World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:15, No:05, 2021

Culvert Blockage Evaluation Using Australian Rainfall And Runoff 2019

Authors : Rob Leslie, Taher Karimian

Abstract : The blockage of cross drainage structures is a risk that needs to be understood and managed or lessened through the design. A blockage is a random event, influenced by site-specific factors, which needs to be quantified for design. Under and overestimation of blockage can have major impacts on flood risk and cost associated with drainage structures. The importance of this matter is heightened for those projects located within sensitive lands. It is a particularly complex problem for large linear infrastructure projects (e.g., rail corridors) located within floodplains where blockage factors can influence flooding upstream and downstream of the infrastructure. The selection of the appropriate blockage factors for hydraulic modeling has been subject to extensive research by hydraulic engineers. This paper has been prepared to review the current Australian Rainfall and Runoff 2019 (ARR 2019) methodology for blockage assessment by applying this method to a transport corridor brownfield upgrade case study in New South Wales. The results of applying the method are also validated against asset data and maintenance records. ARR 2019 – Book 6, Chapter 6 includes advice and an approach for estimating the blockage of bridges and culverts. This paper concentrates specifically on the blockage of cross drainage structures. The method has been developed to estimate the blockage level for culverts affected by sediment or debris due to flooding. The objective of the approach is to evaluate a numerical blockage factor that can be utilized in a hydraulic assessment of cross drainage structures. The project included an assessment of over 200 cross drainage structures. In order to estimate a blockage factor for use in the hydraulic model, a process has been advanced that considers the qualitative factors (e.g., Debris type, debris availability) and site-specific hydraulic factors that influence blockage. A site rating associated with the debris potential (i.e., availability, transportability, mobility) at each crossing was completed using the method outlined in ARR 2019 guidelines. The hydraulic results inputs (i.e., flow velocity, flow depth) and qualitative factors at each crossing were developed into an advanced spreadsheet where the design blockage level for cross drainage structures were determined based on the condition relating Inlet Clear Width and L10 (average length of the longest 10% of the debris reaching the site) and the Adjusted Debris Potential. Asset data, including site photos and maintenance records, were then reviewed and compared with the blockage assessment to check the validity of the results. The results of this assessment demonstrate that the estimated blockage factors at each crossing location using ARR 2019 guidelines are well-validated with the asset data. The primary finding of the study is that the ARR 2019 methodology is a suitable approach for culvert blockage assessment that has been validated against a case study spanning a large geographical area and multiple sub-catchments. The study also found that the methodology can be effectively coded within a spreadsheet or similar analytical tool to automate its application.

Keywords : ARR 2019, blockage, culverts, methodology
Conference Title : ICHEE 2021 : International Conference on Hydraulic and Environmental Engineering
Conference Location : Sydney, Australia
Conference Dates : May 17-18, 2021