1. Development of Temporal Pattern of Urban Areas and PMP Derivation for Malaysia (May 2004 – December 2006)

Objectives of Project:

- To determine missing short term rainfall intensities and reconstruct in complete data for design of urban drainage systems.
- To construct spatial and temporal distribution of short term rainfall data for designing of urban drainage control.
- To develop Probable Maximum Precipitation (PMP) map for Peninsular Malaysia for designing water related structures.

Conclusions and Recommendations of the Study:
The overall project outputs are typically useful for practicing engineers and researchers in the realm of rainfall in the humid tropics. Heavy investment is actually needed to construct water storages and theirs safety must not be compromised and ensured by proper hydrological design. Understanding of shortterm rainfall in the tropical region is of paramount importance in enhancing capability of rainfall forecasting associated with flash floods. In this regard a continuous long term strategy for urban rainfall data collection needs to be established. There is a need to continue the PMP study involving longer than duration of one day. The embedded large scale monsoons system accompanied by prolonged wet period have to be assessed accurately especially to ensure safety of major dam structures.

The PMP study was largely undertaken with a foreign expert who has done an extensive work in this area and as such it demonstrated a successful scientific collaborative effort. Nevertheless, the outputs are most relevant for other countries in the humid tropics region.

2. Detailed Hydrological Balance Study of Paya Indah Wetlands, Selangor (July 2005 – July 2008)

Objectives of Study:

- To identify and detail the hydrological and climatologically factors controlling the wetlands.
- To establish baseline parameters and conditions against future developmental variance in the wetlands.

Summary and Conclusions of the Study
Local-scaled integrated surface water and groundwater models were developed for the Paya Indah Wetland (PIW) using MIKE SHE and MIKE II. A comparison of simulated and observed instantaneous water level for both surface water and groundwater was performed successfully. Total water balances were computed for the Paya Indah Wetland catchment. The model results were used to perform and quantify the hydrologic effects of various land-use change and groundwater over-extraction scenario.

Limitations of the models arise from the inherent limitations of numerical modeling codes, the lack of detailed input and calibration data, inaccuracies associated with available data. The models and modeling results will be utilized by the department of Irrigation and Drainage (DID) and Paya Indah Wetland officials as part of a Baseline Data Report and subsequent update to the PIW General Plan. Additionally, the models will be continuously

refined as new data become available and new questions arise, and the new models will be used as a tool for evaluating the effects of proposed development projects within and/or adjacent to the catchment and for the preparation of Environmental Impact assessment reports if necessary.

Annual water balances errors for both calibration and validation periods were less than 1%. The seasonal eater balance proved that the model was able to simulate all the hydrological processes (ET, base flow, recharge and surface runoff) adequately. ET loss is higher than other components representing some 65% and 58% of the PPT for the calibration and validation periods respectively. The maximum ET was obtained in the months of May, June, July and August.

Launching the flood mitigation new channel that diverts Cyberjaya water toward Klang River Basin and depletion/vanishing of the North-Inlet-Canal inflow are among the expected impacts of the full development of Cyberjaya. Consequently the water level at the Paya Indah lakes drop some 0.2 to 0.65m.

To sustain the water level of the Paya Indah lakes system, it is necessary to store an additional water volume at the Kuala Langat Swamp Forest by activating or reconstructing the controlled gates along the South-Inlet-Canal which flows across the Kuala Langat Swamp Forest.

Groundwater abstraction is one of the sensitive parameters for the PIW model. Assigning pumping at a rate of 23000 m3/day during calibration and validation periods, gives wellbalance model i.e. Total error percentage is 0.45% and 0.21% for calibration and validation process respectively. While as pumping at the rate of 15,551.65 m3/day produced relatively imbalance model i.e. 1.1% of the rainfall. The results revealed that the deep aquifer might deplete partially or totally depending on the withdrawn quantity.

3. Development of Runoff Generation and Catchment Responses in Forested and Agricultural Sites

(December 2004 – December 2007)

Objectives of Projects:

- To establish time of concentration values for forested and agricultural catchments.
- To determine hydrological coefficients and runoff contributing processes to improve hydrological modeling.
- To validate the spatial effects of rainfall in time of concentration using isotope technique

Summary and Conclusions of the Study

The study aims to quantify runoff generation processes and catchment response in forested and agriculture sites. The findings are crucial to support sustainable plantation which include for the protection of water resources and control of downstream flooding and sedimentation. Detailed hydrological processes and responses in the upstream catchment are still lacking for reliable stream flow modeling.

The study was undertaken at Sedenak oil palm catchments which are under the management of Kulim plantation. The assessment of hydrological properties involved three catchments, namely C1 (newly planted), C2 (young oil palm) and, C3 (matured oil palm). The catchments were intensively monitored for the measurements of rainfall, water level, stream discharge, through fall, stream flow, soil moisture, microclimate and collection of storm water samples for isotopes and chemical analysis.

The following are findings generated from this study:

a. On an evenly basis, base flow contributes between 65% and 74% of the total flow. Storm flow and peak flow were strongly correlated with rainfall.
b. The trash hold rainfalls that produce storm flow are very similar in all the three catchments, between 14.4mm and 14.9mm
c. Evapo-transpiration (ET) values estimated by Penman, Penman-Monteith and Short Period Water Balance show comparable trend and magnitudes whilst the Blaney-Criddle gives relatively high values.
d. Study revealed that the Bransdby-William, rational and DID formulae generated the closest estimates to the observed time of concentration (tc) values (graphical method). New approach to estimate tc using radioisotope tracer (technetium-99m) method, and reveled and acceptable agreement of tc values.
e. The through fall and stream flow coefficient were worked out as 1509.8 mm (53%) and 55.7mm (1.96%) of gross rainfall and about 1282.93 mm or 45%was intercepted by oil palm and lost the atmosphere.
f. The finding of average traveling time was about 4-10 hours for water from the surface to 1.1, 1.5, and 1.6 m for BH1, BH2 and BH3, respectively. The soil water content percentage changes range from 9.5 –23.8% increment at these particular depths. The resistivity imaging surveys has been successfully used in this study to map the soil water content underneath the oil palm catchment up to 6 m depth.

4. Research and Development of Runoff Characteristics to Validate MASMA
   (Dec 2004 –Dec 2007)

Objectives of Study:

The proposed research is to development of urban runoff characteristics and to validate

Rainfall-Runoff charts in the Manual Saliran Mesra Alam (MASMA DID 2002).
The objectives are :

- To define statistical relationship between rainfall and runoff from each sub catchments based on the MSMA (DID, 2002) classified land issue.
- To determine rainfall-runoff coefficient.
- To determine between rainfall intensity and runoff.
- To validate the design chart for rainfallrunoff for Malaysia conditions and not based on Australian data set.

Introduction

The Urban Stormwater management Manual for Malaysia (MSMA) has been commissioned by DID. Urban stormwater management, simply stated, is everything done within a catchment to remedy existing stormwater problems and to prevent the occurrence of new problems (Walesh, 1989). It involves the development and implementation of a combination of structural and non-structural measures to reconcile the conveyance and storage function of stormwater systems with the space and related needs of an expanding urban population. It also involves the development and implementation of a range of best Management Practice (BMPs) to improve the quality of urban stormwater runoff prior to its discharge to receiving waters. The goals of this Manual are to provide guidance to all regulators, planners and designers who are involved in stormwater management. It identifies new direction for stormwater management in urban areas in Malaysia.

Conclusion of the Study

A study has been conducted to determine rainfall- runoff coefficients for urban catchment in Sg. Kerayong Catchment, Kuala Lumpur. Kg. Cheras Baru and Taman Miharja observation station (rainfall and flow), have been chosen as the experimental sub-catchments and the data have been collected by DID since 1997.

From the rainfall runoff observed data, the runoff coefficient, C and the losses from the rainfall events had been determined. The average runoff coefficient, C value obtained for both catchments is 0.7 or is 3.5% less than extrapolated value obtained from the study done by Ruzardi et al. (1999). The initial result from this research will be very useful for further research as indication criteria.