Determination of Surface Runoff and Preparing Digital Elevation Model by using HEC-HMS and GIS and Design Sewer System

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Abstract

Water resource is most important natural resource needed for survival and progressiveness of mankind. To ensure availability of water throughout the year. Surface runoff water harvesting is the collection, accumulation, treatment of purification and storing of storm water is also important. These networks of sewers may consist of house sewer, lateral sewer, branch sewer, main sewer and outfall sewer. be properly and skillfully planned and designed of sewer is most important now a days. Runoff value are predicted with rthe help of hydrograph develop of cathchmate and thus compare analytically. To develop DEM of Manaji Nagar, DEM data available from ISRO and also rainfall data from Indian Meterological Department (IMD) is required. With the help of GIS and HEC-HMS model analysis of Manaji nagar is done to design of sewer system.

Keywords – DEM, GIS, HEC-HMS, SCS Method

I.   INTRODUCTION

1.1 Background

The water in our bodies is essential for our life. Without water, we can't survive. Water is limited vital natural resources, which is indispensable for the expanse of all living matters, plant, animal and man. Portable water which was once through to be an infinite. In certain areas with changing water demand, there is a perceived sense of inadequate rainfall over the year and hence overall yield resulting of this precipitation. With increase in population and due to changing life style of people water demand and domestic sewage has increased. Surface runoff water harvesting is the collection, accumulation, treatment of purification and storing of storm water and also sewerage system must be properly and skillfully planned and designed, so as to remove the entire sewage effectively from the houses and the water from surface runoff. A sewerage system consists of network of sewer pipe laid in order to carry the sewage and surface runoff from individual houses and roads respectively to the sewage treatment plant. It can also include other catchment areas from manmade surfaces, such as road or other urban environment such as parks, garden and playing field.

1.2 GIS

Geographical Information System (GIS) is the computer based tool for mapping and analyzing feature event on earth. GIS technology has played critical roles in all aspects of watershed management, from assessing watershed condition through modeling impacts of human activities on water quality.An advanced information like GIS plays a vital role and serves a complete platform in every phase of infrastructure life cycle. Geographical Information System (GIS) is computer based system that handles the attribute data as well as spatial data where geographical information is an important characteristic. A GIS consist of:

- Computer Hardware and Software-Processes digital data.
- Digital Data the geographical information that you will view and analyze using computer.

1.3 Introduction to HEC-HMS

The HEC-HMS simulation method represent base flow methods to simulate watershed, channel and water control structure behavior, thus predicting now, stage and limiting.

- The slow subsurface drainage of water from a hydrological system in to the watershed channel.
- Direct runoff including overland flow and interflow.
- Watershed precipitation and evaporation these describe the special temporal distribution of rainfall and evaporation from a watershed.
- Runoff volume this address question about the volume of precipitation that falls on the water shed.

1.4 Case Study of Manaji Nagar

Narhe is village under Pune Municipal Corporation with high population and increased rate of transportation needs. Poor drainage in most of the areas in Narhe greatly accelerates deterioration of pavements. The village area has been experiencing drainage congestion and water logging for the last few years which cause serious problems. Increased urban development's without providing sufficient drainage facilities results in water logging leaving parts of the village area inundated for several days. The logged water becomes polluted with solid waste, soil and contaminants, leading to unhealthy environment and spreading serious diseases. Thus, this problem becomes a burden for the residents and the public authorities in Narhe.

Scope of the Study

To calculate the surface water runoff in the Manajinagar. With the use of software such as GIS and HEC-HMS.GIS is used to calculate vertical surface elevation and HEC-HMS is used to calculate amount of surface runoff. Drain out the water which has logged and give direction to surface runoff. The study focuses specifically on the current situation of roads and drainage facilities and identifies causes of drainage problems of roads in Manaji Nagar.

II.   LITERATURE REVIEW

Runoff of various case studied have been analyze by many researches through advanced method like GIS and HEC-HMS. Ishtiyaq Ahmad, Dr. M. K. Verma, had studied the important components of hydrologic cycle is runoff and influenced by various factors including precipitation and watershed characteristics. National Resources Conservation Service (NRSC) has developed a Geographic Information System (GIS) based method. Asmita B. Lakhote , Dr. B. V. Khode , Er. N. Z. Baisware, had studied about the watershed, catchment and drainage basin. Water is very useful parameter of the Environment because it is connected with the soil, drainage, streams, rivers, reservoirs, catchment, basin, vegetation and atmosphere.

III.   METHODOLOGY

Selection of site

Study of climatic condition in Pune

Selection of software GIS and HEC-HMS

Analysis of Digital Elevation Model created in GIS

Analysis Surface Runoff by using HEC-HMS

Design of Drainage Line

3.1 Selection of Area

The selection criteria of area is based on rainfall of the area, Drought condition, water scarcity and population. Manaji Nagar of Narhegaon in Pune district of Maharashtra is one of the village with water logging problem.

Fig.1 Map of Manaji Nagar

3.2 DEM Data

A geographic information system (GIS) is a system design to captured store manipulate, analyze, manage and present spatial data or geographical data. GIS applications are tools that allowed user to create interactive queries (user created searches), analyze spatial information, edit data in maps and present the result of all this operations. It has attached to many operations and has many applications related to engineering, planning, management, transport, insurance, telecommunication and business. For that reason, GIS and location applications can be the foundation for many locations-enabled services that rely on analysis and visualization. Solution for groundwater recharge will be provided with the help of DEM.

3.3 Role of HEC –HMS

Detailed technical report and usermanual. HEC-HMS can be process geospatial data in GIS. Calibration is performed using an optimization algorithm. Compatible with other HEC-HMS program due to common data storage system. Allow for discharge output values as well as all internal state variable at user define grid location.

Observation and Calculations of Result:

IV.   OBSERVATION

Storm sewer system

• Storm sewer is designed to drain excess rainfall and groundwater from paved streets, parking lots, sidewalks, and roofs.

• Storm sewers vary in design from small residential dry wells to large municipal systems.

• Storm sewers are present on most motorways, freeways and other busy roads, as well as towns in areas which experience heavy rainfall flooding areas which experience heavy rainfall, flooding and coastal towns which experience regular storms.

4.1 GIS analysis:

Analysis is one of the major and most influential phases of infrastructure life cycle. Analysis guides us about the validity and correction of design or we can say that analysis is method which supports our design.

4.2 HEC-HMS:

- The slow subsurface drainage of water from a hydrological system in to the watershed channel.
- Direct runoff including overland flow and interflow.
- Watershed precipitation and evaporation these describe the special temporal distribution of rainfall and evaporation from a watershed.
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V. RESULT AND CONCLUSION

5.1 Global Summary of Manaji Nagar:

Fig.2 Average rainfall Pune, India

The average rainfall from Feb-May 15.75mm, from June-Sep 136.425mm and from Oct-Dec 37.63mm. The wettest month (with the highest rainfall) is **July** (187.2mm). The driest month (with the lowest rainfall) is **January** (0mm). The average annual rainfall 60.133mm.

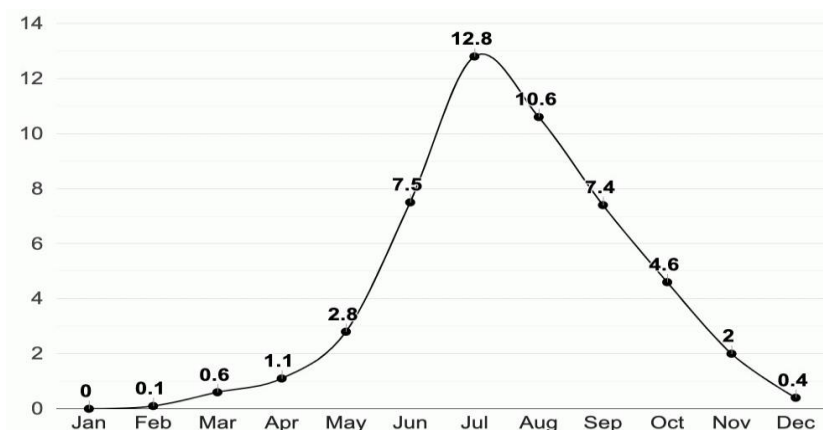### 5.2 Result of Outlet from Manaji Nagar:

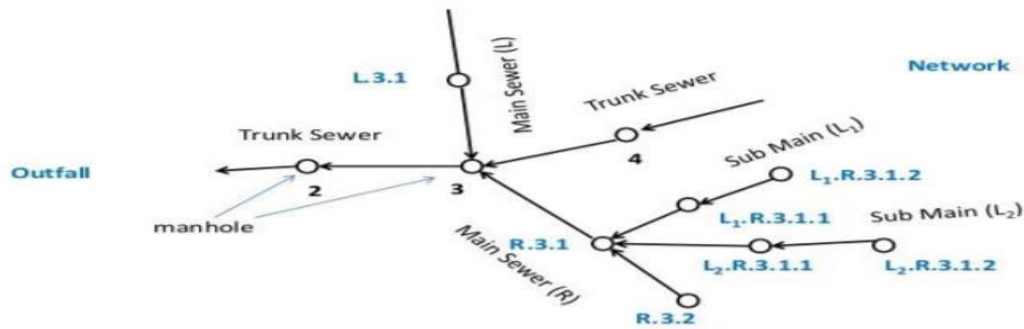Fig.3 Average rainfall days Pune, India

Fig.4 General Nomenclature Sewer System

VI. CONCLUSION

- In Narhegaon we considered the use of separate sewerage system. In two pipe separated system, storm water can be collected through storm drains.
- Despite the initial high cost, separating storm water from waste water is much more advantageous because it helps to eliminate combined sewer overflow and prevents flooding by increasing the capacity.
- The village faces issue regarding its sewerage and drainage system. It would therefore be better if separated sewerage system is implemented increasing the efficiency of out the building handling of waste output.
- At presently side drains are provided for storm water collection. For long term it would help in saving cost as a separate system would mean rainwater can be recycled. Maintenance is easier as pipes are separated and can be individually repaired and fixed.

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