AN ANALYSIS OF THE INFLUENCE OF THE FIELD LEVEL HYDRAULIC PROPERTY APPROXIMATIONS IN STORMWATER MODELLING

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DECLARATION

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S. S. Wanniarachchi Date

The above candidate has carried out research for the MPhil thesis under my supervision.

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Professor N. T. S. Wijesekera Date

An analysis of the influence of the field level hydraulic property approximations in stormwater modelling

ABSTRACT

This study analyses the effect of the catchment field approximations for accurate flood hydrograph prediction. Considering the availability of gauged data, the Karasnagala watershed of Attanagalu Oya, located in Gampaha district in the Western province of Sri Lanka was modelled with EPA SWMM 5. Following an event based approach, 3 days Minimum Inter event Time (MIT) and 0 mm/day Minimum inter Event Depth (MED) were used as the threshold. Fifty events were separated from the 1971 to 1982 period. Concave method and constant slope method were compared for baseflow separation in this study. Four major field approximation types were identified as stream geometrical parameters approximations, soil infiltration parameter approximations, approximation of watershed intermittent storages, and subcatchment delineation approximation. Quantitative representation of the catchment intermittent storages and qualitative representation of the connectivity of the catchment intermittent storages were identified as the objectives of the layout parameter optimization. Soil parameter approximations and the stream network geometry parameter approximations were verified by the field observations. Model calibration and verification revealed that EPA SWMM5 can be successfully used to develop regional Karasnagala watershed model with mean ratio of absolute error (MRAE) 0.289 for calibration, and 0.375 MRAE for verification. Incorporation of intermittent storages with optimized model layout obtained best fitting of hydrograph recession MRAE 0.167. Evaluation of available models and the modelling carried out with calibration & verification revealed that EPA SWMM 5 can be used to develop a rural watershed model. Field approximation for subcatchment lumping with a 16 sub basin configuration showed the marginal increment of modelling error when compared with distributed modelling. Stream parameter approximations revealed that the head water streams/lesser order streams parameters sensitivity is higher than the higher order streams. In soil parameter approximations, saturated hydraulic conductivity of the soil was the most influencing parameter.

Key Words: Field approximations, SWMM, Rural watershed, MIT

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Abbreviation	Description
BFI	Baseflow Index
DEM	Digital Elevation Model
EPA SWMM	Environmental Protection Agency Storm Water Management Model
GIS	Geographic Information System
GPS	Global Position System
HEC-HMS	Hydraulic Engineering Center –Hydrologic Modelling System
ILLUDAS	Illinois Urban Drainage Area Simulator
LID	Low Impact Development
MED	Minimum -inter-Event Depth
MIT	Minimum Inter-event Time
MOUSE	Model for Urban Sewers
MRAE	Mean Ratio of Absolute Error
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
NS	Nash-Sutcliffe efficiency coefficient
SD	Standard Deviation
SF_{Peak}	Streamflow Peak
UH	Unit Hydrograph
USD	United States Dollars
WBM	Water Balance Model