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Semi-distributed Storm Water Management Model for Urban Flood Mitigation and Management through LID's

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Abstract

The management of the chronic urban flooding is one of the leading challenges presently facing in any parts of the India. Impact of flood rates can be observed in high rates due to increasing in impervious area, climate change and a lack of review when adopting drainage network. A SWMM (storm water management model) is an effective tool to analysis the amount to which the proposed solution will mitigate the flooding in the study area. The pilot study area taken in this study is highly influenced by impact of storm water generation due to increase in buildup areas in the city. The present study reveals the effectiveness and modality of SWMM for best LID (Low Impact Development) controls for real world solutions.

Keywords: Flood management, Drainage network, Low Impact Development, SWMM.

Introduction:

Urban flooding is a rising phenomenon in recent time. It is specific in the fact that the cause is a lack of drainage in an urban area. Problem associated with urban floods increases if no changes are made to unplanned expansion and poor management of urban area introduce land degradation, water logging, deterioration of roads an increase of impervious land increases the impermeability of land due to urbanization. Flooding give rise to hydrological problems which cause degradation of the quality of flows in both the drainage networks serving the urban area and the underlying aquifers.

An urban flood occurs when water overflow drainage, water logging (zammer et al 2013). In recent scenario, climatic change main factor is, the intensity of rainfall is more in short duration due to which flooding in urban areas is very common (Awakimjan et al 2015). The flooding is natural phenomenon but human activities has significantly increase the flood risk (Gupta and Nair 2011; Prasad 2014) over the last few era, the priority of developing cities is different according to their growth.

The main aim of urban drainage is drainage hygiene, environmental protection, flood protection (choc at et al, 2007) for larger and stronger storms, extensive land use changes & increasing climatic variability is to be treat with appropriate water management method (XU el at 2015), urban flood as a risk, characterized by (Thieken et al, 2006) the exceedance chances of the conceivably harming flood situation in a given area with determined time frame.

Flood inundation modelling has major role in flood mitigation and minimizing its effects. Most flooding is brought about by substantial and intense precipitation in zones where lacking of drainage network framework can't manage abundance measure of runoff effectively. Lack of poor storm water management practices in urban area can be even more dangerous than many natural disasters.

A low impact development (LID) urban drainage uses efficient and tempting micro scale techniques to control unplanned structure of watershed, minimize pollution and most important to control storm water runoff. LID is a generally new idea in storm water the executives, which uses a site structure system with an objective of keeping up or recreating the pre improvement hydrologic routine utilizing plan procedures to make a practically equal hydrologic scene (U.S EPA,2000).LID is a generally new idea in storm water the executives, which uses a site structure system with an objective of keeping up or recreating the pre improvement hydrologic routine utilizing plan procedures to make a practically equal hydrologic scene (U. S EPA,2000). LID also have the advantage of effectively removing nutrients, reducing the volume and intensity of storm water flows because of the deficiencies related to urbanization, problem of drainage as discussed above, there is an acute need to devise an innovative LID planning tool for engineers and decision makers.

Materials and Methods:

Study Area:

Raipur city is the capital of Chhattisgarh; it is formerly a part of Madhya Pradesh before Chhattisgarh was formed on Nov 2000. The city is administrated by Raipur municipal cooperation (RMC). Raipur district is located in the center of the Chhattisgarh state and is bounded by East longitude 81.586° and 81.683° and by north latitude 21.201° and 21.324° . Rainfall is endowed with high rainfall. The district receives its rainfall mainly from the south-west monsoon. Raipur has witnessed a high growth rate in population, which has not been matched with a corresponding sanitation infrastructure (RMC et. al.2011).

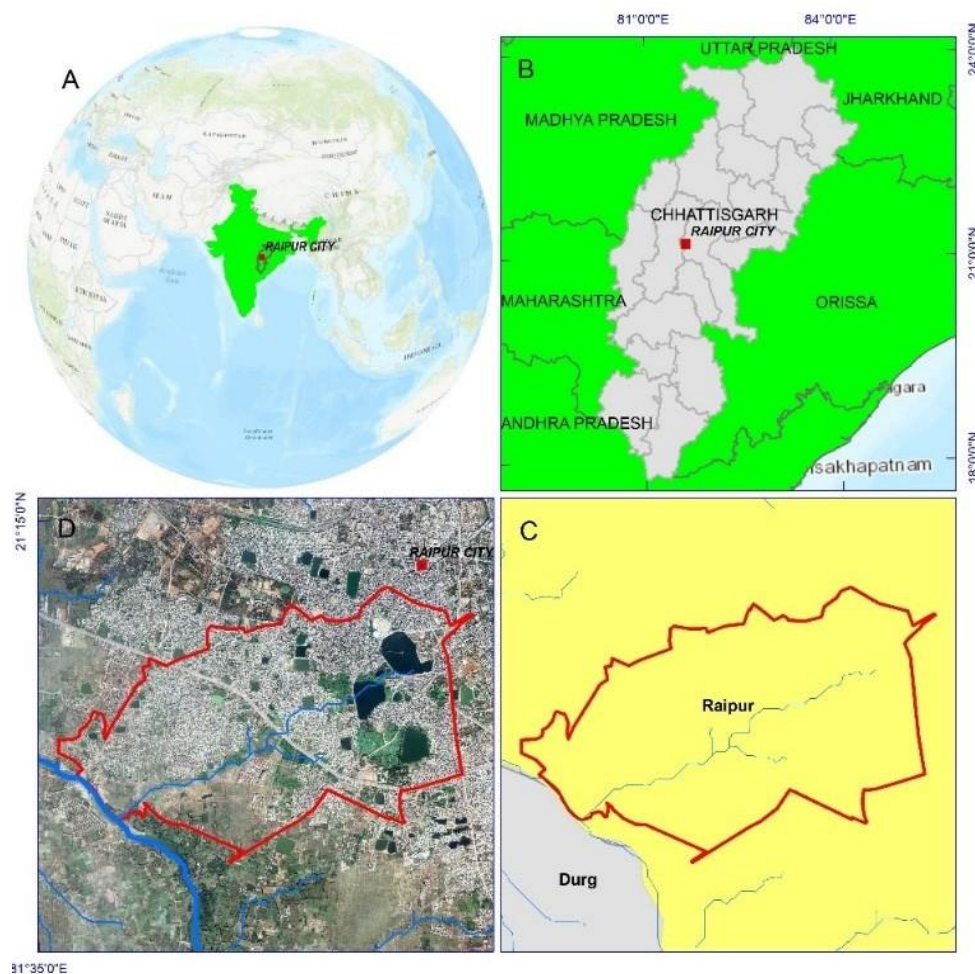
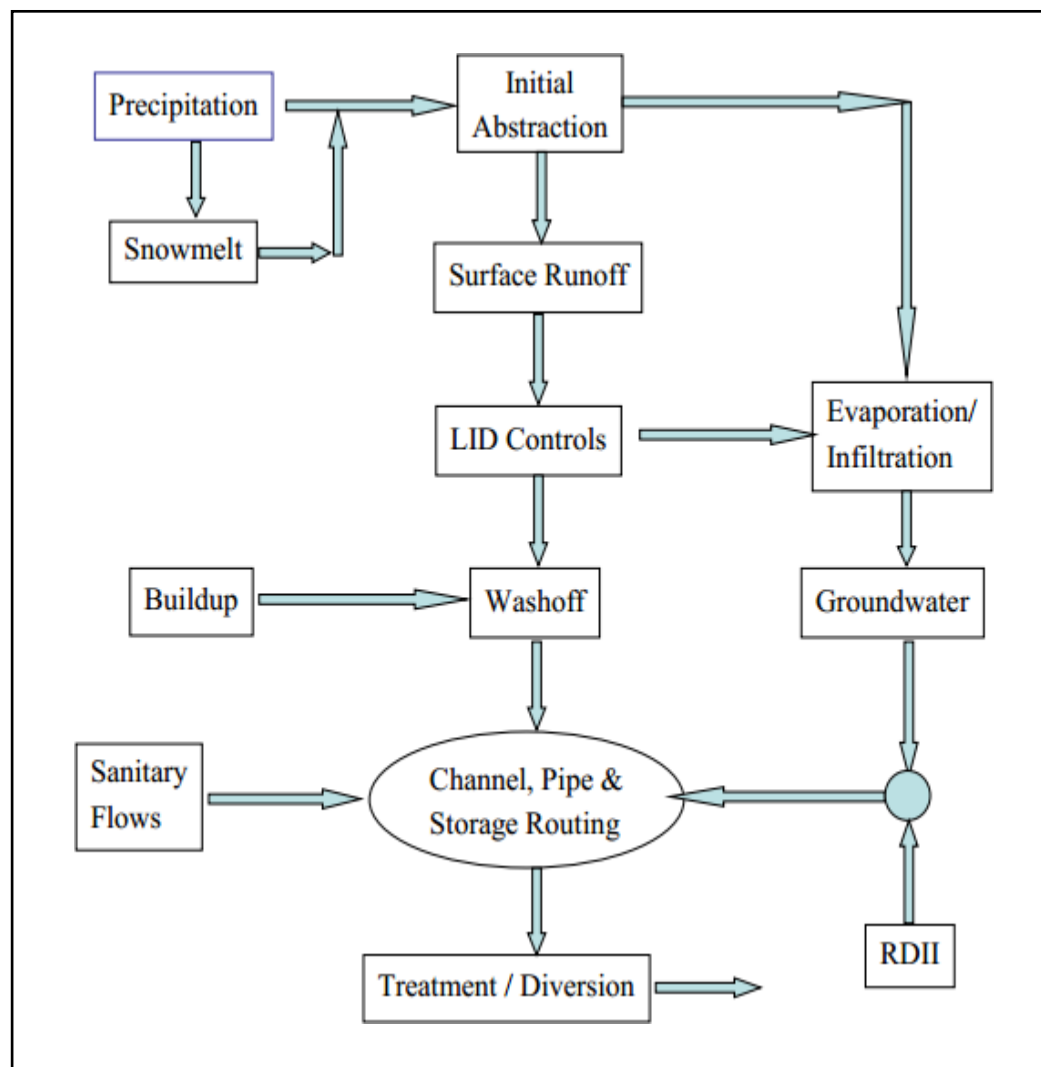


Figure 1: Location map of the study area

Urban overflow amount and quality establish issues of both chronic and current nature. Urban communities, since long, have accepted the accountability of control of storm water flooding and treatment of point source (e.g. Metropolitan sewage) of waste water.

The hydraulic procedures happening with in SWMM conveyance compartment include:



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- Outside inflow of surface runoff, ground water interflow, precipitation subordinate, rainfall-dependent infiltration/inflow.
- Pipes and storage units, unsteady, on uniform flow routing through any configuration of open channels, pipes and storage units.
- Different conceivable stream routines, for ex backwater, surcharging, switch stream.

Data Required:

SWMM'S visual objects may be arranged together to represent a storm water drainage network framework. These items can be shown on a guide in the SWMM work space.

1. Rain gauge
2. Sub catchment
3. Junction nodes
4. Conduits

Rainfall Analysis:

To run the model in SWMM, it is necessary to feed the rainfall time series data in hourly format. Generation of IDF (intensity duration frequency curve) for design period of rainfall of past and generate for future scenario and simulate in SWMM to know the possibility of flood in that storm.

Sustainable Approach:

In 1972, US Federal Clean Water Act has fundamentally extended storm water management in the United States from flood mitigation into both storm water quality and quantity controls. So one of them is dispose on site runoff volume using device.

Low impact development (LID) is an ecologically – based storm water management approach favoring soft engineering to manage rainfall on site through vegetated treatment network. The goal of lid is to sustain a site predevelopment hydrologic regime by using technique that infiltrate, filter store and evaporate storm water close to it source.

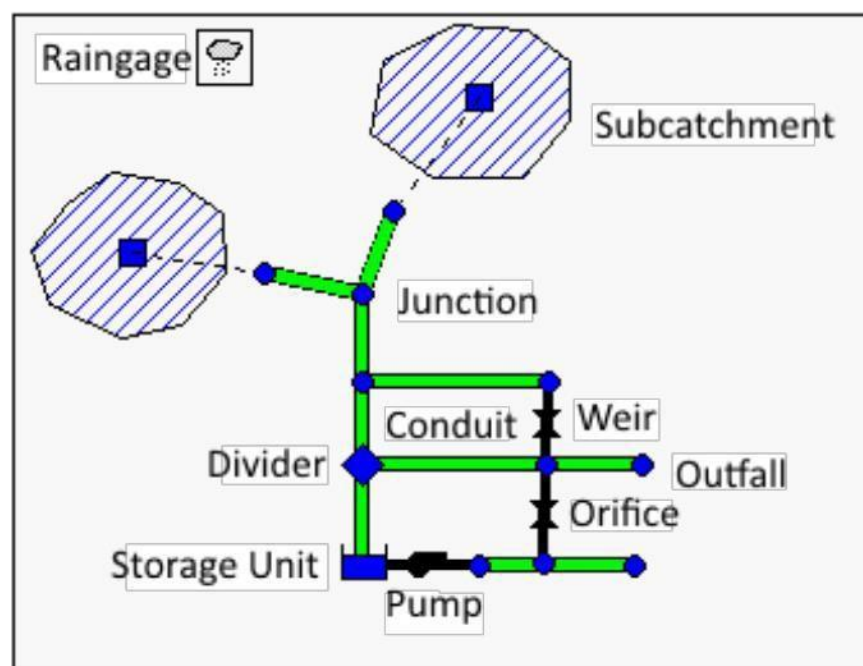


Figure 3: EPA-SWMM semi-distributed flood simulation protocol

Source: Storm water management user manual

Common LID'S: in-built

1. Bio-retention/rain gardens
2. Disconnection of impervious areas
3. Dry wells
4. Filter strips
5. Grassed swales/bio-retention swales
6. Infiltration trenches
7. Permeable pavement
8. Rain barrels
9. Vegetated roofs



Figure 4: Examples of low impact development (LID) practices

Summary and Conclusion:

This paper present about urban flooding due to unplanned expansion and with different factors like intensity of storm at that duration in urban area. Urban development is causing significant environmental impact, ecosystem, losing vegetative area and more flooding, higher level of contaminants in receiving water. Paper also describes a feasible application of EPA SWMM. The parameters encoded into the model were controlled by various method and a few strategies were utilized for their assurance so as to survey their effect, moreover observed discharge and precipitation information, essential to adjust the model, were resolved either for old or current storm events. It gives a framework which comprehends the hydrological forms that occur in urban domain and shows that a variety of indirect data can be useful for a watershed model application.

It is concluded that there is need to provide a sustainable approach in the form of LID (Low impact development) for storm water management system and practices to reduce the flooding and to improve the water availability and the ground water recharge in urban areas.

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