Hydrological and Stochastic Uncertainty: Linking Hydrological and Water Resources Yield Models in an Uncertainty Framework

D.A. Hughes¹, S.J.L. Mallory¹, B. Haasbroek², G.G.S. Pegram³ and E. Kapangaziwiri¹

¹Institute for Water Research, Rhodes University, Grahamstown, 6140, South Africa; ²Hydrosol, Pretoria, South Africa; ³Department of Civil Engineering, University of KwaZulu-Natal, Durban, South Africa.

Standard approaches to water resources assessments in South Africa involve generating time series of natural hydrology at a number of nodes within a basin using a hydrological model coupled with simulating reservoir storage, abstractions, return flows, etc. using a system yield model. To account for some of the uncertainties in the representivity of the natural flow simulations, the yield models currently include a stochastic stream flow generator and the output is typically a yield curve quantifying likely yields with different probabilities of exceedence. Recent developments in hydrological modelling highlights the importance of including parameter uncertainty especially in ungauged basins. However this is difficult to achieve with existing yield models without major structural changes. The alternative is to use the hydrological model to generate natural hydrology ensembles that account for both the parameter uncertainty and the stochastic uncertainty (but using a stochastic rainfall model) and use these ensembles as input to a yield assessment model without using the stochastic stream flow generation component. This paper describes the methods and reports on a comparison of the two approaches in terms of modelling efficiency, similarity of yield probability assessments and the relative contributions of parameter and stochastic uncertainty. This initial study is limited to a single basin (Mgeni River at Midmar Dam) in KwaZulu-Natal Province, South Africa. The hydrological model used is the Pitman monthly time-step model, the rainfall model is a spatio-temporal stochastic model and the system yield model used is the Water Resources Modelling Platform.