

**SULIT**



First Semester Examination  
2017/2018 Academic Session

January 2018

**EAH417 – Urban Water Management  
(Pengurusan Air Bandar)**

Duration : 2 hours  
(Masa : 2 jam)

Please check that this examination paper consists of **THIRTEEN** (13) pages of printed material including appendix before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **TIGA BELAS** (13) muka surat yang bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

**Instructions:** This paper contains **SIX (6)** questions. Answer **FOUR (4)** questions.

**Arahan** : Kertas ini mengandungi **ENAM (6)** soalan. Jawab **EMPAT (4)** soalan.]

In the event of any discrepancies, the English version shall be used.

*[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]*

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**SULIT**

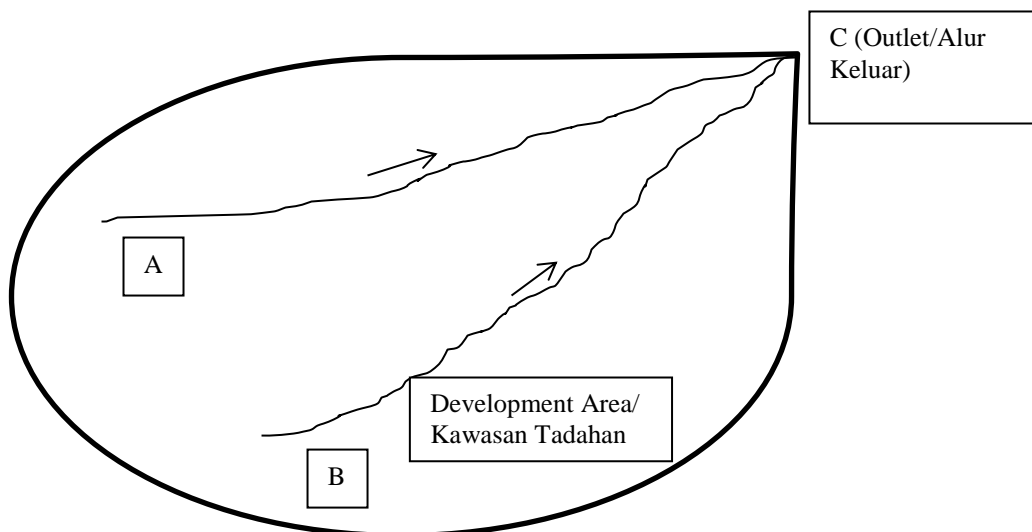
1. A development area is drained by grass channel AC and BC which flows to the outlet C as in **Figure 1**. The area of the development is 25 ha and consists of residential mainly terrace houses. Compute the volume of surface runoff using Rational Method Hydrograph Method (RMHM) of Type 2 for 50 year ARI. The data for the development area and grass channels are given in **Table 1**. Use Ibu Bekalan Sg. Kulim for IDF station.

*Kawasan pembangunan disalurkan oleh saluran berumput AC dan BC yang mengalir ke alur keluar C seperti di **Rajah 1**. Kawasan pembangunan dengan keluasan 25 ha dibangunkan dengan kawasan perumahan yang terdiri dari rumah teres. Hitung isipadu air larian menggunakan kaedah RMHM Jenis 2 untuk 50 tahun ARI. Data kawasan pembangunan dan saluran berumput diberikan dalam **Jadual 1**. Gunakan Ibu Bekalan Sg. Kulim untuk stesen IDF.*

[25 marks/markah]

**Table 1:** Development area and grass channel characteristics  
**Jadual 1:** Ciri kawasan pembangunan dan saluran berumput

Reach/ Ruas	Overland/Air Larian			Grass Channel/Saluran Berumput			
	$L_o$ (m)	$n^*$	$S_o$ (%)	$L_d$ (m)	$n$	$S_d$ (m/m)	$R$ (m)
AC	150	0.035	5.0	850	0.035	0.010	0.16
BC	200	0.035	8.0	950	0.035	0.020	0.16



**Figure 1/Rajah 1**

2. (a) An area of 4500 ha in Lumut, Perak is designated for university campus development. Client specifies for sustainable drainage system to be incorporated in the development and shall be designed based on train of treatment for water quantity control of stormwater. The development area is flat and the infiltration capacity is 30 mm/hr – 60 mm/hr. Discuss and propose the concept and framework for the sustainable drainage system. Select **FOUR (4)** appropriate devices to comply with quantity control of the sustainable drainage system.

*Kawasan seluas 4500 ha di Lumut, Perak akan dibangunkan sebagai kampus universiti. Klien telah menggariskan untuk menerapkan sistem saliran mesra alam di dalam pembangunan kampus tersebut dan rekabentuknya adalah berdasarkan kepada rawatan bersiri untuk kawalan kuantiti air ribut. Kawasan pembangunan adalah rata dan keupayaan penyusupan adalah 30 mm/jam – 60 mm/jam. Bincang dan cadangkan konsep rangka kerja sistem saliran mesra alam. Pilih **EMPAT (4)** peranti yang sesuai untuk memenuhi kawalan kuantiti sistem saliran mesra alam.*

[10 marks/markah]

- (b) Fast food restaurant will be developed on 10 000 m<sup>2</sup> lot area in Parit Buntar, Perak. An above ground storage will be provided in the lawn and garden area at the front of the site. The impervious area consists of restaurant building, perimeter road and carparks which is 80% of the project area. The lawns and garden cover 20% of the project area. Determine the permissible site discharge (PSD) for the onsite detention (OSD).

**Note:** Based the OSD by assuming  $t_c = 0.75$  hr,  $t_{cs} = 0.5$  hr,  $^5I_{45} = 100$  mm/hr,  $Q_p = 0.15$  m<sup>3</sup>/s and ,  $Q_a = 0.20$  m<sup>3</sup>/s.

*Restoran makanan segera akan dibangunkan di sebuah lot seluas 10 000 m<sup>2</sup> di Parit Buntar, Perak. Kemudahan OSD di atas permukaan tanah dicadangkan untuk disediakan pada kawasan halaman dan taman di hadapan tapak restoran tersebut. Kawasan tidak telap terdiri dari bangunan restoran, jalan perimeter dan tempat letak kereta yang mempunyai keluasan 80% dari kawasan projek. Kawasan halaman dan taman mempunyai keluasan 20% dari kawasan projek. Tentukan aliran keluar dari tapak yang dibenarkan (PSD) untuk OSD tersebut.*

**Nota:** Anggapkan perkara berikut untuk pengiraan:  $t_c = 0.75$  hr,  $t_{cs} = 0.5$  hr,  $^5I_{45} = 100$  mm/hr,  $Q_p = 0.15$  m<sup>3</sup>/s and ,  $Q_a = 0.20$  m<sup>3</sup>/s.

[15 marks/markah]

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3. a) Discuss why an engineer that designs a water quality treatment facility requires local knowledge on site condition and pollutants generated.

*Bincangkan mengapa seorang jurutera merekabentuk sebuah fasiliti rawatan kualiti air memerlukan pengetahuan tempatan terhadap keadaan tapak dan bahan cemar yang dihasilkan.*

[10 marks/markah]

- b) Estimate the preliminary size of a water quality pond required to meet Pollutant Reduction Target (**Table 2**; DID 2012) according to Manual Saliran Mesra Alam (2012) of the residential area Taman Ilmu, Seberang Perai Selatan (65 ha). The average runoff coefficient of the area is 0.65, which was calculated based on the actual imperviousness of the mixed development residential area (e.g. Bungalow, Link House, Flat and Open Spaces).

*Anggarkan saiz awal kolam kualiti air yang diperlukan untuk memenuhi kriteria Sasaran Pengurangan Pencemaran (**Jadual 2**; JPS 2012) menurut Manual Saliran Mesra Alam (2012) dari kawasan kediaman Taman Ilmu, Seberang Perai Selatan (65 ha). Purata pekali air larian daripada kawasan adalah 0.65, yang dikira berdasarkan kawasan tidak telap dari kawasan kediaman pembangunan bercampur (e.g. Banglo, Rumah Teres, Flat dan Kawasan Lapang).*

[15 marks/markah]

**Table 2** : Pollutant Reduction Targets

Pollutant	Reduction Targets (%)
Floatables/Litters	90
Total Suspended Solids (TSS)	80
Total Nitrogen (TN)	50
Total Phosphorus (TP)	50

**Note:** Relevant local regulatory authorities may set higher (stringent) targets depending on the sensitivity and level of pollution in the surrounding areas

**Jadual 2** : Sasaran Pengurangan Pencemaran

Pencemaran	Sasaran Pengurangan (%)
Objek terapung/Sampah	90
Jumlah Pepejal Terapung (TSS)	80
Jumlah Nitrogen (TN)	50
Jumlah Fosforus (TP)	50

**Nota:** Syarat relevan sasaran pihak berkuasa tempatan sedikit tinggi bergantung kepada sensitiviti dan tahap pencemaran di kawasan sekitar

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4. a) Discuss the importance of water quantity, quality and aesthetic in Best Management Practices (BMPs). Discuss on how BMPs can be applied in residential areas.

*Bincangkan kepentingan konsep kuantiti, kualiti dan estetik dalam Pengurusan Praktik Terbaik (BMPs). Bincangkan bagaimana BMPs dapat diaplikasikan di kawasan perumahan.*

[10 marks/markah]

- b) The average annual rainfall for the Perai catchment is 2780 mm. **Appendix G** (JPS 2012) shows an annual pollutant loads for the catchment. Determine the annual pollution loading of TSS, TN, TP and PB (in tonnes/yr) generated from a 1050 ha mixed development area located in upstream of Sg. Perai as shown in **Table 3**.

*Jumlah purata hujan tahunan bagi tadahan Perai ialah 2780 mm. **Lampiran G** (JPS 2012) menunjukkan beban pencemar tahunan bagi kawasan tadahan tersebut. Tentukan beban pencemaran tahunan TSS, TN, TP dan PB (dalam tan/tahun) yang dihasilkan dari 1050 ha kawasan pembangunan bercampur yang terletak di hulu Sg. Perai seperti dalam **Jadual 3**.*

[15 marks/markah]

**Table 3:** Land use pattern in Sg Perai Sub-Catchment

Sub Area	Type	Area (ha)
1	Light Industrial (124 ha)	150
2	Residential	410
3	Commercial	290
4	Roads and Highways	100
Total		950

**Jadual 3:** Corak guna tanah di kawasan Sub-Tadahan Sg Perai

Sub kawasan	Jenis	Luas (ha)
1	Industri Ringan (124 ha)	150
2	Perumahan	410
3	Komersial	290
4	Jalan dan Lebuhraya	100
Jumlah		950

5. (a) The project “Cadangan Mendirikan Sebuah Surau Al-Fatonah” is to be constructed on 3 ha area private land in Puchong, Selangor. Design the size of a grass swale to convey a 5-year ARI design flow.

*Projek "Cadangan Mendirikan Sebuah Surau Al-Fatonah" akan dibina di tanah persendirian seluas 3 ha di Puchong, Selangor. Rekabentuk saiz saluran berumput untuk mengalirkan 5 tahun ARI rekabentuk aliran.*

[25 marks/ markah]

6. (a) An asphalt road with Manning’s coefficient,  $n$  of 0.018 is to be designed with a cross slope of 0.05, a longitudinal slope of 0.03 and triangular gutter is to be used for pavement drainage. The proposed roadway site is located in Bukit Larut, Taiping. Determine the spread of water on the roadway if the roadway section is 20 m wide with a length of 200 m.

*Jalan raya asfalt mempunyai pekali Manning,  $n$  adalah 0.018 direkabentuk dengan cerun silang sebanyak 0.05, cerun membujur 0.03 dan longkang segitiga digunakan untuk saliran turapan. Tapak jalan raya yang dicadangkan ini terletak di Bukit Larut, Taiping. Tentukan penyebaran air di jalan raya jika seksyen jalan raya ini selebar 20 m dengan panjang 200 m.*

[25 marks/markah]

## APPENDIX A/LAMPIRAN A

Selected Equations for rainfall intensity, overland flow and OSD.

$i = \frac{\lambda T^\kappa}{(d + \theta)^\eta}$
$t_o = \frac{107n^*L^{1/3}}{S^{1/5}}$
$PSD = \frac{a - \sqrt{a^2 - 4b}}{2}$
$a = \left(4 \frac{Q_a}{t_c}\right) \left(0.333t_c \frac{Q_p}{Q_a} + 0.75t_c + 0.25t_{cs}\right)$
$b = 4Q_a Q_p$
$SSR = 0.06t_d(Q_d - c - d)$
$c = 0.875 PSD \left(1 - 0.459 \frac{PSD}{Q_d}\right)$
$d = 0.214 \frac{PSD^2}{Q_d}$

**APPENDIX B/LAMPIRAN B**

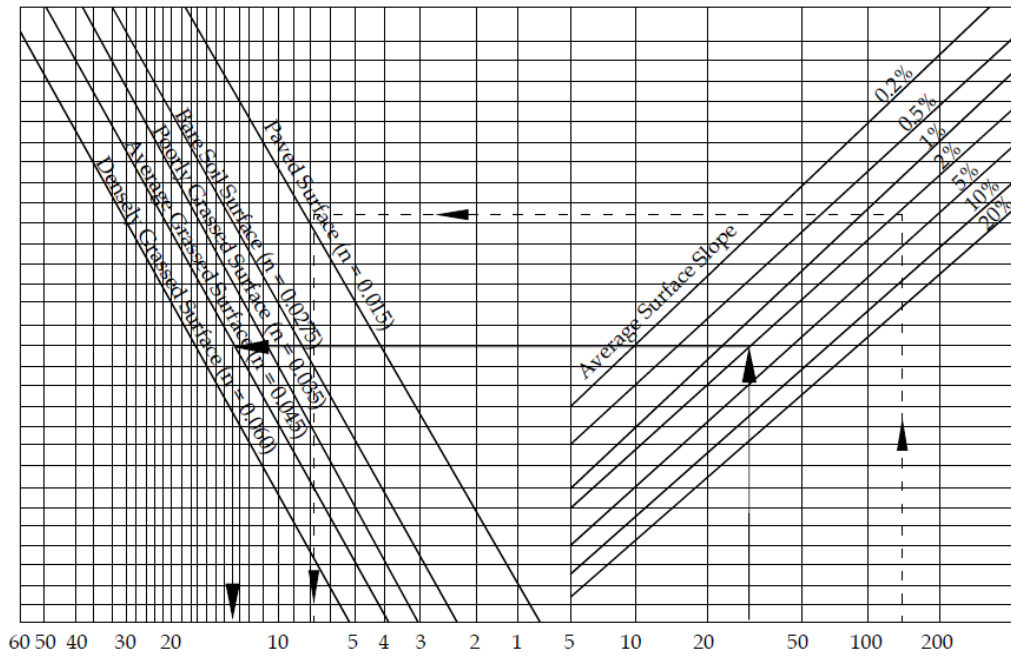
Fitting Constant for Design Rainfall Estimation (Ibu Bekalan Sg. Kulim Station, Bukit Larut, Puchong)

Location & Station ID	ARI,T (years)	Storm duration $d$	$\lambda$	$\kappa$	$\theta$	$\eta$
Ibu Bekalan Sg. Kulim	-	-	57.832	0.188	0.245	0.751
Puchong Drop, KL	5	0	69.650	0.151	0.223	0.880
Bukit Larut, Taiping	10	12.50	87.236	0.165	0.258	0.842



APPENDIX C/LAMPIRAN C

Nomograph for the Estimation of Overland Flow Time (to)



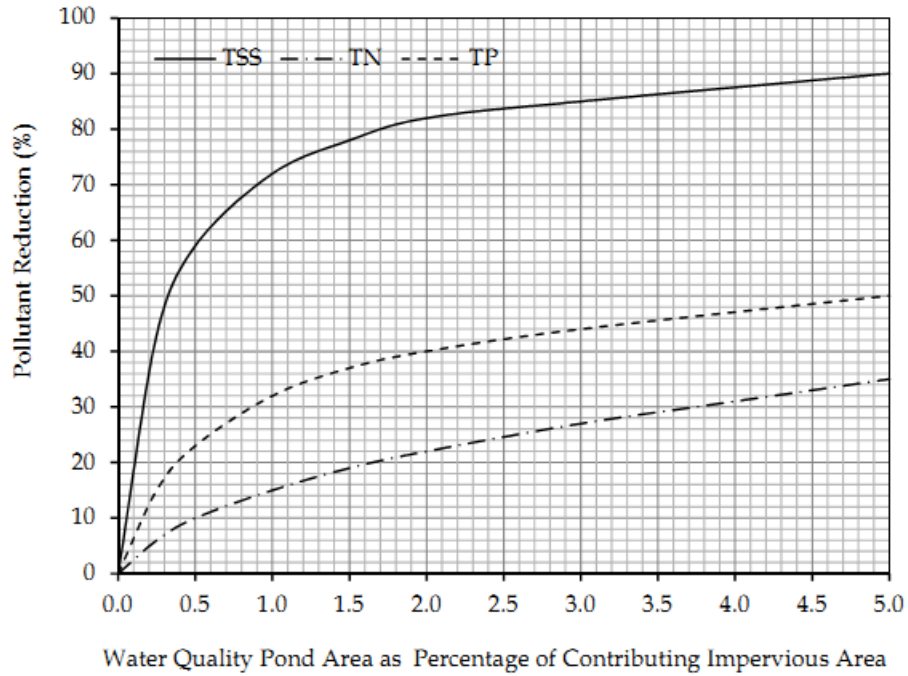
## APPENDIX D/LAMPIRAN D

## Runoff Coefficient

Landuse	Runoff Coefficient (C)	
	For Minor System (≤10 year ARI)	For Major System (> 10 year ARI)
Residential		
Bungalow	0.65	0.70
Semi-detached Bungalow	0.70	0.75
Link and Terrace House	0.80	0.90
Flat and Apartment	0.80	0.85
Condominium	0.75	0.80
Commercial and Business Centres	0.90	0.95
Industrial	0.90	0.95
Sport Fields, Park and Agriculture	0.30	0.40
Open Spaces		
Bare Soil (No Cover)	0.50	0.60
Grass Cover	0.40	0.50
Bush Cover	0.35	0.45
Forest Cover	0.30	0.40
Roads and Highways	0.95	0.95
Water Body (Pond)		
Detention Pond (with outlet)	0.95	0.95
Retention Pond (no outlet)	0.00	0.00

**APPENDIX E/LAMPIRAN E**

Pollutant Reduction Curves (Adapted from Melbourne Water, 2005 and Darwin Harbour, 2009)



b) Water Quality Pond

## APPENDIX F/LAMPIRAN F

Classification of Treatment Targets for Individual BMPs (Adapted from Melbourne Water, 2005)

Pollutant	Target of Treatment		
	Low	Medium	High
TSS	Less than 40% of particulates greater than 0.125mm retained.	40-70% of particulates greater than 0.125mm retained.	More than 70% of particulates greater than 0.125 mm retained.
Nutrients (TN & TP)	Less than 10% reduction	10-40% reduction	More than 40% reduction

Note: There is insufficient data available to give firm guidance on gross pollutants. The level of treatment chosen has an effect on the area required for the BMPs. However, in all situations, the overall pollutant reduction by any BMPs or treatment train (at least) *must comply* with the criteria given

## APPENDIX G/LAMPIRAN G

Mean EMC Values for Selected Landuses

Pollutants		Landuses			
Parameter	Unit	Residential	Commercial	Industrial	Highway
TSS	mg/L	128.00	122.00	166.00	80.00
Turbidity	NTU	122.00	96.00	147.00	69.00
TDS	mg/L	131.00	43.00	137.00	38.00
pH	-	6.46	6.77	6.66	6.57
BOD	mg/L	17.90	22.90	19.30	14.90
COD	mg/L	97.00	134.00	140.00	81.00
AN	mg/L	0.73	0.85	1.00	0.44
TKN	mg/L	2.38	2.53	4.25	1.43
TN	mg/L	4.21	4.84	5.00	2.25
TP	mg/L	0.34	0.32	0.49	0.16
O&G	mg/L	2.00	4.00	NA	3.00
Zn	mg/L	0.19	0.34	0.43	0.21
Pb	µg/L	6.00	22.00	12.00	20.00
Cu	µg/L	28.00	37.00	42.00	28.00
Cr	µg/L	4.00	32.00	31.00	11.00
Ni	µg/L	10.00	17.00	30.00	15.00
Cd	µg/L	6.00	26.00	5.00	10.00

Source: Local stormwater studies conducted by DID in Malacca, Damansara, Penang and Kajang

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