CHAPTER VII

SCENARIOS

In this chapter the Paya Indah wetland's integrated model for surface and subsurface flow interactions was used to predict and analyze hydrological and environmental impacts of four (major) different scenarios involving alternative drainage and development schemes leading to the formulation of a Water Management Plan for the Paya Indah wetland. Significant changes in surface water inflow due to land use and an increase in groundwater abstraction were incorporated to properly represent the field conditions. Watershed management scenarios that are likely might alter the quantity and timing of water exiting the Paya Indah Lakes system were simulated using the validated model as a baseline scenario (Figure 7.1) in order to evaluate their impacts on the watershed hydrology. Cyberjaya development Flagship zone phase I is included in the baseline scenario since it has been already initiated. The scenarios that were studied included:

(i) Cyberjaya Development Flagship Zone: Phase II

(ii) Cyberjaya Full Development and the E-Village

(iii) Removal of peat cover for development

(iv) Groundwater over-abstraction

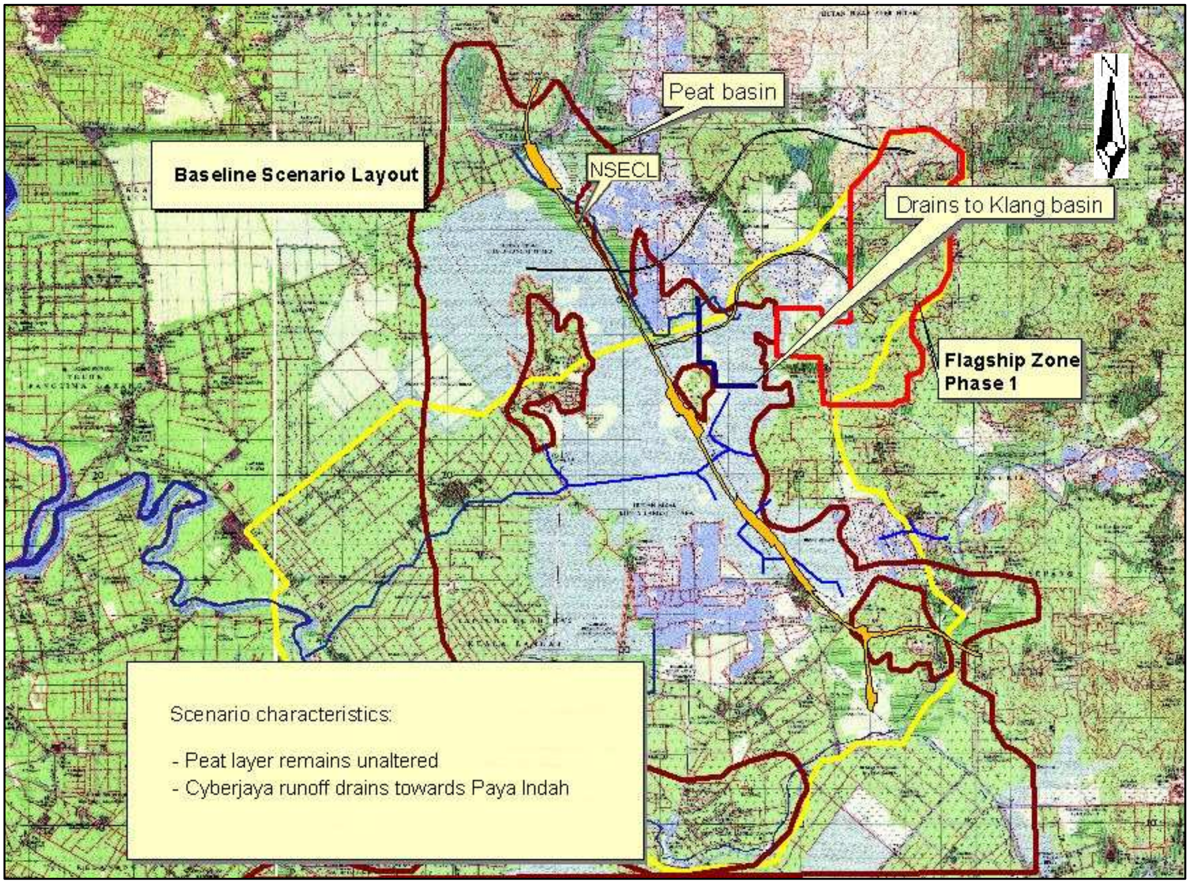

FIGURE 7.1
Layout of Baseline Scenario

7.1 CYBERJAYA DEVELOPMENT FLAGSHIP ZONE: PHASE II

In the flagship zone phase II the runoff is diverted to the new constructed canal which is located to the west of the zone. This canal drains north into the Klang River basin due to expansion in urbanization. This scenario requires reducing the permeability of the peat soil within the developed zone up to 1E-9 m/s in order to represent the permeability value that is applied to the compacted soil materials used in the developed areas within the modelled catchment. The layout of Phase II Development of Cyberjaya scenario and it associated impacts are highlighted in Figures 7.2 and 7.3 respectively. Only a very small portion of the peat basin is located within the phase 1 Flagship development. The development is located outside the catchment for Paya Indah. In all scenarios it was assumed that the North-South Expressway Central Link (NSECL) is impermeable. Hence, impacts on groundwater levels in the peat basin (i.e. the shallow aquifer) east of the highway might not be in a direct contact with areas on the western side of the highway. This scenario may result in dropping of groundwater table in the peat layer about 0.1 m to 0.5 m depending on how far the location is from the proposed development zone as illustrated in Figure 7.3.

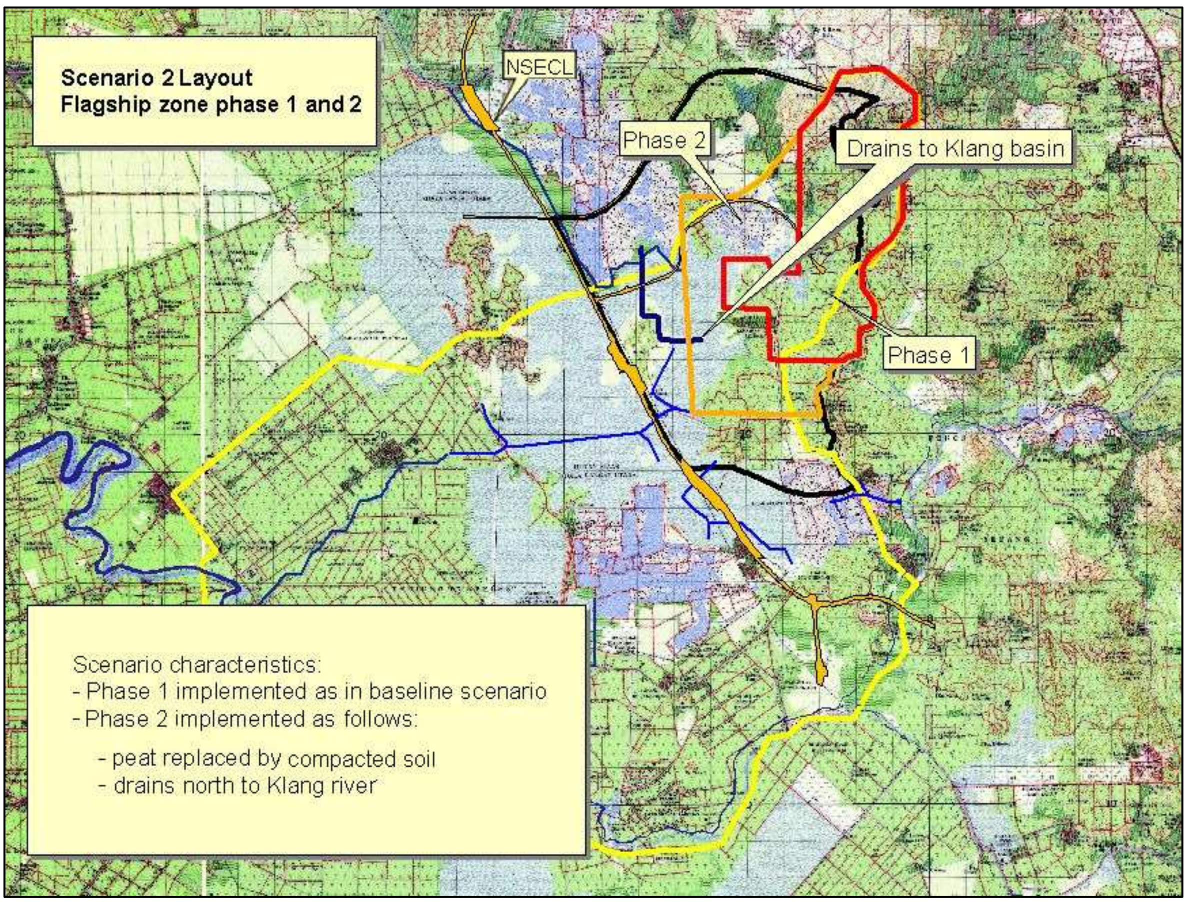

FIGURE 7.2
Layout of Phase II of Cyberjaya Development Scenario

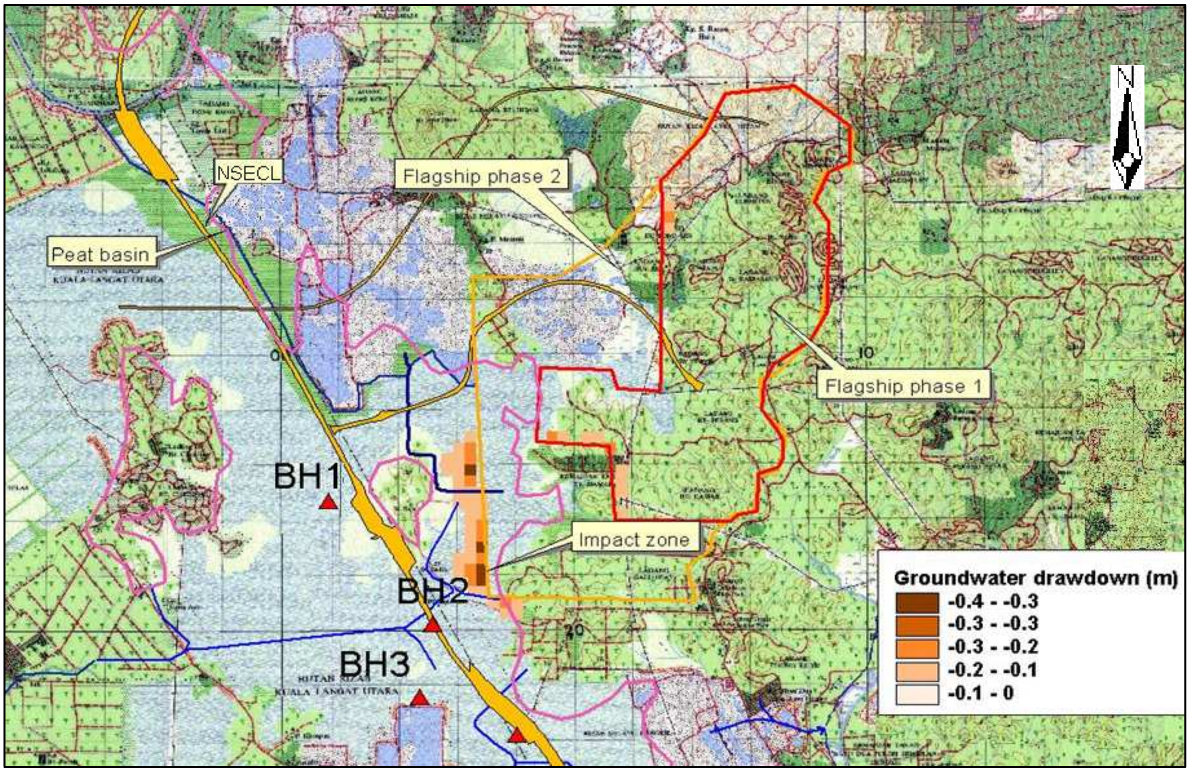

FIGURE 7.3
Impact of Phase II Development of Cyberjaya on the Groundwater Table in the Peat Layer

7.2 CYBERJAYA FULL DEVELOPMENT AND THE E-VILLAGE

In this scenario the urbanized area is further expanded and included the development of E-village, assuming depletion of the inflow from SWL1 as result of developing the new drainage channel. The channel was proposed mainly to mitigate the expected floods that might be generated simultaneously with the completion of the Cyberjaya development which requires diversion of the runoff water from Cyberjaya area towards the Klang River basin i.e. outside the Paya Indah catchment. Consequently there is an immediate drop in the surface water level ranging approximately between 0.2 m to 0.65 m compared to the current situation. Figures 7.4– 7.7 show the impact of this scenario on the water level of the Paya Indah lake system. Surprisingly, there was no any noticeable impact on the Tin-group lakes (i.e. Tin, driftwood, Perch and Marsh). Again this result evidenced that these lakes might receive some their recharge from the adjacent peat layer through Tin Lake. On the other hand, despite the considerable influence of the urbanization on surface runoff in both the wet and dry seasons, there is no noticeable impact on the groundwater level in the deep aquifer. However, the shallow groundwater in the peat layer tends to drop within the range of 0.05 m up to 0.5 m particularly along the North South Expressway Central Link (NSECL), the Outlet drainage canal, and east of the Paya Indah lakes system (Figure 7.8).

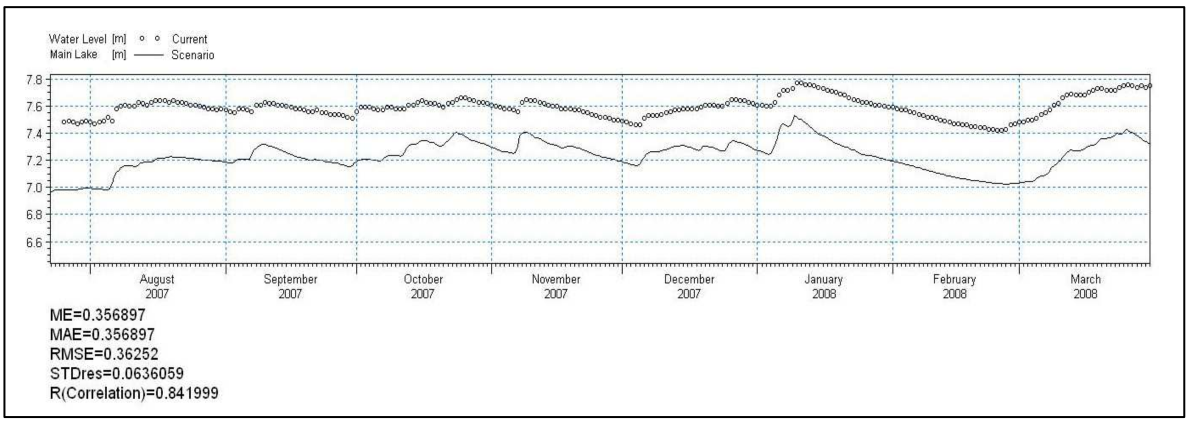

FIGURE 7.4
Effect of Depletion of the Inflow from Cyberjaya on Main Lake

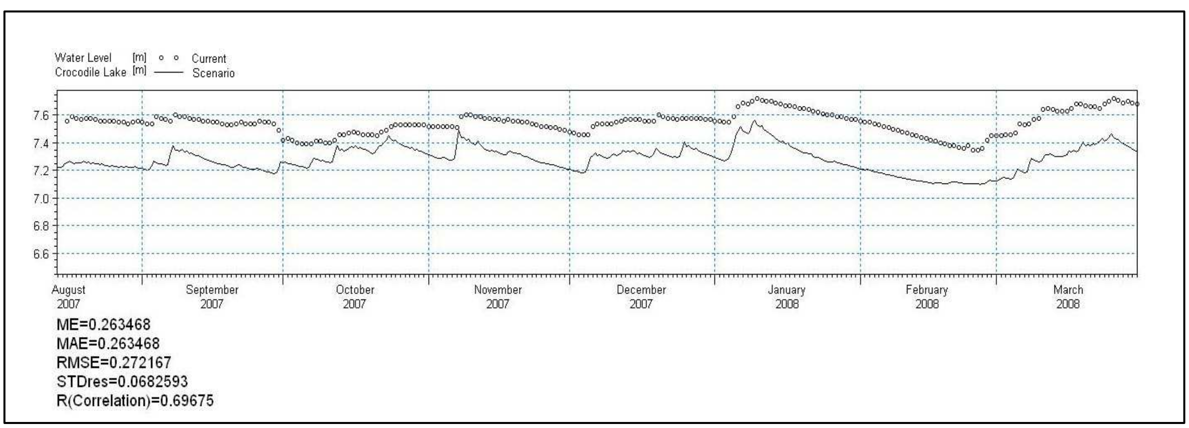

FIGURE 7.5
Effect of Depletion of the Inflow from Cyberjaya on Crocodile Lake

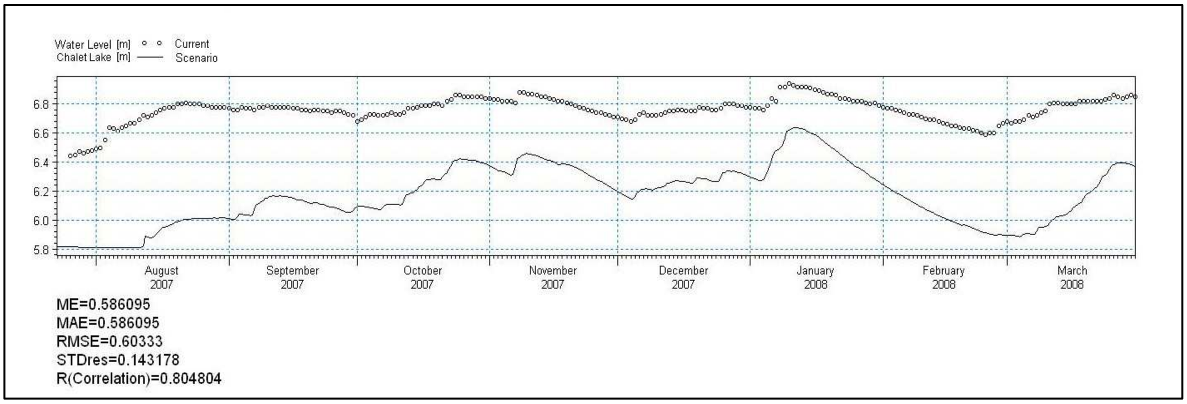

FIGURE 7.6
Effect of Depletion of the Inflow from Cyberjaya on Chalet Lake

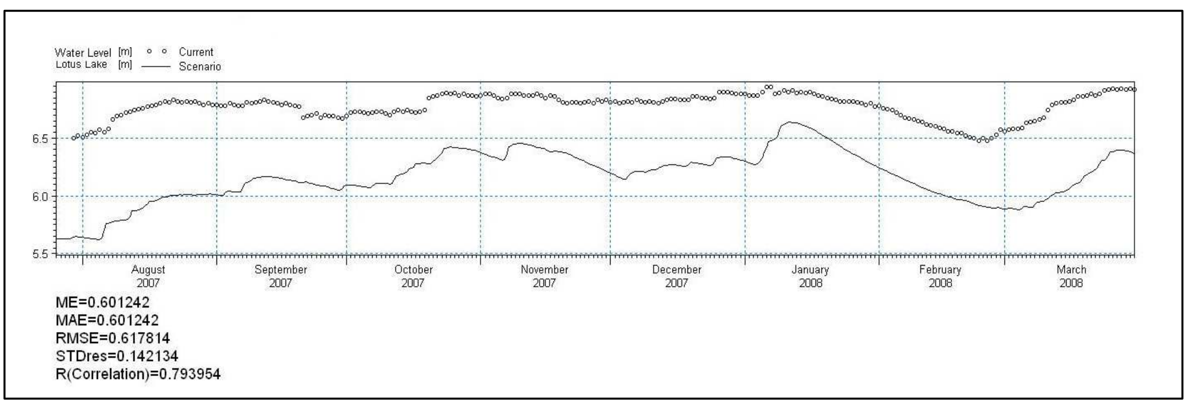

FIGURE 7.7
Effect of Depletion of the Inflow from Cyberjaya on Lotus Lake

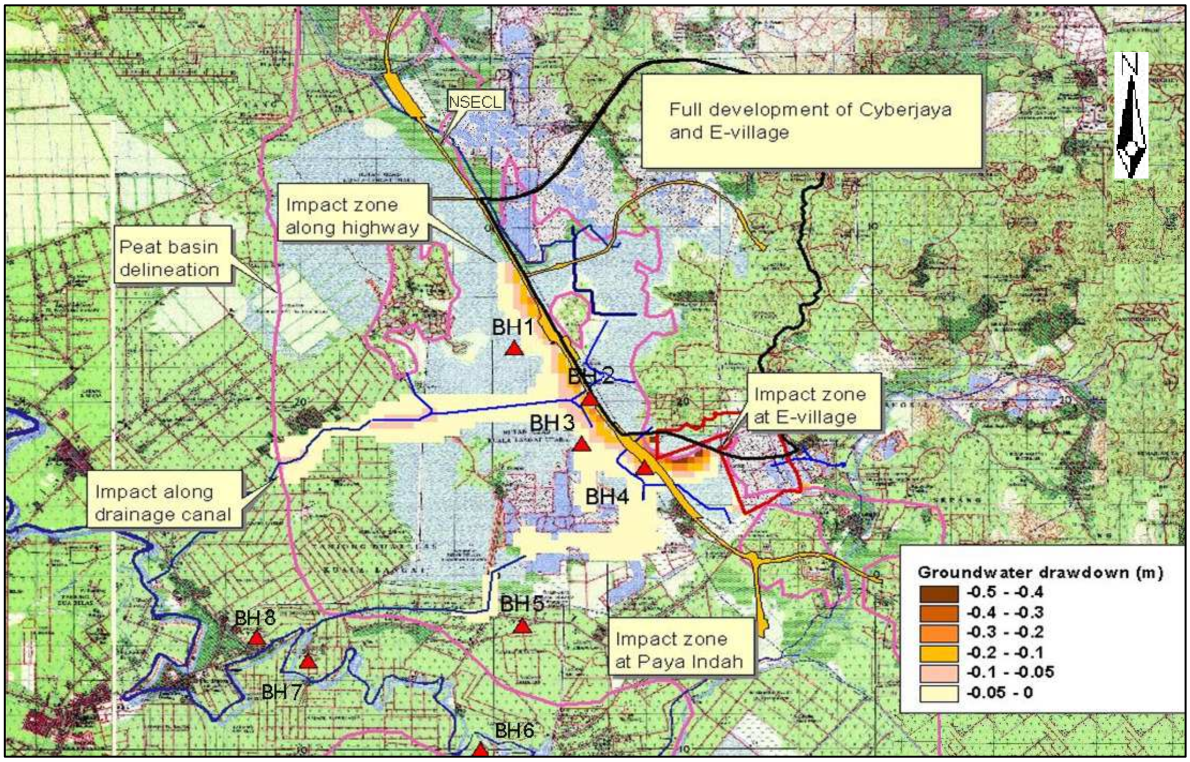

FIGURE 7.8
Impacts of Cyberjaya and E-village Full Development on the Groundwater Table in the Peat Layer

7.3 REPLACEMENT OF PEAT LAYER

This scenario represents the general tendency to develop all the area occupied by peat into residential area. If this happened then a process of replacement of the whole peat layer will take place then followed by a process of placing a low permeability soil material if not compacted. Despite being happened within a narrow zone, in fact this scenario typically had happened during the construction of the NSECL Highway which divides the catchment into two halves (Omar et al., 1999). The process was required removing a six-meter layer thick of peat along the proposed zone of the highway then followed by refilling of a very low permeability soil. Figure 7.9 outlined the scenario and extent and depth of the peat.

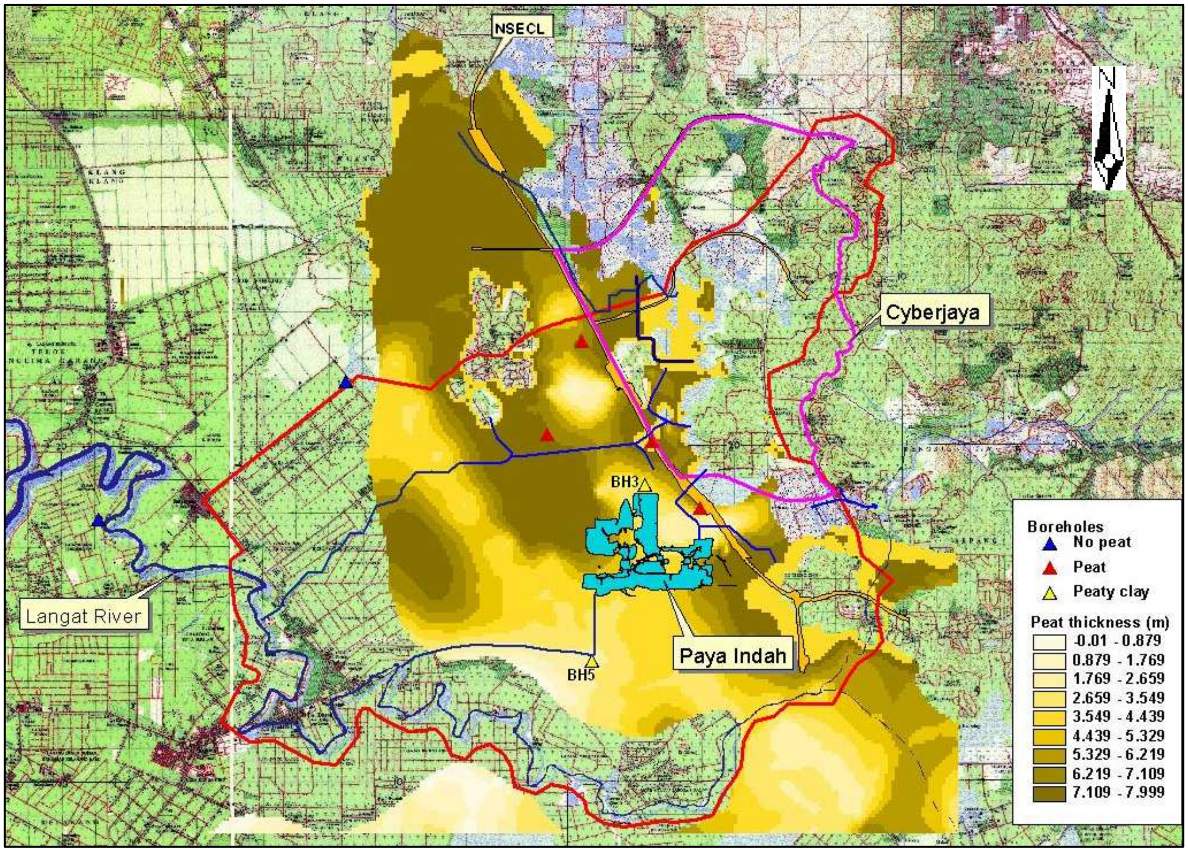

FIGURE 7.9
Layout of the Peat Basin

With the exception of the Tin Lake (Figure 7.10), it seems that this scenario has insignificant impacts on the whole lake system. Despite the relatively small drop of about 0.10 m in the water level of the Tin Lake, the result itself provided another evidence of a development of lateral flow between the Tin Lake and the adjacent peat layer. Conversely, the groundwater head in the deep aquifer has dropped dramatically to an average level of ~1.5 m (Figures 7.11 – 7.12). The result of this scenario is in consistent with the arguments made in Chapter 6 of this thesis, in that at certain conditions peat layer can recharge the deep aquifer.

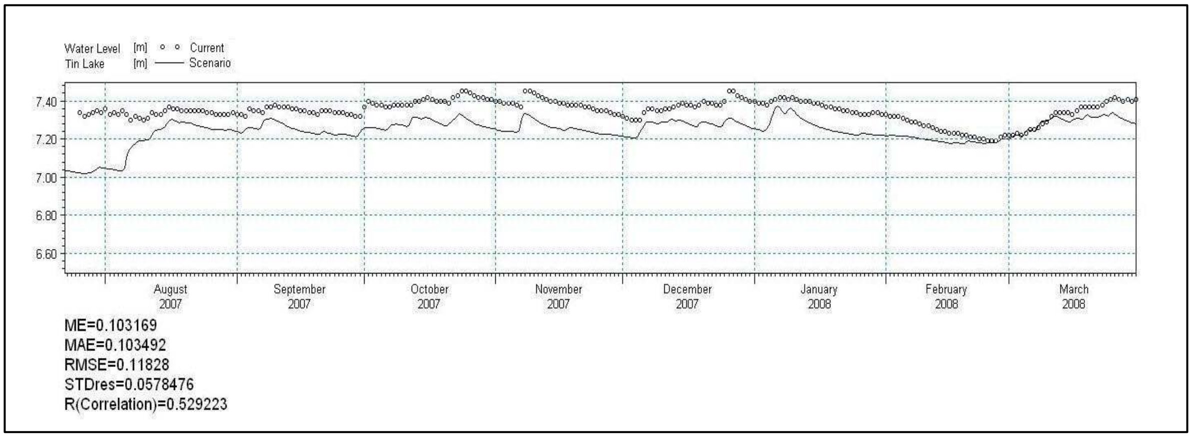

FIGURE 7.10
Effect of Replacement of the Peat Layer by a Low Permeability Soil Material on Tin Lake

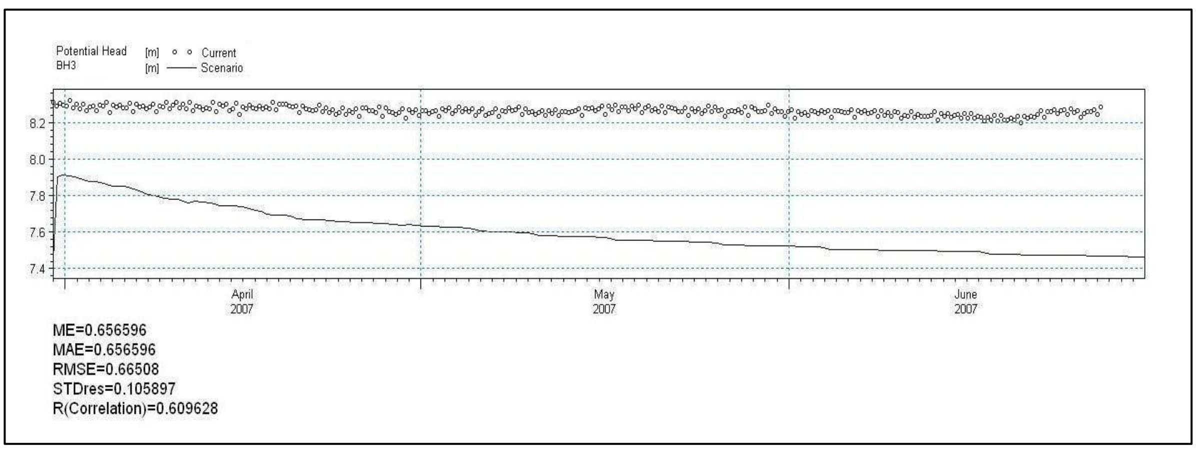

FIGURE 7.11
Effect of Replacement of the Peat Layer by a Low Permeability Soil Material on BH3

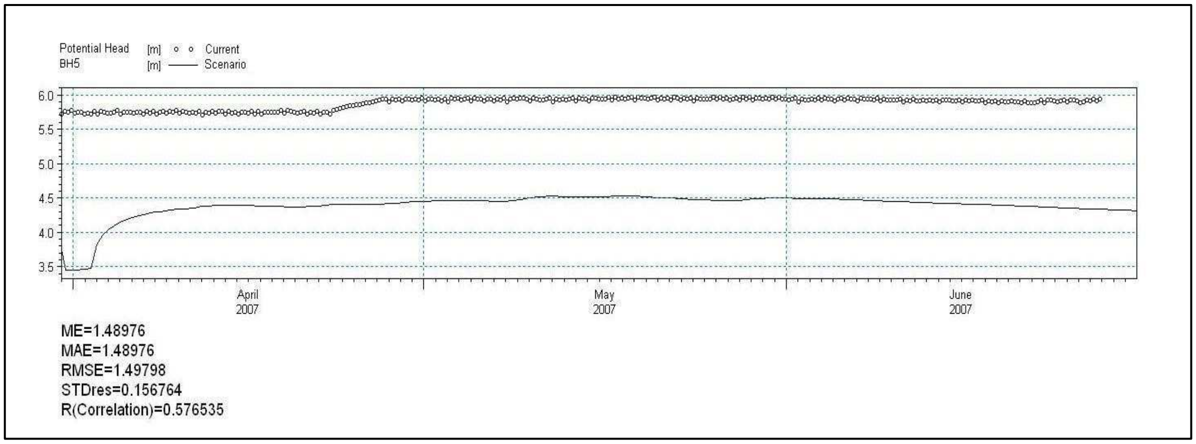

FIGURE 7.12
Effect of Replacement of the Peat Layer by a Low Permeability Soil Material on BH5

7.4 GROUNDWATER OVER- ABSTRACTION

Based on the discussion stated in Chapters 6.2 and 6.3 of this thesis, several Sub-scenarios for groundwater abstraction were simulated to assess the subsequent impacts on the catchment hydrology. These scenarios include:

(i) pumping of 35000 m^3/day

(ii) pumping of 39000 m^3/day

(iii) pumping of 40000 m^3/day

(iv) pumping of 46000 m^3/day

(v) pumping of 70000 m^3/day

Results are presented in Table 7.1. During all the scenarios the groundwater table drop range between around 0.0 m to -3.0 m with reference to the sea level. This range coincides with the groundwater level in the baseline scenario which in turn, indicates that present condition is within the critical zone of the pumping impact. The results show the groundwater depleted completely in the well when pumping rate was assigned for $3.5X10^4$ m^3/day which represent 21.56 % of the aquifer storage of ~ 162,333 m^3/day (Table 6.1). Accordingly, any increase in the abstraction beyond this value, enhances the pre-possessor to reduce (adjust) the abstracted volume.

TABLE 7.1
Impacts of Groundwater Over-abstraction Scenarios

Pumping Rate Scenario (m^3/day)	**Impacts**	
	Aquifer	**Groundwater Table**
$3.5X10^4$	Specified extractable volume is equal to the applied volume during the simulation.	Drops ~ 4 m b.s.l. at BH7 and 0.0m b.s.l. BH6
$3.9X10^4$	Groundwater abstractions were switched off due to drying filters. Accordingly the total extractable volume has been reduced by 1.1%	-ditto-
$4.0X10^4$	Groundwater abstractions were switched off due to drying filters. Accordingly the total extractable volume has been reduced by 4.87%	-ditto-
$4.6X10^4$	Groundwater abstractions were switched off due to drying filters. Accordingly the total extractable volume has been reduced by 18.6%	-ditto-
$7.0X10^4$	Groundwater abstractions were switched off due to drying filters. Accordingly the total extractable volume has been reduced by 50.6%	-ditto-