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D02 – Drainage Impact Assessment Report

S16 Planning Application for Proposed Temporary Cold Storage for Poultry and Distribution Centre for a Period of 3 Years and Filling of Land for Site Formation Works at Various Lots in D.D. 89 and Adjoining Government Land, Man Kam To Road, Sha Ling, New Territories

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Company Details

Name:	SMEC Asia Limited		
Address:	27/F Ford Glory Plaza, 37-39 Wing Hong St, Cheung Sha Wan, Kowloon, Hong Kong		
Tel:	+852 3995 8100	Fax:	+852 3995 8101
Email:	hongkong@smec.com	Website:	www.smec.com

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1 PROJECT BACKGROUND

1.1 Introduction

1.1.1 Hong Kong Chilled Meat & Poultry Association ("HKCMA" or "the Applicant") plans to construct and operate a Temporary Cold Storage and Distribution Centre ("the Centre" or "the Proposed Development") for a period of three years at Lots 471 S.B RP (Part), 472, 473, 474, 475, 476, 483, 501, 502, 504 S.B, 505 and 506 S.B RP in D.D.89 and adjoining Government Land, Man Kam To Road, Sandy Ridge in New Territories ("the Site").

1.1.2 The Site is currently zoned "Agriculture" (AGR) under the Approved Fu Tei Au and Sha Ling Outline Zoning Plan ("OZP") No. S/NE-FTA/16. In accordance with paragraph 10(a) of the Explanatory Note of the OZP, temporary use or development of any land or building not exceeding a period of three years would require planning permission from the Town Planning Board ("TPB"). Therefore, a Section 16 Planning Application with an application number A/NE-FTA/201 was made and approved with conditions on 28 May 2021.

1.1.3 In order to provide better design to provide a more cost-effective of operating the Centre, the following major modifications to the approved planning application have been proposed:

- Changing the Site boundary from 20,506m^2 to 16,060m^2 approximately;
- Combining Blocks 1 and 2 into one Main Block;
- Changing the maximum building height from 10.4m above ground to 20.675m above ground;
- Changing the Total Floor Area from 12,736m^2 to 11,615m^2 approximately;
- Changing the Plot Ratio from 0.621 to 0.723; and
- Changing the site coverage from 31.51% to 56.94%.

1.1.4 A new planning application shall be made under Section 16 of the *Town Planning Ordinance* ("TPO") for the aforementioned major modifications. SMEC Asia Ltd ("SMEC") has been commissioned to prepare this Drainage Impact Assessment ("DIA") Report for supporting this new planning application.

1.2 Site Description

1.2.1 The Site is an elongated strip of land bounded by Man Kam To Road to the east and Lo Wu Station Road to the south with a total area of about 16,060m^2 in Sandy Ridge, which is close to the border between the Lo Wu Boundary Control Point ("BCP") and Man Kam To BCP in the North District. The Site is currently a vacant land overgrown with weeds and different tree groups. There is a watercourse cutting middle of the site running from the northeast to southeast direction, separating the Site into two halves.

1.2.2 The Site location and its environs are shown on ***Figure 1-11*** which the uses surrounding the Site include:

- To the north, northwest and west: dwellings and residential temporary structures, Sandy Ridge Cemetery and the planned Sandy Ridge Columbarium.
- To the east and southeast: The pipelines of the Dongjiang Water, Man Kam To Road, temporary structures, Boarder District Police Headquarter and Police Dog Unit and Force Search Unit Training School.
- To the south: Sha Ling Playground and Lo Wu Station Road.

1.3 Project Description

1.3.1 The Centre will be built upon a site area of about 16,060m^2 with a Gross Floor Area ("GFA") of about 11,615m^2 and a plot ratio of about 0.723, comprising the following major components:

- Main block comprises a cold storage area and ancillary storage/office, area for corridor, staircase and lift
- A Plant Room and Transformer Room (exempted from GFA)
- Guard House

1.3.2 The existing watercourse running through the Site from northeast to southwest direction will be decked over underneath the Proposed Development.

1.3.3 The indicative layout and sectional plans of the Proposed Development can be referred to the Planning Statement.

1.4 Objectives of this Report

1.4.1 The objectives of this DIA Report are to:

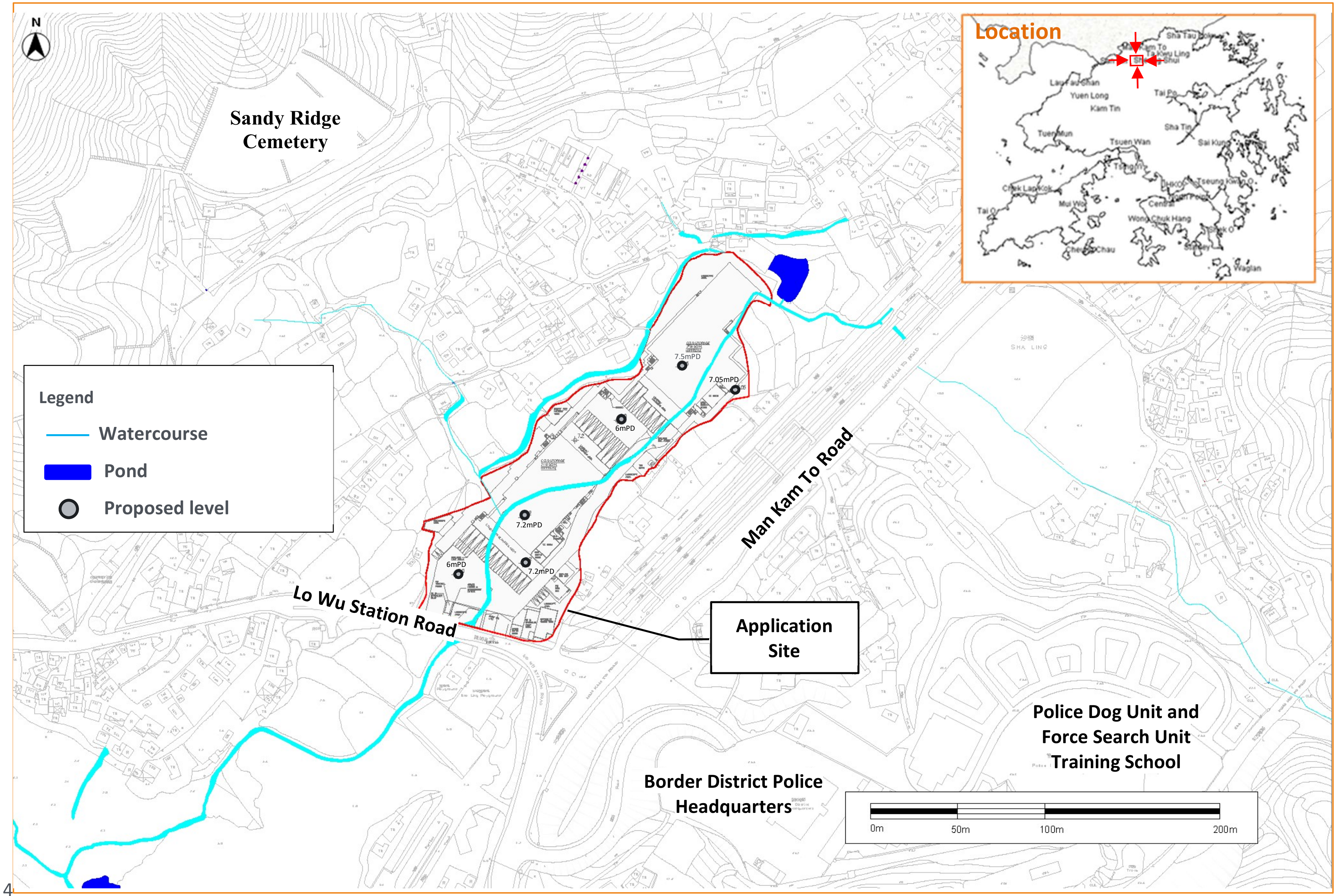
- Assess the potential drainage impacts arising from the Site.
- Recommend the necessary mitigation measures to alleviate any impacts.

1.5 Reference Materials

1.5.1 In evaluating the drainage impact arising from the Proposed Development, the following materials have been referred to:

- Drainage Services Department ("DSD") publication Stormwater Drainage Manual (with Eurocodes incorporated) – Planning, Design and Management (2018 Edition).
- DSD publication Stormwater Drainage Manual CORRIGENDUM No. 1/2022 ("SDM 2022")
- DSD Advice Note No. 1 – Application of the Drainage Impact Assessment Process to Private Sector Projects.
- GeoInfo Map reviewed on 16 August 2021

Figure 1-1: Site Location and its Environs



2 DESCRIPTION OF EXISTING ENVIRONMENT AND DRAINAGE CONDITIONS

2.1 Site Location and Topography

2.1.1 The area of the application site is about 16,060m^2 and is located at North District range from +4.5mPD to +6.13mPD.

2.1.2 As illustrated on ***Figure 1-11***, the Site is situated in Sandy Ridge that is an elongated strip land bounded by Man Kam To Road to the east and Lo Wu Station Road to the south. It is adjacent to the Sandy Ridge Cemetery that is bounded by Lo Wo Station Road and Shenzhen River.

2.1.3 Based on desktop study, there is an existing watercourse running from the surround of Sha Ling passing underneath the pipelines at Man Kam To Road and bisecting the whole site. It is connected to the existing box culvert at Lo Wo Station Road adjacent to the Sha Ling Playground which leads further downstream to connect to Ng Tung River. There is another watercourse along the northern part of the Site boundary which will eventually join the watercourse within the Site and discharge downstream.

2.2 Existing Baseline Conditions

2.2.1 According to the previous site inspection conducted on 17 August 2021, the Site is currently a vacant land overgrown with weeds and different tree groups. Moreover, several ditches/watercourses were observed inside the Site, which are connected to surrounding catchments.

2.2.2 There is continuous flow observed in the watercourse downstream of the box culvert, but relatively low level comparing to the height of the box-culvert.

2.2.3 During the site inspection, it was observed there is an on-going construction near the concrete batching plant that is upstream of the Site near the Sha Ling Road and the flow collected will eventually discharge into this box culvert.

3 DRAINAGE ANALYSIS

3.1 Assumptions and Methodology

3.1.1 Peak instantaneous runoff before and after the Proposed Development was calculated based on the Rational Method. The recommended physical parameters, including runoff coefficient (C) and storm constants for different return periods, are as per the Stormwater Drainage Manual.

3.1.2 The Rational Method has been adopted for hydraulic analysis and the peak runoff is given by the following expression:

$$Q_p = 0.278\, C\, i\, A \qquad \text{--- Equation 1}$$

where
- Q_p = peak runoff in m^3/s
- C = runoff coefficient
- i = rainfall intensity in mm/hr
- A = catchment area in km^2

3.1.3 Rainfall intensity is calculated using the following expression:

$$i = \frac{a}{(t_d + b)^c} \qquad \text{--- Equation 2}$$

where
- i = rainfall intensity in mm/hr
- t_d = duration in minutes ($t_d \leq 240$)
- a, b, c = storm constants given in Table 3 of SDM

3.1.4 For a single catchment, duration (td) can be assumed equal to the time of concentration (tc) which is calculated as follows:

$$t_c = t_0 + t_f \qquad \text{--- Equation 3}$$

where
- t_c = time of concentration
- t_0 = inlet time (time taken for flow from the remotest point to reach the most upstream point of the urban drainage system)
- t_f = flow time

3.1.5 Generally, t_0 is much larger than t_f. As shown in Equation 2, t_d is the divisor. Therefore, larger t_d will result in smaller rainfall intensity (i) as well as smaller Q_p. For the worst case scenario, t_f is assumed to be negligible and so:

$$t_d = t_c = t_0$$

$$t_0 = \frac{0.14465\, L}{H^{0.2}\, A^{0.1}} \qquad \text{--- Equation 4}$$

where
- A = catchment area (m^2)
- H = average slope (m per 100 m), measured along the line of natural flow, from the summit of the catchment to the point under consideration
- L = distance (on plan) measured on the line of natural flow between the summit and the point under consideration (m)

3.1.6 The capacities of the drainage pipes have been calculated using the Colebrook-White Equation, assuming full bore flow with no surcharge, as follows, incorporating 10% sedimentation in the calculation of drainage flow capacity in accordance with the Stormwater Drainage Manual:

$$V = -\sqrt{32gRs} \times \log\left(\frac{k_s}{14.8R} + \frac{1.25\upsilon}{R\sqrt{32gRs}}\right) \qquad \textbf{--- Equation 5}$$

where	V	=	mean velocity (m/s)
	g	=	gravitational acceleration (m/s^2)
	R	=	hydraulic radius (m)
	k_s	=	hydraulic pipeline roughness (m)
	υ	=	kinematic viscosity of fluid (m^2/s)
	s	=	hydraulic gradient (energy loss per unit length due to friction)

3.1.7 On the other hand, the capacity of open channel has been calculated using the Manning's Equation:

$$V = \frac{R^{1/6}}{n} \times \sqrt{Rs} \qquad \textbf{--- Equation 6}$$

where	V	=	mean velocity (m/s)
	R	=	hydraulic radius (m)
	n	=	Manning coefficient ($s/m^{1/3}$)
	s	=	hydraulic gradient (energy loss per unit length due to friction)

3.2 Assessment Assumptions

Identification of Catchments

3.2.1 Based on desktop study and site observation, although the Site is adjacent to the Sandy Ridge Cemetery, majority of the surface runoff from the Sandy Ridge Cemetery mainly flows to Shen Zhen River and partially to Ng Tung River via separate drainage system that is along a road which leads the Lo Wu Station Road and eventually discharge into Ng Tung River, and therefore not included as upstream catchments of the Site.

3.2.2 Catchments A to D were identified to be the catchments to be most relevant for this Site based on the topographical data available on Slope Information System of CEDD and the surveys map obtained from Lands Department. The indicative catchment plan is shown on ***Figure 3-11*** and briefly described below:

- Catchment A: covered by natural slope and village houses/ temporary structure Sha Ling area.
- Catchment B: near the pipeline area that accommodate the fresh water mains alongside the Man Kam To Road
- Catchment C: composed of farmland/ grassland and village houses/ temporary structure comprises of Sub-Catchments C1, C2 ("the Site") and C3.
- Catchment D: occupied by a concrete batching plant.

3.2.3 The surface runoff from Catchments A, B, C1, C3, D will be collected into the watercourse that gather at the box culvert underneath Lo Wu Station Road that eventually conveyed to Ng Tung River. Details of the catchments are described in paragraphs below.

Surface Runoff from Catchments

3.2.4 As shown on ***Figure 3-11***, runoff from Catchment A will be collected by the existing watercourse within Catchment A and pass underneath Man Kam To Road and run into the Site underneath the superstructures and then further drain to the existing box culvert via the existing watercourse. As such, runoff arising from Catchment A should be taken into account in this DIA.

3.2.5 Runoff from Catchment B will flow along the pipeline area and collected into a U-channel that eventually leads to the existing box culvert downstream.

3.2.6 According to the topographical data and desktop study, the runoff from Catchments C1 should flow to the stream that is along the north of site boundary. Then the watercourse will connect the existing watercourse within the Site and eventually discharge to downstream via the box culvert.

3.2.7 Runoff from Catchment C2 and C3 would flow towards the watercourse within the Site. The flow will pass through the Site connecting the existing watercourse and eventually discharge to downstream via the box culvert.

3.2.8 Runoff from Catchment D will flow towards the Sha Ling Road and collected into the existing watercourse, therefore it will be taken into account in this DIA.

3.2.9 The calculation methods of corresponding catchments are summarised in ***Table 3.1*** and the photos of relevant watercourse and watercourse will be shown on ***Figure 3-11***.

Table 3.1: Method for Estimating the Surface Runoff from Surrounding Catchments

Catchment	Estimating Method for Surface Runoff
Catchment A	Rational Method
Catchment B	Rational Method
Catchment C	Rational Method
Catchment D	Rational Method

3.2.10 As the runoff from Catchments A, B, C1, C3 and D were calculated by Rational Method, information of the catchment area and runoff coefficients are necessary.

Site Surface Characteristics and Runoff Coefficient of the Site

3.2.11 The Site is located in Catchment C2. An elevated platform will be constructed above the ground of the Site and the Site including its facilities will mainly be on the platform.

3.2.12 The Site is currently a vacant land overgrown with weeds and different tree groups. As such, for conservative approach, it is assumed that the Site is currently 99% grassland and 1% concrete paved area.

3.2.13 For the Proposed Development, about 25.6% site coverage of greenery will be provided. Therefore, it was assumed that the paving condition of the Proposed Development will comprise approximately 25.6% soft landscape and 74.4% paved area.

3.2.14 The Site is relatively flat, with reference to the DSD's Stormwater Drainage Manual, the runoff coefficients of paved surface and grassland at existing site are 0.95 and 0.25, respectively. As a result, the respective average runoff coefficients of 0.26 and 0.77 were adopted for the Site before and after the Proposed Development, respectively, as summarised in ***Table 3.2***.

Table 3.2: Surface Characteristics and Runoff Coefficients of the Site

SCENARIO OF PROJECT	AREA	SURFACE CHARACTERISTICS	RUNOFF COEFFICIENT
Before Development	16,060 m^2	1%paved+99% grassland	0.26
After Development		74.4% paved + 25.6% soft landscape	0.77

Site Surface Characteristics and Runoff Coefficient of Surrounding Catchments

3.2.15 Areas of farmland, grassland and natural slope are assumed to be soft landscape, while the remaining areas of village houses, temporary structure and fresh water mains are assumed to be paved area. The paving conditions are summarised in ***Table 3.3***.

3.2.16 With reference to the Stormwater Drainage Manual, the runoff coefficients for Catchments A are assumed are 0.95 for paved surface and 0.35 for soft landscape, respectively. On the other hand, as Catchments B, C1, C3 and D are relatively flat, the runoff coefficients of paved surface and soft landscape are 0.95 and 0.25, respectively. The runoff coefficients of related catchments are summarised in ***Table 3.3***.

Table 3.3: Surface Characteristics and Runoff Coefficients of Surrounding Catchments

CATCHMENT	SURFACE CHARACTERISTICS	OVERALL RUNOFF COEFFICIENT	CATCHMENT AREA (m^2)
Catchment A	47% paved + 53% soft landscape	0.63	63,483
Catchment B	100% paved	0.95	11,345
Catchment C1	23% paved + 77% soft landscape	0.41	84,389
Catchment C3	10% paved + 90% soft landscape	0.32	6,613
Catchment D	100% paved	0.95	9,212

3.2.17 Based on the existing topography, overland flow from these surrounding Catchments A, B, C1 and D, which are essentially the upper catchments of the Site, are collected into the existing watercourse in the same manner as the existing, drainage conditions shall remain the same as existing. Overland flow from Catchment C3 would be flow toward the watercourse within the Site. The estimated flow path of surrounding catchments is indicated in ***Figure 3-11.***

3.3 Estimated Existing and Future Runoff

Peak Runoff from the Site

3.3.1 Based on the assumption as described in paragraphs 3.2.1 to 3.2.14, the runoff from the Site (Catchment C2) before and after development was estimated based on the return periods of 2, 10 and 50 years.

3.3.2 The estimated peak runoff generated from the Site before development is 0.187m^3/s.

3.3.3 To consider the effect of climate change in the drainage design, the projection of rainfall increase by 11.1% given in SDM 2022 Table 28 is adopted. The runoff of the Site after development is 0.761m^3/s under 50 years return period. There will be around 303% increase in the estimated peak runoff due to the Proposed Development under 50 years return period. Detailed calculations are provided in ***Table 3.4*** and ***Appendix A***.

Table 3.4: Estimated Peak Runoff of the Site (Catchment C2)

RETURN PERIOD	ESTIMATED PEAK RUNOFF (m^3/s)		
	BEFORE DEVELOPMENT	AFTER DEVELOPMENT	INCREMENT
2 Years	0.119	0.496	317%
10 Years	0.157	0.670	328%
50 Years	0.187	0.761	307%

3.4 Peak Runoff from Other Sub-Catchment

3.4.1 The existing runoff generated from other surrounding sub-catchments has been evaluated and are summarised in ***Table 3.5***. Detailed calculations are provided in ***Appendix A***.

Table 3.5: Estimated Existing Runoff from Other Catchments

RETURN PERIOD	ESTIMATED PEAK RUNOFF FROM SUB-CATCHMENTS (m^3/s)					
	CATCHMENT					
	A	B	C1	C3	D	SUB – TOTAL
2 Years	1.09	0.35	0.10	0.07	0.34	2.84
10 Years	1.44	0.46	1.31	0.10	0.43	3.74
50 Years	1.72	0.55	1.56	0.12	0.51	4.46

3.5 Total Peak Runoff

3.5.1 Under 50 years return period, the estimated existing peak runoff generated from the surround sub-catchments A, B, C1, C3 and D is 4.46m^3/s; and the estimated total peak runoff from Catchment A, B, C1, C2, C3 and D from upstream to the box culvert downstream after development with climate change factor is approximately 5.71m^3/s. However, it should be noted to avoid adverse impact to the downstream box culvert due to the additional flow from C2, it is proposed to include stormwater storage tanks on-site for collecting stormwater generated from C2. Details are discussed in ***Section 3.6***.

3.6 Proposed Drainage Layout

On-site Storage Facility

3.6.1 It is understood that the drainage facilities at the downstream might not be capable of receiving additional flow from the Site. In order to avoid additional drainage impact on the municipal drainage system, two on-site underground stormwater storage tanks are proposed to store the additional runoff due to the Site. The tentative locations of two on-site underground stormwater storage tanks are indicated in ***Figure 3-22***.

3.6.2 Underground storage tank is more favourable for hydraulic flow and flow can be directly collected into the storage tank by gravity. The flow from the Site will be collected by the periphery U-channel drainage network and conveyed to the underground storage tank by gravity. Level sensors will be installed to trigger the pump start/stop and activate the valve to open/ close so that the water in the storage tank can be discharged under a controlled manner. The indicative cross-section of storage tank and with water intake and discharge mechanism is provided in ***Appendix B***.

3.6.3 The stored stormwater will either be reused on-site as much as practicable (e.g., floor mopping, toilet flush, etc.) or transported to the nearby active farmlands for irrigation (i.e. the farmland to the southwest of the Site), while the exact outlet needed to be confirmed during the detailed design stage, as such only the surplus water will be drained off to the proposed stormwater system. It is proposed outlet of the storage tank to be equipped with control e.g. valve so that the stormwater that are not used can be discharged into the box culvert after heavy raining under a controlled manner.

3.6.4 In case of power failure, emergency generator will be used as the power supplier of the pump. Regular maintenance of the equipment will be carried out, spare pump will be used to maintain the operation when there is equipment failure.

3.6.5 The indicative cross-section of storage tank and the pumping system is provided on ***Appendix B***.

On site Storage Tank Sizing

3.6.6 Since Rational Method is not based on a total storm duration, but rather a period of rain that produces the peak runoff rate. The method cannot compute the runoff volumes unless the total storm duration is assumed. Therefore, 4 hours storm duration is proposed to be used as to design the size of on-site storage tank. This duration is sufficient to cover the effective life of many rainstorms (Royal Observatory, 1981). With reference to the IDF relationship of North District Area stated in Table 2d of the Stormwater Drainage Manual (DSD, 2018), the rainfall intensity of 54.9mm/h was adopted, which is based on 4 hours rainfall duration for 50 years return period.

3.6.7 The runoff coefficients of 0.26 and 0.77, as mentioned in ***paragraph 3.2.16*** were adopted for the Site before and after the Proposed Development, respectively.

3.6.8 The sizing of stormwater storage Tank is summarised and calculated in ***Table 3.6*** and in ***Appendix D***.

Table 3.6: Estimated stormwater storage tank size

SCENARIO UNDER 50 YEARS RETURN PERIOD	Area, m^2	Runoff Coefficient	Rainfall Intensity, mm/hr	Peak Runoff Rate, m^3/s	Duration, hours	Estimated Runoff Volume, m^3
Before Development	16,060	0.26	54.9	0.063	4	907
After Development		0.77		0.189	4	2,721
					Incremental Runoff	**1,814**

3.6.9 As shown in Table 3.6, the incremental runoff volume is 1,814 m^3 under 50 years return period. Thus, the designed storage capacity should be at least 1,814 m^3. The tentative locations of the two storage tanks are shown on ***Figure 3-22.***

3.6.10 Adding buffer storage of about 15% in case of emergency, the tank volume of approx. 2,070 m^3. The storage tank in the southwest of the Site with dimensions of area of 480 m^2 and 3m deep and the storage tank southeast of the site with dimensions of area of 210 m^2 and 3m deep is proposed to be provided.

Proposed Stormwater Collection System

3.6.11 Two peripheral U- channels with grating covers are proposed to be running at the perimeter of the Site. The U-shape channels will be in a combination of size ranging from Ø300-700mm at an average gradient 1 in 250 to collect the runoff from the Site. Each of the two peripheral U-channels will eventually connect to catchpit pit that can connect to the storage tank mentioned in ***paragraph 3.6.9***. Catchpit with sand trap and cover will also be provided on-site to minimise sand/silt go into the drainage system. The indicative location and path of proposed parameter drain was shown on ***Figure 3-22***. The typical drawing of the U-Channel and catchpit with sand trap and cover is provided in ***Appendix C***.

3.6.12 Flow collected into U-channel section *Start 1* to *MH7* will be split at *MH7*. There are two outlets at *MH7*, one to the tank and one continue along the U-channel. Part of the flow will continue to flow along the U-channel and eventually directly discharge to watercourse, whereas flow that exceeds the U-channel capacity will be overflowed into *MH7* and will be discharged by gravity into the stormwater storage tank. Surface runoff collected in the stormwater storage tank will be stored and pumped out to the watercourse when it is low flow. See ***Appendix B*** for details of the illustration of mechanism.

3.6.13 Similar arrangement will also apply for the U-channel section *Start 2* to *MH15.* There are two outlets at MH15, and MH15 is equipped with an overflow weir. Part of the flow will continue to flow along the U-channel and eventually directly discharge to watercourse, whereas flow that exceeds the U-channel will be overflowed into the *MH15* and will be discharged by gravity into the stormwater storage tank. Surface runoff collected in the stormwater storage tank will be stored and pumped out to the watercourse when it is low flow. See ***Appendix B*** for details of the illustration of mechanism. The total runoff to be discharged into the watercourse will not be more than the estimated peak runoff generated from the Site before development.

3.6.14 An indicative drawing of the catchpit with sand trap design is provided in ***Appendix C***. The typical design of the peripheral U- Channel is presented in ***Table 3.77***. Detailed calculations for impact assessment of proposed drainage channels and the design of on-site storage tank are provided in ***Appendix D***.

Table 3.7: Drainage Capacity of Proposed Peripheral Channels

Description	Size, mm	Related Catchment	Runoff, m^3/s	Capacity, m^3/s	% of Capacity Used	Sufficient Capacity?
U-shape Channel from Start 1 to CP8	300 - 700	Catchment C2	0.03-0.39	0.06-0.54	49%-73%	YES
U-shape Channel from CP8 to Box Culvert[1]	350	Catchment C2	0.08	0.08	99%	YES
U-Shape Channel from Start 2 to MH15	300 - 700	Catchment C2 and C3	0.04-0.4	0.06-0.54	46%-75%	YES
U-shape Channel from MH15 to Box Culvert[1]	350	Catchment C2 and Catchment C3	0.22	0.22	100%	YES
Pipe MH7 to Tank 1	Ø 700	Catchment C2	0.39	0.63	62%	YES
Pipe MH15 to Tank 2	Ø 600	Catchment C2	0.18	0.42	44%	YES
Pipe Tank 1 to Box Culvert	Ø 500	Catchment C2	0.11	0.26	43%	YES
Pipe Tank 2 to Box Culvert	Ø 400	Catchment C2	0.19	0.15	51%	YES

Note:

1. The maximum capacity of the U-shape channel is designed based on the existing runoff of Catchment C2 and C3.

Maintenance of Existing Watercourse

3.6.15 The existing watercourse passing through the Site is proposed to be decked over to minimise disturbance to it. To support regular maintenance, manholes for watercourse are proposed to be installed along the existing watercourse with an interval of 60m in which the indicative location of maintenance manholes can be referred to ***Figure 3-22***.

Drainage Point

3.6.16 The runoff from the surrounding catchments run into the existing stream which located underneath the proposed platform inside the Site as before the Proposed Development. The collected runoff from the existing watercourse would be diverted to southwest of the Site and discharged to downstream through a box culvert with 5000mm (W) x 1550mm (H) with 1% fall laid under the Lo Wo Station Road, as shown on **Figure 3-22** and the detail drawing of the box culvert underneath Lo Wu Station is shown on ***Appendix E***.

3.7 Proposed Mitigation Measures

3.7.1 Water quality is the key environmental impact arising from the construction works. In addition, objects such as soil, construction materials, etc. accidentally falling into the watercourses/drainage can cause blockage in the watercourses/drainage. To avoid adverse impact on the watercourses and public drainage system in the vicinity of the Site during construction and operation of the Proposed Development, the guidelines published by the government shall be followed, including but not limited to those as follows:

1. Practice Notes for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers ("PNAP") ADV-27 *Protection of Natural Streams/Rivers from Adverse Impacts arising from Construction Works* published by the Building Department ("BD")
2. PNAP ADV-4 *Control of Environmental Nuisance from Construction Site* published by the BD;
3. Practice Notes for Registered Contractors ("PNRC") 61 *Protection of Natural Streams/Rivers from Adverse Impacts arising from Construction Works* published by the BD;
4. PNRC 17 *Control of Environmental Nuisance from Construction Site* published by the BD;
5. *Recommended Pollution Control Clauses for Construction Contracts* ("RPCC") published by the Environmental Protection Department ("EPD");
6. Professional Persons Environmental Consultative Committee ("ProPECC") Practice Note ("PN") 1/94 *Construction Site Drainage* published by the EPD.

3.7.2 With reference to the measures recommended in the above guidelines, the following measures shall be provided, implemented and maintained by the Contractor to minimise impact to the watercourses:

1. The proposed works site in the proximity of natural rivers and streams should be temporarily isolated, such as by placing of sandbags or silt curtains with lead edge at bottom and properly supported props, to prevent adverse impacts on the stream water qualities.
2. Stockpiling of construction materials, if necessary, should be properly covered and located away from any natural stream/river.
3. Construction debris and spoil should be covered up and/or properly disposed of as soon as possible to avoid being washed into nearby rivers/streams by rain.
4. Construction effluent, site run-off and sewage should be properly collected and/or treated. Wastewater from a construction site should be managed with the following approach in descending order:
   (a) minimisation of wastewater generation;
   (b) reuse and recycle;
   (c) treatment.

5. Supervisory staff should be assigned to station on site to closely supervise and monitor the works.
6. Incorporate temporary drainage system with de-silting facility before connecting directly to the main drainage system.
7. Install sand trap, settling pit or grease trap as necessary.
8. Install perimeter drainage channels or place sand bags along the low end of boundary.
9. Install pH adjustment facilities or petrol interceptor as necessary.
10. Cover open site area with gravel as far as practicable.
11. For site maintenance:
    (a) clear trapped debris and sediments frequently.
    (b) maintain sanitary condition at effluent disposal point.
    (c) pump and properly drain away all stagnant water.
    (d) cover open stockpiles of construction materials and temporarily exposed slope by tarpaulin or similar fabric, especially during rainy season.
    (e) Manholes shall always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers.
12. Surface run-off from construction/reinstatement sites shall be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sediment basins. Temporary construction drainage or earth bunds or sand bag barriers shall be provided on site to properly direct storm water to such silt removal facilities. Perimeter channels at site boundaries shall be provided where necessary to intercept storm run-off from outside the Site so that it will not wash across the Site.
13. Silt removal facilities, channels and manholes shall be maintained and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all times.
14. Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites shall be covered with tarpaulin or similar fabric during rainstorms. Measures shall be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.
15. No filling of the existing watercourse

Figure 3-1: Identification of Surrounding Catchments

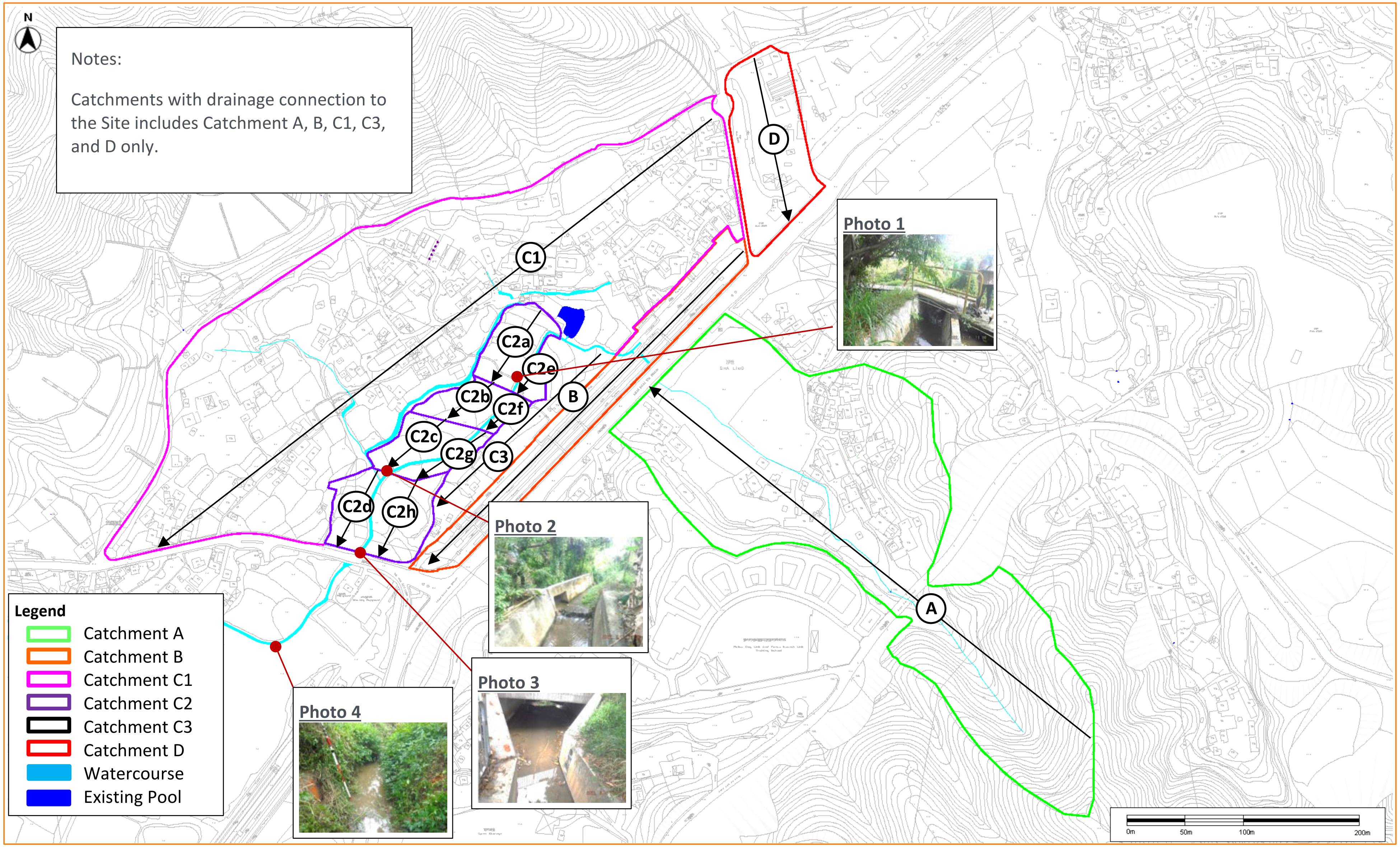
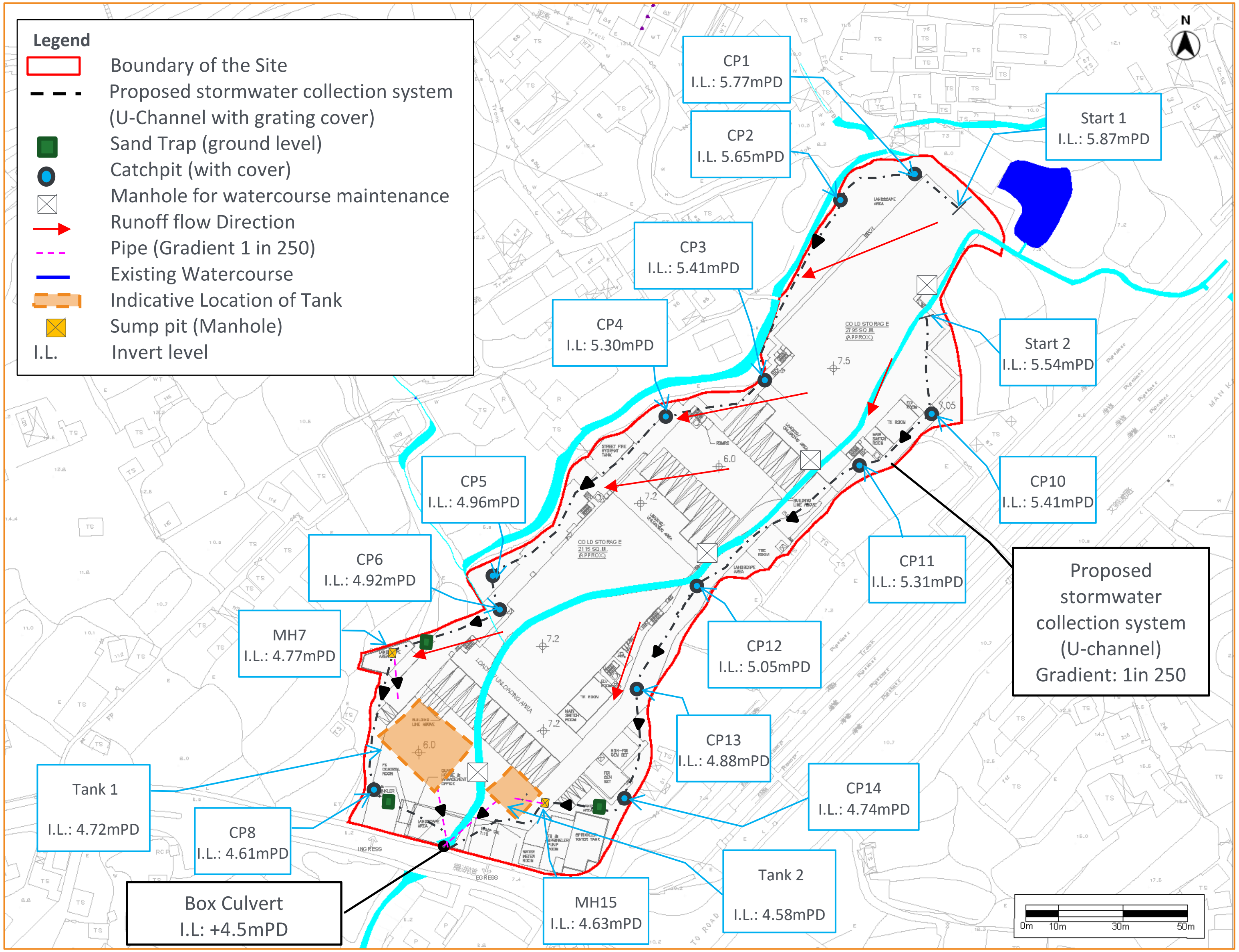


Figure 3-2: Indicative Proposed Drainage Layout



4 CONCLUSION

4.1.1 Potential drainage impacts that may arise from the Site after construction of the Proposed Development have been assessed.

4.1.2 The peak runoff before and after the development of the Site were estimated using Rational Method and based on the catchment surface characteristics for the existing environment and the Proposed Development. The paving area of the Site will increase to 74.4%, additional surface runoff will be generated from the site. The estimated peak runoff generated from the Site and the surrounding catchments with climate change factor are $0.76m^3/s$ and $4.95m^3/s$ under 50 years return period, and the total estimated peak flow from the Site and surrounding catchments to the box culvert downstream with climate change factor is about $5.71m^3/s$.

4.1.3 U-shape peripheral channels has been proposed to be installed at the boundary of the Site to collect surface runoff from the Site (Catchment C2) and Catchment C3. The U-shape channels of size 300-700 mm dia. have been proposed. Based on the calculation, the utilisation rate of the proposed U-shape peripheral channels and pipes is about 46-75% under the 50 years return period, which shows there is sufficient capacity to accommodate flow arise Site after Proposed Development.

4.1.4 The incremental runoff before and after the development were estimated for sizing an on-site storage tank. Assuming the rainfall duration of 4 hour based on a return period of 50 years, two on-site storage tanks of total no less than $1,814m^3$ is proposed to temporarily store the runoff due to the Proposed Development during heavy rainstorm. Adding buffer storage of about 15% in case of emergency, the tank volume is approx. $2,070m^3$. The storage tank in the southwest of the Site with dimensions of area of 480 m^2 and 3m deep and the storage tank southeast of the site with dimensions of area of 210 m^2 and 3m deep is proposed to be provided. It will be sufficient to meet the storage volume required. No adverse drainage impact to the existing drainage system is anticipated due to the Proposed Development, subject to the following condition:

(a) At least 25.6% of the Site area shall be soft landscape.

4.1.5 This DIA Report indicates the initial findings regarding drainage impact and indicative drainage layout. A qualified engineer should be engaged by the Architect/Contractor of the Proposed Development to review and provide detailed designs for the internal Site drainage layout, including the water storage tank. A “Drainage Proposal” including detailed designs based on calculations and quantitative assessments, as well as hydraulic model if necessary, shall be prepared by the qualified engineer and submitted to the drainage Authority, EPD and DSD, for their review and approval prior to the commencement of work. The Applicant shall obtain the consent from the owner of the existing watercourse for discharging of storm water prior to commencement of the proposed works. All the relevant government departments shall also be consulted with when necessary.

Appendix A RUNOFF CALCULATIONS

Calculation of Runoff for Return Period of 2 Years

climate change
11.10%

Catchment ID	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Duration (t_d), min	Storm Constants			Runoff intensity (i), mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
						a	b	c				
Before the Proposed Development												
Catchment A	0.0635	16.29	526.2	14.42	20.26	1004.5	17.24	0.644	97.33	0.63	0.0401	1.086
Catchment B	0.0113	1.28	164.20	8.89	10.71	1004.5	17.24	0.644	117.61	0.95	0.0108	0.352
Catchment C1	0.0844	3.94	365.80	12.94	17.00	1004.5	17.24	0.644	103.20	0.41	0.0347	0.995
Catchment C2	0.0161	0.69	237.30	14.05	16.69	1004.5	17.24	0.644	103.82	0.26	0.0041	0.119
Catchment C3	0.0066	1.51	118.90	6.57	7.89	1004.5	17.24	0.644	125.96	0.32	0.0021	0.074
Catchment D	0.0092	4.98	84.30	3.55	4.49	1004.5	17.24	0.644	138.33	0.95	0.0088	0.337
											Total (General Scenario)	**2.963**
After the Proposed Development												
Catchment A	0.0635	16.29	526.2	14.42	20.26	1004.5	17.24	0.644	97.33	0.63	0.0401	1.206
Catchment B	0.0113	1.28	164.20	8.89	10.71	1004.5	17.24	0.644	117.61	0.95	0.0108	0.392
Catchment C1	0.0844	3.94	365.80	12.94	17.00	1004.5	17.24	0.644	103.20	0.41	0.0347	1.106
Catchment C2a	0.0030	0.20	83.0	7.43	7.90	1004.5	17.24	0.644	125.94	0.77	0.0023	0.090
Catchment C2b	0.0023	0.20	56.0	5.16	5.47	1004.5	17.24	0.644	134.46	0.77	0.0018	0.073
Catchment C2c	0.0024	0.20	60.0	5.51	5.84	1004.5	17.24	0.644	133.04	0.77	0.0018	0.075
Catchment C2d	0.0024	0.20	76.1	6.98	7.40	1004.5	17.24	0.644	127.57	0.77	0.0018	0.073
Catchment C2e	0.0008	0.20	58.0	5.96	6.28	1004.5	17.24	0.644	131.45	0.77	0.0006	0.024
Catchment C2f	0.0006	0.20	45.3	4.80	5.05	1004.5	17.24	0.644	136.05	0.77	0.0004	0.018
Catchment C2g	0.0012	0.20	89.0	8.71	9.20	1004.5	17.24	0.644	121.89	0.77	0.0010	0.036
Catchment C2h	0.0034	0.20	68.3	6.04	6.42	1004.5	17.24	0.644	130.95	0.77	0.0026	0.107
Catchment C3	0.0066	1.17	85.72	4.99	5.94	1004.5	17.24	0.644	132.68	0.32	0.0021	0.087
Catchment D	0.0092	4.98	84.30	3.55	4.49	1004.5	17.24	0.644	138.33	0.95	0.0088	0.374
											Total (General Scenario)	**3.661**

Note:

1) Runoff is calculated in accordance with DSD's "*Stormwater Drainage Manual (with Eurocodes incorporated) - Planning, Design and Managemen* t" (SDM), fifth edition, January 2018 and DSD publication Stormwater Drainage Manual CORRIGENDUM No. 1/2022.
2) Time of concentraction td= to+tf; where tf time of flow in urban drainag esystem = length of drain/ velocity. Velocity assumed 1.5m/s for natural flow and 3m/s assumed for flow in urban area.
3) The gradient of Catchement C2 after development is assumed to be 1:500.

climate change
11.10%

Calculation of Runoff for Return Period of 10 Years

Catchment ID	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Duration (t_d), min	Storm Constants			Runoff intensity (i) mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
						a	b	c				
Before the Proposed Development												
Catchment A	0.0635	16.29	526.2	14.42	20.26	1157.7	19.04	0.597	129.34	0.63	0.0401	1.443
Catchment B	0.0113	1.28	164.20	8.89	10.71	1157.7	19.04	0.597	152.72	0.95	0.0108	0.458
Catchment C1	0.0844	3.94	365.80	12.94	17.00	1157.7	19.04	0.597	136.20	0.41	0.0347	1.313
Catchment C2	0.0161	0.69	237.30	14.05	16.69	1157.7	19.04	0.597	136.92	0.26	0.0041	0.157
Catchment C3	0.0066	1.17	85.72	4.99	5.94	1157.7	19.04	0.597	169.52	0.32	0.0021	0.100
Catchment D	0.0092	4.98	84.30	3.55	4.49	1157.7	19.04	0.597	175.70	0.95	0.0088	0.427
											Total (General Scenario)	**3.898**
After the Proposed Development												
Catchment A	0.0635	16.29	526.2	14.42	20.26	1157.7	19.04	0.597	129.34	0.63	0.0401	1.603
Catchment B	0.0113	1.28	164.20	8.89	10.71	1157.7	19.04	0.597	152.72	0.95	0.0108	0.508
Catchment C1	0.0844	3.94	365.80	12.94	17.00	1157.7	19.04	0.597	136.20	0.41	0.0347	1.459
Catchment C2a	0.0030	0.20	83.0	7.43	7.90	1157.7	19.04	0.597	162.07	0.77	0.0023	0.116
Catchment C2b	0.0023	1.20	56.0	3.60	3.91	1157.7	19.04	0.597	178.31	0.77	0.0018	0.097
Catchment C2c	0.0024	2.20	60.0	3.41	3.74	1157.7	19.04	0.597	179.10	0.77	0.0018	0.100
Catchment C2d	0.0024	3.20	76.1	4.01	4.43	1157.7	19.04	0.597	175.96	0.77	0.0018	0.100
Catchment C2e	0.0008	4.20	58.0	3.24	3.56	1157.7	19.04	0.597	179.96	0.77	0.0006	0.033
Catchment C2f	0.0006	5.20	45.3	2.50	2.75	1157.7	19.04	0.597	183.91	0.77	0.0004	0.024
Catchment C2g	0.0012	6.20	89.0	4.38	4.88	1157.7	19.04	0.597	173.99	0.77	0.0010	0.052
Catchment C2h	0.0034	7.20	68.3	2.95	3.33	1157.7	19.04	0.597	181.07	0.77	0.0026	0.148
Catchment C3	0.0066	1.17	85.72	4.99	5.94	1157.7	19.04	0.597	169.52	0.32	0.0021	0.111
Catchment D	0.0092	4.98	84.30	3.55	4.49	1157.7	19.04	0.597	175.70	0.95	0.0088	0.475
											Total (General Scenario)	**4.826**

Note:

1) Runoff is calculated in accordance with DSD's "*Stormwater Drainage Manual (with Eurocodes incorporated) - Planning, Design and Managemen* t" (SDM), fifth edition, January 2018 and DSD publication Stormwater Drainage Manual CORRIGENDUM No. 1/2022.
2) Time of concentraction td= to+tf; where tf time of flow in urban drainag esystem = length of drain/ velocity. Velocity assumed 1.5m/s for natural flow and 3m/s assumed for flow in urban area.
3) The gradient of Catchement C2 after development is assumed to be 1:500.

Calculation of Runoff for Return Period of 50 Years

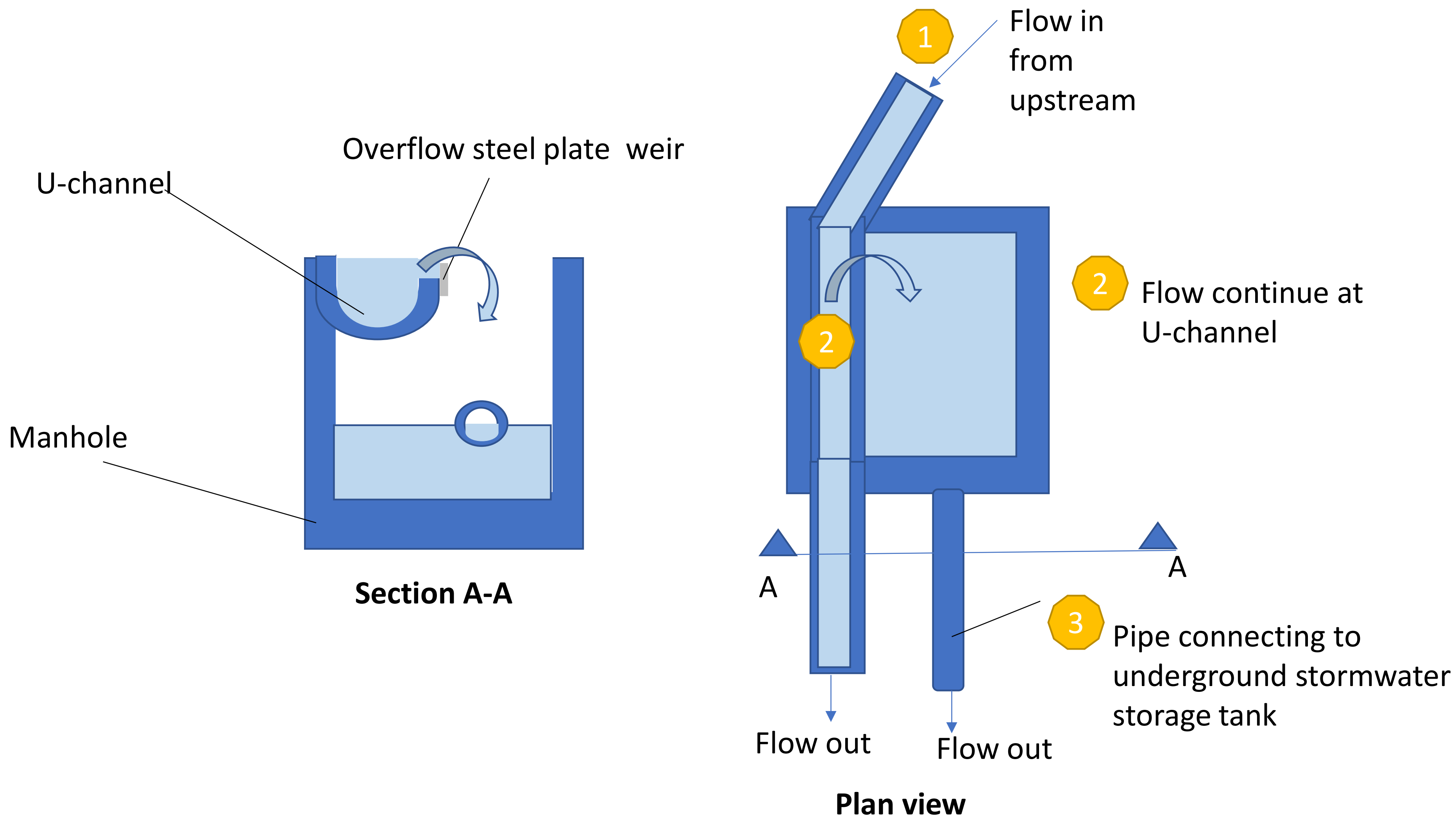
climate change
11.10%

Catchment ID	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Duration (t_d), min	Storm Constants			Runoff intensity (i) mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
						a	b	c				
Before the Proposed Development												
Catchment A	0.0635	16.29	526.2	14.42	20.26	1167.6	16.76	0.561	153.95	0.63	0.0401	1.717
Catchment B	0.0113	1.28	164.20	8.89	10.71	1167.6	16.76	0.561	182.00	0.95	0.0108	0.545
Catchment C1	0.0844	3.94	365.80	12.94	17.00	1167.6	16.76	0.561	162.12	0.41	0.0347	1.563
Catchment C2	0.0161	0.69	237.30	14.05	16.69	1167.6	16.76	0.561	162.98	0.26	0.0041	0.187
Catchment C3	0.0066	1.17	85.72	4.99	5.94	1167.6	16.76	0.561	202.56	0.32	0.0021	0.119
Catchment D	0.0092	4.98	84.30	3.55	4.49	1167.6	16.76	0.561	210.22	0.95	0.0088	0.511
											Total (General Scenario)	**4.642**
After the Proposed Development												
Catchment A	0.0635	16.29	526.2	14.42	20.26	1167.6	16.76	0.561	153.95	0.63	0.0401	1.908
Catchment B	0.0113	1.28	164.20	8.89	10.71	1167.6	16.76	0.561	182.00	0.95	0.0108	0.606
Catchment C1	0.0844	3.94	365.80	12.94	17.00	1167.6	16.76	0.561	162.12	0.41	0.0347	1.737
Catchment C2a	0.0030	0.20	83.0	7.43	7.90	1167.6	16.76	0.561	193.39	0.77	0.0023	0.139
Catchment C2b	0.0023	0.20	56.0	5.16	5.47	1167.6	16.76	0.561	204.97	0.77	0.0018	0.112
Catchment C2c	0.0024	0.20	60.0	5.51	5.84	1167.6	16.76	0.561	203.05	0.77	0.0018	0.114
Catchment C2d	0.0024	0.20	76.1	6.98	7.40	1167.6	16.76	0.561	195.61	0.77	0.0018	0.112
Catchment C2e	0.0008	0.20	58.0	5.96	6.28	1167.6	16.76	0.561	200.89	0.77	0.0006	0.037
Catchment C2f	0.0006	0.20	45.3	4.80	5.05	1167.6	16.76	0.561	207.14	0.77	0.0004	0.028
Catchment C2g	0.0012	0.20	89.0	8.71	9.20	1167.6	16.76	0.561	187.86	0.77	0.0010	0.056
Catchment C2h	0.0034	0.20	68.3	6.04	6.42	1167.6	16.76	0.561	200.21	0.77	0.0026	0.163
Catchment C3	0.0066	1.17	85.72	4.99	5.94	1167.6	16.76	0.561	202.56	0.32	0.0021	0.132
Catchment D	0.0092	4.98	84.30	3.55	4.49	1167.6	16.76	0.561	210.22	0.95	0.0088	0.568
											Total (General Scenario)	**5.712**

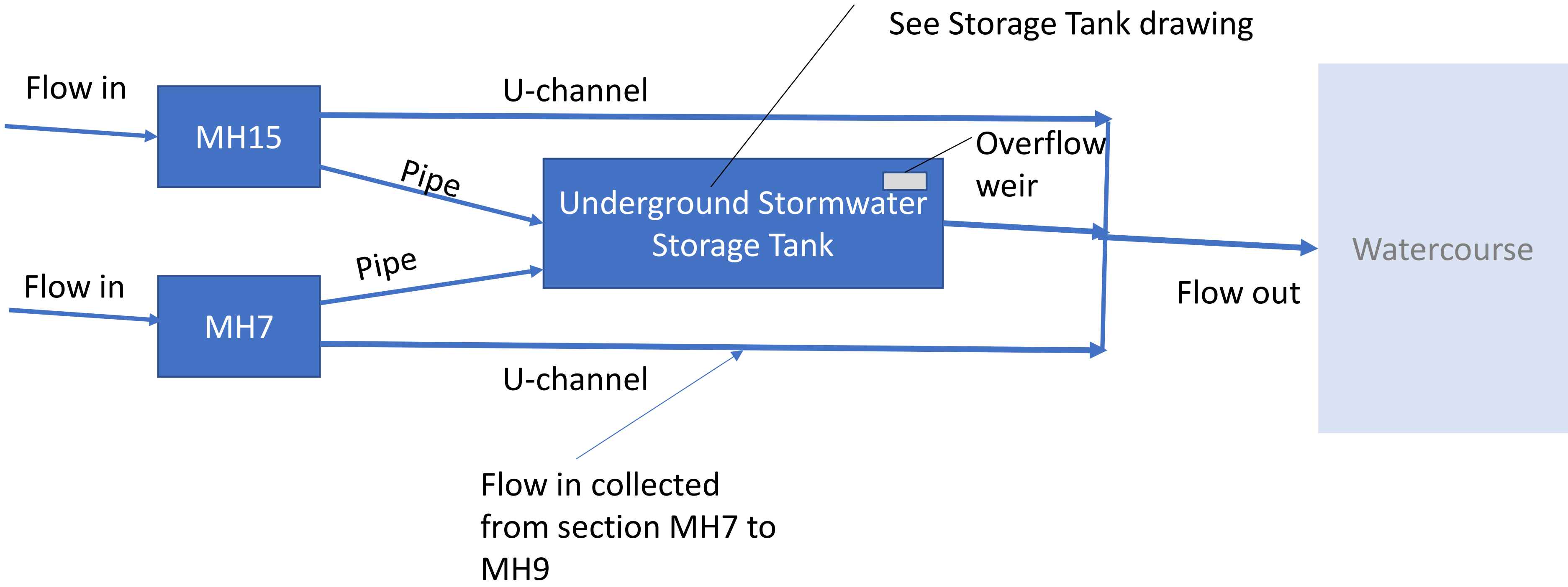
Note:

1) Runoff is calculated in accordance with DSD's "*Stormwater Drainage Manual (with Eurocodes incorporated) - Planning, Design and Managemen* t" (SDM), fifth edition, January 2018 and DSD publication Stormwater Drainage Manual CORRIGENDUM No. 1/2022.
2) Time of concentraction td= to+tf; where tf time of flow in urban drainag esystem = length of drain/ velocity. Velocity assumed 1.5m/s for natural flow and 3m/s assumed for flow in urban area.
3) The gradient of Catchement C2 after development is assumed to be 1:500.

Appendix B INDICATIVE SCHEMATIC DIAGRAMS FOR MANHOLE AND STORAGE TANK

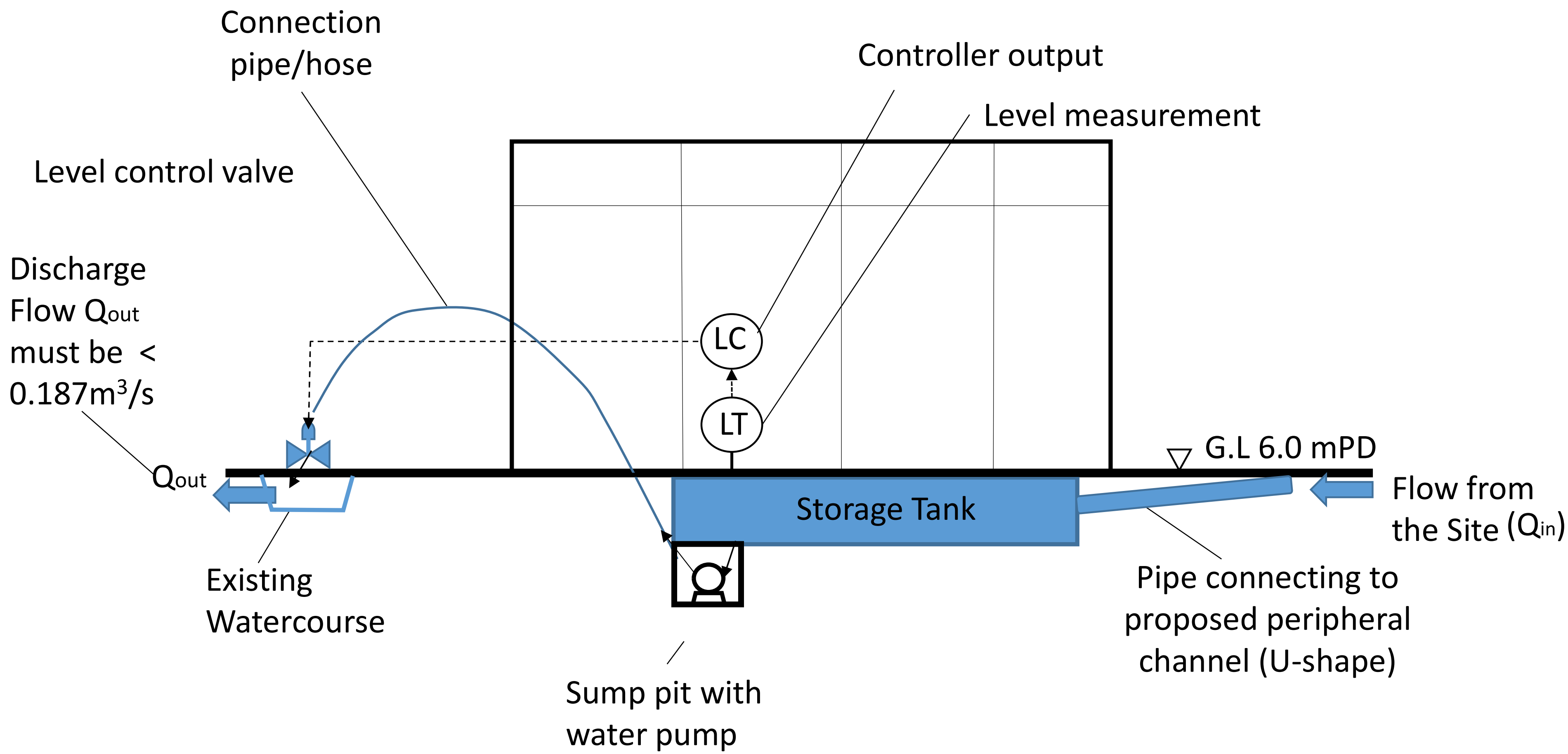


Indicative Drainage Mechanism at MH7 and MH15

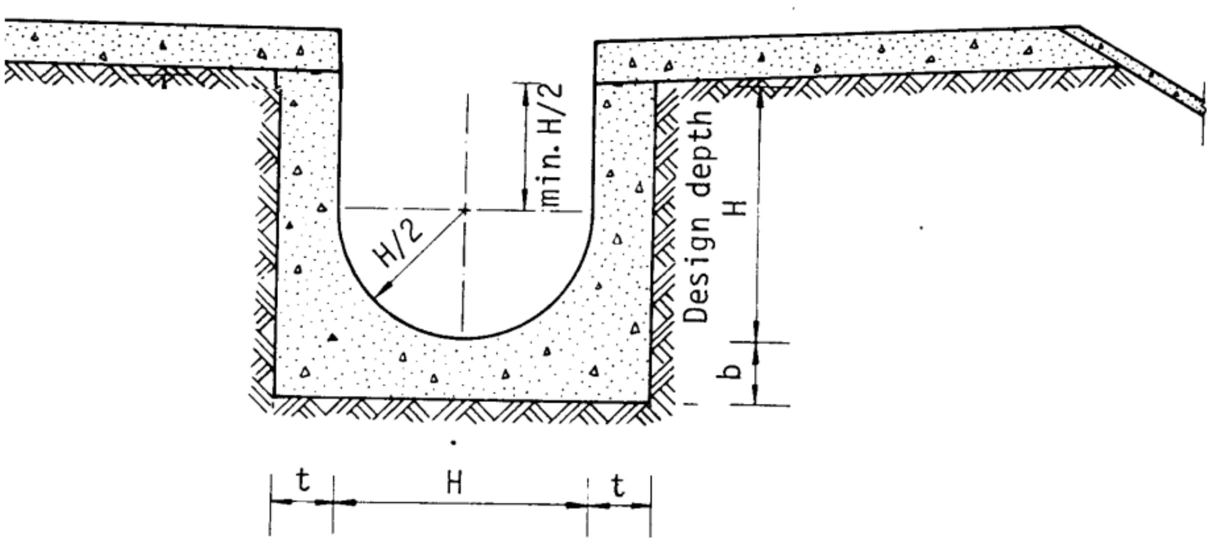


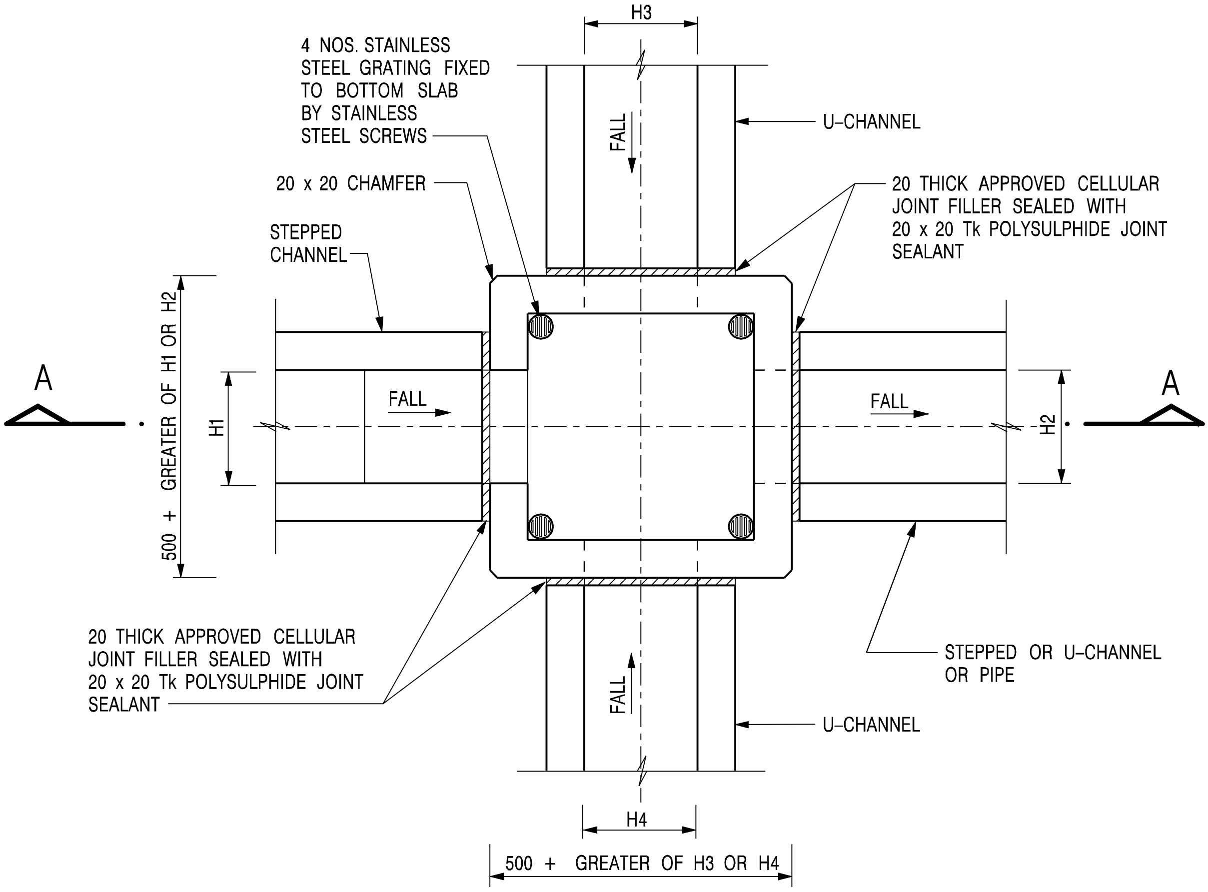
Indicative Drainage Mechanism from MH7 and MH15 to Underground Stormwater Storage Tank and Watercourse

Water Intake and Discharge Mechanism with Storage Tank Underground



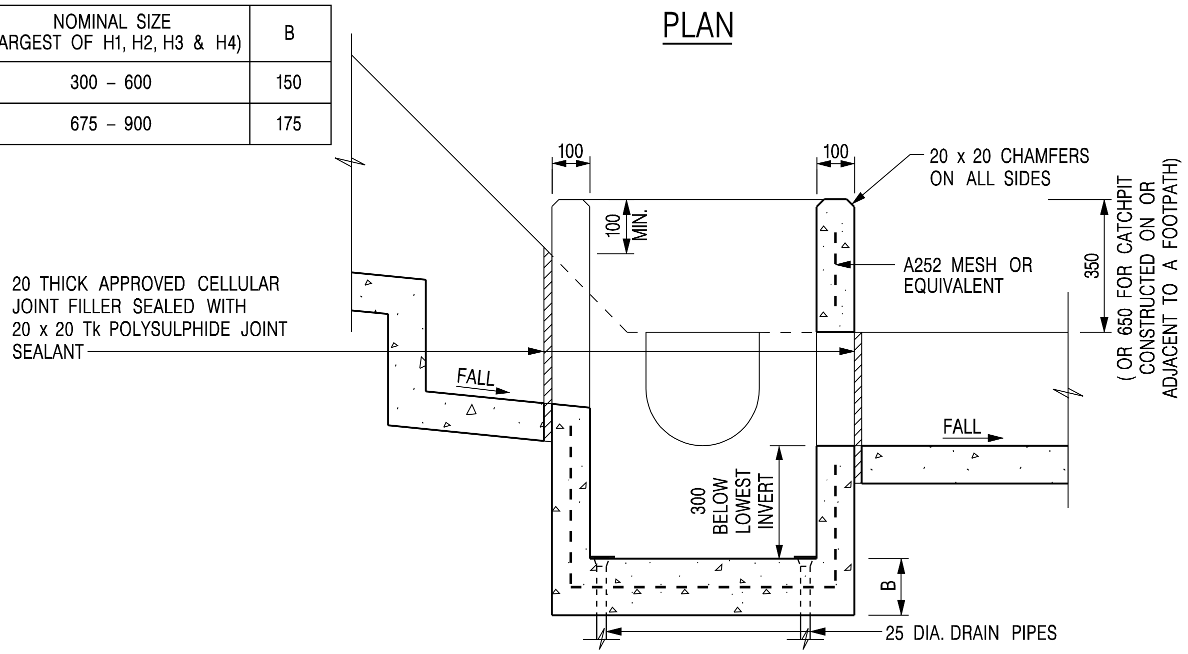
Appendix C DRAWINGS OF TYPICAL DETAILS OF U-CHANNEL AND CATCHPIT


min. H/2
H/2
Design depth
H
b
t
H
t



PLAN

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



SECTION A – A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. REFER TO SHEET 2 FOR OTHER NOTES.

REF.	REVISION	SIGNATURE	DATE
–	FORMER DRG. NO. C2406J.	Original Signed	03.2015

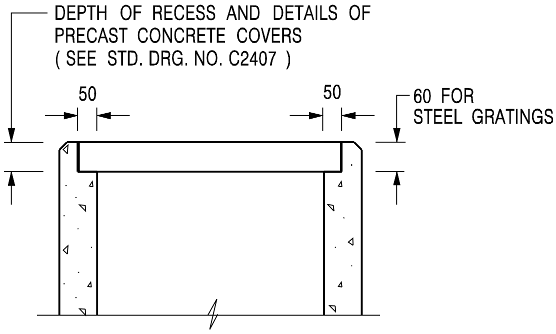
CATCHPIT WITH TRAP (SHEET 1 OF 2)

CEDD CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

SCALE 1 : 20

DATE JAN 1991

DRAWING NO. C2406 /1



ALTERNATIVE TOP SECTION
FOR PRECAST CONCRETE COVERS / GRATINGS

NOTES:

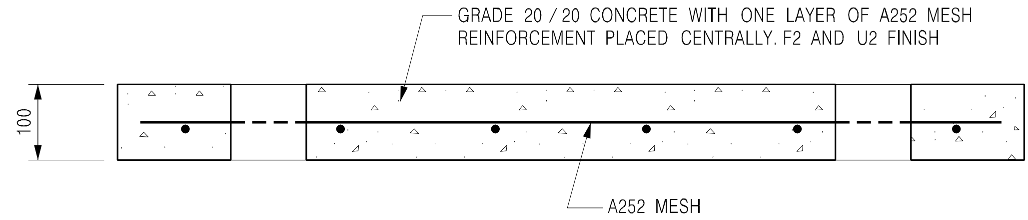
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL CONCRETE SHALL BE GRADE 20 / 20.
3. CONCRETE SURFACE FINISH SHALL BE CLASS U2 OR F2 AS APPROPRIATE.
4. FOR DETAILS OF JOINT, REFER TO STD. DRG. NO. C2413.
5. CONCRETE TO BE COLOURED AS SPECIFIED.
6. UNLESS REQUESTED BY THE MAINTENANCE PARTY AND AS DIRECTED BY THE ENGINEER, CATCHPIT WITH TRAP IS NORMALLY NOT PREFERRED DUE TO PONDING PROBLEM.
7. UPON THE REQUEST FROM MAINTENANCE PARTY, DRAIN PIPES AT CATCHPIT BASE CAN BE USED BUT THIS IS FOR CATCHPITS LOCATED AT SLOPE TOE ONLY AND AS DIRECTED BY THE ENGINEER.
8. FOR CATCHPITS CONSTRUCTED ON OR ADJACENT TO A FOOTPATH, STEEL GRATINGS (SEE DETAIL 'A' ON STD. DRG. NO. C2405 / 2) OR CONCRETE COVERS (SEE STD. DRG. NO. C2407) SHALL BE PROVIDED AS DIRECTED BY THE ENGINEER.
9. IF INSTRUCTED BY THE ENGINEER, HANDRAILING (SEE DETAIL 'J' ON STD. DRG. NO. C2405 / 5; EXCEPT ON THE UPSLOPE SIDE) IN LIEU OF STEEL GRATINGS OR CONCRETE COVERS CAN BE ACCEPTED AS AN ALTERNATIVE SAFETY MEASURE FOR CATCHPITS NOT ON A FOOTPATH NOR ADJACENT TO IT. TOP OF THE HANDRAILING SHALL BE 1 000 mm MIN. MEASURED FROM THE ADJACENT GROUND LEVEL.
10. MINIMUM INTERNAL CATCHPIT WIDTH SHALL BE 1 000 mm FOR CATCHPITS WITH A HEIGHT EXCEEDING 1 000 mm MEASURED FROM THE INVERT LEVEL TO THE ADJACENT GROUND LEVEL. AND, STEP IRONS (SEE DSD STD. DRG. NO. DS1043) AT 300 c/c STAGGERED SHALL BE PROVIDED. THICKNESS OF CATCHPIT WALL FOR INSTALLATION OF STEP IRONS SHALL BE INCREASED TO 150 mm.
11. FOR RETROFITTING AN EXISTING CATCHPIT WITH STEEL GRATING, SEE DETAIL 'G' ON STD. DRG. NO. C2405 / 4.
12. SUBJECT TO THE APPROVAL OF THE ENGINEER, OTHER MATERIALS CAN ALSO BE USED AS COVERS / GRATINGS.

REF.	REVISION	SIGNATURE	DATE
A	MINOR AMENDMENT.	Original Signed	04.2016
–	FORMER DRG. NO. C2406J.	Original Signed	03.2015

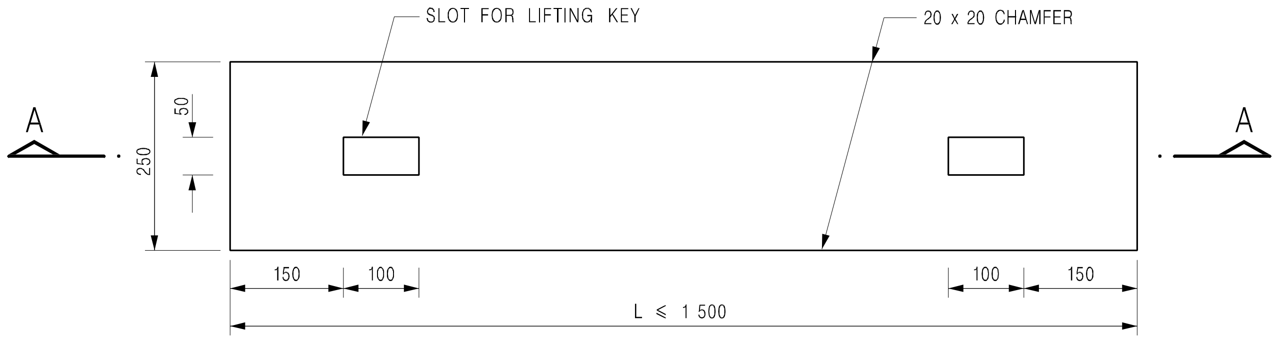
CATCHPIT WITH TRAP
(SHEET 2 OF 2)

CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

SCALE 1 : 20
DATE JAN 1991
DRAWING NO. C2406 / 2A

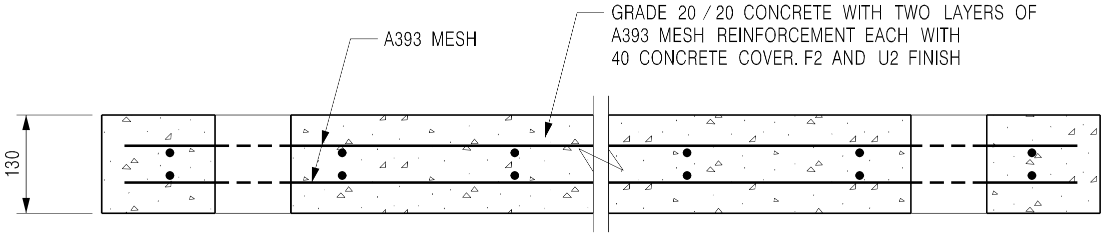


SECTION A – A

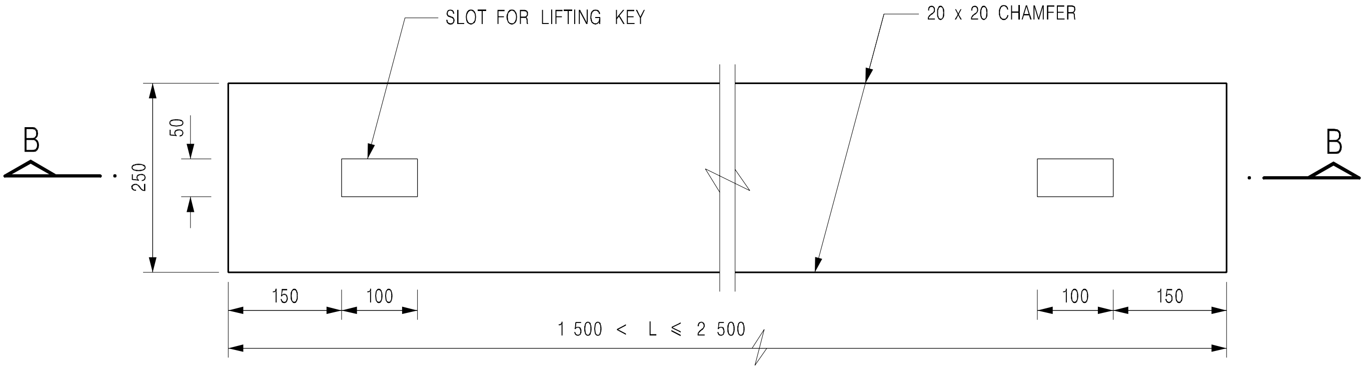


PLAN

TYPE 1 – FOR SPAN UP TO 1.5 m



SECTION B – B



PLAN

TYPE 2 – FOR SPANS 1.5 m TO 2.5 m

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL EXTERNAL EDGES OF THE COVERS SHALL BE 20mm CHAMFERED.

REF.	REVISION	SIGNATURE	DATE
B	NAME OF DEPARTMENT AMENDED.	Original Signed	01.2005
A	GENERAL REVISION	Original Signed	12.2002

PRECAST CONCRETE COVERS FOR CATCHPIT AND SAND TRAP

CEDD CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT

SCALE 1 : 10

DATE JAN 1991

DRAWING NO. C2407B

興土木 利民生 齊拓展 創明天

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Appendix D CALCULATION OF DRAINAGE CAPACITY

Calculation of Drainage Capacity for Return Period of 50 Years

From	To	Description	U-Shape Channel / Pipe	Length	Diameter	Upstream Invert Level	Downstream Invert Level	Slope (s)	Cross Section Area, m2	Wetted Perimeter	Hydaralius Radius, m	Manning Roughness Coefficient	Mean Velocity, m/s	Capacity Flow, m^3/s	Total Runoff, m^3/s	% of capacity	Remark
Start 1	CP1	C2a	U-Shape Channel	26.4	0.30	5.87	5.77	0.0040	0.08	0.77	0.10	0.018	0.78	0.06	0.03	62%	OK
CP1	CP2	C2a	U-Shape Channel	28.4	0.40	5.77	5.65	0.0040	0.14	1.03	0.14	0.018	0.94	0.12	0.07	57%	OK
CP2	CP3	C2a	U-Shape Channel	60.2	0.50	5.65	5.41	0.0040	0.22	1.29	0.17	0.018	1.09	0.22	0.14	63%	OK
CP3	CP4	C2a+C2b	U-Shape Channel	27.7	0.60	5.41	5.30	0.0040	0.32	1.54	0.21	0.018	1.23	0.36	0.18	49%	OK
CP4	CP5	C2a+C2b	U-Shape Channel	84.9	0.60	5.30	4.96	0.0040	0.32	1.54	0.21	0.018	1.23	0.36	0.25	70%	OK
CP5	CP6	C2a+C2b+C2c	U-Shape Channel	11.2	0.70	4.96	4.92	0.0040	0.44	1.80	0.24	0.018	1.37	0.54	0.37	68%	OK
CP6	MH7	C2a+C2b+C2c+C2d	U-Shape Channel	36.2	0.70	4.92	4.77	0.0040	0.44	1.80	0.24	0.018	1.37	0.54	0.39	73%	OK
MH7	CP8	C2d + Flow from manhole to box culvert under normal condition	U-Shape Channel	40.9	0.35	4.77	4.61	0.0040	0.11	0.90	0.12	0.018	0.86	0.08	0.06	66%	OK
CP8 [4]	Box culvert	Flow from manhole to box culvert under normal condition	U-Shape Channel	27.3	0.35	4.61	4.50	0.0040	0.11	0.90	0.12	0.018	0.86	0.08	0.08	99%	OK
Start 2	CP10	C2e+C3	U-Shape Channel	32.1	0.30	5.54	5.41	0.0040	0.08	0.77	0.10	0.018	0.78	0.06	0.04	75%	OK
CP10	CP11	C2e+C3	U-Shape Channel	24.9	0.40	5.41	5.31	0.0040	0.14	1.03	0.14	0.018	0.94	0.12	0.08	70%	OK
CP11	CP12	C2e+C2f+C2g+C3	U-Shape Channel	64.3	0.60	5.31	5.05	0.0040	0.32	1.54	0.21	0.018	1.23	0.36	0.16	46%	OK
CP12	CP13	C2e+C2f+C2g+C2h+C3	U-Shape Channel	44.2	0.70	5.05	4.88	0.0040	0.44	1.80	0.24	0.018	1.37	0.54	0.22	50%	OK
CP13	CP14	C2e+C2f+C2g+C2h+C3	U-Shape Channel	35.2	0.70	4.88	4.74	0.0040	0.44	1.80	0.24	0.018	1.37	0.54	0.39	73%	OK
CP14	MH15	C2e+C2f+C2g+C2h+C3	U-Shape Channel	26.5	0.70	4.74	4.63	0.0040	0.44	1.80	0.24	0.018	1.37	0.54	0.40	75%	OK
MH15 [4]	Box culvert	Flow from manhole to box culvert under normal condition (part of the flow from C2 and flow from C3)	U-Shape Channel	32.6	0.5	4.63	4.50	0.0040	0.22	1.29	0.17	0.018	1.09	0.22	0.22	100%	OK

From	To	Description	U-Shape Channel / Pipe	Length	Diameter	Upstream Invert Level	Downstream Invert Level	Slope (s)	Cross Section Area, m2	Wetted Perimeter, m	Hydaralius Radius, m	k_s [2] mm	g m/s^2	Kinematic Viscosity m^2/s	V m/s	Capacity Flow, m^3/s	Total Runoff, m^3/s	% of capacity	Remark
MH7	Tank 1	C2a+C2b+C2c+2d	Pipe	14.2	0.70	4.77	4.72	0.0040	0.385	2.199	0.18	0.300	9.81	0.000001	1.82	0.63	0.39	62%	OK
MH15	Tank 2	C2e+C2f+C2g+C2h+C3	Pipe	10.5	0.60	4.63	4.58	0.0040	0.283	1.885	0.15	0.300	9.81	0.000001	1.66	0.42	0.18	44%	OK
Tank 1 [3]	Box culvert	C2a+C2b+C2c+2d	Pipe	17.5	0.50	4.57	4.50	0.0040	0.196	1.571	0.12	0.300	9.81	0.000001	1.47	0.26	0.11	43%	OK
Tank 2 [3]	Box culvert	C2e+C2f+C2g+C2h+C3	Pipe	20.0	0.40	4.58	4.50	0.0040	0.126	1.257	0.10	0.300	9.81	0.000001	1.29	0.15	0.07	51%	OK

Legend

d = pipe diameter, m

r = pipe radius (m) = 0.5d

A_w = wetted area (m^2) = p r^2

P_w = wetted perimeter (m) = 2pr

R = Hydraulic radius (m) = A_w/P_w

s = Slope of the total energy line

k_s = equivalent sand roughness, mm

V = Velocity of flow calculated based on Colebrook White Equation, m/s

Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s

Q_p = Estimated total peak flow from the Site during peak season, m^3/s

Remarks

[1] The proposed U-channel is assumed to be concrete-lined channels under bad condition based on a conservative approach, therefore the manning coefficient of 0.018s/m $^{1/3}$ is assumed as per the SDM.

[2] The material of proposed drainage pipe is assumed to be galvanised iron with coated cast iron generally under bad condition based on a conservative approach, therefore pipelines roughness coefficient ks of 0.3mm is assumed as per the SDM.

[3] The maximun amount of runoff to be pumped from the tank to the box culvert is assumed to be the runoff of Catchment C2 before development under 50 Years Return Period.

[4] The maximum capacity of the U-shape channel is designed based on the existing runoff of Catchment C2 and C3.

Tank Sizing for Stormwater Storage Tank

Catchment ID	Catchment Area (A), km^2	Runoff intensity (i), mm/hr [2]	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s	Duration of Storm, hours	Runoff Volume Required, m^3
C2 Before Proposed Development	0.0161	54.90	0.26	0.0041	0.063	4.000	907
C2 After Proposed Development	0.0161	54.90	0.77	0.0124	0.189	4.000	2,721
						Incremental Runoff	**1,814**

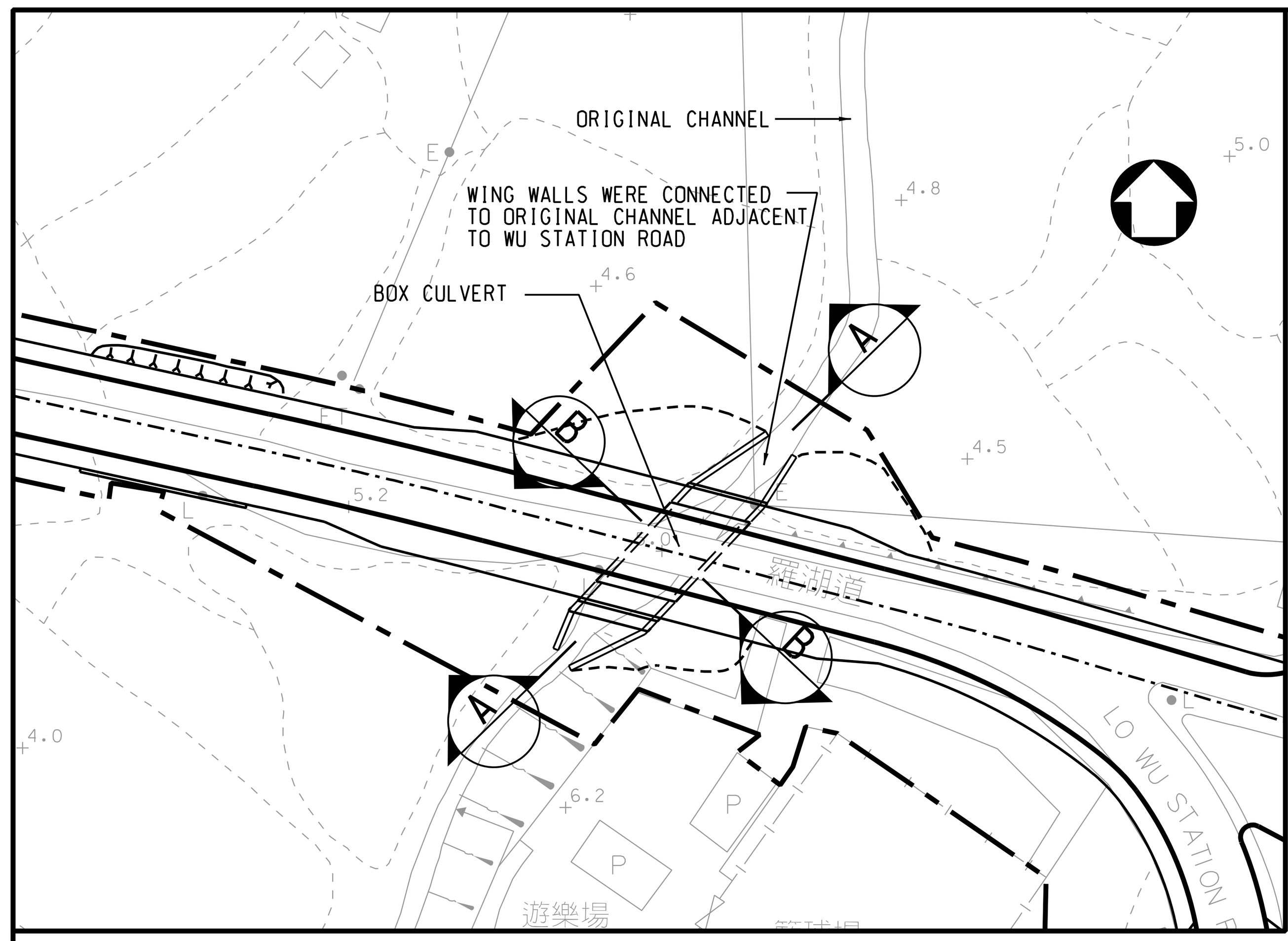
Tank	Length (L), m	Width (W), m	Depth (D), m	Design Volume, m^2
Tank 1	24	20	3	1,440
Tank 2	15	14	3	630

Note:

1) Runoff is calculated in accordance with DSD's "*Stormwater Drainage Manual (with Eurocodes incorporated) - Planning, Design and Managemen* t" (SDM), fifth edition, January 2018 and DSD publication Stormwater Drainage Manual CORRIGENDUM No. 1/2022.

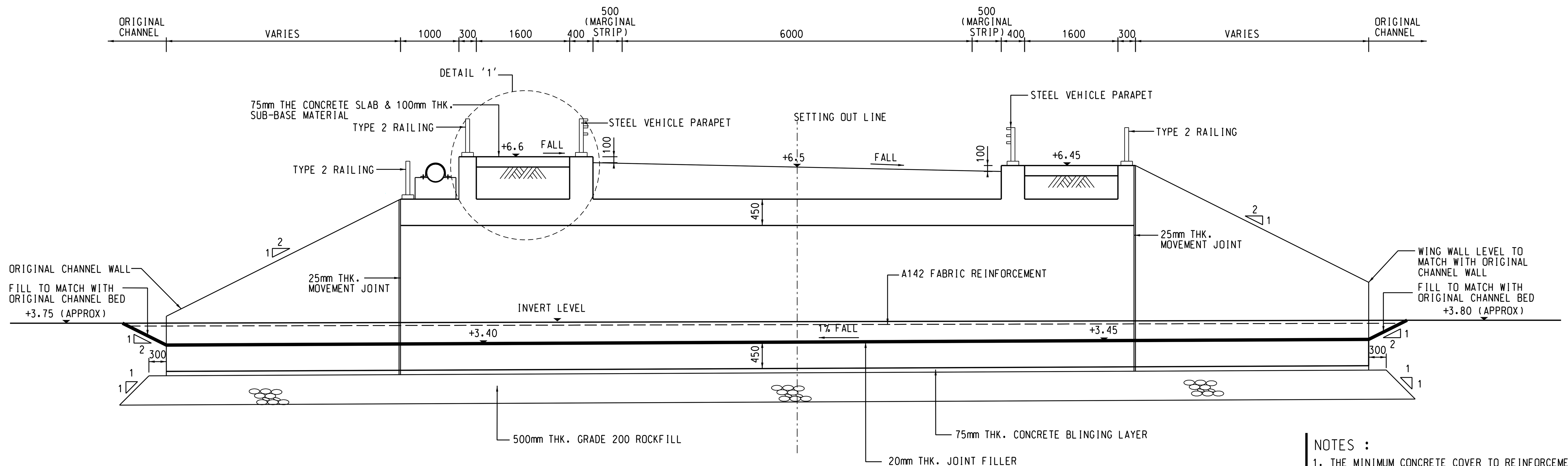
2) Extreme intensity under 50 years return period is based on Table 2a of SDM

Appendix E DRAWINGS OF BOX CULVERT UNDERNEATH LO WU STATION ROAD



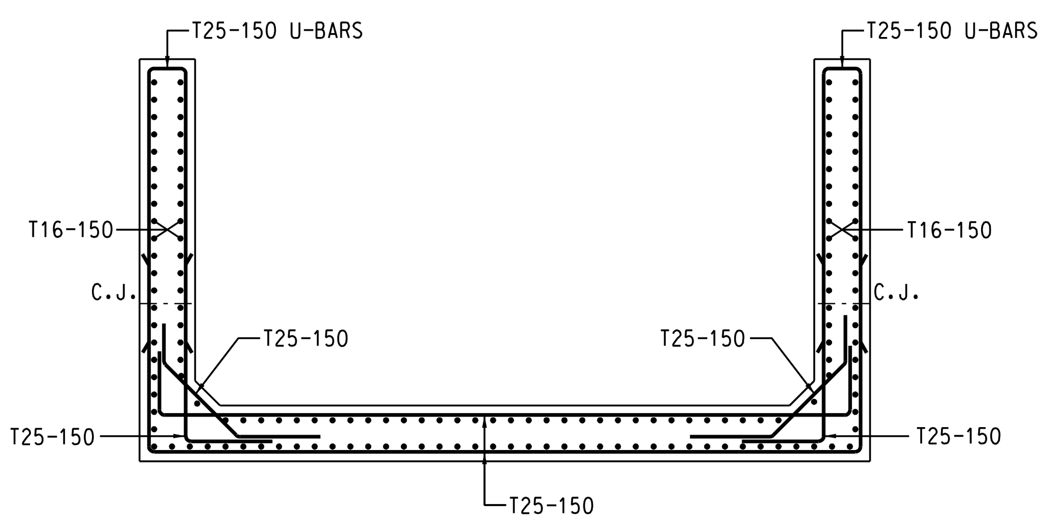
GENERAL LAYOUT OF BOX CULVERT

SCALE 1 : 500



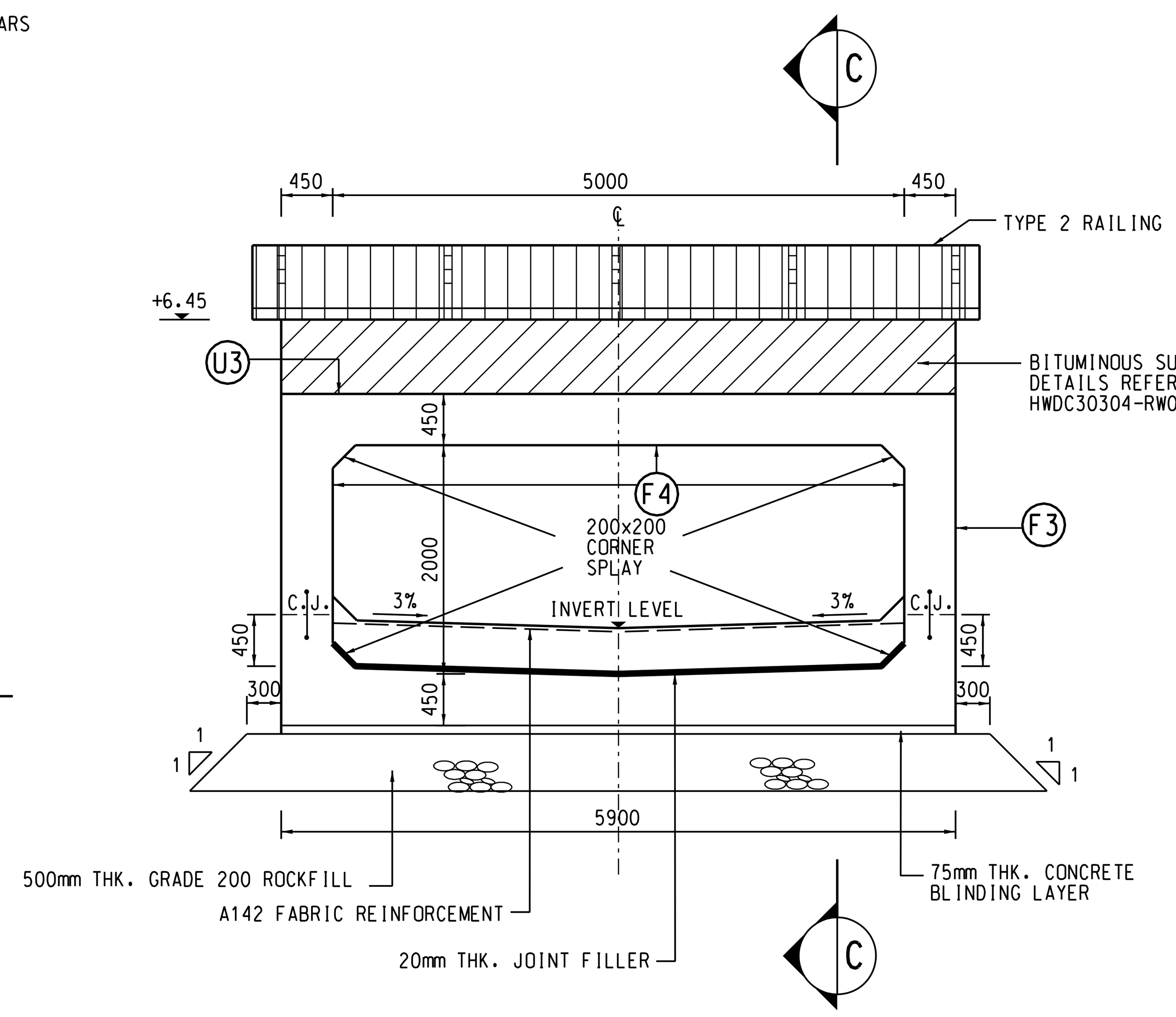
ELEVATION OF BOX CULVERT (SECTION A - A)

SCALE 1 : 50



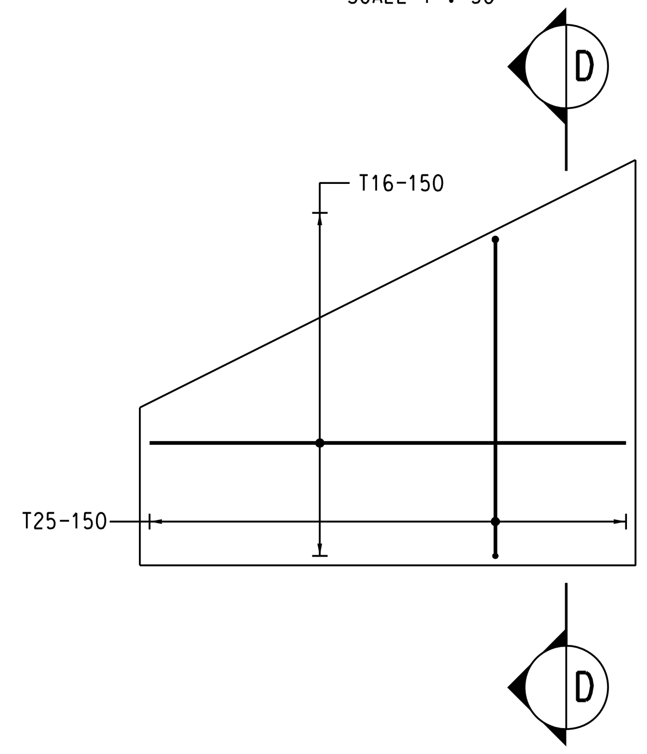
WING WALL REINFORCEMENT DETAIL (SECTION D - D)

SCALE 1 : 50



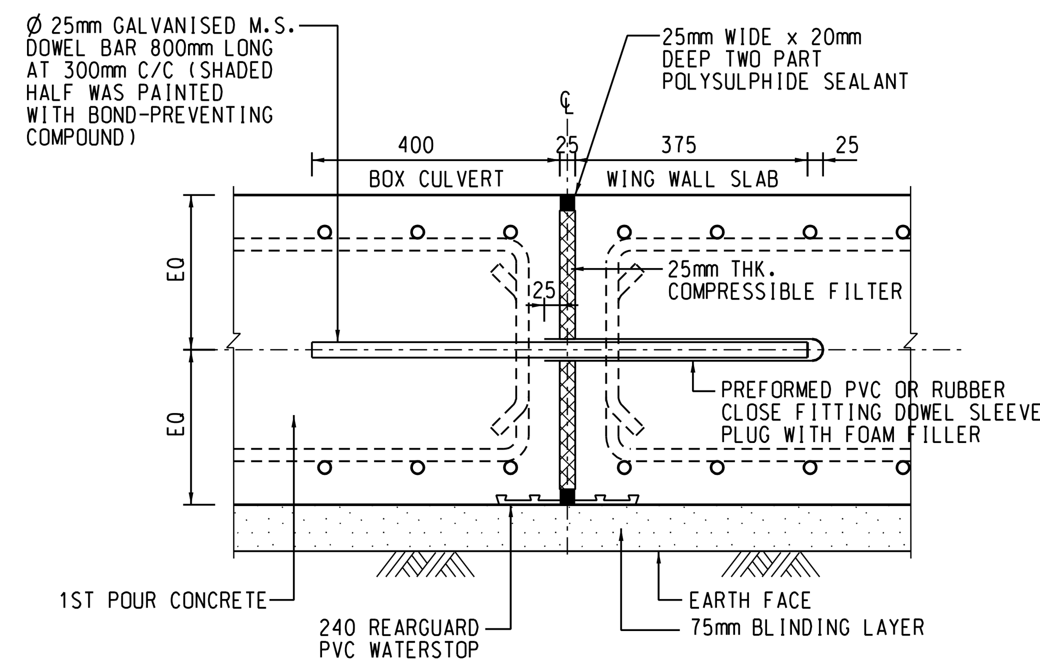
SECTION OF BOX CULVERT

SCALE 1 : 50



TYPICAL R.C. DETAILS OF WING WALL

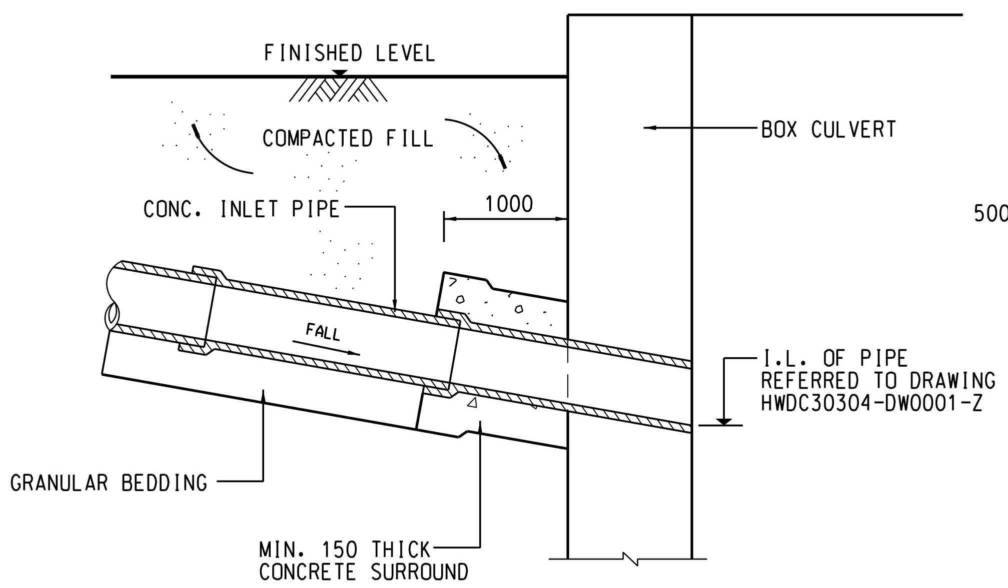
SCALE 1 : 50



MOVEMENT JOINT AT BASE SLAB WITH WATERSTOP

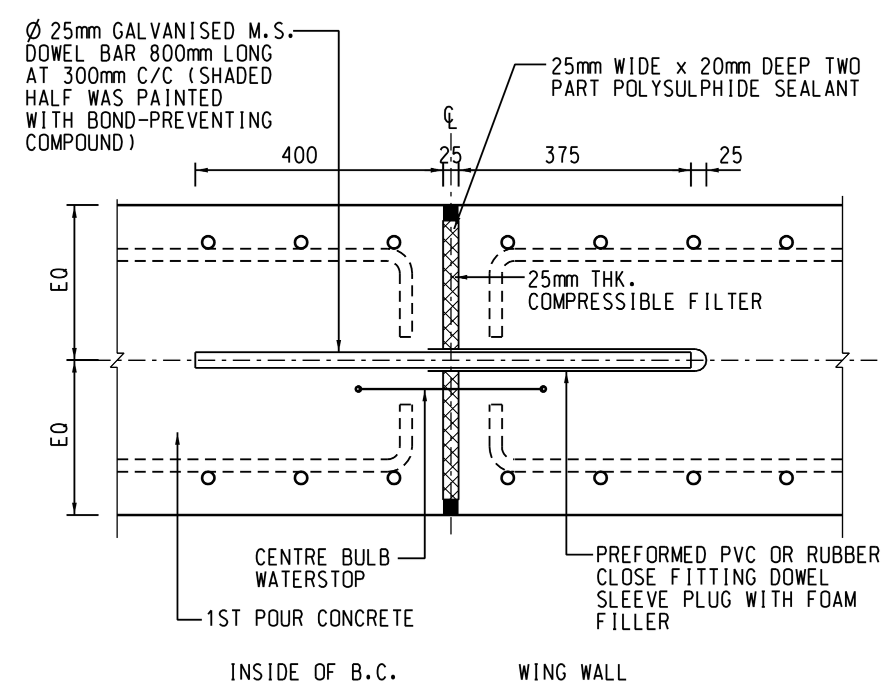
SCALE 1 : 10

NOTE : WATERSTOP ON WALL WAS EXTENDED TO 50mm BELOW FINISHING GROUND LEVEL.



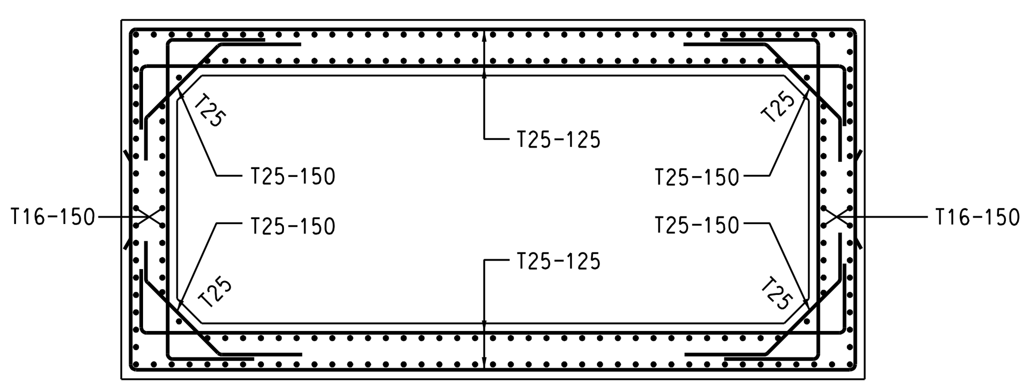
TYPICAL DETAIL OF PIPE CONNECTION TO BOX CULVERT

SCALE 1 : 5



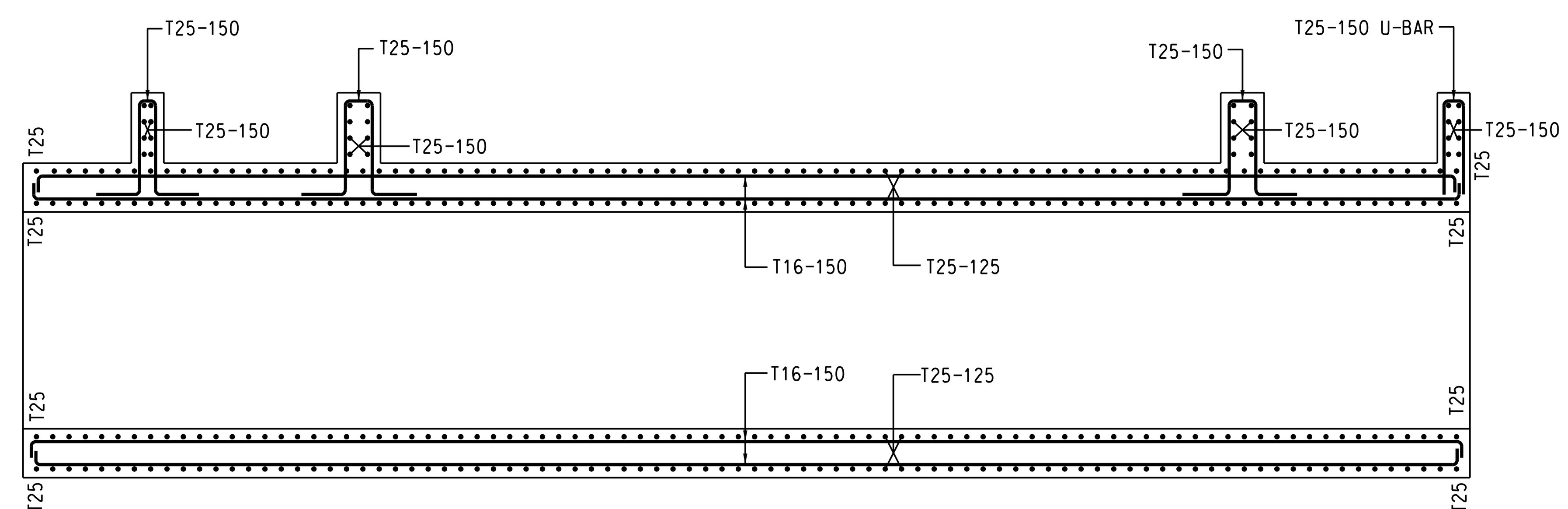
MOVEMENT JOINT AT WALL STEM WITH WATERSTOP

SCALE 1 : 10



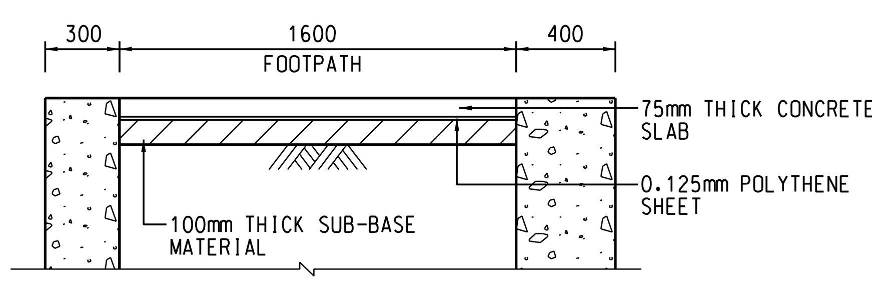
BOX CULVERT REINFORCEMENT DETAIL B - B (SECTION B - B)

SCALE 1 : 50



BOX CULVERT REINFORCEMENT DETAIL C - C (SECTION C - C)

SCALE 1 : 50



DETAIL '1'

SCALE 1 : 25

NOTES :

1. THE MINIMUM CONCRETE COVER TO REINFORCEMENT WAS 45mm UNLESS OTHERWISE STATED.
2. DETAILS STEEL VEHICLE PARAPET REFERRED TO HyD STD. DWG NO.SSD141-B.
3. ALL DIMENSIONS WERE IN MILLIMETERS, UNLESS OTHERWISE SPECIFIED.
4. CONCRETE GRADE WAS 40/20D AND CONFORMED TO CONSTRUCTION STANDARD CS1:1990.
5. 25 x 25 CHAMFER UNLESS STATED OTHERS WAS PROVIDED AT EXTERNAL CORNER OF CONCRETE SURFACE LESS THAN 120 DEGREES.
6. THE LEVELS SHOWN ON THE DRG WERE INDICATIVE ONLY THE EXACT LEVELS WERE DETERMINED ON SITE.
7. DETAILS OF THE DRAWING EXTRACTED FROM MCAL'S DRAWING No. 96802/14/01101C.

no.	date	description	initial
Z	22.01.14	AS CONSTRUCTED	SIGNED W.P. WONG (E/NT2-3)

REVISION

	post	name	initial	date
designed	ACE/NT2-1	C.Y. WONG	SIGNED	26.02.09
drawn	TO/3-1	S.C. CHAN	SIGNED	26.02.09
checked	SE/NT2	W.S. MAK	SIGNED	26.02.09

approved

SIGNED
S.W. CHU — 26.02.09
Chief Highway Engineer / Works — Date

contract no.

file no.

project no. 63OG041X

project

IMPROVEMENT TO
LO WU STATION ROAD

drawing title

BOX CULVERT DETAILS

drawing no. HWDC30304-MC0009-Z

scale A1 AS SHOWN

office

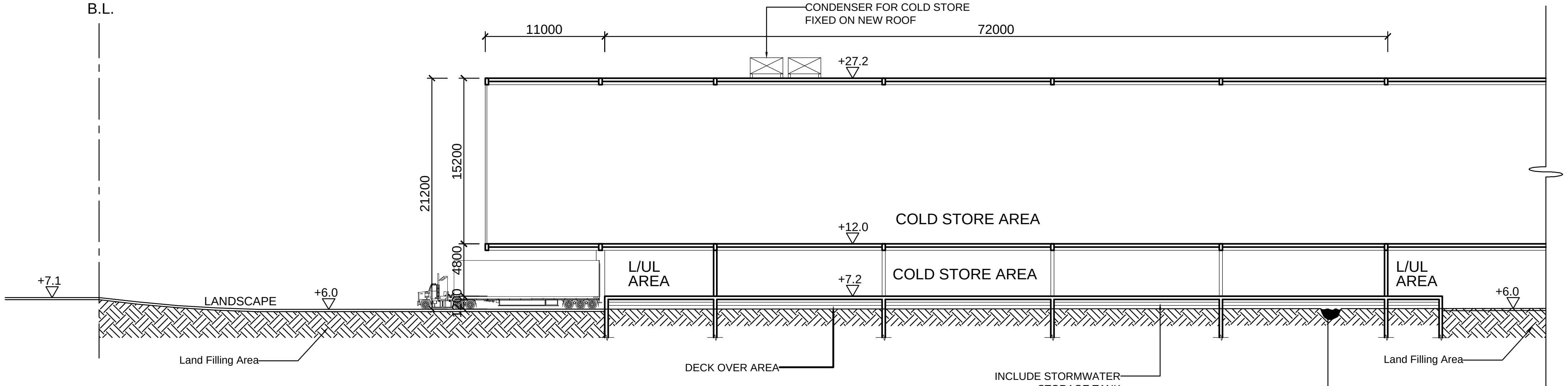
WORKS DIVISION

HIGHWAYS DEPARTMENT HONG KONG

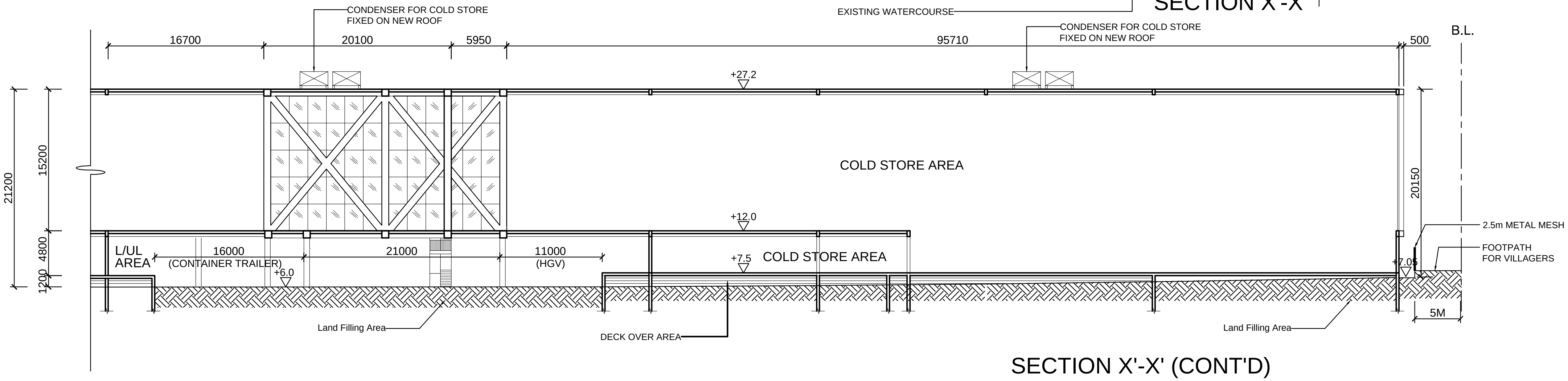
A1 841x594

0 10 20 30 40 50 60 70 80 90 100 mm SCALE 1 : 1

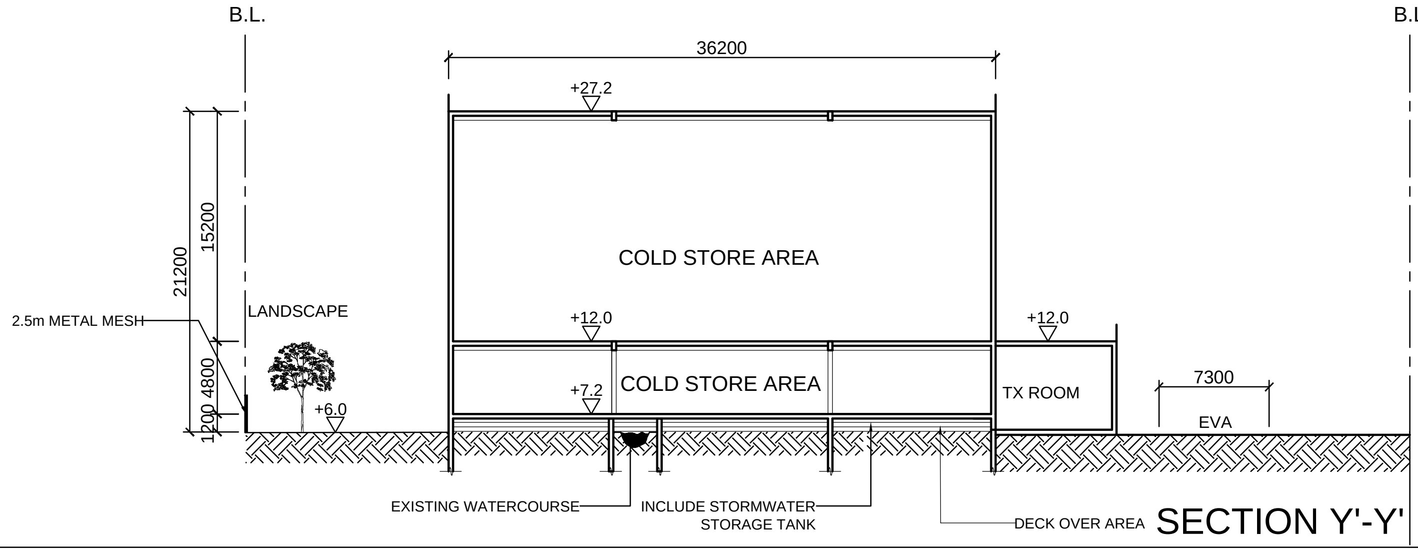
Appendix F SECTIONAL VIEWS OF THE SITE



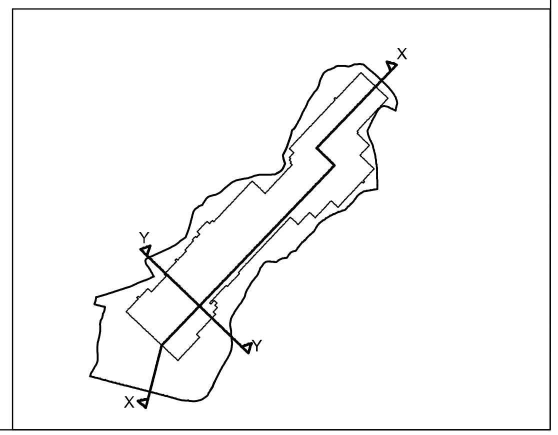
SECTION X'-X'



SECTION X'-X' (CONT'D)



SECTION Y'-Y'



Architect	Project	Designed By	Drawn By	Date Drawn	Checked By
		DY	NC	2022'7'5	DY

MG DESIGN H.K. LTD.

MG DESIGN H.K. LTD. Architecture Planning Interior

MG 建築師設計香港有限公司

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PROPOSED TEMPORARY STORAGE AND DISTRIBUTION OF CHILLED POULTRY/MEAT

Lots 471 S.B RP (Part), 472, 473, 474, 475, 476, 482 RP,483, 484, 487 RP, 497 S.A RP, 501, 502, 504 S.B, 505 and 506 S.B RP and adjoining Government Land in D.D. 89, Man Kam To Road, Sandy Ridge, New Territories

Drawing Title: SECTION X'-X' & SECTION Y'-Y'

Project No.	Scale	Drawing No.	Rev.
21/HK/MKT01	1:500 on A3	SC-001	C

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