

Public Abstract

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Graduation Term:FS 2016

Department:Civil Engineering

Degree:MS

Title:GIS Gravity Sewer Alignment:

Identifying Energy-Conserving Routes for Critical Shear Stresses

Gravity sanitary sewer design is based on hydraulic principles with the goal of long-term viability by “self-cleansing” action. Traditionally, gravity sanitary sewer systems are aligned directly from origin to destination within existing property boundaries or rights-of-way and suggested velocity constraints. The conventional “rule of thumb” estimates for design velocity, however, do not consistently generate the critical boundary shear stresses for self-cleansing action. The sewer routing methodology proposed herein is based on conserving the potential energy provided by elevation and slope in order to maintain flow, generating sufficient shear stresses for self-cleansing action, and minimizing additional energy inputs and expenses. The methodology deploys tools in the ESRI ArcGIS interface for analysis. The appropriate pipe size based on boundary shear stresses generated, depth of flow constraints, and flow conditions are predetermined calculations. Elevation data of the interest area provides an elevation grid from which the generated boundary shear stresses are determined and compared to the critical shear stress necessary to self-cleansing action by the sanitary sewer particles. The methodology is applied to a small elevation grid for verification of calculations and then to a study area to demonstrate applicability. The self-cleansing route is compared to a direct baseline route for cost parameters that are represented as length and slope ranges. The findings support that the methodology can identify energy-conserving sewer routes that reduce the cost of implementation with less trenching relative to achieving the minimum slope and, by extension, potentially reduce the ongoing operation cost with fewer pumping stations. The method can be applied to new development sites to conserve energy resources by selecting the most efficient and cost-effective routes.