Sustainable Urban Drainage Systems (SUDS)

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ABSTRACT

Sustainable Urban Drainage Systems (SUDS) are the recommended techniques towards solving three major problems in Malaysia which are flash flood, water scarcity and water pollution. Practically, most of our stormwater runoff especially in urban areas is catered by conventional drainage systems that carry runoff to the downstream by rapid disposal concept. In order to manage these three major problems, SUDS provide long term solutions to urban drainage management. Sustainable drainage is a concept that includes long term environmental and social factors in decisions about drainage. It takes account of the quantity and quality of runoff, and the amenity value of surface water in the urban environment. With the particular design and right combination of SUDS techniques, the systems will operate holistically. From the aspect of quantity control, these integrated designs become as a runoff controller and flood protector by attenuation of runoff flow by implementing for example grass swale, dry detention basins, ponds and etc. Besides, it also increases infiltration and indirectly contributes to conservation of groundwater resources. From the aspect of quality, with a treatment train, it will minimize the amount of pollution entering the downstream waterways. The SUDS systems will allows sedimentation, pollutant removal, and purification process which occur in the grass swale, bio-filtration basins, ponds, wetlands and etc. Finally, for the amenity aspect, the systems will blend the landscapes and surrounding areas to be more relax, rejuvenate, leisure and environmentally friendly.

In Malaysia condition, the implementation of the system is still in an early stage and we need to change our conventional thinking to balance the impact of urban drainage on flood control, quality management (pollution prevention) and amenity. Sustainable urban drainage provides a solution to this problem. Sustainable urban drainage systems offer control at source solution and we need to be conscious that the systems do not only solve the flash flood and water scarcity problems but also our water pollution problems. By implementing SUDS, Malaysia can avoid flash flood, water shortage (rainwater reuse) and water pollution in the near future.

This paper will describe Malaysian experience in handling the pilot project based on Malaysian manual known as Urban Stormwater Management Manual (MSMA) which is effective on 2001. This manual has been launched by Department of Irrigation and Drainage Malaysia, which is responsible for water resources in Malaysia. Basically the manual comprises all the Best Management Practices (BMPs) and SUDS techniques based on Malaysian condition. The construction of Bio-Ecological Drainage Systems (BIOECODS) at Engineering Campus, University Sains Malaysia (USM) as a pilot project for Malaysia, which is one of the research collaboration between DID and USM was completed end of the year 2002. BIOECODS offers an exemplary model for urban stormwater management under tropical climates. BIOECODS (Figure 1) consists of three components namely ecological swales (Type A, Type B and Type C) (Figure 2), biofiltration storage (Dryponds), and Ecological ponds (Wetpond, Detention Pond, Constructed Wetland, Wading River and Recreational Pond) (Figure 3).

Investigation of BIOECODS capability in order to manage stormwater runoff in the 320 acres catchments areas of the Engineering Campus has been conducted since the year 2003. This paper discusses the performance of BIOECODS recorded based on the latest data collected (Figure 4, Table 1, Table 2). On quantity and quality aspect, it has been proven that the systems can minimize changes to the hydrological characteristics of a catchments area, prevent the pollution from contaminating stormwater and promote the amenity value at USM Engineering Campus by natural mechanism such as infiltration, flow retardation, storage and purification before discharging stormwater to the downstream end which is Sungai Kerian. The results of the study indicate that BIOECODS can be a viable method for the water quantity and quality treatment of site runoff (Zakaria et. al. 2003, Ayub et al. 2005, Parkinson & Mark, 2005). Biodiversity at the site is also maintained as shown in Figure 5.

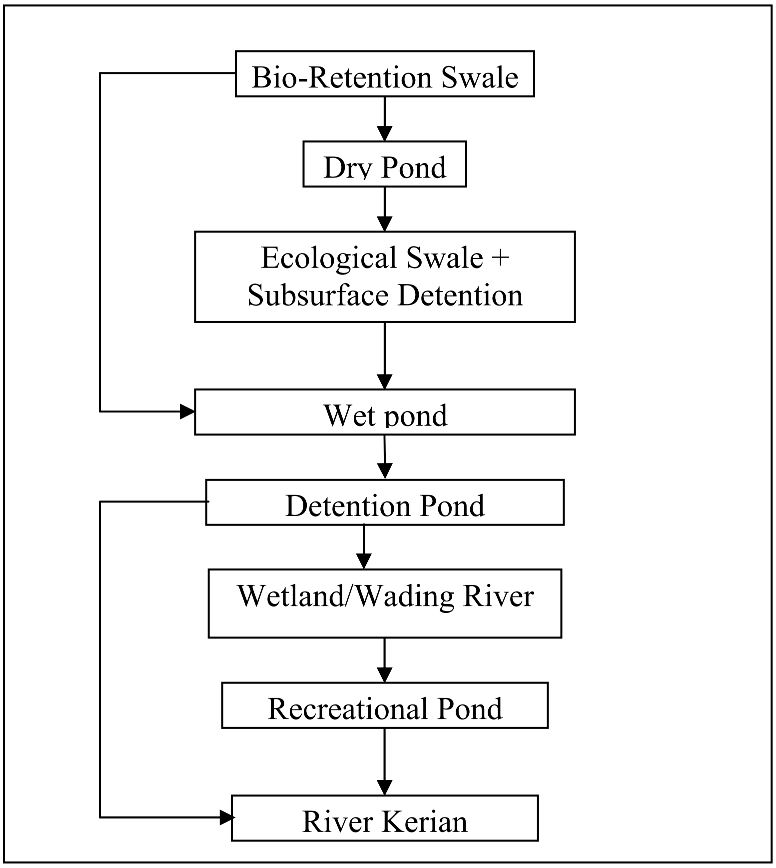

Figure 1 Schematic Diagram of BIOECODS

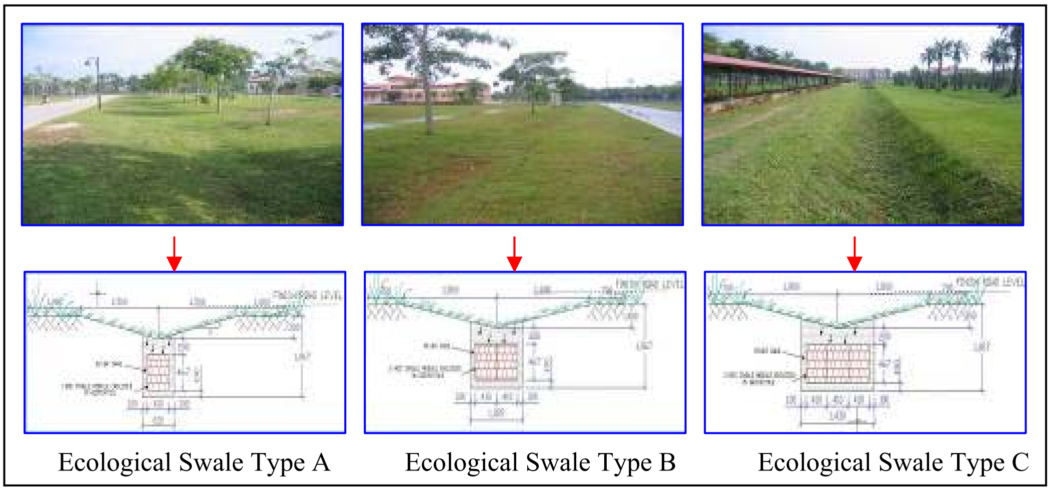

Figure 2 Bio-Ecological Swale Type A, Type B and Type C

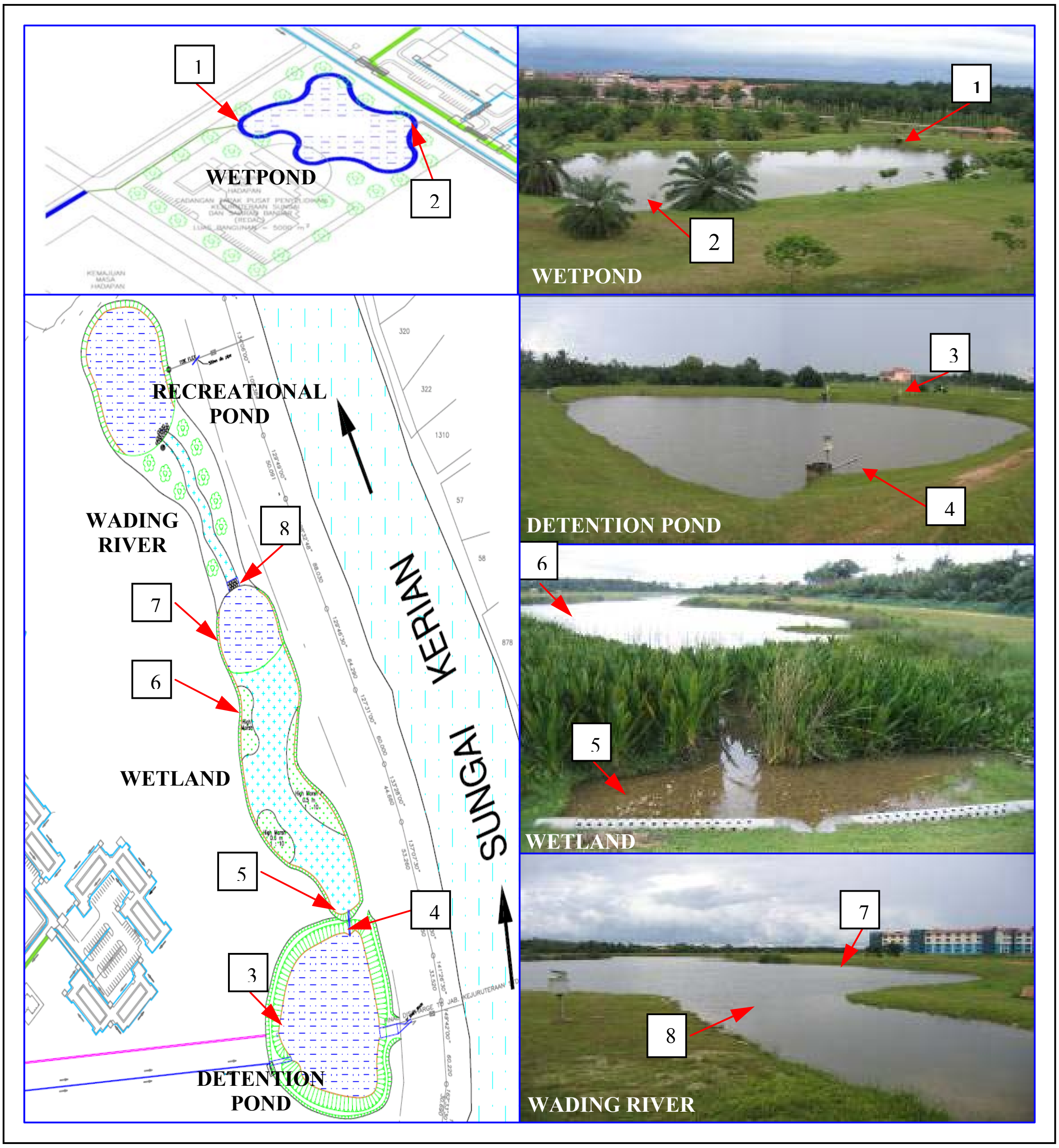

Figure 3 Samplings location at Wet pond, Detention Pond, Wetland and Wading River

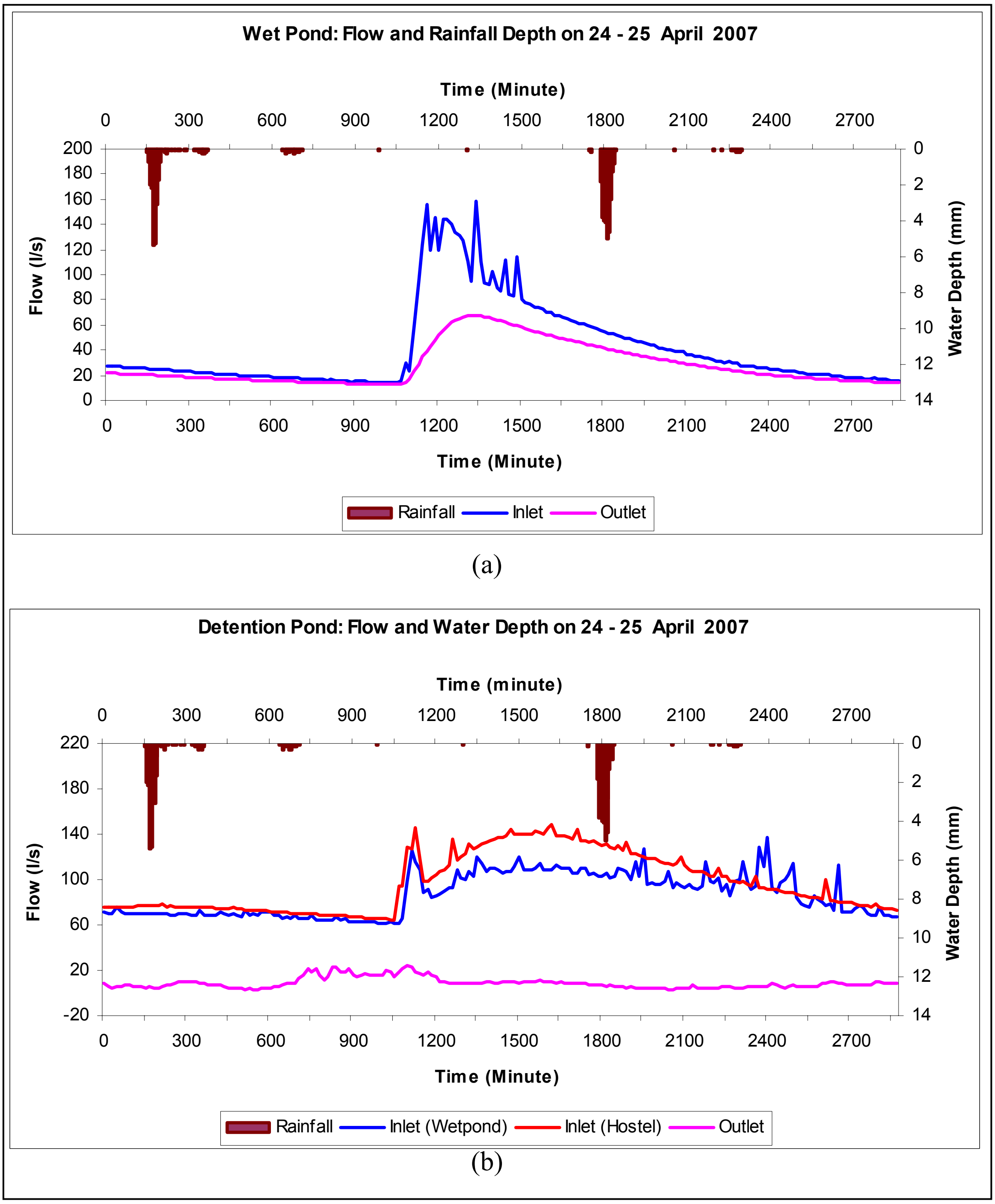

Figure 4 Examples of Recent Results on the Applicability of the Wetpond and Detention Pond in Peak Flow Attenuation

Figure 5 Biodiversity at BIOECODS

Table 1 Swale: 11 July 2006 (< 3 Month ARI)

Station	pH	DO (mg/L)	Temp. (^oC)	Turbidity (NTU)	BOD_5 (mg/L)	TSS (mg/L)	TP (mg/L)	COD (mg/L)	NH_3-N (mg/L)
GS4	7.0	6	23	18	2.25	0	0.4	12	0.2
GS6	7.3	7	25	19	1.69	0	0.1	2	0.2
GS7	7.1	6	24	9	0.69	0	0.2	18	0.1
GS10	9.4	6	22	11	1.47	0	0.2	46	0.1
GS9	6.9	6	21	9	1.4	0	0.2	24	0.2
GS8	6.5	6	22	20	0.28	0	0.3	18	0.6
Mean	7.4	6	23	14	1.3	0	0.2	20	0.2
Median	7.1	6	23	15	1.4	0	0.2	18	0.2
Standard Deviation	1.0	0	2	5	0.7	0	0.1	15	0.2
Class II B, WQI	**6 - 9**	**5 - 7**	**-**	**50**	**3**	**50**	**-**	**25**	**0.3**
Standard B, EQA 1974	**5.5 - 9**	**-**	**40**	**-**	**50**	**100**	**-**	**100**	**-**

Table 2 Ecological Pond: 15 March 2007 (< 1 Month ARI)

Station	pH	Temp. (^oC)	Turbidity (NTU)	BOD_5 (mg/L)	TSS (mg/L)	COD (mg/L)	NH_3-N (mg/L)
Inlet WP	6.9	25	56	5.6	0	4	0.4
Outlet WP	7.0	27	66	3.8	0	2	0.5
Inlet DP	7.0	28	47	11.39	0	76	0.4
Outlet DP	6.9	28	46	11.49	0	19	0.3
In. Wetland	6.8	29	22	2.5	0	2	0.3
High Marsh	6.8	28	16	11.37	0	2	0.0
Micro Pool	6.7	29	35	0.8	0	10	0.0
Out. Wetland	6.8	27	8	4.4	0	19	0.1
Mean	6.8	28	37	6.4	0	17	0.3
Median	6.8	28	41	5.0	0	7	0.3
Standard Deviation	0.1	1	20	4.4	0	25	0.2
Class II B, WQI	**6 - 9**	**-**	**50**	**3**	**50**	**25**	**0.3**
Standard B, EQA 1974	**5.5 - 9**	**40**	**-**	**50**	**100**	**100**	**-**

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