Design of Storm Water Drainage Using SWMM Software

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Abstract- *Due to urbanization and fast growth of the cities, the need for proper storm water disposal is required. The augmentation of existing storm water drainage network of city is going to be assessed, followed by in depth analysis, planning and design by SWMM Software. Storm water drainage issue is one of the considerable challenges facing in many parts of Ahmedabad and its surrounding areas. So, the study focuses on the assessment of storm water drainage system in Chharodi village as a design of storm water by using SWMM software. Planning for storm water management should be done considering the entire drainage area, including characteristics (size, vegetation, land use, topography), runoff condition (the rate and amount of runoff), future development. Here the warm use of SWMM Software, TCX converter and Quikegrid software to analysis and suggest storm water and design of water logged area in Chharodi lake village Ahmedabad.*

Keywords- Discharge, Google Earth pro, TCX Converter software, Quikegrid software, SWMM software, Topographic area (Altitude, longitude and latitude) ,Water elevation profile.

I. INTRODUCTION

Storm water runoff plays a large role in local water pollution. As the runoff flows across the ground, it picks up pollutants and carries them into local waterways, such as rivers, lakes, and streams, before eventually making its way into the ocean. In a natural system, a variety of plants act as filters that clean pollution from the water as it percolates into the ground. Without these natural filters, pollutants and other debris accumulate and are washed into bodies of water. In addition to transporting pollutants, runoff can also cause erosion and sedimentation by sweeping away and displacing soil.

It can also cause localized flooding when storm drains take on too much water at once. Storm drains lead directly unfiltered and untreated into local waterways, such as the Reedy River. This means anything that makes its way down a storm drain, including storm water, pollution, sediment, debris, etc. will end up in the water.

By focusing on pollutants that areswept up by storm water, we help to reduce our impact by keeping these harmful substances out of the path of runoff and out of our water drainage facilities becomes essential. Strom water has become a central issue in urban planning and management, particularly in developed area with substantial urban infrastructure in place.

The magnitudes of investment required to construct, operate and maintain urban storm drainage facilities and the potential for significant adverse social and environmental impacts mandate the use of the best possible method for planning, analysis and design by SWMM Software.

The design of a drainage system must address the needs of the travelling public as well as those of the local community through which it passes. The drainage system for a roadway traveling an urbanization region is more complex than for roadway travel for rural area.Storm water management policies that emphasis expedient removal of storm water from communities for the protection of human health and properties.

The design of storm water management system is currently undergoing scrutiny and revision. This corresponded with revisions to the understanding of ecology as well as deeper richer understanding of the natural science especially the role with which humans play to these systems. The result induced some to associate not just the contaminants picked up by storm water to be a major cause of urban stream degradation but also the way in which the landscape was being transformed by urban development and the conventional ways that this development accounted for storm water.

II. AIM AND OBJECTIVE

- To measure the capacity of storm water network in selected catchment area.
- To prepare storm water management plan and design by SWMM Software.
- To contribute effort that aim at improving the storm water disposal problem of Chharodi village.

III. LITERATURE REVIEW

The search of peer-reviewed scientific literature and evaluation of the over 150 articles returned that the use of the SWMM model to help solve water management issues in urban environments high- lights the relevance of the model to drainage design and planning. The analysis focused on reporting model performance data for both hydrologic and water quality endpoints. From the articles reviewed, the relevant information on sensitive parameters, calibration methods, and calibration/validation statistics were extracted. From this collection, SWMM was found to be applied to a wide range of problems related to urban storm water, which can be attributed to it being a flexible and parsimonious simulation tool for urban hydrology and water quality that is adequate for most of its intended applications.

In general, urban storm water management model is the standard tool used to help engineer to simulate the hydrological process. There are many models with the different applications range from small catchment to a large catchment have been developed. Every software has its own specific characteristics and respective applications. Several models are used to model gauged and ungauged study area. Each model has several disadvantages such as lack of user-friendly characteristics, large data requirements and nonappearance of clear declarations of their boundaries. In order to overcome these imperfections, it is required for the models to include rapid advances in remote sensing technologies.

IV. STUDY AREA

Figure 1. Chharodi lake village map

The study area was located at Chharodi, Ahmadabad which is 23.033, and 72.460 latitude and longitudinal. Total area of Chharodi is 1.847 km or 19.995 ha.

ChharodiLake for irrigation, cultivating of different crops. Using lake through drinking facility has been completed.

V. METHODOLOGY

Steps in using SWMM:

1. Specify a default set of options and object properties to use
2. Draw a network representation of the physical components of the study area
3. Edit the properties of the objects that make up the system
4. Select a set of analysis options
5. Run a simulation
6. View the results of the simulation
7. Setting Object Properties:
8. Property editor window:
9. Time series editor:
10. Simulation options dialog:
11. Simulation options dialog:
12. Viewing the Status Report:
13. Summary Result:
14. Viewing Results on the Map:
15. Viewing a Time Series Plot:
16. Profile plot dialog:

DEM Tools: A digital elevation model is a 3D CG presentation of a terrain’s surface-commonly of a planet, moon, or asteroid-created from a terrain’s elevation data. DEMs are used often in geographic information systems and are the most common basis for digitally produced relief maps.

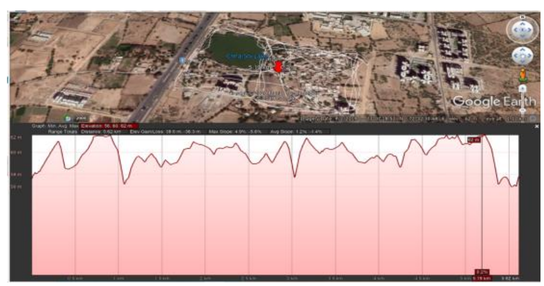
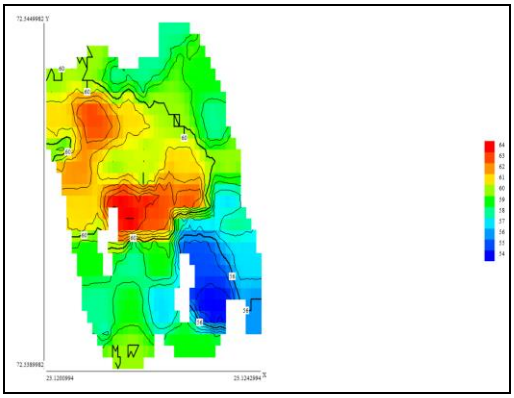


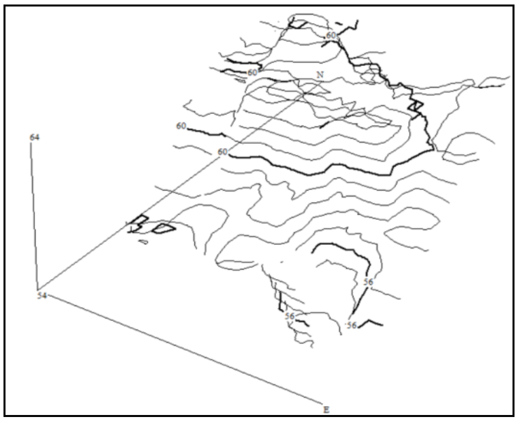
Figure 2: Digital Elevation Map of Chharodi lake village

Contour Map: It is map illustrated with contour lines, for example a topographic map which thus shows valleys and hills, and the steepness or gentleness of slopes. The contour interval of a contour map is the difference in elevation between successive contour lines.

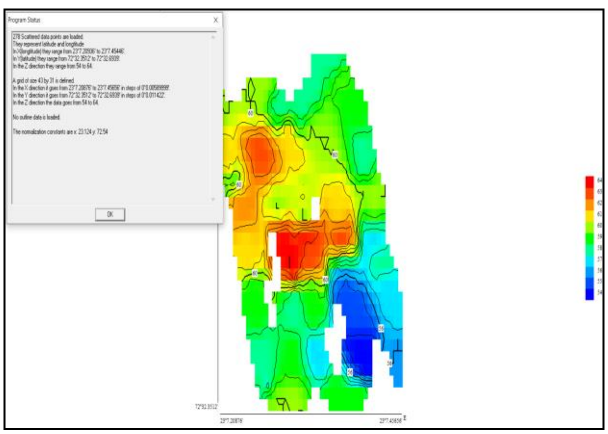
Analysis of data: The information about pipeline and its direction, the depth, the flow measurement, topography etc. will be collected and analysed. The spatial data analysis will be carried out by Google earth pro, TCX Converter, Quick Grid and SWMM software.



Graph 1: 2D Contour map of Chharodi lake village



Graph 2: 3D Contour map of Chharodi lake village



Graph 3: Program report of Chharodi lake Village

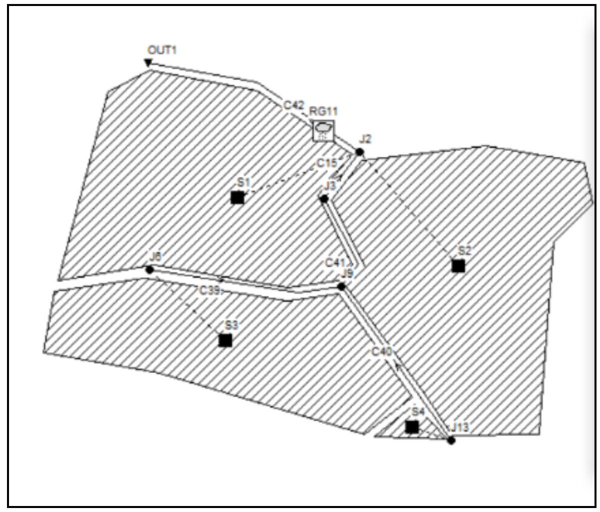


Figure 3: Drainage network of Chharodi lake village with component

Run simulation of Project:

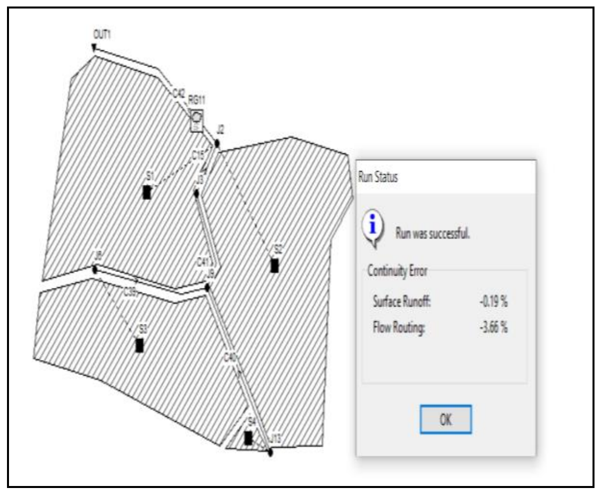


Figure 4: Run Status of project

Status report of project:

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.007)
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DESIGN OF STORM WATER BY USING SWMM SOFTWARE IN CHHARODI LAKE VILLAGE

*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... KINWAVE
Starting Date ............ JAN-05-2020 00:00:00
Ending Date .............. JAN-05-2020 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 01:00:00
Routing Time Step ........ 30.00 sec


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......        10.623         5.000
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         3.747         1.764
Surface Runoff ...........         1.063         0.500
Final Surface Storage ....         5.833         2.745
Continuity Error (%) .....        -0.189
```

```
Continuity Error (%) .....        -0.189


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         1.007        10.065
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.619         6.188
Internal Outflow .........         0.133         1.333
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.291         2.914
Continuity Error (%) .....        -3.661


*************************************
Highest Flow Instability Indexes
*************************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.52
Percent Not Converging      :     0.00


***************************
Analysis begun on:  Wed Feb 12 10:56:34 2020
Analysis ended on:  Wed Feb 12 10:56:34 2020
Total elapsed time: < 1 sec
```

Project Work with map for allNode, Outfall and Sub catchment properties: for J-13 to Out-1& for J-6 to Out-1:

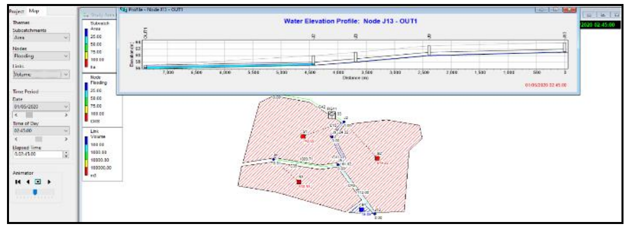


Figure 5: Water elevation of project: J 13 to Out 1

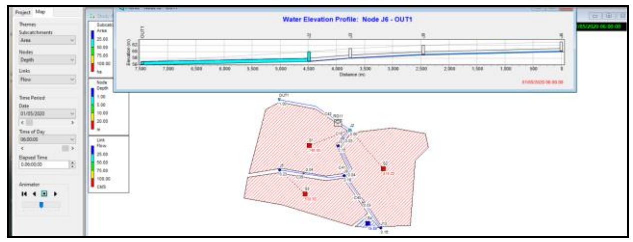
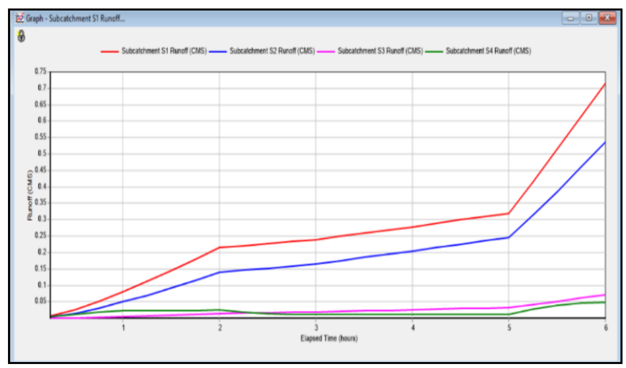
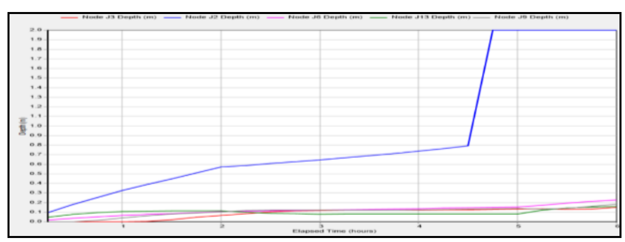


Figure 6: Water elevation of project: J 6 to Out 1

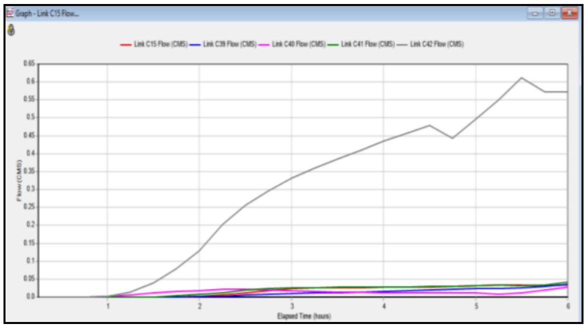
Time Series Scatter Plot Selection with Scatter Graph: for Subcatchment& Node:



Graph 4: All Sub catchment Runoff with respect to Time



Graph 5: All Node Depth with respect to Time



Graph 6: All Conduits Flow with respect to Time

Calculation of Runoff for Chharodi lake Village:

Land use		**Total Area (Sq. km)**		**Total Area %**
1.Residence		13.581		70
2.Lake/land		7.466		20
3.Paved Land (Road)		9.8		10
Land use	Area (Sq. km)	Coefficient	Average Rainfall Intensity (mm/hours)	Total Runoff (m^3/hours)
Residence	13.58	0.40	0.971	5.27
Lake	7.46	0.90	0.971	6.51
Paved land	9.8	0.40	0.971	3.8

Time Series Scatter Plot Selection with Scatter Graph: for Link

VI. CONCLUSION

1. The Land use of Chharodi lake village is cover by residential, Lake and road. The storm water capacity is inadequate to meet the increasing demand. There are 4 number of Sub catchment area, 5 number of Conduits and Junction in Chharodi lake village to mitigate the water logging problem and increasing Mosquitos.
2. There is storm water drainage in Chharodi lake 1000mm Diameter with respect to elevation of water profile which used by software. The minimum velocity of 2.0 ft/sec (0.6 m/sec) with flow at ½ full or full depth and the maximum average velocity of 10-12 ft/sec (2.5-3.0 m/sec) at design depth of flow so, in this software get 0.76 m/sec velocity determined.
3. From drainage network analysis we can conclude that the flow direction of water, Catchment area, Depth of pipe (Conduits) and Junction, flow accumulation means water collecting in sub stream (Outfall), impervious and pervious surface and their factors (Coefficient).
4. From Surface analysis we can observe elevation from contour map, from direction of slope faces. By surface analysis we get topographical information like slope, elevation, hilly area (Latitude, Longitude, Altitude) by TCX Converter and the get graph by QuikeGrid Software.

VII. ACKNOWLEDGEMENT

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