



LATEST DEVELOPMENT ON ECO-POND CONSTRUCTION

The ecological pond system comprising of wet pond, detention pond, wetland, wading river and recreational pond represents the second phase of development of the Bio-Ecological Drainage System or BIOECODS at USM Engineering Campus, Nibong Tebal, Penang. The ecological pond system acts as a quantity control and treatment train for quality control due to the engineering campus development.

Wet pond and detention pond were designed for water quantity control. The wet pond covers an area of 4500 m² with a volume of 5000 m³. It was designed to cater 10 years ARI flow of 3.53 m³/s, whereas the detention pond covers an area of 10 000 m² with a volume of 18 000 m³. It was designed to cater flow for 10 to 50 years ARI.

For water quality control purpose, the flow for 3 month ARI will be directed to the constructed wetland with 155 m length and 60 m width. The wetland covers an area of 9110 m² with two zones of low and high marsh and is planted with six species.

The wading river is a meandering stream with 100 m length with its bed made up of sand and very coarse gravels. The river has a trapezoidal cross section with a top width of 25m and can cater flow up to 25 m³/s. It will also be used as a research station for river morphological study.

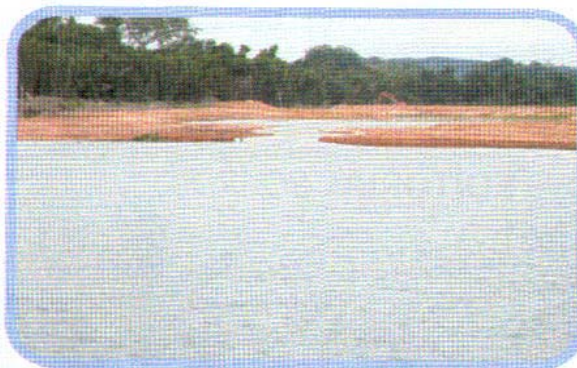
The final discharge of the BIOECODS will be a "Crystal Clear Blue Water Lake". This man-made lake covering an area of 8000 m² with 1.1m depth will be used for recreational activities such as canoeing and fishing. The construction of the ecological pond system is expected to be completed by December 2002.



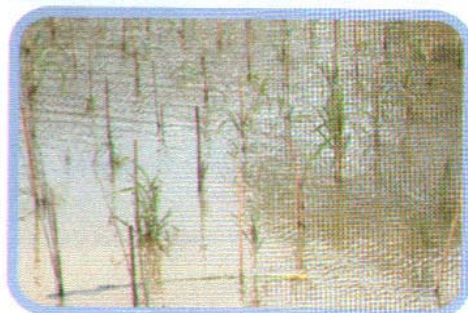
wetland



wading river



crystal clear blue water lake



wetland plants



wet pond

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By Associate Prof Dr Nor Azazi Zakaria, REDAC Director

This issue of REDAC bulletin focuses on the Research, Development and Consultancy works that REDAC has involved since 1997. A summary of each completed project is given highlighting the work carried out. The funders of the projects include the Ministry of Science, Technology and the Environment (MOSTE) through its Intensification of Research in Priority Areas (IRPA) grants, Department of Irrigation and Drainage (DID), Seberang Perai Municipal Council (MPSP), Contractors and University Technology Petronas (UTP). REDAC has received RM6 million for the last five years to conduct research and consultancy.

The completed research includes projects on Sediment Transport in Rivers, Sustainable Urban Drainage Systems (SUDS) using infiltration engineering systems at USM Perak Branch Campus, experimental works on the modular component of Bio-Ecological Drainage System (BIOECODS), pump modeling, and Environmental Management Plan (EMP) for the development of University Technology Petronas Campus at Tronoh, Perak.

Besides research and development projects, REDAC expertise is also sought for consultancy works including feasibility study on flood mitigation and drainage improvements in Seberang Perai areas by the MPSP and DID, Penang. These works include drainage upgrading, and design of pump house and tidal gate.

During the past six months (January - June 2002), the pilot project on BIOECODS receives several visitors from local and international institutions highlighting the significant contribution from this pilot project on the Sustainable Development in Urban Areas covering the environmental aspects such as zero flash flood and water contamination, and rainwater harvesting. REDAC is expecting several international visits in August 2002 to BIOECODS project confirming its status as "World Class Research Programme" certified by the USM Vice Chancellor's Advisory Committee in November 2001. The project also receives Silver Medal Award during the I-TEX 2002 (International Invention, Innovation, Industrial Design and Technology Exhibition) held in Kuala Lumpur on 29-31 March 2002. The model exhibited in I-TEX 2002 was subsequently handed over to National Science Centre, Kuala Lumpur on 1st July 2002 for educational purpose.

REDAC continues to receive new funding including the 8th Malaysia Plan's IRPA grants amounting to RM600,000.00 for research on River Engineering and Urban Drainage. Through its connection with international research institution, REDAC is expecting to receive funding from international funders in the near future. Finally, I would welcome any joint research with local and international research institution and agencies within the research scope of REDAC namely River Management, Stormwater Management, Hydroinformatics and Environmental Management.

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Kampar River @ Kg. Jahang, Gopeng

Awards & Honours



Silver Medal (BIOECODS)

I.TEX 2002

International Invention, Innovation, Industrial Design & Technology Exhibition 2002

Date : 29 to 31 March 2002

Venue : Hall 2, Mid-Valley Exhibition Centre,
Kuala Lumpur, Malaysia

BIOECODS Model Hand Over Ceremony TO NATIONAL SCIENCE CENTRE, KUALA LUMPUR

1st JULY 2002



Exco Member 2002/2004

MALAYSIAN NATIONAL COMMITTEE
ON IRRIGATION AND DRAINAGE (MANCID)

Project Title : The Development of HEC-Series Programme To Predict Sediment Movement for Rivers in Malaysia
Funder : Ministry of Science, Technology and the Environment (IRPA 08-02-05-6006)
Project Period : April 1997 to March 2001

The objectives of the study are:

- To evaluate the applicability of HEC-6 programme to predict sediment transport rates and flood levels for rivers in Malaysia
- To appraise the existing sediment transport equations
- To develop sediment transport equations for rivers in Malaysia
- To develop flood risk map (Pari River, Ipoh)

Four rivers were selected as study sites namely Pari River (Ipoh), Kerayong River (Kuala Lumpur), Kulim River (Kulim) and Malacca River (Malacca City). Total bed material loads were collected from these rivers. The appraisals of the existing sediment transport equations show that Yang, Ackers & White and Graf equations are suitable for the prediction of sediment transports in these rivers. A number of equations were also developed for the prediction of sediment transport rates using the collected sediment transport data especially for low to medium flows. Further data collection for high flows are being carried out.

During the study period, a 50-year flood occurred at Pari River on the 19th November 1997 causing structural damages to the rigid bank walls on both sides of the river especially at bends.

Subsequently, the flood hydrograph was used to calibrate the HEC-6 model to predict the recorded flood water levels. A good agreement was found between the predicted and observed water levels using Yang equation.

Another model namely, FLUVIAL-12 was also used to predict the erosion and deposition trends during the flood. The calibration results using Yang and Graf equations show that the FLUVIAL-12 model could well predict the observed erosion and deposition patterns along the river including at the bends. The results from the calibration of HEC-6 and FLUVIAL-12 models were then used for the rehabilitation work of Pari River.

A flood risk map was also developed for Pari River to represent the effect of the flood event by developing an ArcView GIS extension namely AVHEC-6.AVX integrating the HEC-6 model within GIS environment. The extension has the capability of analyzing the computed water surface profiles generated from HEC-6 model and producing a related flood map for Pari River in the ArcView GIS.

The study was conducted by ten postgraduate students (3 PhD, 7 MSc) and 20 papers have been presented at national and international conferences. Three journal papers are being reviewed for possible publications in international journals.



1997 Flood @ Pari River



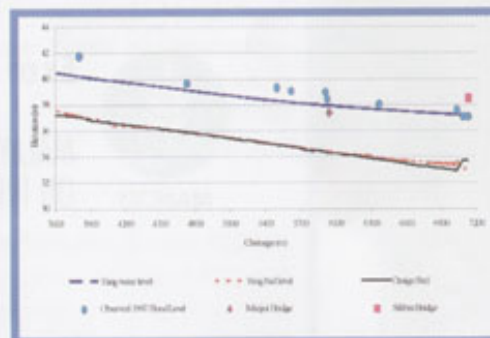
River Improvement



Flood Map



Sand Dredging



HEC-6 Modelling



Sand Dredging

Project Title: Peak Flow Attenuation Using Infiltration Engineering Systems and Storage Tank At Universiti Sains Malaysia, Perak Branch Campus
Funder: Department of Irrigation and Drainage (DID)
Duration: 1 Dec 1998 to 31 Dec 2000



This final draft report presents the concept and results for subsurface infiltration and storage tank systems which were used to control stormwater quantity in Engineering Campus, Universiti Sains Malaysia, Tronoh, Perak.

The purposes of this study are:

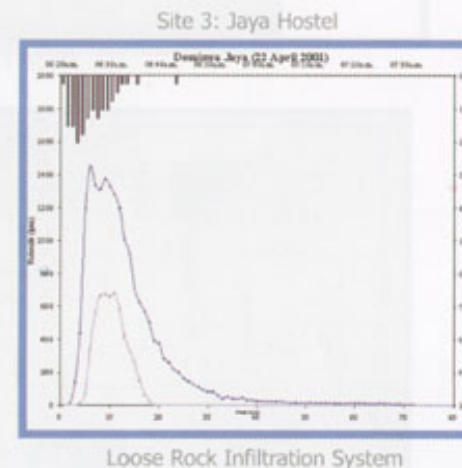
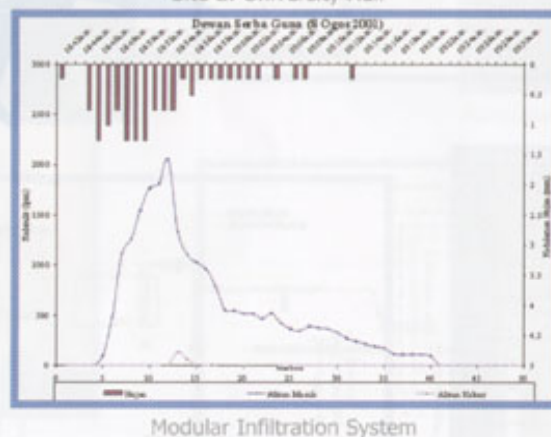
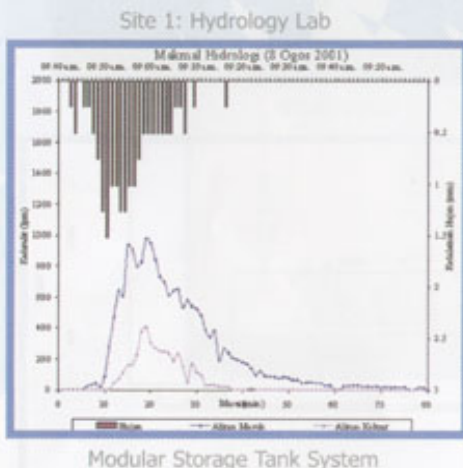
- As a pilot research for Malaysian application
- To study the efficiency of subsurface infiltration and storage tank to attenuate stormwater runoff
- To study the effectiveness and efficiency of infiltration and storage tank technique to reduce flood woes in Malaysia
- To analyses cost benefit of the systems
- To provide a sustainable environment for urban communities

Three different infiltration and storage techniques have been selected based on the surrounding soil conditions and were constructed at threesites. These systems are modular infiltration system, loose rock infiltration system and modular storage tank system.

Data acquisition has been carried out into two stages from July 2000 to March 2001 (Stage I) and from April 2001 to September 2001 (Stage II). Stage II was executed after few modifications have been done to improve system efficiency. Around 50 rainfall events were recorded and analyzed.

Accompanied with this report, a guideline on infiltration and storage tank design for Malaysian application has been drafted.

Site 2: University Hall

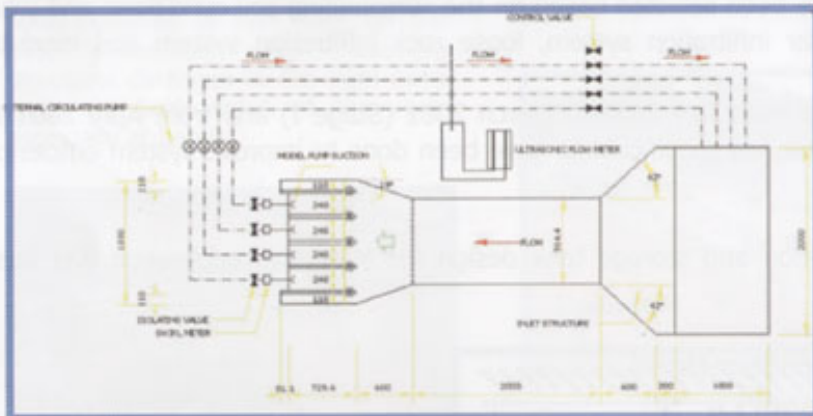


Project Title : Pump Modeling for Proposed Flood Mitigation and Pump House Construction at Taman Chai Leng, Perai, Penang.
Client : Oristan Engineering Sdn. Bhd.
Duration : 1 August 1999 - 31 Dec 1999

This report covers the testing program undertaken in designing pump sump for Taman Chai Leng Flood Mitigation in Seberang Perai Tengah, Penang. The operations of four pumps on the 1/10th scale physical model for the proposed pumping station were tested in Hydrology/Hydraulics Laboratory at Universiti Sains Malaysia, Perak Branch Campus, Seri Iskandar.

The purposes of hydraulic model test are to identify:

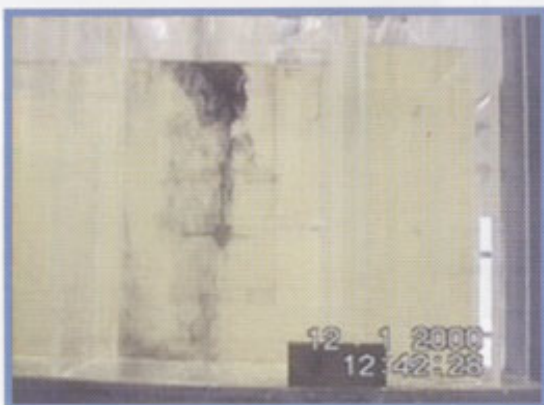
1. Surfaces vortices that may draw air from free surfaces into the pump, causing unbalanced loading of the impeller, periodic vibrator and reduction in pump capacity.
2. Subsurface vortices, which may emanate from the floor, side or back walls, or both, entering the pump, causing vibration and cavitation.
3. Pre-rotation of flow entering the pump which will change the attached angle of the impeller blades from the design value and may affect pump efficiency and cause cavitation.
4. An uneven distribution of flow at the pump throat which may cause vibration and cavitation.
5. Separation of flow from the pump suction bell surface extending to the throat which may cause a non-uniform flow field at the impeller and also the possibility of cavitation.



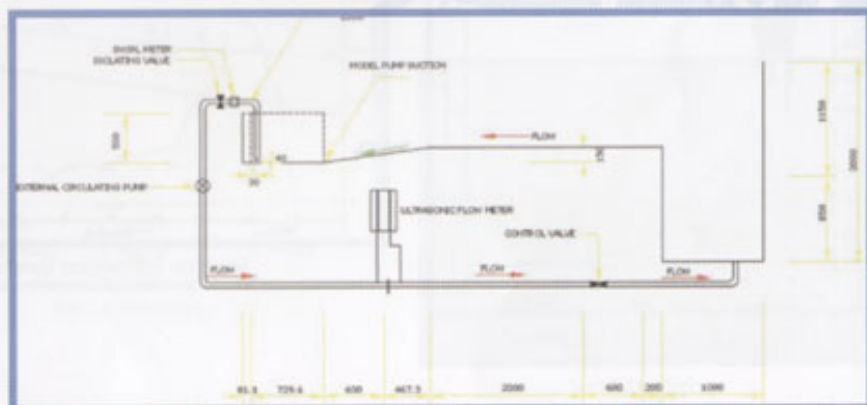
Model Plan



Pump Sump



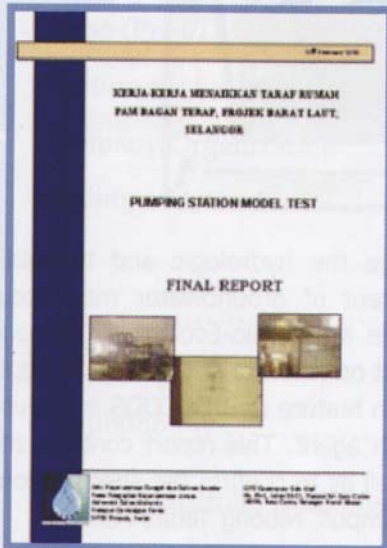
Subsurface Vortices



Model Side View

Project Title : **Pump Modeling for Proposed Pump House Construction at Bagan Terap, Selangor**
 Funder : **GTS Contractor Sdn. Bhd.**
 Project Period : **01 September 1999 - 30 November 1999**

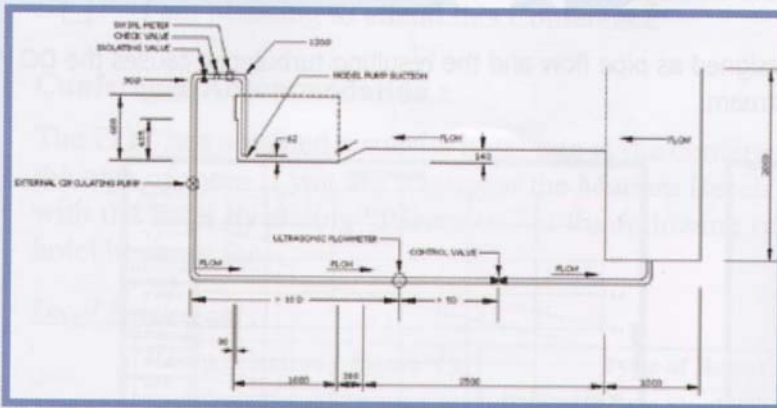
This report covers the testing program undertaken in designing inlet structure or pump sump improvements for the Bagan Terap Pump House, Sg. Besar, Selangor. The operations of four pumps on the 1/10th scale physical model for the proposed pumping station were tested in Hydrology/Hydraulics Laboratory at Universiti Sains Malaysia, Perak Branch Campus, Seri Iskandar.



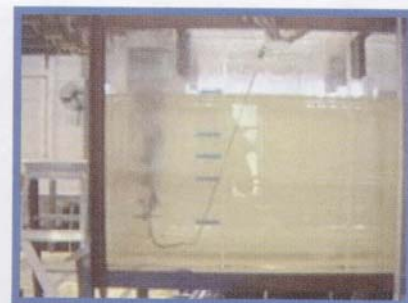
Bagan Terap Pumping Station abstracts irrigation water from Sg. Ulu Bernam, Selangor D.E. Flow is delivered to irrigation distribution system via a discharge bay structure.

The existing pumping station, commissioned some years ago, is now under capacity and consequently a new pump station is proposed. This will include the replacement of the existing pumps station with higher capacity units and the installation of larger diameter delivery irrigation network. To gauge the effects of the refurbishment, model test study was commissioned.

The proposed pumping station sump will house four Flygt series 7101 pumps, each maximum rated at 1.8 cumecs or 1800 L/s. The pumps will deliver flow via four new 1.2 m diameter discharge pipes into the new discharge structure.



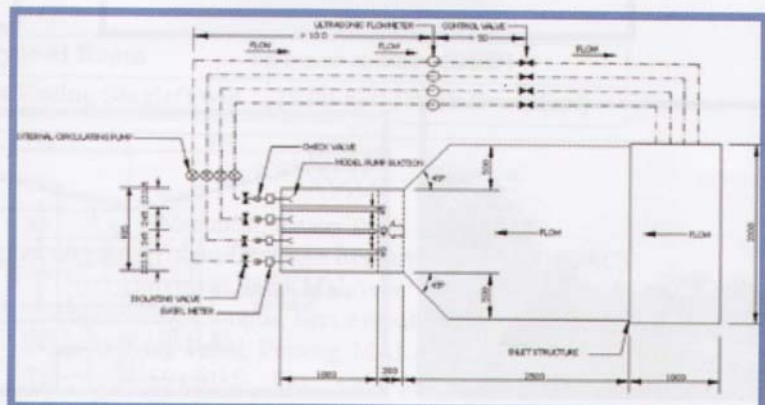
Model side view



Pump sump

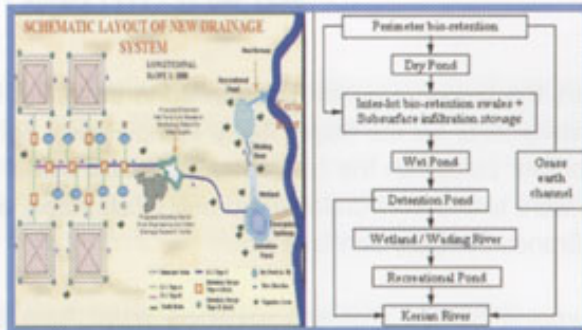


Subsurface vortices

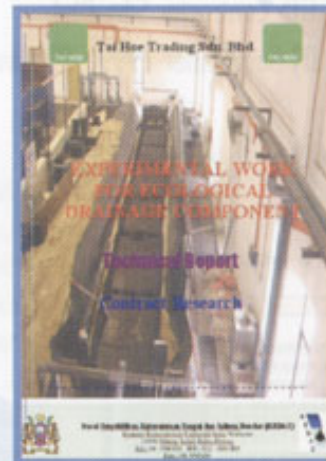


Model plan

Project Title: Experimental Work For Ecological Drainage Component
Funder: Tai Hoe Trading Sdn. Bhd.
Duration: 15 Sept 2000 - 15 Dec 2000



BIOECODS Concept

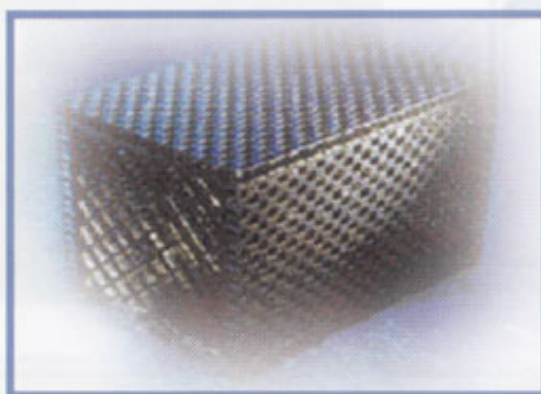


Rapid development in Malaysia with the construction of new towns may change the hydrologic and hydraulic characteristics of previously rural catchments. Flash flood and lower replenishment of groundwater may occur downstream of the new development areas as a result of increase in impermeable areas. Bio-Ecological Drainage System (BIOECODS) is an alternative urban stormwater management approach based on "control-at Source" concepts combining infiltration, detention storage as well as conveyance to delay flow. The main feature of BIOECODS is the use of subsurface drainage modules acting as both stormwater conveyor and attenuation agent. This report contains the study of drainage modules in order to determine their suitability and workability as well as to confirm the specifications of these components under local condition as implemented at the USM Engineering Campus, Nibong Tebal, Penang.

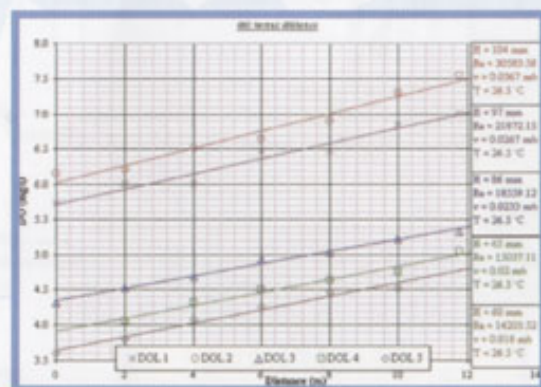
The objectives of this study are:

- 1) to test the hydraulic capacity of the drainage module
- 2) to check the water quality improvement capability of the drainage module

The results show that the drainage module should be designed as pipe flow and the resulting turbulence causes the DO level to increase with the distance as flow travels downstream.



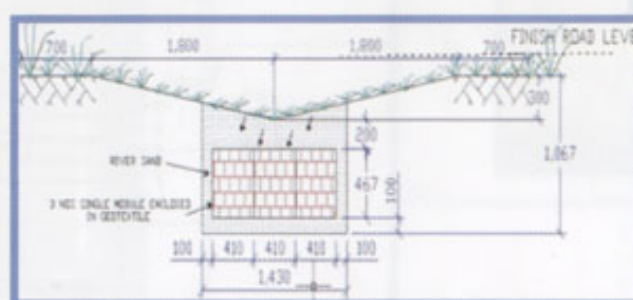
Modular drainage component



Improvement in DO levels with distance



Constructed Ecoswale



Ecoswale Cross Section



Constructed Ecoswale

Project Title: Feasibility Study on Flood Mitigation and Drainage Improvement in Valdor, Seberang Perai Selatan, Penang
Funder: Department of Irrigation and Drainage (DID), Penang
Duration: 01 July 1999 - 31 December 1999

Valdor village and its surrounding areas which covers an area of approximately 160 hectares, is situated in Mukim 3, Seberang Perai Selatan. This area has been served by two main outlet drains namely Parit Pertanian and Parit Paya Mahang, which are maintained by JPS. The drainage problem encountered by the village is partly due to the absence of proper network of internal drains within the village. The flooding problem has worsened with the rapid increase in development and the change in landuse pattern, i.e. from a predominantly rural and agricultural/farm setting to that of a newly developed settlement area.

The principal objectives of the study are listed as follows:

- a) To study the flooding and drainage problems in the study area.
- b) To propose feasible flood mitigation and drainage enhancement works for immediate implementation to cater for the study area.
- c) To propose conceptual and preliminary designs of the proposed works including their layout and typical designs of components and to determine the land acquisition requirements.
- d) To collect data and information required for the detailed design of the works.

Four alternatives have been proposed in this study which can be categorised into two main categories namely, Conventional Drainage System (Alternatives I and III) and Ecological Drainage System (Alternatives II and IV). Both structural and non-structural flood mitigation measures have been proposed to mitigate the flood problems.



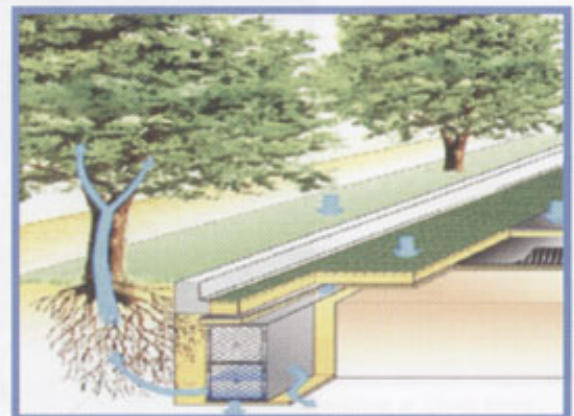
Animal Farm Waste



Typical Swale After Construction



Existing Conventional Drainage System



Proposed Ecological Drainage System

Project Title : Feasibility Study on Flood Mitigation and Drainage for Sungai Rambai Valley and Its Surroundings, Seberang Perai Tengah, Penang

Client : Seberang Perai Municipal Council (MPSP)

Duration : 01 July 1999 - 31 Dec 1999

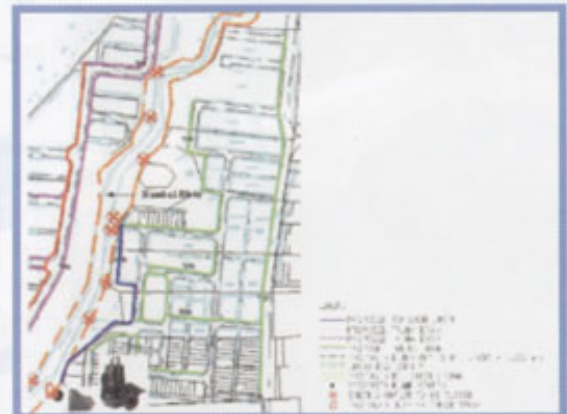
The study area covers Taman Seri Rambai, Taman Makok, Taman Desa Damai, Taman Sungai Rambai, Taman Sri Jaya, Taman Padang Lallang, Taman Mutiara and its surrounding. The study area is approximately 343 ha and drained by two parallel channels - Sungai Rambai and Parit 4. Sungai Rambai has two main upstream tributaries and discharges into Sungai Juru through a tidal gate at Juru Dam. Parit 4 is an extension of Sungai Permatang Rotan and has two gated outlets to Sungai Juru. Sungai Rambai and Parit 4 are linked by three cross drains. Frequent flooding in Lembah Sungai Rambai and its surroundings has been a long-standing issue which is of considerable concern to the relevant authorities.

The components of the proposed flood mitigation schemes consists of bunding along Sungai Rambai, upgrading Parit 4 and trunk drains, construct monsoon drains, flood control gates and pumping system and install gross pollutant traps (GPT) and sediment basin.

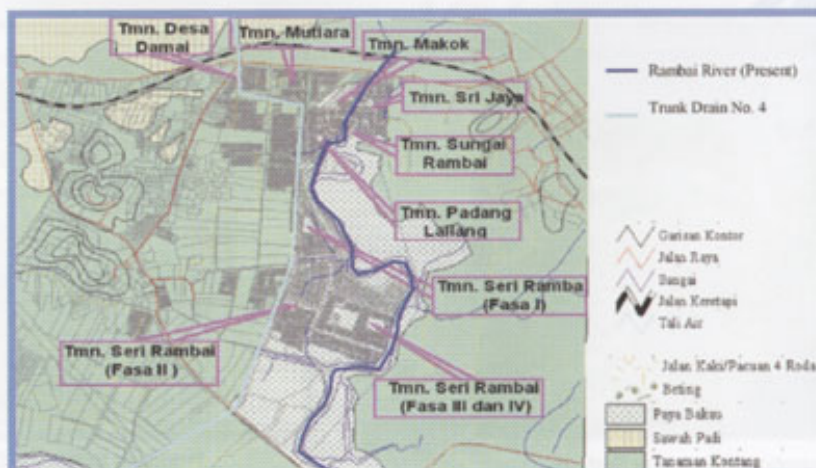
Three alternatives have been proposed in this study. Alternative 1 is a pumping-based solution. Detention facilities are not included in this alternative. Alternative 2 is a detention-based solution. The zero peak discharge will be achieved and the main waterways will not be burden by the runoff from the study area. Rainfall harvesting is also suggested to further reduce the volume of stormwater in the drains during rainfall events (Alternative 3).



September 1999 flood



Proposed Flood Mitigation Measures



Sungai Rambai Valley

Project Title: Feasibility Study and Detail Design of Flood Mitigation and Drainage Improvement in Chain Ferry, Seberang Perai, Penang
Funder: Seberang Perai Municipal Council (MPSP)
Duration: 1 July 1999 - 31 Dec 1999

The study area consists of Chain Ferry which is situated in Seberang Perai Utara district, Penang. The study area is bounded by Sungai Perai on the south and east and Butterworth Air Force Base to the north which covers a total area of 244.6 ha.

The flood prone areas in Chain Ferry concentrated in the west of Federal Route 1 and its surrounding areas. Due to rapid development and lack of improvement for the existing drainage infrastructure, parts of the study area is affected by high tide and flash flood. The flood duration is short and it usually occurs in the months of May and November. The flooding problems in Chain Ferry are caused by the inadequacy of existing drainage system and tidal effect. Moreover, the level of construction platform is lower than the desirable platform levels.

The principal objectives of the study include the following:

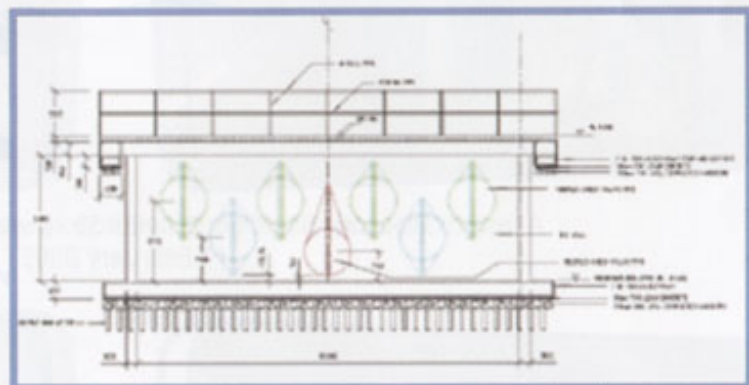
- (a) To study flooding and drainage problems in the study area.
- (b) To propose feasible flood mitigation and drainage enhancement works for immediate implementation in the study area.
- (c) To propose conceptual and preliminary designs of the proposed works including their layout and typical designs of components and to determine the land acquisition requirements.
- (d) To collect data and information required for the detailed design of the works.



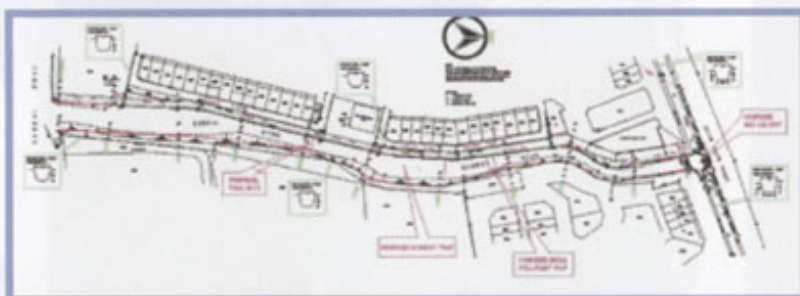
Siltation in the Existing Drain



Existing Drainage Condition at Chain Ferry



Proposed Tidal Gate



Proposed Drainage Improvement Scheme



Existing Drainage Condition at Chain Ferry

Site Visit &



A visit to Bioecods Site from the School Of Housing, Building and Planning
(30 Jan 2002)



A visit to Bioecods Site from Atlantis Stormwater Plc, Sydney, Australia
(4 February 2002)



A visit to Bioecods Site from River Division, Department of Irrigation And Drainage Malaysia
(20 Feb 2002)



Exhibition



I-Tex 2002 Exhibition at Kuala Lumpur
(29-31 Mac 2002)



The opening Ceremony of EUREKA Complex, Usains Holding,
(2nd May 2002)



Bioecods Model Handover Ceremony to National Science Centre, Kuala Lumpur
(1st July 2002)

Project Title: Feasibility Study and Detailed Design of Flood Mitigation and Drainage Improvement in Taman Mangga, Taman Pinang, Taman Sentul, Taman Sentul Jaya and its surroundings, Seberang Perai, Penang

Funder: Seberang Perai Municipal Council (MPSP)

Duration: 15 Dec 1999 - 15 Mei 2000

The study area consists of Taman Pinang, Taman Mangga, Taman Sentul and Taman Sentul Jaya which are situated in Seberang Perai Tengah district. The study area is located near Parit No. 5 and the area is affected by the tidal influence. The flood prone areas in the study area concentrated in the west of Federal Route 1 and its surrounding areas. Due to rapid development and lack of improvements for the existing drainage infrastructure, parts of the study area are affected by high tide and flash flood. The duration of flooding is short and it usually occurs in the month of May and November. The flooding problem in the study area are caused by inadequacy of existing drainage system and tidal effect. Moreover, the level of construction platform is lower than the desirable platform levels.

This project is categorised into two phases

- Phase 1 covers feasibility study
- Phase 2 covers detailed design and construction

The proposed implementation programme consists of two categories, namely the construction of pumping station and upgrading internal drainage system. The constructions of new drains and pump houses were completed in 31st December 2001.



Upgraded Covered Drain



Upgraded Open Drain



Upgraded Open Drain



Completed Pump House, Taman Mangga

Project Title: Environmental Management Plan for Universiti Teknologi Petronas
Funder: Institute of Technology, Petronas Sdn. Bhd.
Duration: September 1999 to August 2002

Environmental Management Plan (EMP) is an environmental requirement to minimize impact of development to the environment. This plan relates the Environmental Impact Assessment (EIA) of the development project to the policies of regulating bodies. The Environmental Management Plan also outlined actions to be taken to ensure proper environmental observations by all parties involved in the project. USM is the EMP consultant for the development project of Universiti Teknologi Petronas, thus was responsible to monitor the environmental adherence throughout the construction period until the project is handed over to the owner.

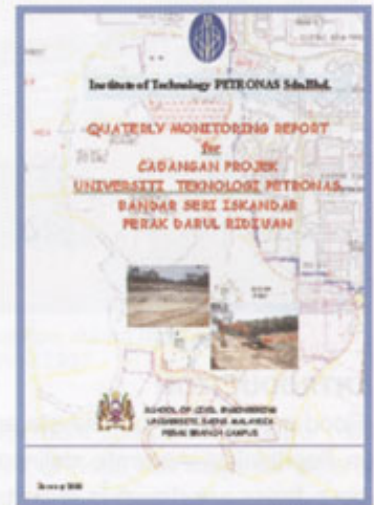
EMP ensures that the following impacts are minimized and controlled within the desirable limits and complied with all applicable standard and guidelines:

- Soil erosion and sedimentation
- water quality pollution
- Air quality pollution
- Noise pollution
- Ecology
- Construction traffic

USM is responsible in preparing EMP report, conduct monitoring and auditing, conduct environmental training to contractors and site inspections throughout the construction period.

The scope includes the following:

- Preparing Environmental Management Plan (EMP) as a proper environmental approach during project implementation to conform with approved EIA report by DOE, EIA Condition's Approval from DOE and related Authorities and Contract Specifications.
- Review the mitigation and abatement measures proposed in the EIA report, and Erosion and Sediment Control Plan (ESCP) by contractors.
- To set out a comprehensive program which forms the basis for implementing environment mitigation measures, environment monitoring and environment auditing of the construction works by the Contractor.
- To ensure that the Contractor engaged by the Government comply with all applicable environmental standard and guidelines, legislative requirements, limit values and other relevant conditions related to the environments in the implementation of the project.
- To specify a detailed environment monitoring and auditing program to ensure that the Contractor and all Sub-contractors comply with all stipulated requirements throughout the duration of the project.
- To ensure all activities and operations of the Contractor are protected from any environmental impacts throughout the construction phase of the project. It shall also include but not limited to environmental monitoring, conservation and preservation and auditing activities.



Erosion Mitigation Measure



Water Quality @ Outlet



Slope Protection Measure



Building In Progress



Completed Building

Name: **Shanker Kumar Sinnakaundan (PhD Candidate),
National Science Fellowship Scheme (NSF MOSTE)**
redac04@eng.usm.my

Project Title : **Hydraulic Modeling and Flood Risk Analysis
Incorporating Sediment Transport**

Effective Date of Candidature: **1 August 2000 - 30 September 2005**

Supervisors: **1. Assoc. Prof. Dr Aminuddin Ab Ghani
2. Dr Mohd Sanusi S. Ahmad**



INTRODUCTION

Flood prone areas in Malaysia are still under heavy development because there are no sustainable guidelines for development in floodplains. Accurate delineation of floodplain boundaries is a critical step in floodplain management where floodplain boundaries are drawn is important to emergency management personnel, developers as well as ordinary citizens. Yet all the existing conventional methods for floodplain mapping are labor intensive and time-consuming and they lack repeatability because of the complexities and uncertainties embedded in the process. The results also cannot show the actual flooded location and possible risk to the structures such as building and roads in the area. Furthermore, the spatial variation in the hydraulic processes requires a dependable hydraulic model that must contain 3 major elements; (1) the mathematical equations that govern the hydraulic processes (2), maps that define the study area and (3) database tables that describes the information on a spatial variation and input parameters of the model.

OBJECTIVE

The main Objective of this research is to develop a procedure that integrates all the three elements stated above using Geographic Information Systems (GIS) as a complete model operating environment.

METHODOLOGY

Sediment transport processes were considered in this research to simulate flood profiles based on the river equilibrium theory suggested by Lane (1959). This concept involves the inter-relation of four basic factors namely sediment discharge (Q_s), sediment particle size (d_{50}), stream flow (Q_w) and stream slope (S). Channel equilibrium occurs when all four variables are in balance. Furthermore, there is no particular attempt yet in Malaysia to provide accurate flood risk maps taking into account of sediment movement along the river channel. The Urban Storm Water Management Manual for Malaysia which was introduced by Department of Irrigation and Drainage Malaysia (DID) in year 2000 requires all drainage designs to consider risk factors. Non-structural measures such as setting of minimum floor levels and/or platform levels may also be used to mitigate the effects of floods larger than the design event (DID, 2000).

The model will be constructed under a Geographic Information System (GIS) and based on the concepts of embedded and object-oriented programming which allows all the regular model procedures such as construction, simulations, modifications, and result-processing to be activated directly from point and click options. Based on this, a map-based hydraulic model incorporating sediment transport process in river channel will be developed to simulate flood profiles the Pari River in Ipoh, Perak, Malaysia (Figure 1) which has the history of serious flood problems (Figure 2) .

Initial modeling needs were identified by developing an ArcView GIS 3.2a extension namely AVHEC-6.avx and HEC-6 hydraulic and sediment transport model for flood inundation mapping. The extension was written in an Avenue Script language and Dialog Designer with a series of point and click options. It has the capability of analyzing the computed water surface profiles generated from HEC-6 model and producing a related flood map in ArcView GIS 3.2a.

Flood inundation maps were produced for the subsequent flood scenarios with the simulated results from HEC-6 Model and draped over an integrated multi-resolution digital terrain model (Fig. 3 & Fig. 4). Preliminary results of the research indicate that GIS provide an effective environment for flood risk assessment and the integration of GIS with hydraulic modeling is not only feasible but also mutually beneficial for both GIS users and hydraulic modelers.

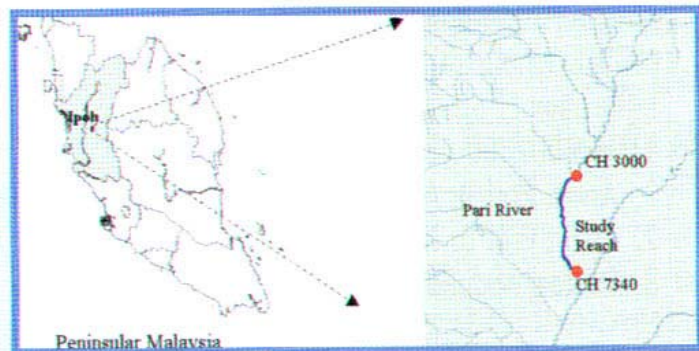


Fig. 1 Study Area: Pari River, Ipoh



Fig. 2 Pari River overflow during flood on 19th Nov 1997

EXPECTED RESULTS

The proposed methodology can yield a better dissemination of floodplain information management compared to paper maps in terms of consistency, efficiency and accuracy. Greater focus will be given to the development of flood risk maps for different return periods (ARI). Flood plains along Pari River will then be classified according to risk zones for future development. The integrated spatial database, and graphic User Interface (GUI) for HEC-6 model will be developed in Arc View GIS to get a fully functioned GIS based hydraulic model.

CONCLUSIONS

The embedded modeling approach provides planners and decision makers with a very powerful tool for floodplain management that cannot be accomplished using either GIS or hydraulic modeling alone. As outlined, a tightly coupled model with a Geographic Information Systems can improve the quality and power of analysis, provides functionality for data capture, data editing, pre-processing, build queries, simulation and sophisticated results visualization. The use of GIS based flood risk analysis model will tremendously improve the understanding of the complex hydraulic and hydrology processes that governs the flood plains.

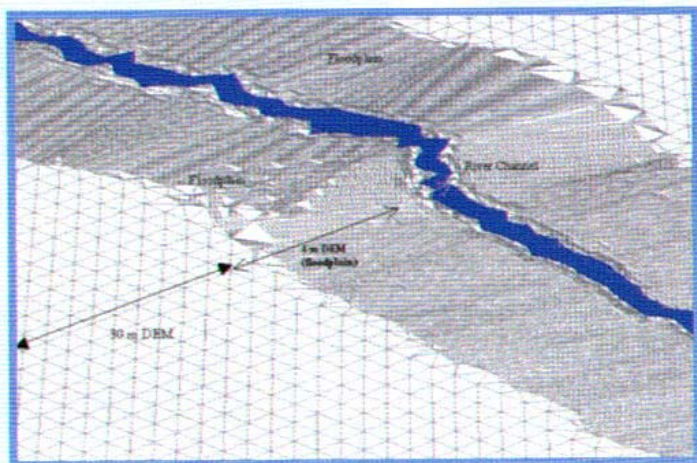


Fig. 3 Water Surface Elevation TIN draped over ITIN

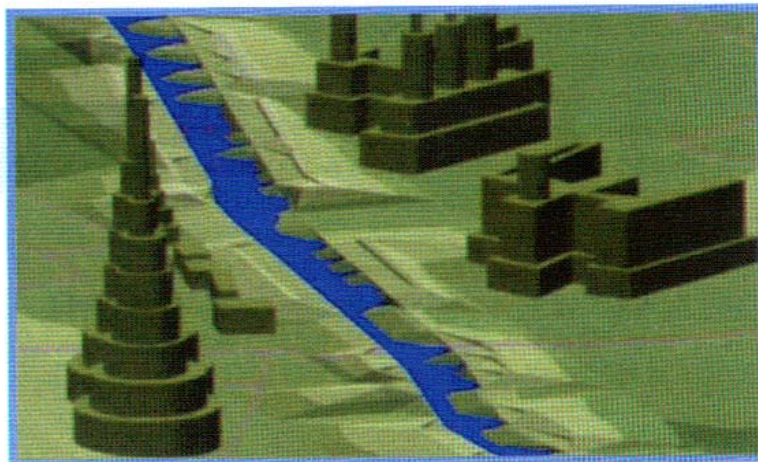


Fig.4 3D Flood map $Q= 12.50 \text{ m}^3/\text{s}$, 1997 discharge hydrograph

LATEST PUBLICATIONS

Sinnakaudan, S., Ab Ghani, A., S. Ahmad, M. S., & Zakaria, N, A. Flood Risk Mapping for Pari River Incorporating Sediment Transport. *Journal of Environmental Modeling and Software*, Elsevier Science Ltd. (in press).

Sinnakaudan, S., Ab Ghani, A., Chang, C.K., & Zakaria, N, A. (2002). Flood Inundation Analysis Using HEC-6 and ArcView GIS 3.2a. 5th International Conference On Hydro - Science & - Engineering. Warsaw University Of Technology, September 18 - 21.

Sinnakaudan, S., Ab Ghani, A., Chang, C.K., S. Ahmad., M. S & Zakaria, N, A. (2002). Integrated Triangular Irregular Network (ITIN) Model for Flood Risk Analysis. Case Study: Pari River, Ipoh, Malaysia. Thirteenth Asia and Pacific Division Congress of International Association of Hydraulic Engineering Research on Hydraulic and Water Resource Engineering in early 21st Century. Singapore, August 6-8, Vol.2, pp.656-660.

"...models are like maps: never final, never complete until they grow as large and complex as the reality they represent" - (James Gleick,1999)



Name:

**Stephen Tan Boon Kean (PhD candidate,
MOSTE Scholarship)**

Project Title :

Infiltration Effect On Channel Routing Process

Effective Date of Candidature:

1st March 2000 - 28 February 2005

Supervisors:

1. Assoc. Prof Dr Aminuddin Ab Ghani
2. Assoc. Prof Dr Nor Azazi Zakaria
3. Dr Rozi Abdullah

INTRODUCTION

Urbanization is necessary for a developing country, such as Malaysia. However, one of the results of urbanization is an increase in frequency and magnitude of flooding in the newly urbanized area. A sustainable drainage system with the following characteristics should be proposed to minimize the negative impact of urbanization on both hydrological and environmental aspects:

- Capable of attenuating post-development peak flow to pre-development level
- Capable of reducing the increased runoff volume where the only choice is to implement infiltration practices.
- Capable of treating runoff (at least treating the first flush).

Among the structural BMPs facilities, Swales possess all the above characteristics. However, the effectiveness of Swales in reducing flood risks and runoff purification, has to be studied and confirmed before it can be applied widely as the main conveyance of runoff for both minor and major storm events in Malaysia. Data collected from the Bio-Ecological Drainage System (BIOECODS) implemented at USM Engineering Campus will be used for numerical model development

OBJECTIVE

This research is conducted to achieve these objectives :

- Develop a numerical model (i.e. distributed/hydraulic model) for channel routing process incorporating infiltration.
- Study the effectiveness of infiltrating channel in both peak flow attenuation and runoff volume reduction.
- Establish optimum design criteria for infiltrating channel which incorporate Malaysian climate condition.

METHODOLOGY

- Development of numerical models:
 - Model M1: A numerical model (Kinematic wave solved with non-linear fully implicit scheme) representing the channel routing process without infiltration.
 - Model M2: A numerical model consists of sub-module M1 and an infiltration sub-module
- Calibration and verification of the developed models
 - Model M1 is mainly calibrated and verified with hypothetical data generated by dynamic wave equations.
 - Model M2 is calibrated and verified by both laboratory and site data.



Ecological swale type B



Ecological swale type A



Ecological swale type C



Perimeter swale

- The main equipments needed are:

- American Sigma 950AV flow meter (laboratory test)
- ISCO flow module (site data collection)
- Laboratory flume
- XP-SWMM (Version 6.1)

- Model behaviors analysis

- Study of effectiveness of infiltrating channel in both peak flow attenuation and runoff volume reduction.
- Optimization of design criteria for infiltrating channels incorporating Malaysian climate condition.

EXPECTED RESULTS

- Numerical models (Model M1 and Model M2)
- Design tools (such as analytical solution, charts or table)

Teaching And Research On River Engineering At Universiti Sains Malaysia

By Associate Prof. Dr. Aminuddin Ab. Ghani - Deputy Director REDAC



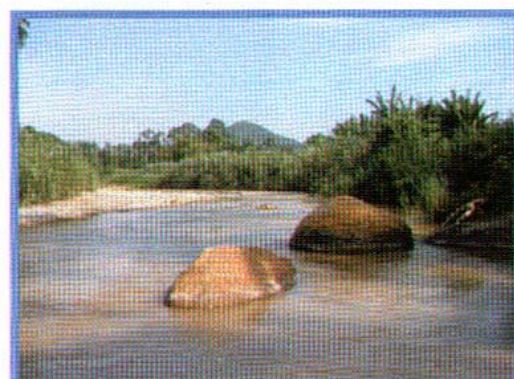
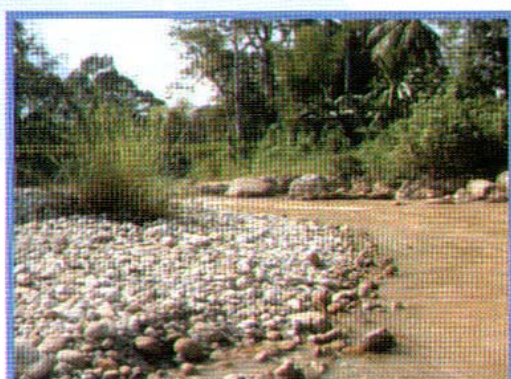
The River Engineering course has been taught at the School Of Civil Engineering since the Academic Year 1993/1994. Since the introduction of the three-year programme, the River Engineering course has been offered as an elective course. More than 300 hundred students have taken the course since Academic Year 1998/1999 making it a popular elective course. For the new four-year programme, the course has been modified whereby the theoretical part is taught in Hydraulics and the design part is taught in Hydraulic Structure.

The River Engineering course introduces the students to sediment transport principles required to understand the river behavior such as river response to catchment changes either due to natural causes or human made. The students are highlighted with topics such as sediment characteristics, flow resistance in alluvial channels, sediment transport equations and stable channel design. Field data collection involving measurement of sediment loads such as bed and suspended loads, and grab sampling of bed material, forms the practical aspects of the course. The students are also introduced to fluvial modeling using widely used models such as FLUVIAL-12 and HEC-6. The applications of the sediment transport theory including design of river bank protection works and flood risk mapping for Pari River are also highlighted.

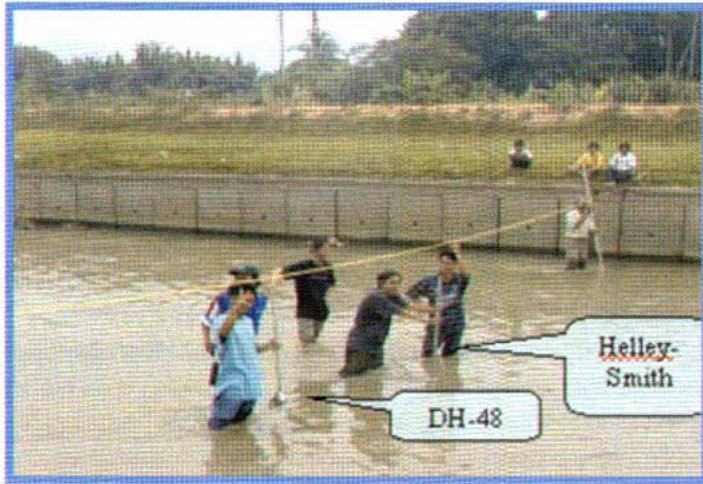
Extensive research on sediment transport with funding from USM and IRPA grants further enhances the teaching of the River Engineering course. A total of 10 postgraduate students have been involving in the on-going research whereby 6 of them have graduated and obtained their MSc degrees. Latest research results are incorporated as teaching materials making students aware of the latest technology on River Engineering. A number of papers have also been presented throughout the years at various national and international conferences highlighting the application of sediment transport principles in understanding the river behavior.

A "River Basin Management" seminar was conducted in 1995 by Prof. D. G. Jamieson from Univ. of Newcastle Upon Tyne, UK. In 1996, Prof. Rodney White from Hydraulic Research, Wallingford, UK conducted a seminar on "Recent Development in River Engineering". A short course "Sediment Transport: Theory and Application" and a workshop "River Modeling: Case Studies of Pari River and Kerayong River" were conducted in 1998 and 1999 respectively for the engineers from Department of Irrigation and Drainage (DID). The seminars, short course and workshop highlight the application of sediment transport theory in designing flood mitigation projects taking into account the sediment transporting capacity of the river. Through the understanding of the sediment transport theory, rivers nationwide can be maintained as natural as possible in line with the implementation of the new urban stormwater management manual (MSMA).

An international conference is being planned in 2004 with the emphasis on preserving the natural characteristics of rivers and applying "Back To Nature" approach for channelized rivers.



Natural Reach of Kampar River



Suspended load measurement with DH-48 and bed load measurement with Helley-Smith



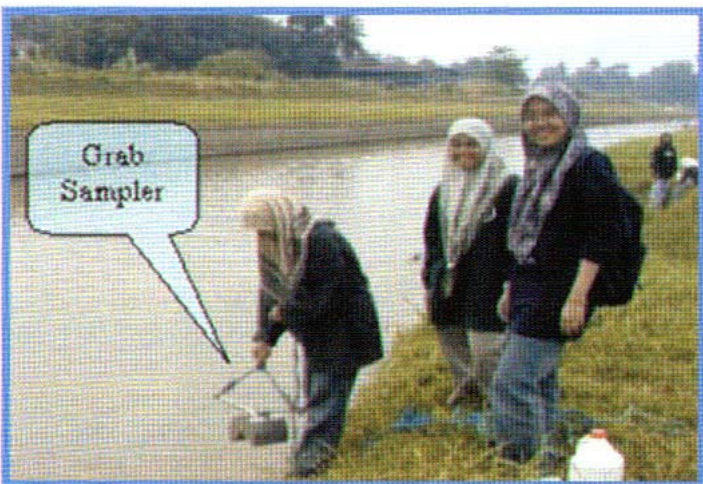
Velocity measurement using electromagnetic current meter



Cross section measurement



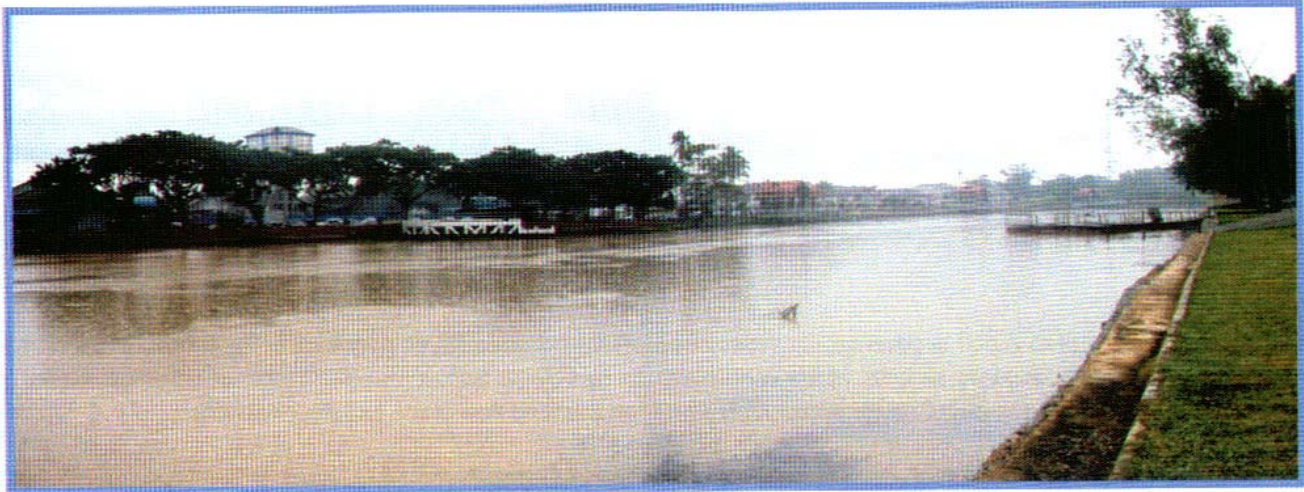
Bed material measurement location



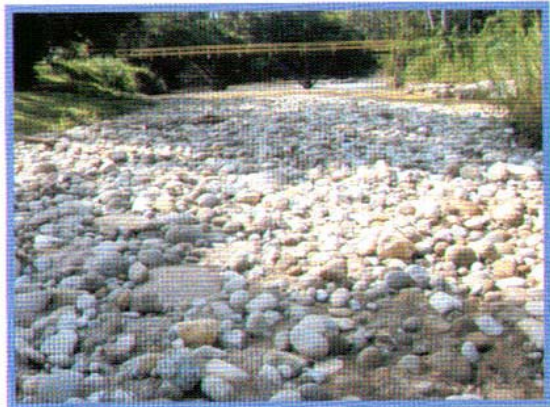
Bed material sampling



Bed material samples



River Front Enhancement (Kerian River @ Parit Buntar)



Natural Reach (Kampar River @ Gopeng)



Stormwater Management Model (SWMM)

By Dr Rozi Abdullah

INTRODUCTION

The transformation of rainfall to runoff is governed by series of processes occurred within river basin. The processes for rainfall-runoff transformation of river basin include; process which contributes to hydrologic losses; transformation of effective rainfall to direct runoff hydrograph; and routing the direct runoff hydrograph along the overland flow plane and river network.

A hydrologic loss is the amount of rainfall which is retained within the river basin. The component of hydrologic losses includes the amount of rainfall intercepted by the vegetation canopy, depression storage and rainfall which infiltrates on the ground surface.

The amount of hydrologic losses is required to determine an effective rainfall. The technique such as unit hydrograph method, time-area method or kinematics wave algorithm can be used to transform the rainfall into direct runoff hydrograph.

Direct runoff hydrograph is routed through the overland flow plane and river reach to determine the outflow hydrograph at the outlet of the catchments. The rainfall-runoff transformation is a complex process and computational intensive. Thus, it is desirable to use a computer model such as SWMM to model the rainfall-runoff transformation and drainage system for a given development area.

SWMM for Urban Drainage Modeling

SWMM can effectively be used to model the urban drainage system and evaluate the performance of the drainage plan for a particular development. SWMM consists of three main blocks (Fig. 1) with a unique function assign to each block.

- Service Block - contain the statistic block, graph block, combine block and temp block which support the computational block such as in the output computation.
- Executive Block - This is an interface block which acts as linkages to other blocks.
- Computational Block - contain the runoff block, transport block, extran block and storage/treatment block. The runoff block generates direct runoff hydrograph from the rainfall hyetograph based on antecedent moisture condition and land use. Transport block is used for routing through the overland flow plane and river reach. Storage/treatment block is used in the design of BMPs for water quality control.

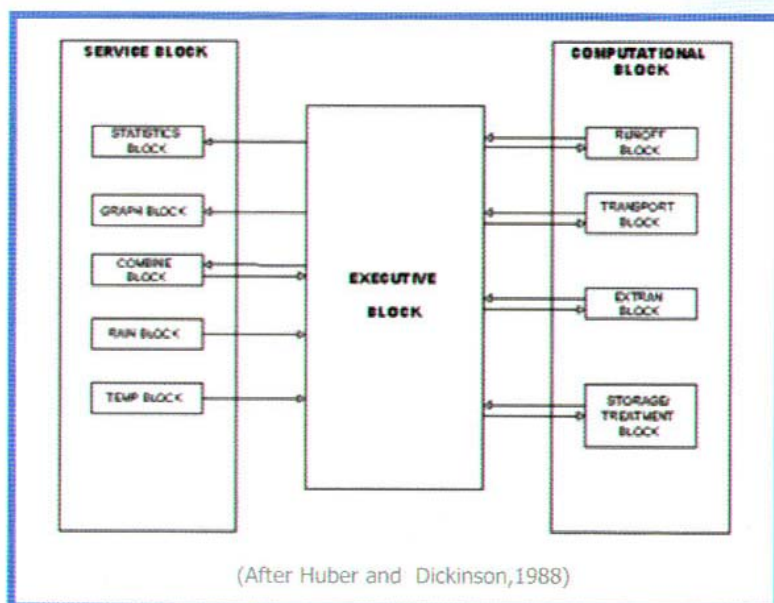


Figure 1

The rainfall-runoff simulation (Fig.2) assumes that sub-catchments behave as a non linear reservoir with rainfall as an input and the output consists of infiltration, evaporation and surface runoff. The amount of water retain in the sub-catchments through depression storage consists of interception and ground surface ponding.

The surface runoff will be generated in the event that rainfall amount exceeds the depression storage. The continuity equation is used to compute the volume of stormwater in the sub-catchment and manning equation is used to compute the rate of surface runoff.

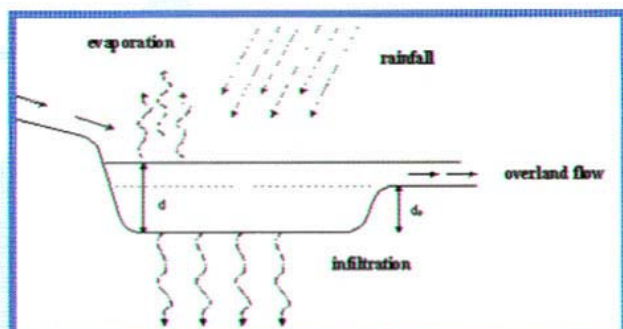


Figure 2

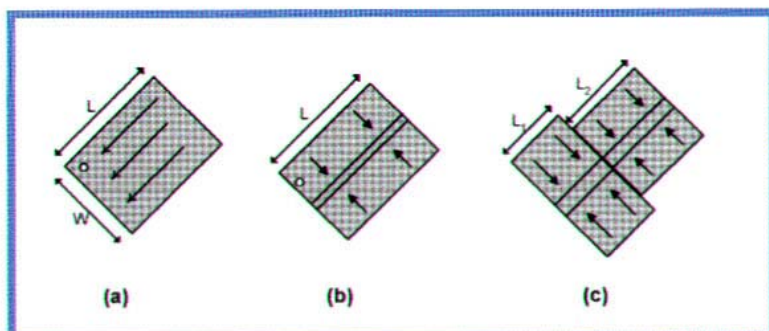


Figure 3

SWMM used spatial conceptualization to determine the width of overland flow. Figure 3 shows three different type of spatial conceptualization to determine the width of overland flow.

CONCLUSION

The Stormwater Management Model has been used to model the Bio Ecological Drainage (BIOECODS) system which is constructed at Engineering Campus, Nibong Tebal. This is essential to conduct detail evaluation of hydrologic and hydraulic aspects of BIOECODS.

Latest Publication

TITLE	AUTHORS	JOURNAL / CONFERENCE
Calibration of the Soil Conservation Services (SCS) Method in Peninsular Malaysia using Sungai Chalok Catchment, Negeri Terengganu	Rozi Abdullah, Yip Hing Wai, & Aminuddin Ab. Ghani.	Bulletin Institution of Engineers Malaysia, pp. 29-34, June 2002
Alternative Solutions to Conventional Drainage Systems using Bio-Ecological Drainage Systems: Design and Concepts, Part 1	Lariyah Mohd Sidek, Nor Azazi Zakaria, Aminuddin Ab. Ghani, & Rozi Abdullah	Bulletin Board of Engineers Malaysia, Vol. 15, No.2, pp. 46-51, June 2002
Accurate Flood Plain Definition For Sustainable Flood Risk Analysis	Shanker Kumar Sinnakaudan, Aminuddin Ab Ghani, Mohamad Sanusi Ahmad & Nor Azazi Zakaria	Proc. 2nd National Civil Engineering Conference -Star Cruses Superstar Gemini - Penang-Phi-Phi Island- Phuket. 5-8 February 2002
The Need of Integrated River Basin Management for Juru River Basin Catchment to Alleviate Flood Woes and River Pollution	Lau Tze Liang, Nor Azazi Zakaria, Aminuddin Ab. Ghani, Rozi Abdullah & Lariyah Mohd Sidek	Proc. 2nd National Civil Engineering Conference -Star Cruses Superstar Gemini - Penang-Phi-Phi Island- Phuket. 5-8 February 2002
Nature-Friendly Urban Drainage System as A Part of New Development Landscape BIOECODS Case Study	Nor Azazi Zakaria, Aminuddin Ab. Ghani, Rozi Abdullah, Lariyah Mohd Sidek, Abdul Hamid Kassim, & Anita Ainan	National Seminar on World Day for Water'2002, Kuantan, 25-26 March 2002
The Use and Development of Bio-Ecological Drainage Systems (BIOECODS) Under Tropical Climate	Lariyah Mohd Sidek, Nor Azazi Zakaria, Aminuddin Ab. Ghani, & Rozi Abdullah	Second World Engineering Congress, Kuching, Sarawak, 22-25 July 2002

Project Title	Project Leader (Project No.)	Amount (RM)
Flood Risk Mapping For Rivers in Malaysia Incorporating Sediment Transport in River Channel: Case Study of Pari River, Ipoh, Perak	Assoc. Prof. Dr. Aminuddin Ab. Ghani (09-02-05-1030 EA 001)	126, 000.00
Development of Soil Classification With Respect to Infiltration Capacity for Major Cities in Malaysia: Butterworth, Ipoh, Kuala Lumpur	Assoc. Prof. Dr. Nor Azazi Zakaria (09-02-05-1031 EA 001)	172, 100.00
Development of Engineered Sediment Trap for Conventional Drainage System	Assoc. Prof. Dr. Aminuddin Ab. Ghani (09-02-05-1032 EA 001)	147, 000.00
Hydraulic Capacity of Ecological Drainage System	Dr. Rozi Abdullah (09-02-05-1033 EA 001)	143, 900.00
	Grand Total (RM)	589, 000.00

Redac's New Comers



Name : **Nasrul Osman**
Position : **Clerk**



Name : **Wong Lai Peng**
Position : **Research Officer**



Name : **Salwahidayah Othman**
Position : **Research Officer**



Name : **Chang Chun Kiat**
Position : **Research Officer**

Editor's Note



Assoc. Prof. Dr.
Aminuddin Ab. Ghani

- **REDAC invites** all interested researchers or engineers to **contribute articles** (max. 6 pages, A4 size) and email them to: redac02@eng.usm.my

- REDAC will be organising an International Conference on **Managing Rivers in the 21st century "Issues & Challenges"** in **June 2004, Penang**. Information on the conference will be regularly updated in our website,

<http://www1.eng.usm.my/redac/>