

Design and Mapping of Underground Sewerage Network using GIS & GPS - A Review Paper

Madhuri R. Patil¹, S. M. Bhosale²

¹M-Tech Scholar, Environmental Science and Technology, Department of Technology, Shivaji University, Kolhapur, Maharashtra-416004, India,

²Assistant Professor, Environmental Science and Technology, Department of Technology, Shivaji University, Kolhapur, Maharashtra-416004, India,

Abstract - The village infrastructure, mainly the water supply and sewerage system are vital for rural, household and industrial activities have generated wastewater, and household wastewater contains organic and inert matter in poised, colloidal and dissolved form. The critical issue of grampanchayat is wastewater management in a rural environment. If the grampanchayat wastewater is not suitably collected, treated and disposed, the related effects cause serious peril to the environment.

Many small villages do not have suitable drainage system. As on date all the household wastewater is either send in open drain or in open area around the houses. This is resulting in sterile problems and to provide for; many villages have come up with underground manure collection plan. This study aim at designing collection system for village, the work undertaken uses, GIS as a tool for mapping the collection system (primary and secondary) in order to smooth the progress of further works.

Key Words: Wastewater, colloidal, municipal, underground, sterile, drainage, network and GIS.

1. INTRODUCTION

There are many villages infrastructure, mainly the water supply and sewerage system are vital for urbanization, household and industrial activities have generated wastewater, and household wastewater contains organic and inert matter in poised, colloidal and dissolved form. Now a day's public awareness regarding the treatment of wastewater is increasing because of increasing damage and pollution to the environment. The critical issue of grampanchayat is wastewater management in a rural environment. If the grampanchayat wastewater is not suitably collected, treated and disposed, the related effects cause serious peril to the environment.

Every household is a pollution contributor because of its wastewater, and as per the "polluter pays" concept, every polluter should accept the burden of wastewater treatment. So, to avoid the pollution due to the openly disposed sewage the proper waste water collection system and its proper treatment is necessary.

Many small villages do not have suitable drainage system. In that area there are open gutters used for disposal. At some places the waste water is directly disposed on open grounds near houses. During rainy seasons, due to the intensive rainfall there is overflow of the gutters as a result waste water spreads on open ground and streets. Hence, there is a chance of the contamination of the ground and groundwater resulting from percolation of waste water.

There are probability of spreading of various diseases due to the openly spread waste water. Due to the openly spread waste water there is problem of accident of vehicle due to skidding. So, to avoid the unhygienic conditions & the spreading of the diseases in the area and to keep the healthy environment condition, there must be proper sewage collection system and its disposal with proper treatment.

2. RELEVANCE OF DATA

Many Researchers have given solution for the various villages & cities for providing proper collection system of wastewater. To use given solution by providing proper sewerage system to my case study area.

Hatkanangale village is situated on **16° 44' 38" N Latitude** and **74°26'46" E Longitude**. Hatkanangale is a Taluka in Kolhapur District of Maharashtra State, India. Hatkanangale Taluka Head Quarters is Hatkanangale village.

Hatkanangle village has a population of **approx. 25000**. It faces a harsh problem of collection and treatment of wastewater. According to recent evaluation, for wastewater collection, no system is present in Hatkanangle village. Hence, design & mapping of sewage disposal system which is capable of providing adequate services should be provided in the village.

This project has an objective to design efficient wastewater collection system for the development of Hatkanangle village. It specifically aims to increase access to improve and sustainable domestic sewage disposal system using GIS & GPS and hence provide clean & healthy atmosphere.

Survey of existing network and open drain is carried out. There are no sewer network only open drains and nallas. The total Sewage generated is about 1.52 MLD which directly discharge into nallas and pollute the ground water.

3. PREVIOUS RESEARCH WORKS

1. Urban Development on Sewerage and Sewage Treatment (1993) by CPHEEO manual.

In this manual provides objectives, planning of sewerage system, also show design consideration, population forecast, design criteria, parameters. It provides standard assumptions, tables, and design period for various systems. It provides design of sewer, type of pipe materials, velocity flow and also provides STP process, design and related standard considerations.

2. Swamee, P. K. (2001). "Design of Sewer Line". *Journal Environmental Engineering*.

In this paper provides the major portion of the cost of a wastewater system. In the design of a sewerage system the sewer line is the basic unit occurring repeatedly in the design process. Any savings during the design of this unit will affect the overall cost of the sewerage system. The literature shows that the present status of sewer line designs algorithms use linear programming and dynamic programming. This literature provides the various formulas such as resistance equation, diameter equation, depth equation, maximum velocity and discharge equation and optimization of the equations. Remedial measures are given on minimum cover, self cleansing velocity. In the description of algorithm, the procedure is stepwise given, design example and its solution. An algorithm for optimal design of a sewer line has been described. The resistance equation was used for elimination of design variables.

3. Charalambous, C. and Elimarn, A. A. (1990), "Heuristic Design of Sewer Networks". *Journal Environmental Engineering*.

This paper is presented a Heuristic approaches for the design of sewer networks and the use of standard diameters. This Heuristic provides good and logical (rather than optimal) designs of sewer networks. The necessary and sufficient conditions to determine positions of a lift station are presented in a theorem. Based on this theoretical result, a heuristic design algorithm, using either Manning or the modified Hazen-Williams hydraulic equation, is developed. The proposed heuristic design algorithm takes into account all the structural and hydraulic requirements. In this paper also gives the diagram of geometry of sewer line, shows the level of the pipe. The CPU time for designing sewer networks using the proposed heuristic is less than 10% of the time required for the optimization procedure. Such application indicates the effectiveness of the heuristic in rapidly

providing "good" sewer network designs that are comparable to the optimal ones.

4. Greene, R., Agbenowosi, N. and Loganathan, G. V. (1999). "GIS-based approach to sewer system design". *Journal Environmental Engineering*.

In this paper, planning and design of sewer networks, most decisions are spatially dependent because of the right-of-way considerations and the desire to have flow by gravity. The geographic information system- (GIS-) based approach takes advantage of the spatial analysis capability of GIS in combination with a sewer design program to develop an integrated procedure for the design of sewer systems. The program that was developed uses the user specified manholes' locations to generate the sewer network. The GIS is used to analyze the area's topography, surface features, and street network to delineate sub-watersheds, to locate pump stations, and to determine the path for the force main.

5. Zhao, Y. W., Qin, Y. (2009), "GIS-based optimization for the locations of sewage treatment plants and sewage outfalls - A case study of Nansha District in Guangzhou City, China". *Communications in Nonlinear Science and Numerical Simulation*.

This paper is an application of eco-suitability evaluation based on the GIS spatial analysis to solve the location problem of sewage treatment plants and sewage outfalls. The aim of this study is to identify the critical ecological factors used to be ignored and find a more comprehensive and convenient way to solve the optimization of locations compared to the previous researches. Therefore, the eco-suitability evaluation is introduced to establish the appropriate index system and assess and visualize the suitable areas based on GIS to determine the sewage treatment plants and sewage outfalls locations. As for the case study of Nansha District in Guangzhou City, the eco-suitability evaluation based on GIS is conducted to optimize the locations for sewage treatment and outfalls covering some critical ecological factors. Oriented to the proposed ecological objects and combined with the GIS technology, the simulation results clearly indicate the suitable, generally suitable, and unsuitable location areas, thus facilitating the decision making of the local government in a holistic view of environment management.

6. Gorani, M. A. and Jordan, E. (2012), "Location Optimization of Wastewater Treatment Plants Using GIS: A Case Study in Umm". *Annual Conference of Postgraduate Studies and Scientific Research*.

This paper said up-to-date information system is one of the most useful tools for effective wastewater planning, management and environmental protection. Therefore, it is necessary to have a system which provides

facilities through geo-spatial relationships. GIS-BASED decision support systems for available treatment plants are well suited for informing improved analysis and understanding of the problems of available treatment plants to perform a reliability to improve analysis and understand of the existing situation to choose the appropriate location of treatment through a GIS MODEL BASE using ARCGIS. This study-plan solves the issues and undertaken logics of GIS to identify the critical socio-economic and environmental factors, and find a more comprehensive and convenient way to optimize the locations for wastewater treatment facilities that are suitable for different local conditions. The final map resulting from the multi-criteria analysis gave a total area suitable for wastewater plant of more than 2km of the total area examined. Some areas were obviously unsuitable for their excessive elevation and steep slopes.

7. Fellers J. (2013), "Implementing a Geographic Information System for a Rural Water and Sewer Company: A Case Study of the Newberry County Water and Sewer Authority". Northwest Missouri State University Maryville, Missouri.

In this paper, methodology used in the implementation is derived from previous literature and case studies involving GIS implementation, however, there are some differences in order to meet the needs of NCWSA. Through the pilot implementation, NCWSA has utilized the GIS on a daily basis. The GIS has aided in planning for future capital projects, providing accurate information to maintenance crews during line breaks, and reducing the time required to search for hard copies of as-built drawings, just to name a few. In conclusion, future planning and additions are addressed along with looking at new technology that may help distribute the GIS information to field crews.

8. Muir R. J., "GIS Applications in Urban Drainage Master Planning".

In this paper, GIS applications in water resources management have become widespread and diverse in the province of town. Application areas include urban infrastructure master planning for storm and sanitary drainage systems, water distribution, watershed planning, and regional groundwater protection. This development has occurred despite the challenge faced by users that base data (e.g., DEM's) is not as readily available as in other jurisdictions in North America. Recent applications include aspects of i) data management - reviewing and editing of catchment and infrastructure data for hydraulic simulation models such as XP-SWMM and EPANET, ii) analysis - using custom applications developed for water balance analysis, or using core GIS functions such as geo-processing, surface modelling and hydrologic analysis of major drainage systems within ESRI's Spatial Analyst extension, and iii) presentation - sharing study findings with clients, colleagues and the

public using thematic mapping and 3-dimensional models. These aspects are presented in a case study "City of Stratford, City-Wide Storm System Master Plan", currently being completed on behalf of the City. The study reveals GIS to be as an indispensable, multi-purpose tool for infrastructure master planning that enables sophisticated desktop analyses, efficient simulation model pre and post-processing, and effective data management and communication, all through the use of intrinsic functionality and readily available on-line utilities.

5. METHODOLOGY

In this project, the following methods are to be used as,

✚ Population Projection:

To collect the population details of current year and to do the population forecasting for next some decades of the village.

✚ Population Forecasting:

To calculate the population for next 3-5 decades of the village with help of some methods as Arithmetical Increase Method, Incremental Increase Method & Geometric Progression Method.

✚ Reduced Level:

To find out the reduced levels of each point & to direct of flow of wastewater by using GPS instrument.

✚ Design of Sewer Line:

Wastewater collection system is to provide for the village. So, design of sewer line is most important part of this project. Follow the design criteria & take the useful parameters for the design.

✚ Network of Sewer Line/Pipe:

The planning & controlling of sewer networks & using GIS software to map of sewer line network to the STP.

5. CONCLUSION

After reviewing all the prior researches, we can conclude that the design of sewerage system is most important part of work & also mapping of network. And another part is mapping in GIS software. The main objective of this project is to prepare a base map of work area, contour road network which is also useful for sewer line as sewer lines are located in the centre of road. And the STP locations are also important part of this project. Some researchers are giving the planning & controlling of sewer networks for collection of wastewater.

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