1.1.2 The Application Site is divided into eastern and western parts by the River Beas, with a few local village houses. Access to the Application Site is provided via Hang Tau Road and village track roads (**Figure K1**).
- 1.1.3 The Application Site covers an area of approximately 128,232 m<sup>2</sup>.
- 1.1.4 The Proposed Development consists of kindergartens, primary schools, middle & high schools and ancillary facilities, with a total plot ratio of 1.33. The scheduled year of completion of 2036. A summary of key information of the Proposed Development is shown below in **Table 1-1**.

**Table 1-1 Development Schedule (Final Phase)**

Development Parameter	Proposed Development
<i>Site Area</i>	About 128,232 m <sup>2</sup>
<i>Plot Ratio</i>	About 1.33
<i>Total Gross Floor Area (GFA)</i>	About 171,000 m <sup>2</sup>
<i>Anticipated Population</i>	
<i>Kindergarten</i>	About 600
<i>Grades 1-5</i>	About 1,000
<i>Grades 6-12</i>	About 1,400

- 1.1.5 This DIA is prepared based on available information and requirement under Drainage Services Department (DSD) Advice Note No. 1 – Application to Drainage Impact Assessment Process to Private Sector Projects.

## 2. EXISTING DRAINAGE NETWORK

### 2.1 The Application Site

2.1.1 The Application Site is currently occupied by a number of temporary structures. The land use of the Application Site will be changed to approximately 70% paved after the Proposed Development.

### 2.2 Existing Catchment Drainage

2.2.1 The Application Site lies in the middle reach of River Beas. River Beas runs from the south to the north and discharges into River Indus, which further discharges into Shenzhen River to the north. Shenzhen River flows to the west and eventually discharges into Deep Bay.

2.2.2 River Beas locates within the Indus Basin forming one of the tributaries of River Indus and serves the southwest part of the Indus Basin.

### 2.3 Site Drainage and Sub-catchments

2.3.1 The identified relevant sub-catchments for and in vicinity of the Application Site are shown on **Figure K2**. The existing drainage system in vicinity of the Application Site is shown on **Figure K3**.

2.3.2 Runoff from all sub-catchments (Catchments 1 to 6) drains to the River Beas. Runoff from these area passes through the Application Site and discharge to the River Beas.

### 2.4 Ground Levels

2.4.1 The western part of the Application Site slopes downward from the south and west in general, and dipped gently towards River Beas.

2.4.2 The existing ground level of the western part falls gently from +10.0 mPD to +20.5 mPD (south to north). The existing ground level of the eastern part falls gently from +13.0 mPD to +10 mPD (north to south).

### 3. METHODOLOGY AND DESIGN PARAMETERS

- 3.1.1 The assessment criteria for the Application Site is based on the standards as set out in DSD's 5th edition of Stormwater Drainage Manual (SDM) published in January 2018 and the updates pursuant to Corrigendum No. 1/2022 and No.1/2024 promulgated. Table 10 of the SDM provides the recommended design return periods based on flood levels for the various drainage systems depending on the land use.
- 3.1.2 According to the SDM, 50-year design return period is recommended for the design of drainage system.
- 3.1.3 The Rational Method is adopted for evaluating the runoff for the drainage design.
- 3.1.4 According to the rainfall zone as shown in Figure 3 of SDM, the Application Site is located in an area that adopts rainfall statistics of North District Area. Hence, the design storm constants are adopted in accordance with Table 3a of the SDM corrigendum No.1/2024. The storm constants are shown in **Table 3.1** below.

**Table 3-1 Storm Constants with 50-year Return Period**

Parameter	Value
A	474.6
B	2.9
C	0.371

- 3.1.5 The runoff coefficient (C) values for the Rational Method were adopted in accordance with Clause 7.5.2 of the SDM. A table of runoff coefficient is shown in **Table 3.2** below.

**Table 3-2 Runoff Coefficient**

Land Use	Runoff Coefficient (C) Value
Unpaved (e.g. existing tree groups)	0.35
Paved (e.g. concrete)	0.95

- 3.1.6 The effects of climate change are considered in accordance with Clause 6.8, Table 28 and Table 29 of the SDM corrigendum No.1/2022. A summary of increased rainfall due to climate change is shown in **Table 3.3** below.

**Table 3-3 Rainfall Increase due to Climate Change**

Classification	Rainfall Increase (%)	Sea Level Rise (m)
End of 21 <sup>st</sup> Century (2081-2100)	16.0	0.47

- 3.1.7 Design allowance in the End-21st Century is considered in the calculation as well and summarized in **Table 3-4**.

**Table 3-4 Design Allowance in End of 21st Century**

Rainfall Increase	Sea Level Rise (m)
12.1%	0.23

- 3.1.8 The roughness values of pipes were adopted in accordance with Table 13 and 14 of the SDM. As a conservation approach, 10% (of flow area) sedimentation is adopted for the proposed drainage system in design checking. A summary of roughness coefficients is shown in **Table 3-5** below.

**Table 3-5 Roughness Coefficient**

<b>Classification</b>	<b>Roughness Coefficient</b>	<b>Remarks</b>
Poor Precast Concrete Pipes	Colebrook-White $k_s = 0.6\text{mm}$	Concrete Pipe
Rectangular Channel	Mannings' $n = 0.015$	Peripheral drains

## 4. POTENTIAL DRAINAGE IMPACT OF PROPOSED DEVELOPMENT

4.1.1 The Application Site will be developed into an international school. The Master Layout Plan of the Proposed Development is shown in **Annex 1**.

### 4.2 Changes to Drainage Characteristics

4.2.1 The Proposed Development will induce changes to the land use of the Application Site. The percentage of paved area comprising building blocks, concrete structures, roads and other paved facilities will be increased. As a result, there will be an increase in surface runoff generated from the Application Site.

### 4.3 Volume of Runoff and Peak Runoff Rate

4.3.1 The increase in the peak runoff rates due to the Proposed Development at the Application Site against various rainstorm return periods are shown in **Tables 4-1** below.

4.3.2 The relevant calculations are included in **Annex 1**.

**Table 4-1 Estimated Peak Runoff Rate**

Return Period	Peak Runoff Rate (m <sup>3</sup> /s)		
	Before Development (1)	After Development (2)	Increase in Runoff (2) – (1)
50 years	4.454	6.470	2.016
200 years	5.051	7.338	2.287

## 5. PROPOSED DRAINAGE IMPACT MITIGATION MEASURES

- 5.1.1 To intercept existing overland flow blocked by the Proposed Development, surface channels will be provided along the site boundaries of the Proposed Development. The catchment of the flow intercepted and the proposed drainage system are shown on **Figure K4**.
- 5.1.2 The flow will be discharged to River Beas through the proposed 1200 mm to 1800 mm diameter drains along the public road inside the Application Site.
- 5.1.3 Details of the hydraulic calculations and results of hydraulic check of the proposed drainage system along the public road inside the Application Site are contained in **Annex 3**.
- 5.1.4 The sensitivity checking of River Beas is included in **Annex 4**.
- 5.1.5 The runoff from the Proposed Development and its adjacent catchment as shown in **Figure K4**.

## 6. MAINTENANCE AND CONSTRUCTION CONSIDERATIONS

### 6.1 Maintenance Considerations

- 6.1.1 The parties responsible for managing and maintaining the completed proposed drainage works are listed in **Table 6-1**.

**Table 6-1 Preliminary Management and Maintenance Matrix**

<b>Description of Proposed Drainage Works</b>	<b>Management and Maintenance Party</b>
Stormwater Storage facilities, box culverts, drainage pipes and associated manholes on public roads or outside boundaries	Drainage Services Department
U-channels and associated catchpits which received the surface water inside the Development sites	The Applicant
Stormwater drainage facilities exclusively used for public roads (I.e. carriageway and footpaths.)	Highways Department

### 6.2 Construction Considerations

- 6.2.1 The contractor for the Proposed Development will be responsible for the maintenance of the existing drainage conditions in the vicinity of the Proposed Development during the construction stage. The contract documents will specify that the contractor must put in place appropriate temporary drainage measures to ensure that the flooding conditions during the construction period must not be worse than those under existing conditions.
- 6.2.2 The contractor's attention shall be drawn to the diversion of the existing U-channel along the boundary of the Proposed Development. Such measures must be submitted to the Authorised Person or his representative for approval before construction activities commence.
- 6.2.3 A settling basin will be installed to intercept runoff from the construction Application Site before discharge into the River Beas.

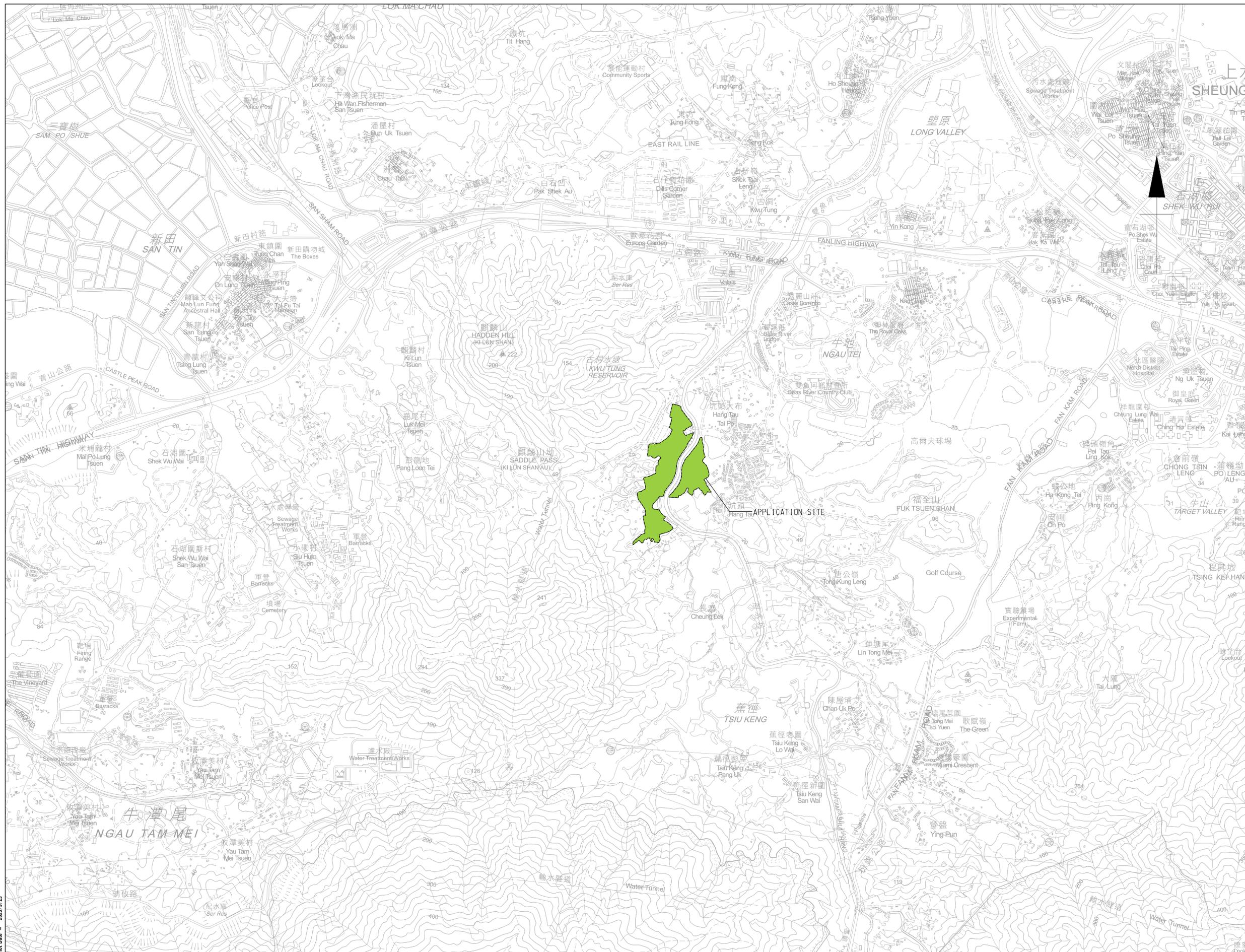
## 7. CONCLUSION

- 7.1.1 The runoff from the Proposed Development and from the adjacent catchment area of the Proposed Development will be diverted by the project proponent. The runoff will be conveyed by the proposed 1200 mm to 1800 mm diameter drains along public road inside Application Site.
- 7.1.2 The runoff generated from the Proposed Development and its adjacent catchment would only utilize about 87% of the proposed 1200 mm diameter drain, about 74% of the proposed 1350 mm diameter drain, about 72% of the proposed 1650 mm diameter drain and about 94% of the proposed 1800 mm diameter drain. The proposed drain in public road inside Application Site discharges into the upstream section of the River Beas.
- 7.1.3 Temporary drainage measures shall be implemented to ensure that the flooding conditions will not be worsened during construction. Periodic inspection by the Authorized Person or his representative will be carried out during construction.
- 7.1.4 With the implementation of the above proposed drainage measures and temporary drainage works, the Proposed Development at the Application Site is technically feasible from drainage impact point of view.

**Figures**

LEGEND:

 THE APPLICATION SITE



Initial	Date	Checked	Date
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Project	S16 APPLICATION FOR PROPOSED INTERNATIONAL SCHOOL IN KWU TUNG SOUTH
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Title	LOCATION PLAN
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Figure No.	K1	Scale	A3 1 : 20000
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LEGEND:

 THE APPLICATION SITE

CATCHMENT	AREA (m <sup>2</sup> )
C1	99045
C2	122826
C3	211950
C4	164692
C5	7603
C6	46806
C7	<b>12500</b>
C8	<b>39500</b>
C9	<b>40000</b>
C10	35300

Initial	Date	Checked	Date

Project

S16 APPLICATION FOR PROPOSED  
INTERNATIONAL SCHOOL IN KWU  
TUNG SOUTH

Title

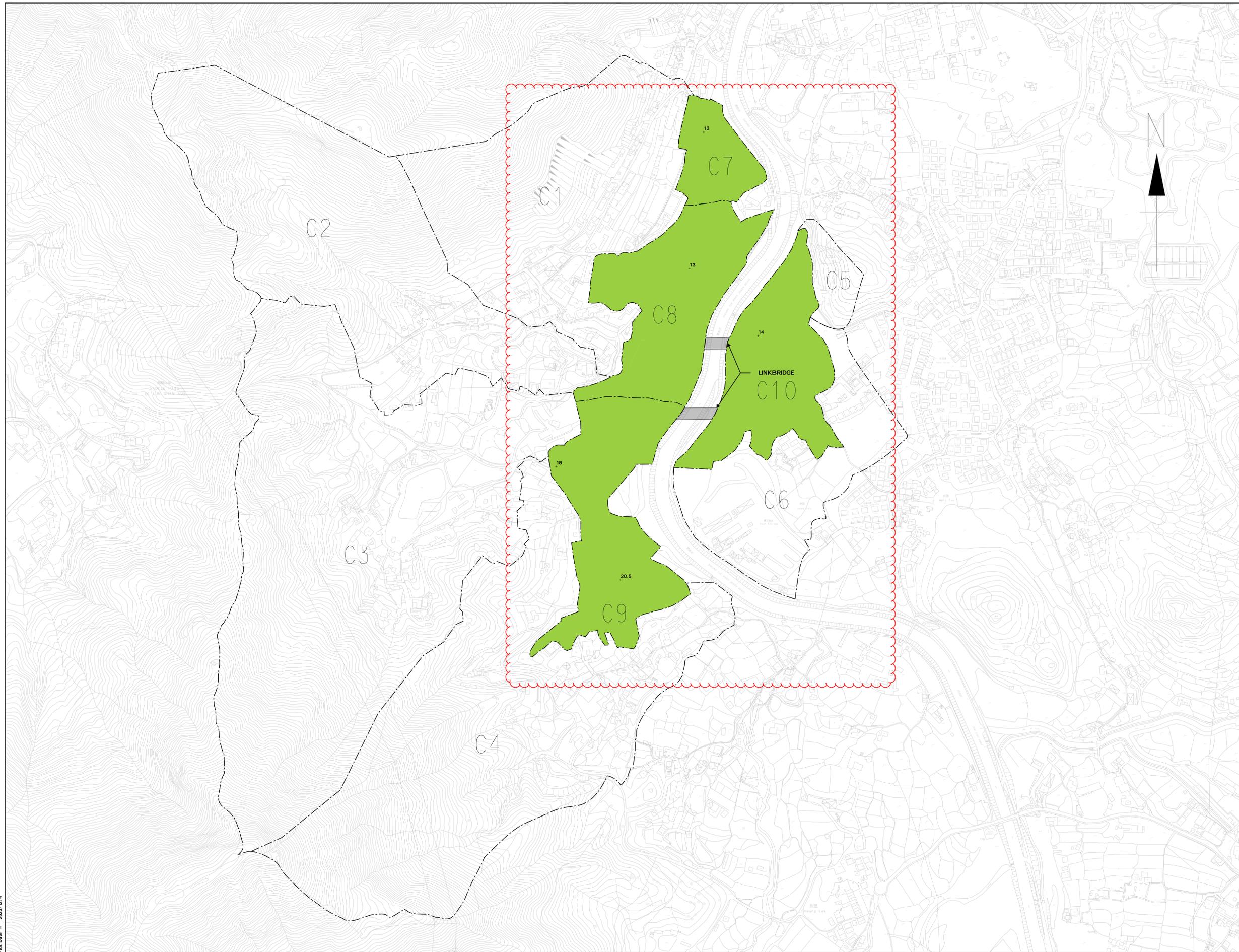
EXISTING CATCHMENT AREA

Figure No.  
K2

Scale  
A3 1 : 5000



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LEGEND:

- EXISTING CATCHPIT
- THE APPLICATION SITE
- EXISTING DRAINAGE PIPE/ CHANNEL



CATCHMENT	AREA (m <sup>2</sup> )
C1	99045
C2	122826
C3	211950
C4	164692
C5	7603
C6	46806
C7	<b>12500</b>
C8	<b>39500</b>
C9	<b>40000</b>
C10	35300

Initial	Date	Checked	Date

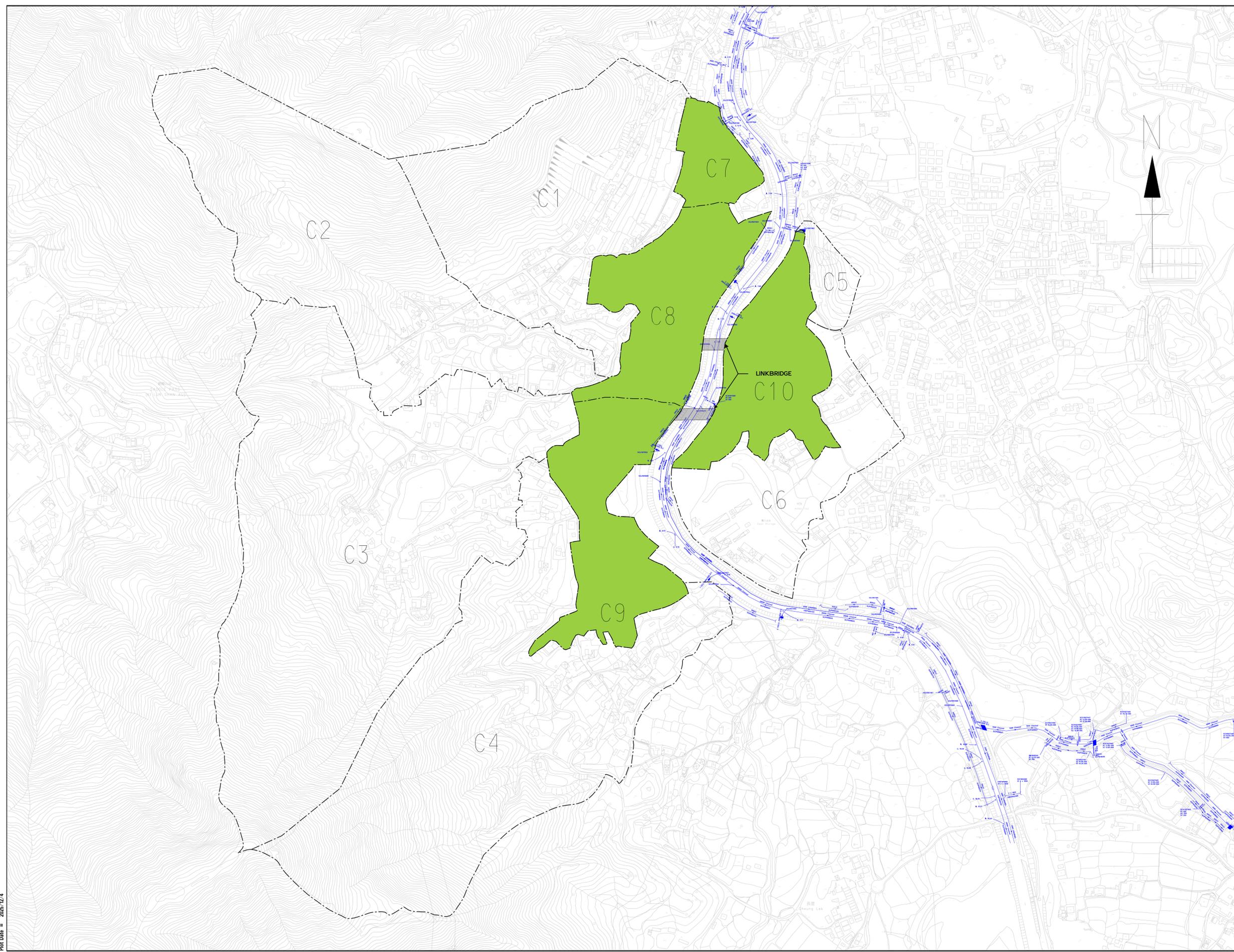
Project

S16 APPLICATION FOR PROPOSED  
INTERNATIONAL SCHOOL IN KWU  
TUNG SOUTH

Title

**EXISTING DRAINAGE  
SYSTEMS**

Figure No. <b>K3</b>	Scale <b>A3 1 : 5000</b>
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LEGEND:

- EXISTING CATCHPIT
- THE APPLICATION SITE
- EXISTING DRAINAGE PIPE/ CHANNEL
- PROPOSED CATCHPIT
- PROPOSED MANHOLE
- 500 PROPOSED 500mm RECTANGULAR CHANNEL
- 900 PROPOSED 900mm RECTANGULAR CHANNEL
- 1100 PROPOSED 1100mm RECTANGULAR CHANNEL
- 1300 PROPOSED 1300mm RECTANGULAR CHANNEL
- 1200 PROPOSED 1200mm DIAMETER STORMWATER DRAIN
- 1350 PROPOSED 1350mm DIAMETER STORMWATER DRAIN
- 1650 PROPOSED 1650mm DIAMETER STORMWATER DRAIN
- 1800 PROPOSED 1800mm DIAMETER STORMWATER DRAIN
- PROPOSED OUTLET
- DISCHARGE OF CATCHMENT AREA WITHIN PROPOSED DEVELOPMENT

CATCHMENT	AREA (m <sup>2</sup> )
C1	99045
C2	122826
C3	211950
C4	164692
C5	7603
C6	46806
C7	<b>12500</b>
C8	<b>39500</b>
C9	<b>40000</b>
C10	35300

Initial	Date	Checked	Date

Project

S16 APPLICATION FOR PROPOSED INTERNATIONAL SCHOOL IN KWU TUNG SOUTH

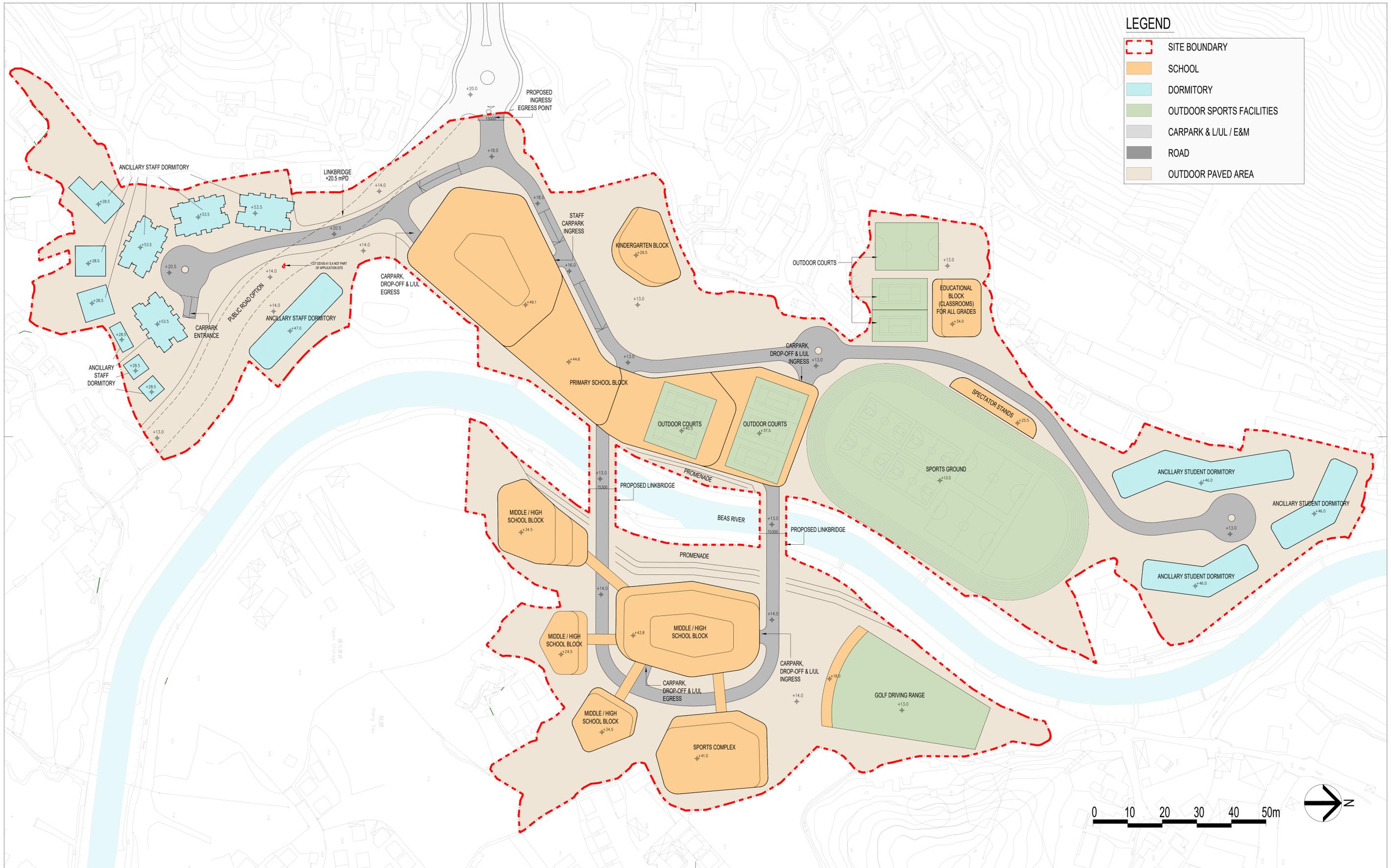
Title

PROPOSED DRAINAGE SYSTEMS

Figure No.	Scale
K4	A3 1 : 5000



**Annex 1**  
**Master Layout Plan**



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A	PLANNING SUBMISSION	I.HKO	I.JHK	I.JHY	11-2025

Rev.	Description	Drawn	Checked	Approved	Date

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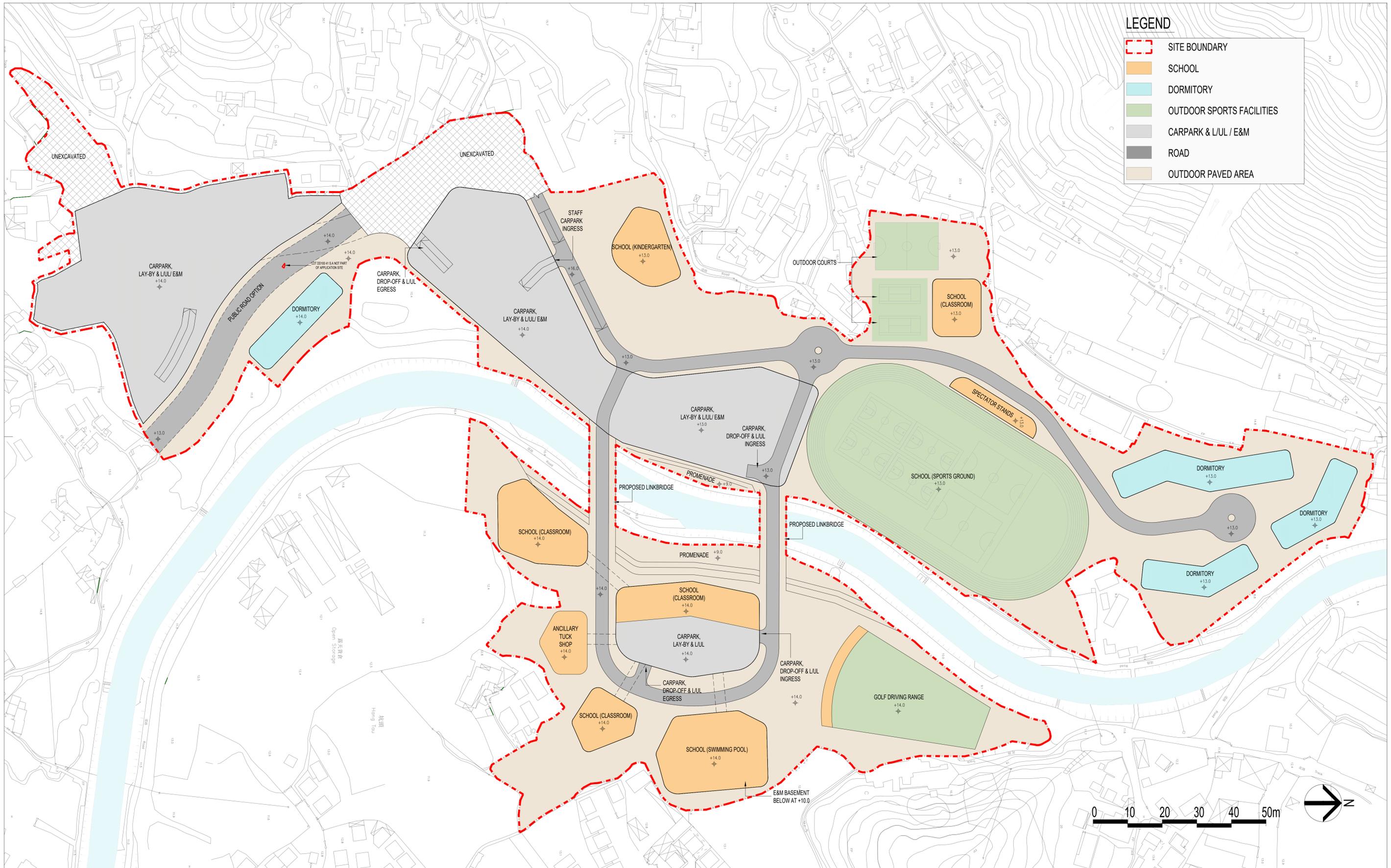
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Project Title  
**PROPOSED INTERNATIONAL SCHOOL DEVELOPMENT AT KWU TUNG SOUTH**

Drawing Title  
**FULL PHASE – MASTER LAYOUT PLAN**

Project No.	25018NT
Scale	1:1000
Issue Date	NOV 2025
Drawing No.	A/GBP_01_

Drawing Purpose



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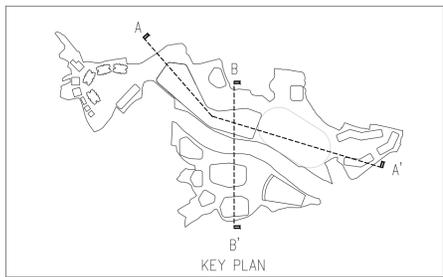
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Drawing Title  
FULL PHASE –  
GROUND FLOOR PLAN

Project No. 25018NT  
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Drawing No. A/GBP\_02

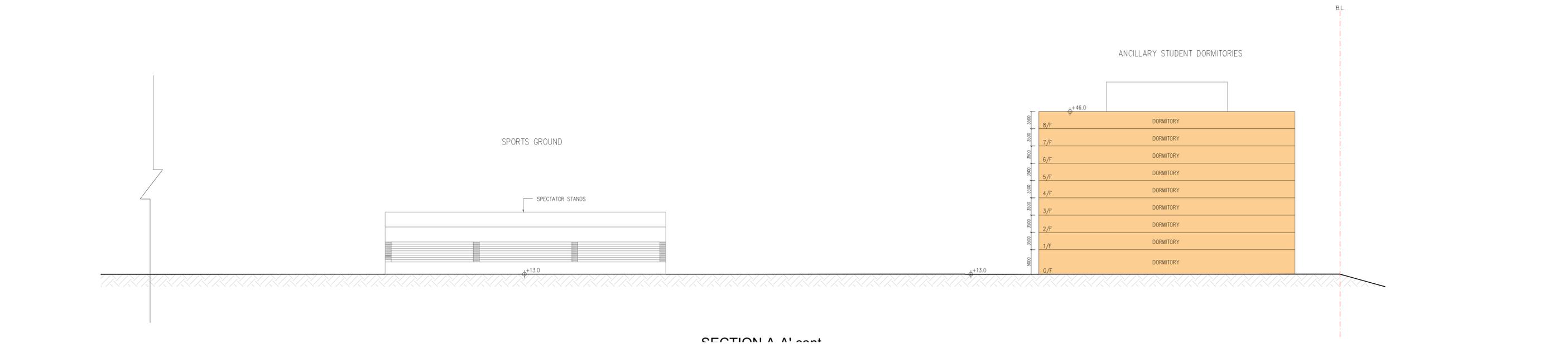
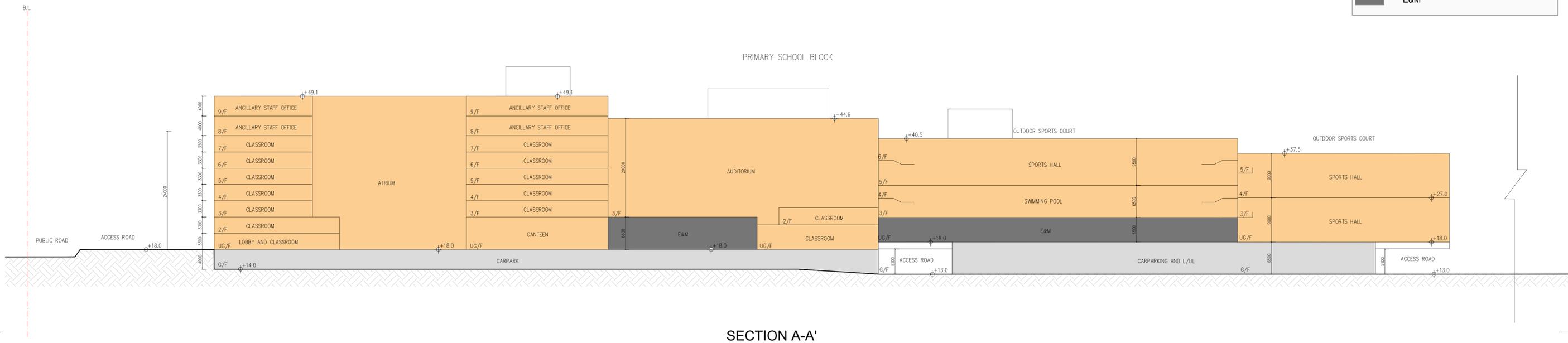
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**LEGEND**

- SITE BOUNDARY
- SCHOOL
- DORMITORY
- OUTDOOR SPORTS FACILITIES
- CARPARK & L/UL
- E&M



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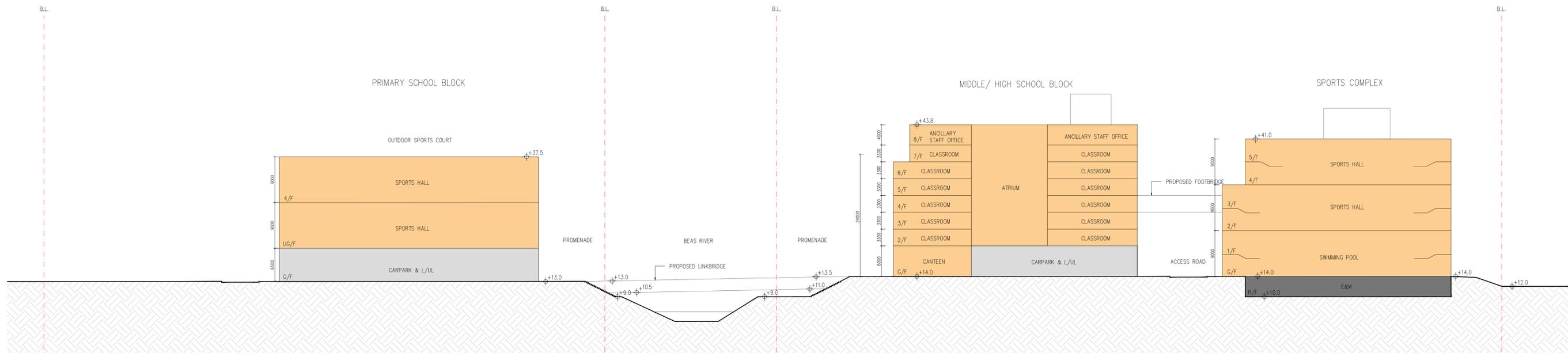
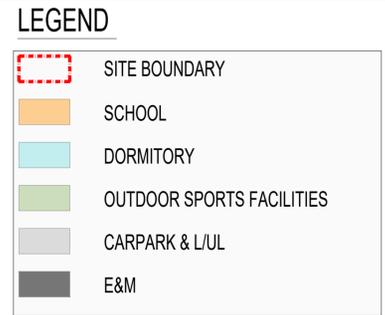
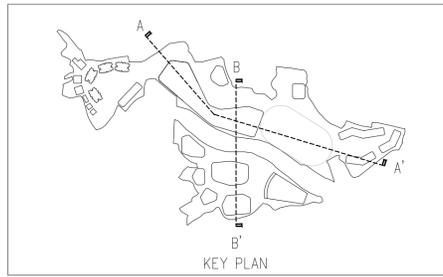
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Drawing Title  
SECTION A-A

Drawing Purpose

Project No. 25018NT  
Scale 1:400 Issue Date NOV 2025  
Drawing No. A/GBP\_05



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Drawing Title  
SECTION B-B

Drawing Purpose

Project No.	25018NT
Scale	1:400
Issue Date	NOV 2025
Drawing No.	A/GBP_06

**Annex 2**  
**Runoff Calculations**

**Capacity Check:**

Catchment C7 and C8 (Before development) (50 years)

**Design Parameters**

Design storm		50	year return period	
Storm constants	a	474.6		
	b	2.9		
	c	0.371		
Average Slope	H	0.30	m/100m	
Length of flow	L	110	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	6.25	min	
Unpaved area	$A_U$	88900	$m^2$	
Runoff coef.	$C_U$	0.35		
Paved area	$A_P$	38100	$m^2$	
Runoff coef.	$C_P$	0.95		
Catchment area	$A_{Total}$	127,000	$m^2$	
Runoff coef.	$C_{average}$	0.53		
Surface roughness	$k_s$	0.6	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	1.14	$mm^2/s$	
Frictional gradient	$S_f$	1 in	100	

**Capacity Check:**

Catchment C7 and C8 (Before development) (50 years)

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$		
		=	3.38	min	
Time of concentration	$t_c$	=	$t_0 + t_f$		
		=	9.63	min	
Intensity	$i$	=	$a / (t_c + b)^c$	x	1.281
		=	238.01	mm/hr	(Climate Change Factor)
Peak runoff	$Q_p$	=	$0.278 C i A$		(SDM Table 28)
		=	4.454	$m^3/s$	

**Capacity Check:**

Catchment C7 and C8 (After development) (50 years)

**Design Parameters**

Design storm		50	year return period	
Storm constants	a	474.6		
	b	2.9		
	c	0.371		
Average Slope	H	0.30	m/100m	
Length of flow	L	110	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	6.25	min	
Unpaved area	$A_U$	38100	$m^2$	
Runoff coef.	$C_U$	0.35		
Paved area	$A_P$	88900	$m^2$	
Runoff coef.	$C_P$	0.95		
Catchment area	$A_{Total}$	127,000	$m^2$	
Runoff coef.	$C_{average}$	0.77		
Surface roughness	$k_s$	0.6	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	1.14	$mm^2/s$	
Frictional gradient	$S_f$	1 in	100	

**Capacity Check:**

Catchment C7 and C8 (After development) (50 years)

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$		
		=	3.38	min	
Time of concentration	$t_c$	=	$t_0 + t_f$		
		=	9.63	min	
Intensity	$i$	=	$a / (t_c + b)^c$	x	1.281
		=	238.01	mm/hr	(Climate Change Factor)
Peak runoff	$Q_p$	=	$0.278 C i A$		(SDM Table 28)
		=	<b>6.470</b>	$m^3/s$	

**Capacity Check:**

Catchment C7 and C8 (Before development) (200 years)

**Design Parameters**

Design storm		200	year return period	
Storm constants	a	501.4		
	b	2.45		
	c	0.348		
Average Slope	H	0.30	m/100m	
Length of flow	L	110	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	6.25	min	
Unpaved area	$A_U$	88900	$m^2$	
Runoff coef.	$C_U$	0.35		
Paved area	$A_P$	38100	$m^2$	
Runoff coef.	$C_P$	0.95		
Catchment area	$A_{Total}$	127,000	$m^2$	
Runoff coef.	$C_{average}$	0.53		
Surface roughness	$k_s$	0.6	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	1.14	$mm^2/s$	
Frictional gradient	$S_f$	1 in	100	

**Capacity Check:**

Catchment C7 and C8 (Before development) (200 years)

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$		
		=	3.38	min	
Time of concentration	$t_c$	=	$t_0 + t_f$		
		=	9.63	min	
Intensity	$i$	=	$a / (t_c + b)^c$	x	1.281
		=	269.91	mm/hr	(Climate Change Factor)
Peak runoff	$Q_p$	=	$0.278 C i A$		(SDM Table 28)
		=	<b>5.051</b>	$m^3/s$	

**Capacity Check:**

Catchment C7 and C8 (After development) (200 years)

**Design Parameters**

Design storm		200	year return period	
Storm constants	a	501.4		
	b	2.45		
	c	0.348		
Average Slope	H	0.30	m/100m	
Length of flow	L	110	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	6.25	min	
Unpaved area	$A_U$	38100	$m^2$	
Runoff coef.	$C_U$	0.35		
Paved area	$A_P$	88900	$m^2$	
Runoff coef.	$C_P$	0.95		
Catchment area	$A_{Total}$	127,000	$m^2$	
Runoff coef.	$C_{average}$	0.77		
Surface roughness	$k_s$	0.6	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	1.14	$mm^2/s$	
Frictional gradient	$S_f$	1 in	100	

**Capacity Check:**

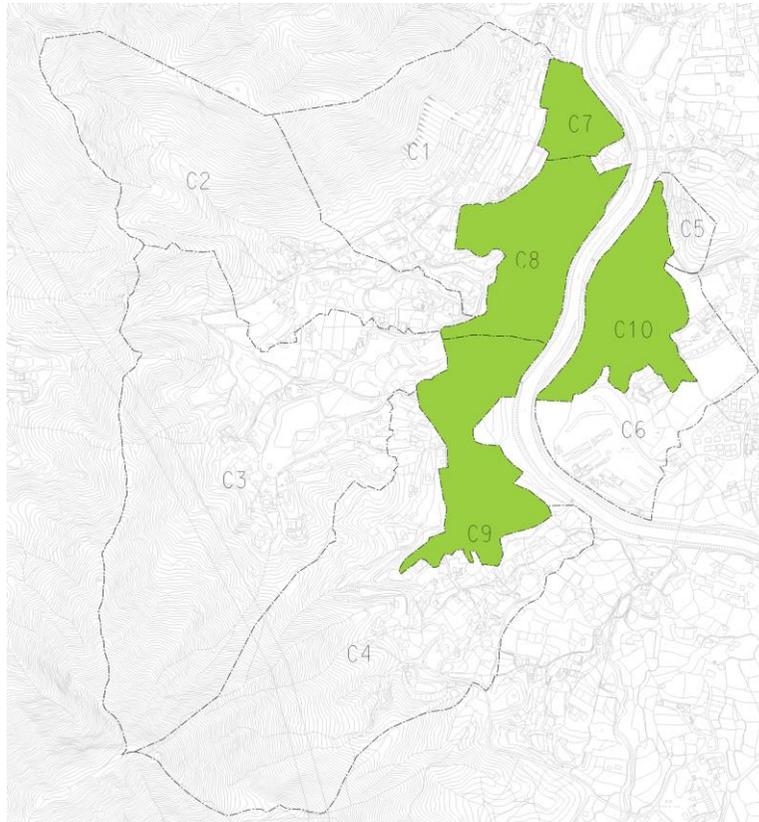
Catchment C7 and C8 (After development) (200 years)

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$		
		=	3.38	min	
Time of concentration	$t_c$	=	$t_0 + t_f$		
		=	9.63	min	
Intensity	$i$	=	$a / (t_c + b)^c$	x	1.281
		=	269.91	mm/hr	(Climate Change Factor)
Peak runoff	$Q_p$	=	$0.278 C i A$		(SDM Table 28)
		=	<b>7.338</b>	$m^3/s$	

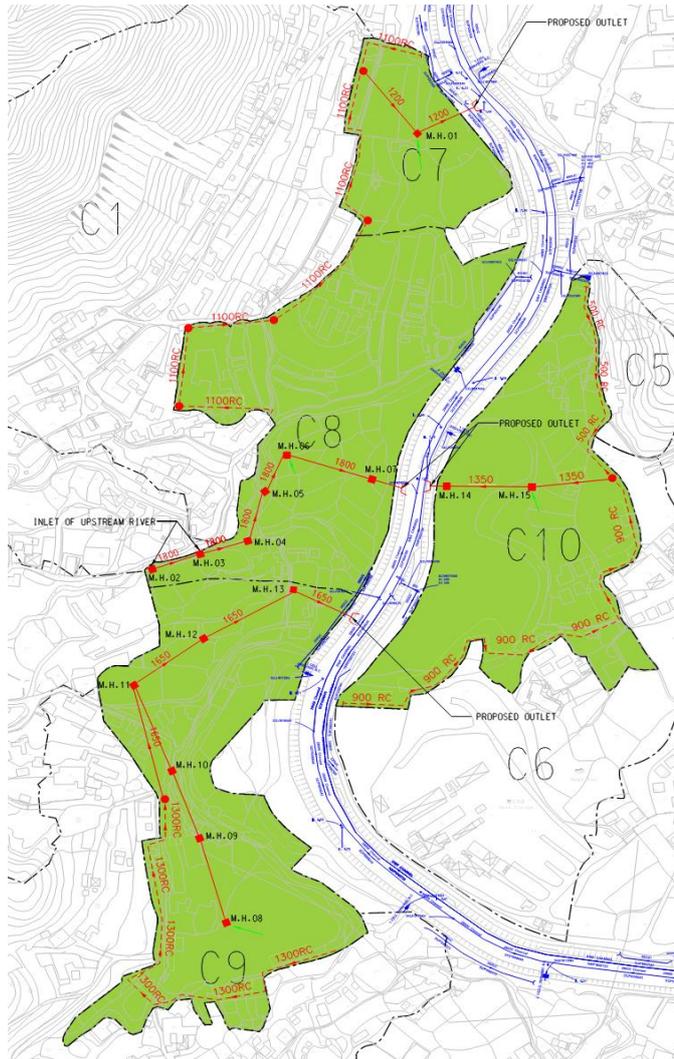
**Annex 3**  
**Design of Drainage System**

**Summary of Catchment Characteristic**



Catchment	Area (m <sup>2</sup> )	Before Development		After Development		Runoff Coefficient		Peak Runoff (50-year return period) (m <sup>3</sup> /s)
		Paved Area (m <sup>2</sup> )	Unpaved Area (m <sup>2</sup> )	Paved Area (m <sup>2</sup> )	Unpaved Area (m <sup>2</sup> )	Paved	Unpaved	
C1	99045	29,714	69,332	29,714	69,332	0.95	0.35	2.646
C2	122,826	36,848	85,978	36,848	85,978	0.95	0.35	3.393
C3	211,950	63,585	148,365	63,585	148,365	0.95	0.35	5.944
C4	164,692	49,408	115,284	49,408	115,284	0.95	0.35	4.583
C5	7,603	2,281	5,322	2,281	5,322	0.95	0.35	0.36
C6	46,806	14,042	32,764	14,042	32,764	0.95	0.35	1.634
C7	13,432	4,030	9,402	9402.4	4029.6	0.95	0.35	0.697
C8	39,500	11,850	27,650	27650	11850	0.95	0.35	1.902
C9	40,000	12,000	28,000	28000	12000	0.95	0.35	1.685
C10	35,300	10,590	24,710	24710	10590	0.95	0.35	1.862

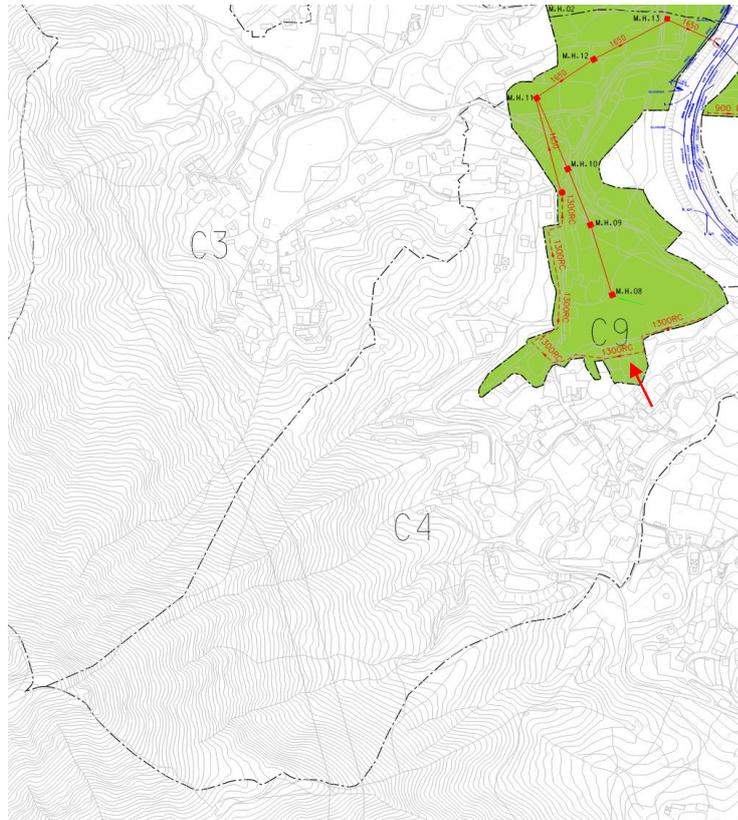
## Summary of Proposed Pipes



Catchment	Proposed Pipes/ Channels
C1	1100 RC
C2	1800mm Pipe
C3	1800mm Pipe
C4	1300 RC
C5	500 RC
C6	900 RC
C7	1200mm Pipe
C8	1800mm Pipe
C9	1650mm Pipe
C10	1350mm Pipe

**Capacity Check:**

**Catchment C4**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>28.00</b>	m/100m	
Length of flow	L	<b>770</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>17.21</b>	min	
Unpaved area	A <sub>U</sub>	<b>115284</b>	m <sup>2</sup>	
Runoff coef.	C <sub>U</sub>	<b>0.35</b>		
Paved area	A <sub>P</sub>	<b>49408</b>	m <sup>2</sup>	
Runoff coef.	C <sub>P</sub>	<b>0.95</b>		
Catchment area	A <sub>Total</sub>	<b>164,692</b>	m <sup>2</sup>	
Runoff coef.	C <sub>average</sub>	<b>0.53</b>		
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s	
Frictional gradient	S <sub>f</sub>	<b>100</b>	1 in	

**Capacity Check:** Catchment C4

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$	
		=	3.20	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	20.41	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	189.03	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>4.587</b>	$m^3/s$

**Using Manning's Equation for Rectangular-Channel Geometry**

<b>Width</b>	<b>1300</b>	<b>mm</b>	<b>Input Parameter</b>
<b>Height</b>	<b>1300</b>	<b>mm</b>	<b>Input Parameter</b>
Area	1.690	$m^2$	
Wetted Perimeter	3.900	m	
Hydraulic Radius	0.433	m	
<b>Slope [Decimal]</b>	<b>0.01</b>		Slope = $\tan \theta$
<b>Manning's Roughness</b>	<b>0.015</b>		for Fair concrete Pipe
Full Flow Velocity $V_u$	3.82	m/s	
Full Flow Discharge	6.45	$m^3/s$	
	387104	l/min	

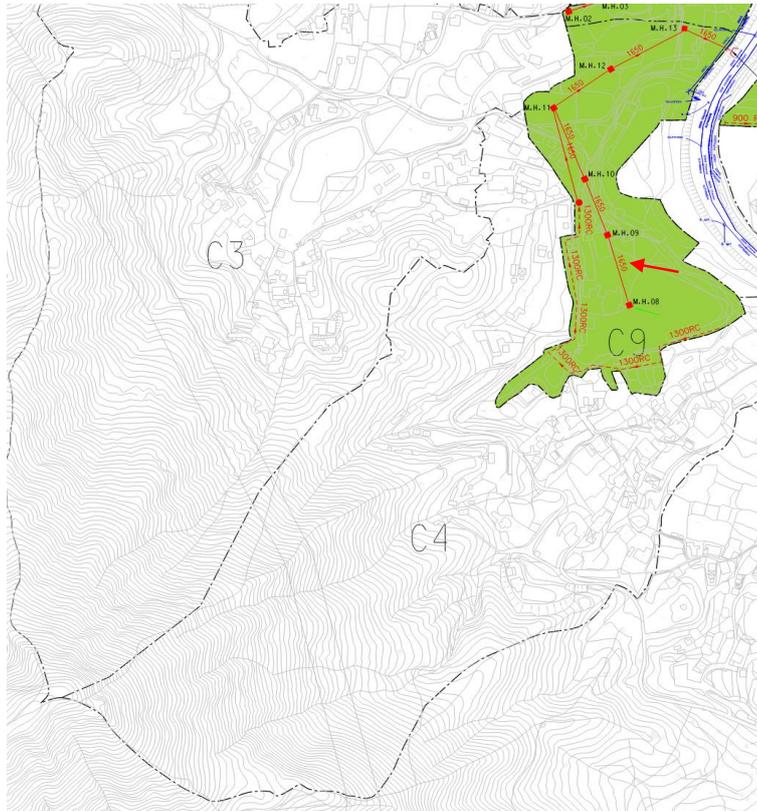
Assume the maximum water depth in the Rectangular-channel be 90% of the size

Water Depth	Area	Wetted Perimeter	Hydraulic Radius	Velocity	Discharge
[mm]	$m^2$	m	m	m/s	$m^3/s$
1170	1.521	3.640	0.418	3.726	<b>5.667</b>

> Peak runoff  $Q_p$

**Capacity Check:**

**Catchment C9**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>2.00</b>	m/100m	
Length of flow	L	<b>381</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>16.63</b>	min	
Unpaved area	A <sub>U</sub>	<b>12000</b>	m <sup>2</sup>	
Runoff coef.	C <sub>U</sub>	<b>0.35</b>		
Paved area	A <sub>P</sub>	<b>28000</b>	m <sup>2</sup>	
Runoff coef.	C <sub>P</sub>	<b>0.95</b>		
Catchment area	A <sub>Total</sub>	<b>40,000</b>	m <sup>2</sup>	
Runoff coef.	C <sub>average</sub>	<b>0.77</b>		
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s	
Frictional gradient	S <sub>f</sub>	<b>100</b>	1 in	

**Capacity Check:**

Catchment C9

**Peak Runoff**

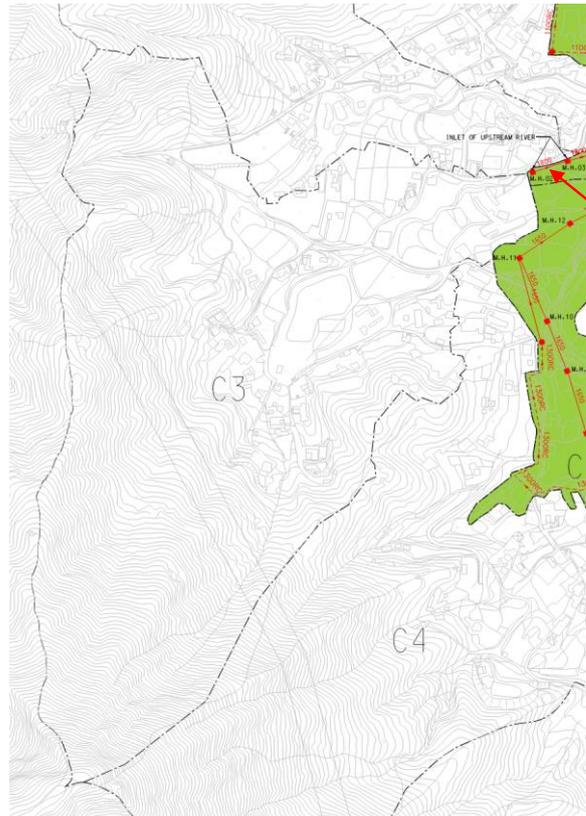
Flow time	$t_f$	=	$L_j / V_j$	
		=	1.40	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	18.02	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	196.75	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>1.685</b>	$m^3/s$
Peak Runoff From C4		=	<b>4.587</b>	$m^3/s$
Total Peak Runoff		=	<b>6.272</b>	$m^3/s$

**Capacity of Drain**

Drain pipe size	D	=	<b>1650</b>	mm
Hydraulic radius	$R = D/4$	=	0.4125	m
Mean velocity (Colebrook-White)	$\bar{V}$	=	$-\sqrt{32gRS_f} \log \left[ \frac{k_s}{14.8R} + \frac{1.255v}{R\sqrt{(32gRS_f)}} \right]$	
		=		
		=	4.55	m/s
Capacity provided	Q	=	$\bar{V} \times$ Cross Section Area of Drain	
		=	<b>9.72</b>	$m^3/s$
Allow 10% Area for Siltation	$Q_{90\%}$	=	<b>8.75</b>	$m^3/s$
		>	Peak runoff $Q_p$	
Utilization		=	$Q_p/Q_{90\%}$	
		=	72%	

**Capacity Check:**

**Catchment C3**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>26.00</b>	m/100m	
Length of flow	L	<b>770</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>17.03</b>	min	
Unpaved area	A <sub>U</sub>	<b>148365</b>	m <sup>2</sup>	
Runoff coef.	C <sub>U</sub>	<b>0.35</b>		
Paved area	A <sub>P</sub>	<b>63585</b>	m <sup>2</sup>	
Runoff coef.	C <sub>P</sub>	<b>0.95</b>		
Catchment area	A <sub>Total</sub>	<b>211,950</b>	m <sup>2</sup>	
Runoff coef.	C <sub>average</sub>	<b>0.53</b>		
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s	
Frictional gradient	S <sub>f</sub>	<b>85</b>	1 in	

**Capacity Check:**

Catchment C3

**Peak Runoff**

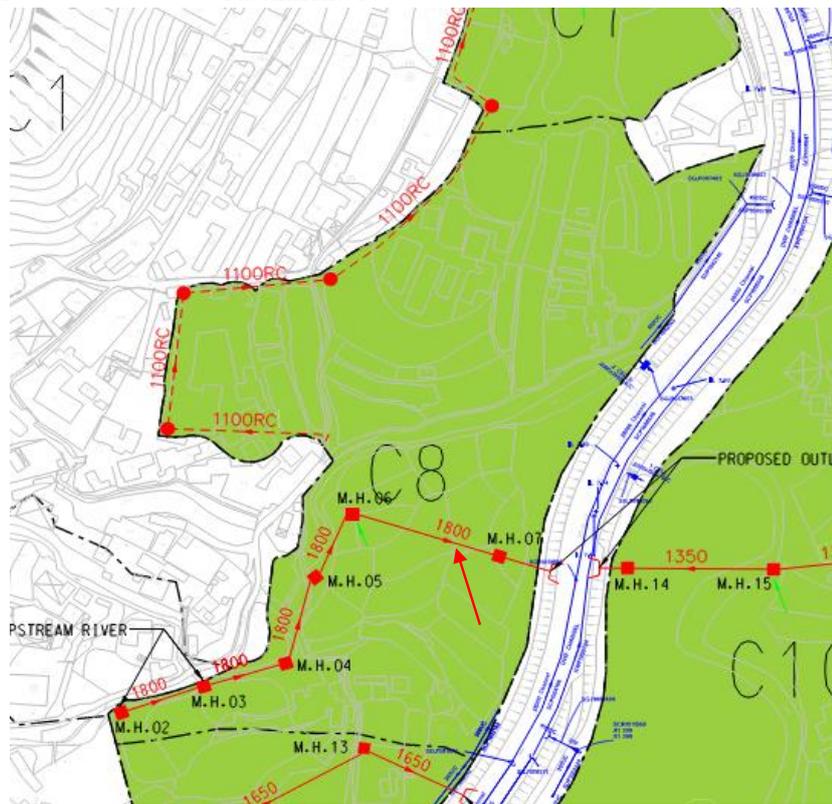
Flow time	$t_f$	=	$L_j / V_j$	
		=	2.95	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	19.98	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	190.34	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>5.944</b>	$m^3/s$

**Capacity of Drain**

Trial pipe size	D	=	<b>1800</b>	mm
Hydraulic radius	$R = D/4$	=	0.45	m
Mean velocity (Colebrook-White)	$\bar{V}$	=	$-\sqrt{32gRS_f} \log \left[ \frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{(32gRS_f)}} \right]$	
		=		
		=	5.20	m/s
Capacity provided	Q	=	$\bar{V} \times \text{Cross Section Area of Drain}$	
		=	<b>13.23</b>	$m^3/s$
Allow 10% Area for Siltation	$Q_{90\%}$	=	<b>11.91</b>	$m^3/s$
		>	Peak runoff $Q_p$	
Utilization		=	$Q_p / Q_{90\%}$	
		=	50%	

**Capacity Check:**

**Catchment C8**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>2.00</b>	m/100m	
Length of flow	L	<b>200</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>8.74</b>	min	
Unpaved area	A <sub>U</sub>	<b>11850</b>	m <sup>2</sup>	
Runoff coef.	C <sub>U</sub>	<b>0.35</b>		
Paved area	A <sub>P</sub>	<b>27650</b>	m <sup>2</sup>	
Runoff coef.	C <sub>P</sub>	<b>0.95</b>		
Catchment area	A <sub>Total</sub>	<b>39,500</b>	m <sup>2</sup>	
Runoff coef.	C <sub>average</sub>	<b>0.77</b>		
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s	
Frictional gradient	S <sub>f</sub> 1 in	<b>85</b>		

**Capacity Check:**

Catchment C8

**Peak Runoff**

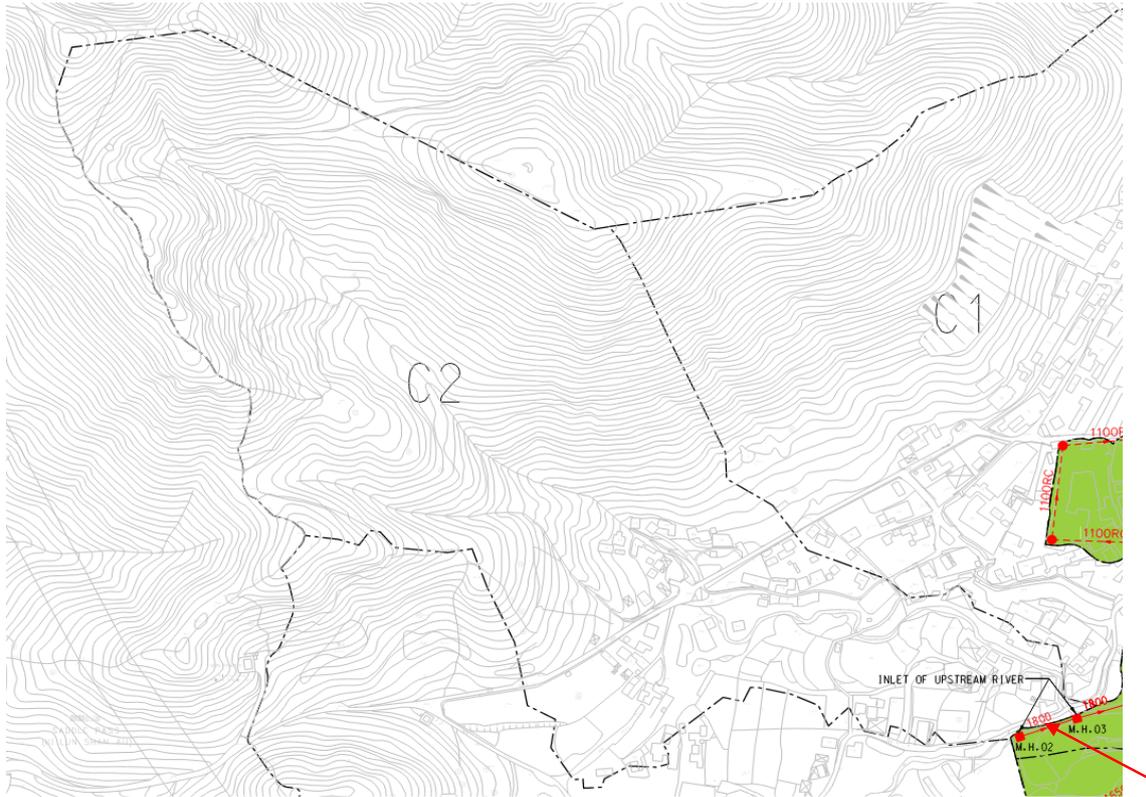
Flow time	$t_f$	=	$L_j / V_j$	
		=	2.95	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	11.69	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	224.91	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	1.902	$m^3/s$
Peak runoff From C3		=	5.944	$m^3/s$
Total runoff		=	7.846	$m^3/s$

**Capacity of Drain**

Trial pipe size	D	=	1800	mm
Hydraulic radius	$R = D/4$	=	0.45	m
Mean velocity (Colebrook-White)	$\bar{V}$	=	$-\sqrt{32gRS_f} \log \left[ \frac{k_s}{14.8R} + \frac{1.255v}{R\sqrt{(32gRS_f)}} \right]$	
		=	5.20	m/s
Capacity provided	Q	=	$\bar{V} \times \text{Cross Section Area of Drain}$	
		=	13.23	$m^3/s$
Allow 10% Area for Siltation	$Q_{90\%}$	=	11.91	$m^3/s$
		>	Peak runoff $Q_p$	
Utilization		=	$Q_p/Q_{90\%}$	
		=	66%	

**Capacity Check:**

**Catchment C2**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>26.00</b>	m/100m	
Length of flow	L	<b>770</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>17.98</b>	min	
Unpaved area	$A_U$	<b>85978</b>	$m^2$	
Runoff coef.	$C_U$	<b>0.35</b>		
Paved area	$A_P$	<b>36848</b>	$m^2$	
Runoff coef.	$C_P$	<b>0.95</b>		
Catchment area	$A_{Total}$	<b>122,826</b>	$m^2$	
Runoff coef.	$C_{Average}$	<b>0.53</b>		
Surface roughness	$k_s$	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	$mm^2/s$	
Frictional gradient	$S_f$	<b>85</b>	1 in	

**Capacity Check:**

Catchment C2

**Peak Runoff**

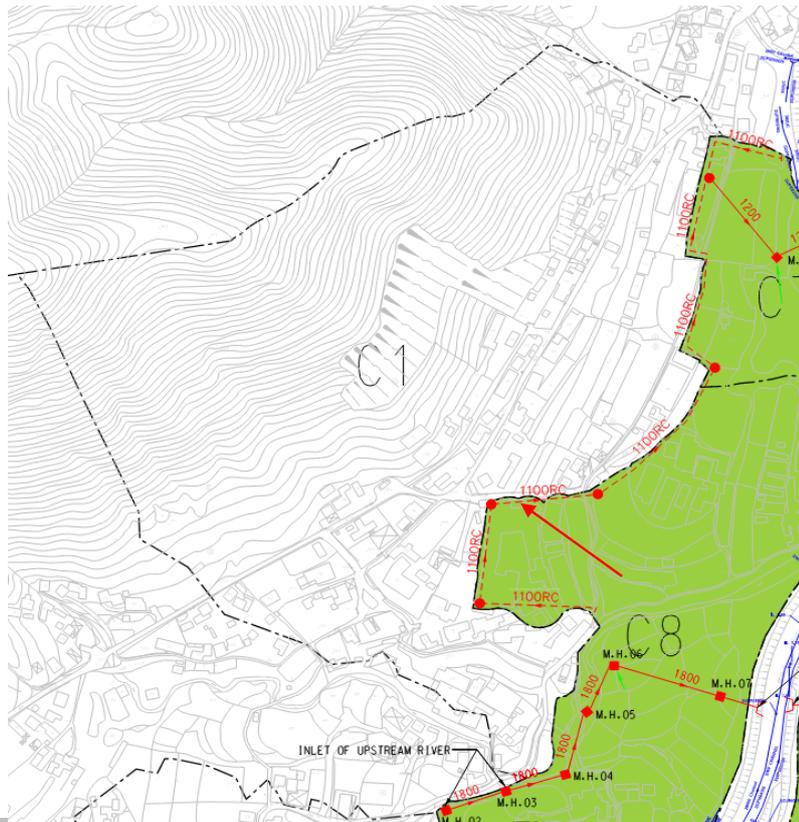
Flow time	$t_f$	=	$L_j / V_j$	
		=	2.95	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	20.93	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	187.47	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>3.393</b>	$m^3/s$
Peak runoff from C3		=	<b>5.944</b>	$m^3/s$
Peak runoff from C8		=	<b>1.902</b>	
Total runoff		=	<b>11.238</b>	

**Capacity of Drain**

Trial pipe size	D	=	<b>1800</b>	mm
Hydraulic radius	$R = D/4$	=	0.45	m
Mean velocity (Colebrook-White)	$\bar{V}$	=	$-\sqrt{32gRS_f} \log \left[ \frac{k_s}{14.8R} + \frac{1.255v}{R\sqrt{(32gRS_f)}} \right]$	
		=	5.20	m/s
Capacity provided	Q	=	$\bar{V} \times \text{Cross Section Area of Drain}$	
		=	<b>13.23</b>	$m^3/s$
Allow 10% Area for Siltation	$Q_{90\%}$	=	<b>11.91</b>	$m^3/s$
		>	Peak runoff $Q_p$	
Utilization		=	$Q_p/Q_{90\%}$	
		=	94%	

**Capacity Check:**

**Catchment C1**



**Design Parameters**

Design storm		<b>50</b>	year return period
Storm constants	a	<b>474.6</b>	
	b	<b>2.9</b>	
	c	<b>0.371</b>	
Average Slope	H	<b>20.00</b>	m/100m
Length of flow	L	<b>770</b>	m
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>19.37</b>	min
Unpaved area	A <sub>U</sub>	<b>69332</b>	m <sup>2</sup>
Runoff coef.	C <sub>U</sub>	<b>0.35</b>	
Paved area	A <sub>P</sub>	<b>29714</b>	m <sup>2</sup>
Runoff coef.	C <sub>P</sub>	<b>0.95</b>	
Catchment area	A <sub>Total</sub>	<b>99,045</b>	m <sup>2</sup>
Runoff coef.	C <sub>average</sub>	<b>0.53</b>	
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s
Frictional gradient	S <sub>f</sub> 1 in	<b>100</b>	

**Capacity Check:** Catchment C1

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$	
		=	3.58	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	22.94	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	181.93	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>2.655</b>	$m^3/s$

**Using Manning's Equation for Rectangular-Channel Geometry**

<b>Width</b>	<b>1100</b>	<b>mm</b>	<b>Input Parameter</b>
<b>Height</b>	<b>1100</b>	<b>mm</b>	<b>Input Parameter</b>
Area	1.210	$m^2$	
Wetted Perimeter	3.300	m	
Hydraulic Radius	0.367	m	
<b>Slope [Decimal]</b>	<b>0.01</b>		Slope = $\tan \theta$
<b>Manning's Roughness</b>	<b>0.015</b>		for Fair concrete Pipe
Full Flow Velocity Vu	3.42	m/s	
Full Flow Discharge	4.13	$m^3/s$	
	247947	l/min	

Assume the maximum water depth in the Rectangular-channel be 90% of the size

Water Depth	Area	Wetted Perimeter	Hydraulic Radius	Velocity	Discharge
[mm]	$m^2$	m	m	m/s	$m^3/s$
900	0.990	3.300	0.300	2.988	<b>2.958</b>

> Peak runoff  $Q_p$

**Capacity Check:**

**Catchment C7**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>2.00</b>	m/100m	
Length of flow	L	<b>120</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>5.84</b>	min	
Unpaved area	A <sub>U</sub>	<b>4030</b>	m <sup>2</sup>	
Runoff coef.	C <sub>U</sub>	<b>0.35</b>		
Paved area	A <sub>P</sub>	<b>9402</b>	m <sup>2</sup>	
Runoff coef.	C <sub>P</sub>	<b>0.95</b>		
Catchment area	A <sub>Total</sub>	<b>13,432</b>	m <sup>2</sup>	
Runoff coef.	C <sub>average</sub>	<b>0.77</b>		
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	ν	<b>1.14</b>	mm <sup>2</sup> /s	
Frictional gradient	S <sub>f</sub>	<b>100</b>	1 in	

**Capacity Check:**

Catchment C7

**Peak Runoff**

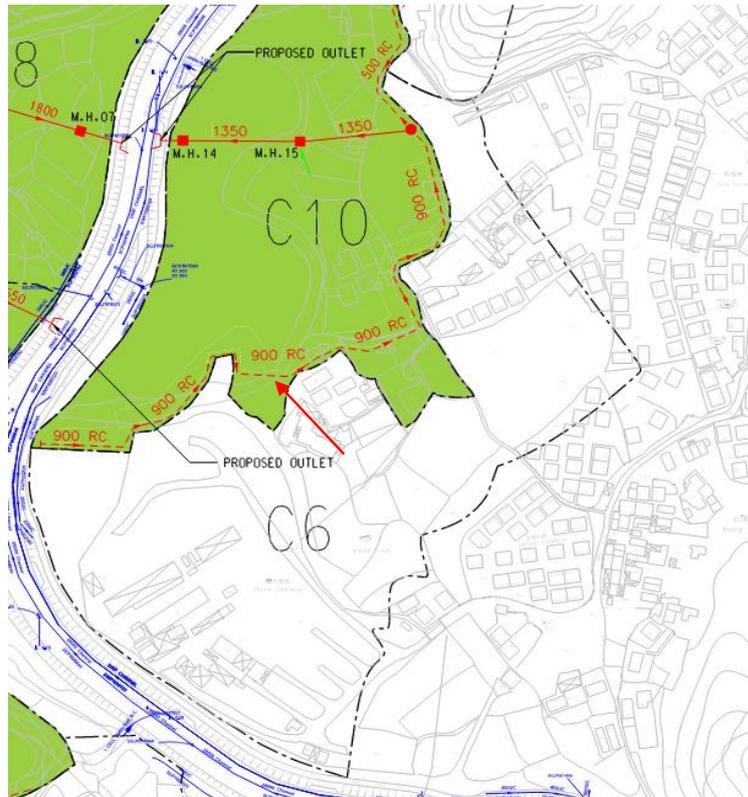
Flow time	$t_f$	=	$L_j / V_j$	
		=	3.20	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	9.04	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	242.27	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	0.697	$m^3/s$
Peak runoff from C1		=	2.655	$m^3/s$
Total runoff		=	3.352	

**Capacity of Drain**

Trial pipe size	D	=	1200	mm
Hydraulic radius	$R = D/4$	=	0.3	m
Mean velocity (Colebrook-White)	$\bar{V}$	=	$-\sqrt{32gRS_f} \log \left[ \frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{(32gRS_f)}} \right]$	
		=	3.74	m/s
Capacity provided	Q	=	$V \times$ Cross Section Area of Drain	
		=	4.23	$m^3/s$
Allow 10% Area for Siltation	$Q_{90\%}$	=	3.81	$m^3/s$
		>	Peak runoff $Q_p$	
Utilization		=	$Q_p/Q_{90\%}$	
		=	88%	

**Capacity Check:**

**Catchment C6**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>0.30</b>	m/100m	
Length of flow	L	<b>240</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>15.07</b>	min	
Unpaved area	A <sub>U</sub>	<b>23403</b>	m <sup>2</sup>	
Runoff coef.	C <sub>U</sub>	<b>0.35</b>		
Paved area	A <sub>P</sub>	<b>23403</b>	m <sup>2</sup>	
Runoff coef.	C <sub>P</sub>	<b>0.95</b>		
Catchment area	A <sub>Total</sub>	<b>46,806</b>	m <sup>2</sup>	
Runoff coef.	C <sub>average</sub>	<b>0.65</b>		
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s	
Frictional gradient	S <sub>f</sub>	<b>100</b>	1 in	

**Capacity Check:** Catchment C6

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$	
		=	4.09	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	19.16	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	192.94	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>1.632</b>	$m^3/s$

**Using Manning's Equation for Rectangular-Channel Geometry**

<b>Width</b>	<b>900</b>	<b>mm</b>	<b>Input Parameter</b>
<b>Height</b>	<b>900</b>	<b>mm</b>	<b>Input Parameter</b>
Area	0.810	$m^2$	
Wetted Perimeter	2.700	m	
Hydraulic Radius	0.300	m	
<b>Slope [Decimal]</b>	<b>0.01</b>		Slope = $\tan \theta$
<b>Manning's Roughness</b>	<b>0.015</b>		for Fair concrete Pipe
Full Flow Velocity Vu	2.99	m/s	
Full Flow Discharge	2.42	$m^3/s$	
	145198	l/min	

Assume the maximum water depth in the Rectangular-channel be 90% of the size

Water Depth	Area	Wetted Perimeter	Hydraulic Radius	Velocity	Discharge
[mm]	$m^2$	m	m	m/s	$m^3/s$
810	0.729	2.520	0.289	2.916	<b>2.126</b>

> Peak runoff  $Q_p$

**Capacity Check:**

**Catchment C5**



**Design Parameters**

Design storm		<b>50</b>	year return period	
Storm constants	a	<b>474.6</b>		
	b	<b>2.9</b>		
	c	<b>0.371</b>		
Average Slope	H	<b>3.00</b>	m/100m	
Length of flow	L	<b>70</b>	m	
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>3.33</b>	min	
Unpaved area	A <sub>U</sub>	<b>3041</b>	m <sup>2</sup>	
Runoff coef.	C <sub>U</sub>	<b>0.35</b>		
Paved area	A <sub>P</sub>	<b>4562</b>	m <sup>2</sup>	
Runoff coef.	C <sub>P</sub>	<b>0.95</b>		
Catchment area	A <sub>Total</sub>	<b>7,603</b>	m <sup>2</sup>	
Runoff coef.	C <sub>average</sub>	<b>0.71</b>		
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm	For Poor Precast Concrete Pipes
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s	
Frictional gradient	S <sub>f</sub>	<b>100</b>	1 in	

**Capacity Check:**

Catchment C5

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$	
		=	6.05	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	9.38	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	239.79	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>0.360</b>	$m^3/s$

**Using Manning's Equation for Rectangular-Channel Geometry**

<b>Width</b>	<b>500</b>	<b>mm</b>	<b>Input Parameter</b>
<b>Height</b>	<b>500</b>	<b>mm</b>	<b>Input Parameter</b>
Area	0.250	$m^2$	
Wetted Perimeter	1.500	m	
Hydraulic Radius	0.167	m	
<b>Slope [Decimal]</b>	<b>0.01</b>		Slope = tan $\theta$
<b>Manning's Roughness</b>	<b>0.015</b>		for Fair concrete Pipe
Full Flow Velocity Vu	2.02	m/s	
Full Flow Discharge	0.50	$m^3/s$	
	30285	l/min	

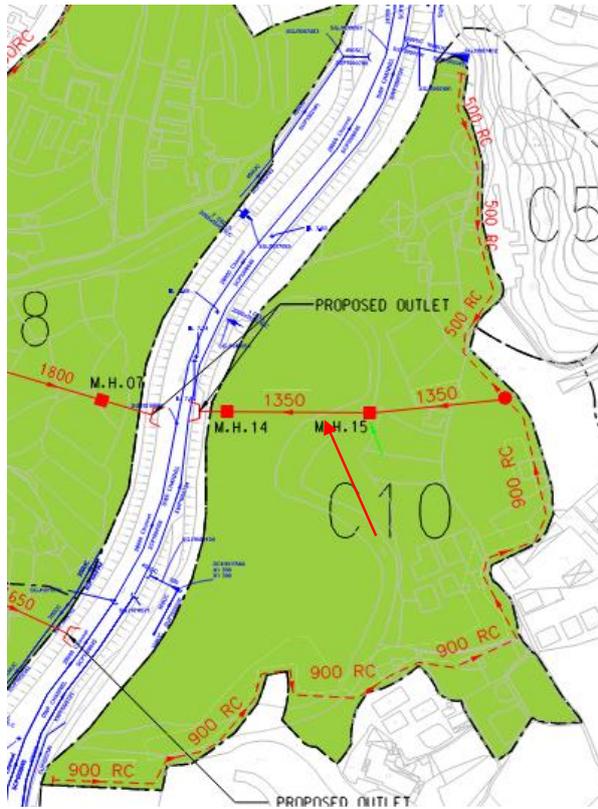
Assume the maximum water depth in the Rectangular-channel be 90% of the size

Water Depth	Area	Wetted Perimeter	Hydraulic Radius	Velocity	Discharge
[mm]	$m^2$	m	m	m/s	$m^3/s$
450	0.225	1.400	0.161	1.971	<b>0.443</b>

> Peak runoff  $Q_p$

**Capacity Check:**

**Catchment C10**



**Design Parameters**

Design storm		<b>50</b>	year return period
Storm constants	a	<b>474.6</b>	
	b	<b>2.9</b>	
	c	<b>0.371</b>	
Average Slope	H	<b>2.00</b>	m/100m
Length of flow	L	<b>120</b>	m
Inlet time $t_0=0.14465L/H^{0.2}A^{0.1}$	$t_0$	<b>5.30</b>	min
Unpaved area	A <sub>U</sub>	<b>10590</b>	m <sup>2</sup>
Runoff coef.	C <sub>U</sub>	<b>0.35</b>	
Paved area	A <sub>P</sub>	<b>24710</b>	m <sup>2</sup>
Runoff coef.	C <sub>P</sub>	<b>0.95</b>	
Catchment area	A <sub>Total</sub>	<b>35,300</b>	m <sup>2</sup>
Runoff coef.	C <sub>average</sub>	<b>0.77</b>	
Surface roughness	k <sub>s</sub>	<b>0.6</b>	mm
kinematic viscosity	$\nu$	<b>1.14</b>	mm <sup>2</sup> /s
Frictional gradient	S <sub>f</sub> 1 in	<b>100</b>	

For Poor Precast Concrete Pipes

**Capacity Check:**

Catchment C10

**Peak Runoff**

Flow time	$t_f$	=	$L_j / V_j$	
		=	3.20	min
Time of concentration	$t_c$	=	$t_0 + t_f$	
		=	8.50	min
Intensity	$i$	=	$a / (t_c + b)^c$	x 1.281 (Climate Change Factor)
		=	246.45	mm/hr (SDM Table 28)
Peak runoff	$Q_p$	=	$0.278 C i A$	
		=	<b>1.862</b>	$m^3/s$
Peak runoff from C5		=	<b>0.360</b>	$m^3/s$
Peak runoff from C6		=	<b>1.632</b>	$m^3/s$
Total runoff		=	<b>3.854</b>	$m^3/s$

**Capacity of Drain**

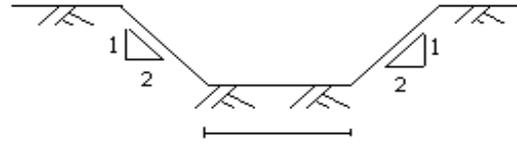
Drain pipe size	$D$	=	<b>1350</b>	mm
Hydraulic radius	$R = D/4$	=	0.3375	m
Mean velocity (Colebrook-White)	$\bar{V}$	=	$-\sqrt{32gRS_f} \log \left[ \frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{(32gRS_f)}} \right]$	
		=	4.02	m/s
Capacity provided	$Q$	=	$\bar{V} \times \text{Cross Section Area of Drain}$	
		=	<b>5.75</b>	$m^3/s$
Allow 10% Area for Siltation	$Q_{90\%}$	=	<b>5.18</b>	$m^3/s$
		>	Peak runoff $Q_p$	
Utilization		=	$Q_p / Q_{90\%}$	
		=	74%	

## **Annex 4**

### **Sensitivity Checking of River Beas**

**Annex 4 Hydraulic calculation at River Beas**

$$Q = \frac{A}{n} S^{1/2} R^{2/3}$$



16m

Area of flow	A =	47.380	m <sup>2</sup>	(Based on as-built drawing)
Wetted Perimeter	P =	26.286	m	
Hydraulic radius	R =	1.802		
Hydraulic gradient	S =	0.002		From as-built
Mannings Coefficient	n =	0.035		Table 13 of SDM

Capacity of Channel	Q =	$\frac{A}{n} \times s^{(1/2)} \times R^{(2/3)}$
	=	93.910 m <sup>3</sup> /s

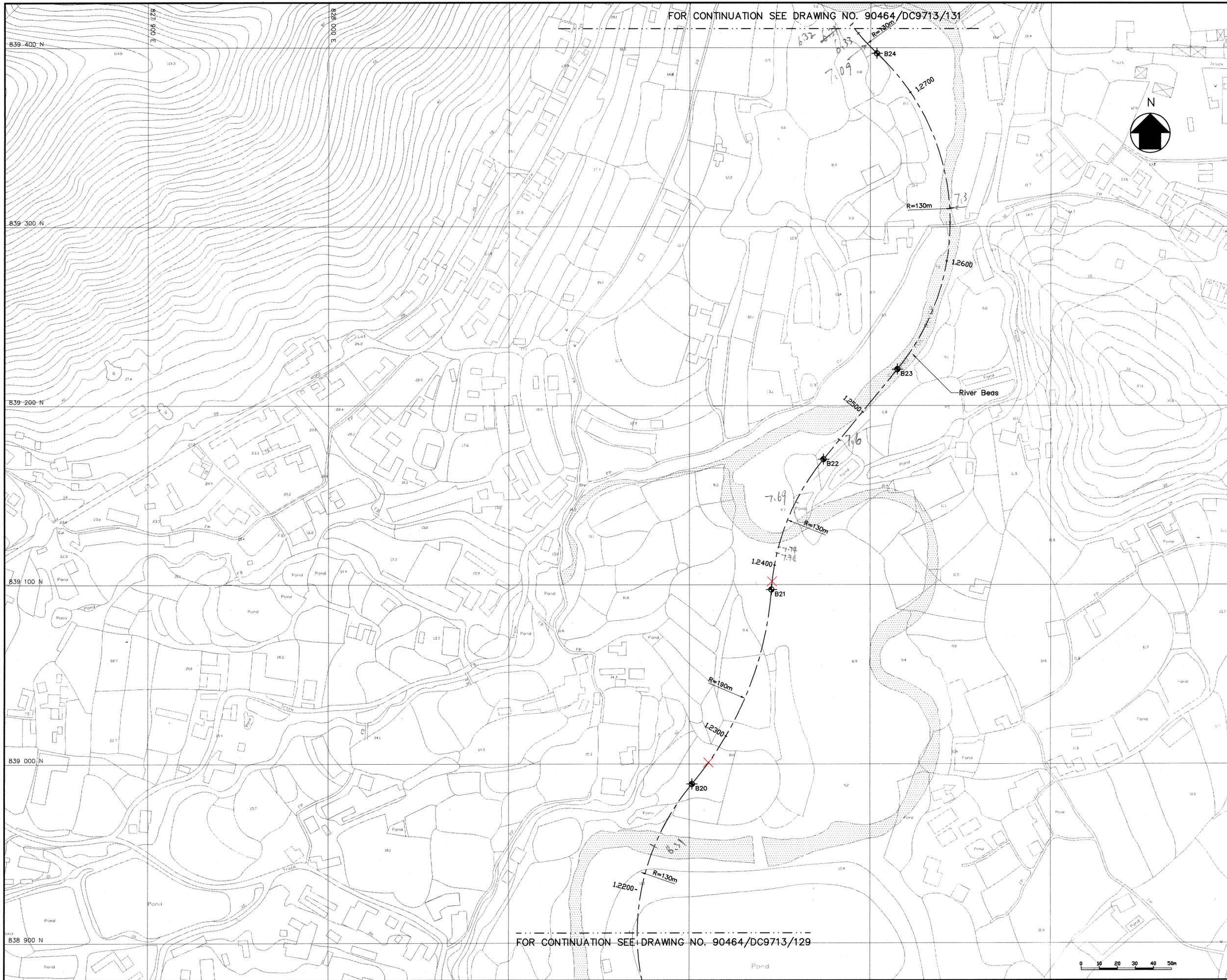
Increase rate of discharge	Q' =	2.28	m <sup>3</sup> /s	(Refer to Annex 1)
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Percentage with respect to Full flow of River Beas	=	2.43%
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**Annex 5**  
**As-built Record of River Beas**



FOR CONTINUATION SEE DRAWING NO. 90464/DC9713/131



**Notes :**  
 1. This drawing is to be read in conjunction with the general notes on drawing No. 90464/DC9713/102 unless otherwise stated.

**Legend:**  
 Setting Out Point

Setting Out Details - River Beds			
Setting Out Point	Easting	Northing	Chainage
B20	828201.550	838988.841	2263.834
B21	828245.403	839097.343	2382.796
B22	828274.218	839170.140	2462.323
B23	828315.109	839220.419	2527.130
B24	828303.592	839396.880	2721.597

B	ABR	As Built Record Drawing	1/10	22.4.03
A	IFT	Tender Drawing	SANGDWM	18.12.98
Rev	Issue Stat	Amendment	By App	Date

Client **DRAINAGE SERVICES DEPARTMENT**

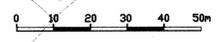
**Contract No. DC/97/13**  
 Project **Rural Drainage Rehabilitation Scheme**

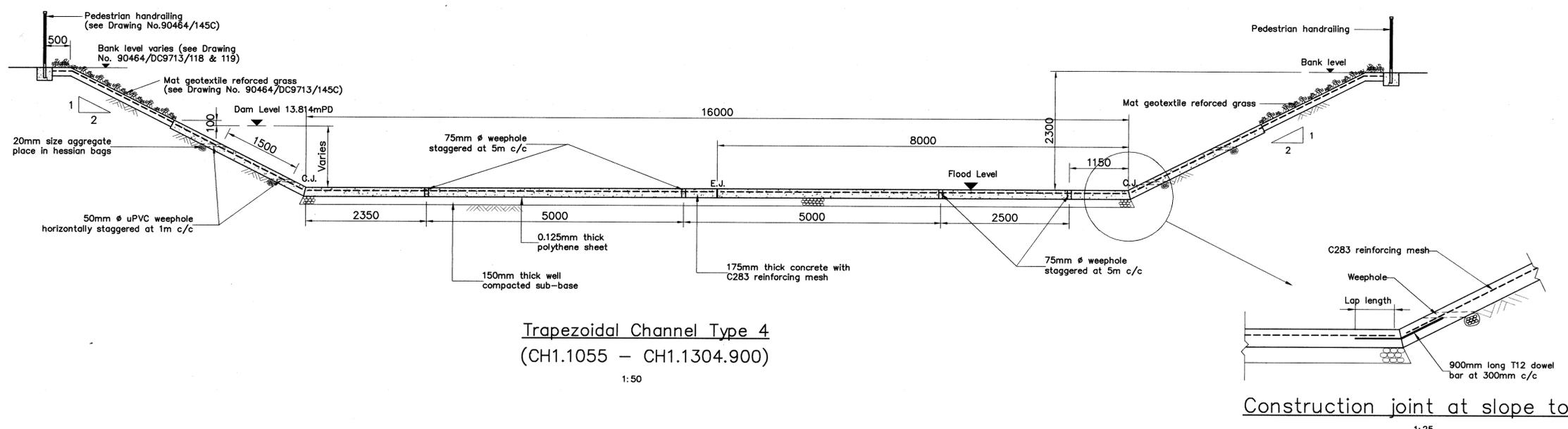
Title **River Beas Channel Setting Out Details**  
 (SHEET 4 OF 7)

**Mouchel**  
 Mouchel Asia Limited  
 Consulting Engineers  
 Drawn YIC Date 22.4.03  
 Checked EL Date 22.4.03  
 Approved KHS Date 22.4.03  
 CAD File No. 713-1308  
 Scale 1 : 1000

First Issued	Drg. No.	Rev.
18.12.98	90464/DC9713/130	B

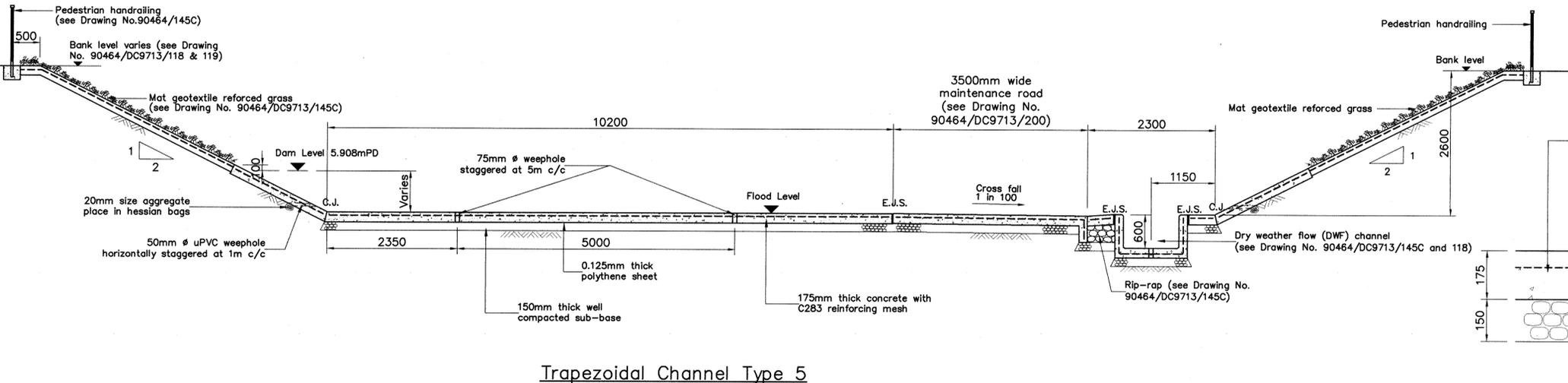
FOR CONTINUATION SEE DRAWING NO. 90464/DC9713/129





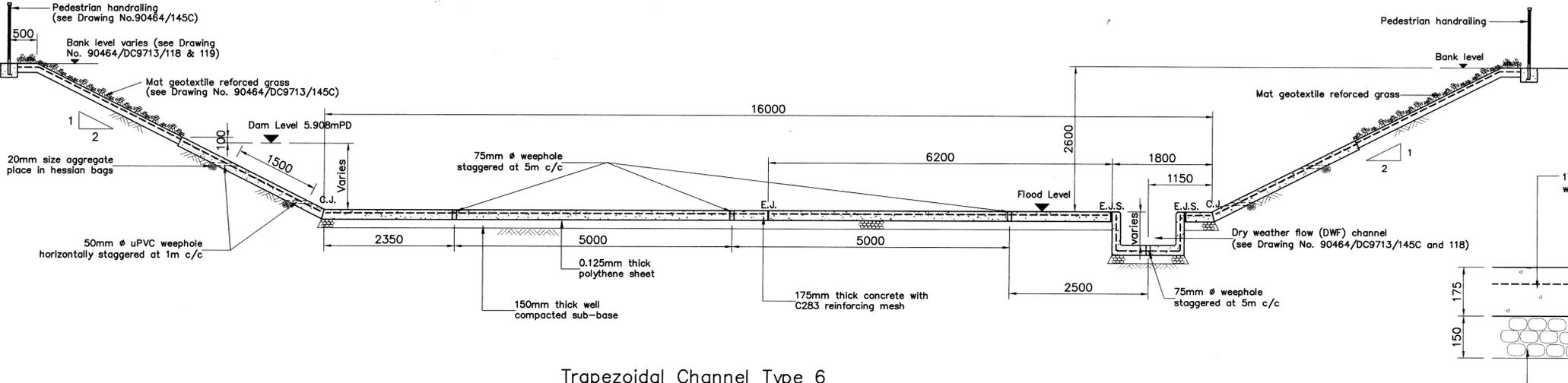
**Trapezoidal Channel Type 4**  
(CH1.1055 - CH1.1304.900)  
1:50

**Construction joint at slope toe**  
1:25



**Trapezoidal Channel Type 5**  
(CH1.2956 - CH1.3315)  
1:50

**Weep hole formed by coring on the bottom slab**  
1:10



**Trapezoidal Channel Type 6**  
(CH1.3315 - CH1.3919.384)  
1:50

**Weep hole with uPVC pipe on the bottom slab**  
1:10

- Notes :
1. This drawing is to be read in conjunction with the general notes on drawing No. 90464/DC9713/102 unless otherwise stated.
  2. For pedestrian handrailing see drawing No. 90464/DC9713/500.
  3. Anchorage and lap length of reinforcement shall conform with section 3.12.8 BS8110 : Part : 1997.
  4. Contraction joints and expansion joints detail for trapezoidal concrete channel type 4, 5 and 6 shall be the same as those shown on drawing No. 90464/DC9713/200.
  5. Concrete grade 40/200.

B	ABR	As Built Record Drawing	22.4.03
A	IFT	Tender Drawing	18.12.98
Rev	Issue Stat	Amendment	By App. Date

Client **DRAINAGE SERVICES DEPARTMENT**

Contract No. **DC/97/13**  
Project **Rural Drainage Rehabilitation Scheme**

Title **River Beas Trapezoidal Concrete Channel Details**

**Mouchel**  
Mouchel Asia Limited  
Consulting Engineers

Drawn	YC	Date	22.4.03
Checked	EL	Date	22.4.03
Approved	KHS	Date	22.4.03
CAD File No.	713-148B		
Scale	As Shown		

First Issued	18.12.98	Dwg. No.	90464/DC9713/148	Rev.	B
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