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# Integration of IR4.0 with Geospacial SuperMap GIS and InfoWorks ICM

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***Abstract*—**Kota Samarahan, the capital of Samarahan division in Sarawak Malaysia, has experienced rapid development in the recent years. However, the intensive urban development has led to urban pluvial flood. Therefore, this research was carried out to reevaluate the sufficiency of existing drainage system at Uni-Central, Kota Samarahan. Normally, water level simulation was carried out using InfoWorks Integrated Catchment Modelling (ICM) alone. However, the modelling process was found to be repetitive, time consuming, complicated and data may input incorrectly. Hence, it is proposed to integrate geospatial with IR4.0 at a global level, by incorporating SuperMap Geographical Information System (GIS) with InfoWorks Integrated Catchment Modelling (ICM) software for water level simulation. Physical data such as drain dimensions and flow were input into SuperMap GIS at initial stage. Thereafter, drainage information was imported into Infoworks ICM. InfoWorks ICM will simulate the water level in drainage system with rainfall intensity of 2, 5, 10, 20 and 50 years Average Recurrence Interval (ARI) and 30, 60, 120 and 360 minutes duration. The modelling process was found easier, simpler and efficient with this integration. Results revealed that Infoworks ICM is able to simulate the water level in the drainage system accurately. The water level in the drainage system was reduced significantly after a detention pond was added at downstream

***Keywords-*** *Water level simulation, SuperMap GIS, InfoWorks ICM, Duration, Average Recurrance Interval*

## I. INTRODUCTION

In Malaysia, flood is consider as one of the most disastrous phenomena. There are a total of 189 river basins in Malaysia, by which 22 of them are in Sarawak (Kueh & Kuok, 2016). Occurrence of flood inevitably had brought major economic losses and devastating social cum environmental impacts to people. Floods not only affecting our daily activities, but also caused damages to properties and injuries. Moreover, the situation is getting worse in urban environment due to increasing of impermeable surfaces. Urban pluvial flooding often take place when amount of rainfall is exceeding the drainage system capacity. Floods are unpredictable as it often happens within a short period, even at areas where flooding event is unlikely to occur (Kuok et al., 2010; Kuok et al., 2012). It was believed the main reason that caused flooding was inappropriate drainage system (Gasim et. al., 2014). Research also found that three out of seven factors resulting in urban flooding are associated to poor drainage system. Hence, it is very important to manage the drainage flow in urban city using mathematical modelling to overcome the flash flood issue.

Infoworks Integrated Catchment Modeling (ICM) is a mathematical software that provides an integrated modeling platform and enables engineers to incorporate natural hydrology and manmade channels into a single model (Thorndahl and Willems, 2008). It allows 1D and 2D hydrodynamic simulation of catchment elements located on or below ground surface. By creating the model and allowing simulation of the water level of the drainage system, the capacity and adequacy of the drainage system including flow paths, directions and destinations, as well as the possibilities of flood occurrence can be determined. Infoworks ICM had been successfully applied for assessing capacity of pipeline drainage system combined with sewer system (Peng et al., 2015), flood mapping and water level prediction due to dam failure (Musa et. al., 2016), flood modelling for rural area to estimate agricultural water losses (Muhadi, et. al., 2017), evaluation of sewerage influence on urban flooding (Leitao et. al., 2015) and assessment of flood hazard considering climate change impacts (Russo et. al., 2013; Kuok et al., 2011a).

However, if the water level simulation of the drainage system was carried out using InfoWorks ICM alone, the process would be very repetitive and time-consuming. Information for each of the drainage system needs to be inputted one after another. If there were some mistakes during inputting the drainage details, it is very difficult to trace and identify the incorrect or inaccurate drainage information. The modelling process will become more difficult and complicated when modelling a drainage system for whole township. Therefore, it is proposed in this study to transfer physical, digital and geospatial information available with the IR 4.0 technologies, such as Geospacial SuperMap Geographic Information System (GIS) into Infoworks Integrated Catchment Modelling (ICM). This Geospacial SuperMap GIS will serve as a platform to organize, manage and access information before integrating with Infoworks ICM for saving the time spent and ease the difficulties for developing drainage system model in Infoworks ICM.

Geographic Information System (GIS) is a system that equips with mapping technology for managing and storing various information, such as information for community drainage system. Having the capability to store massive amounts of data, GIS is able to facilitate the construction of hydrologic models and computation of its output (Taniguchi et. al., 2008). There are various types of GIS software including Maptitude (Gregorio and Samociuk,2013; Torres et.al., 2005; Haider and Donaldson, 2017), ArcGIS (Fallahzadeh et. al., 2017; Ye et. al., 2017; Adegboyega et. al., 2017), QGis (Duarte et.al., 2014; Duarte et. al., 2016), AutoCAD Map 3D. In this study, SuperMap GIS software is utilized to map the drainage system and subsequently integrated with Infoworks ICM for drainage flow design and simulation.

The selected study area is Uni-Central, a developing residential area located in Kota Samarahan, Sarawak, Malaysia. SuperMap GIS has been used for water saving irrigation management (Chen, 2011), crop land suitability analysis (Pan and Pan, 2011), and evaluation of intensive usage of urban land (Zhao et. al., 2013).

## II. STUDY AREA

Kota Samarahan is a fast growing suburb in Sarawak, situated about 30 km south east of Kuching city. Kota Samarahan is the capital of Samarahan division, one of the twelve administrative divisions in Sarawak, Malaysia. It has an area of approximately 508.1Km2 (Samarahan, 2007; Kuok & Bessaih, 2007). Most of the lands in Kota Samarahan are flat, low-lying and non-hilly, except that isolated hills can be found at the floodplains adjacent to Batang Samarahan and Sungai Tuang. The elevation of the flood basin is rarely higher than 5m above mean sea level, which caused the catchment always subject to flood during high tide (Zulkifle, 2015).

Currently, agriculture including coconut, oil palm and pineapples plantation is still the main economic activity in Kota Samarahan. Most of the soils in Kota Samarahan are peat soils and it is deal for coconut, oil palm and pineapples plantation. However, light industries are slowly moving into this suburb developing