

## Environmental protection

### Influence of Catchment Development on Peak Urban Runoff

**A recent WRC-funded study in three catchment areas: Willowspruit, Robert's Place and Rietvlei Dam, Daspoort gauging structure and Kameeldrift catchment.**

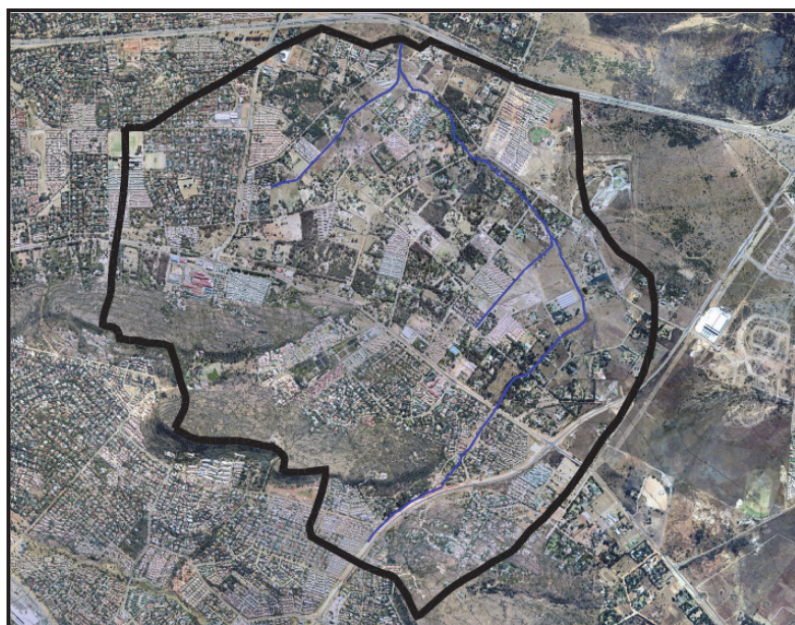
#### Comparative assessment of catchment response

The research reviewed catchment response due to urban development on the basis of comparative assessment. This required the identification of similar rainfall in the catchment during different development stages for which gauged flow rates were recorded. The hypothesis which was reviewed relates to the statement that urban development which creates more impervious areas on the one hand also generated longer times of concentration due to the changes in the length of the flow path as well as more temporal storage capacity which could result in a higher groundwater recharge.

#### Three catchment areas selected

Three different catchments were evaluated:

- Catchment 1 (Willowspruit) in the Tshwane Metropolitan Council Area) was fairly undeveloped for the period for which the discharge was recorded (October 1993 to May 1995).
- Catchment 2 (Robert's Place) is a highly developed urban security complex.
- Catchment 3 (Rietvlei Dam, Daspoort gauging structure and Kameeldrift catchment) were selected to conduct a comparative discharge evaluation for similar rainfall seasons for different levels of catchment development.



*Level of development in the Willowspruit catchment*

## Influence of variation in storm events

Although "similar storms" were selected for comparisons between the discharges during predevelopment versus post development it was realised that even for small catchments the variation in storm events are significant and it was impossible from the limited data to discard the hypotheses. It was concluded that both the temporal rainfall distribution and the influence of antecedent conditions are important when discharge calculating techniques are applied.

## Calculated vs gauged discharged

The assessment of Robert's Place reflected the calculated discharge was at times larger and at times smaller than the gauged discharge. Based on the comparison of calculated discharge (Peak flow rate and volume of discharge) with the recorded data it was impossible to derive any conclusive findings, but to indicate that the modelled results tend to be higher than the recorded runoff data.

## Cumulative rainfall vs cumulated runoff

In the case of the large catchments, a comparison was set between the cumulative rainfall and the cumulative runoff produced by similar rainfall events for different development levels in the catchment. This analysis compared years of similar volumetric rainfall, antecedent conditions and temporal distributions. There was a general trend indicating an increase in the percentage runoff produced as urban development increased, but certain anomalies were observed.

## Identified trends

The study identified trends which reflect that the relationship between the expected increases in urban peak runoff

response resulting from urban development is less than the calculated peak discharge obtained from the use of the deterministic calculation procedures (Rational Method or other deterministic procedures).

## Other influences on runoff

It was also identified that the effect of antecedent conditions (rainfall) is not simply related to the influence on discharge in the following years. Possible causes for this could be related to soil properties and other hydrological parameters.

The effect of temporal distribution seems to have a greater effect on total volume of runoff, but the limited data which was reviewed is insufficient to verify the finding.

## Further research needed

This research project has neither proved with certainty nor disproved the hypothesis that an increase in certain specific urban development will decrease the peak runoff response.

Consideration should be given to conduct further research in this field. It is therefore recommended that further investigation be done for both developed and undeveloped catchments to quantify a full understanding of the influence of drainage structures and different types of catchment development on the stormwater response from urban catchments.

### Further reading:

To obtain the report, *Influence of Catchment Development on Peak Urban Runoff* (Report No: 1752/1/12) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: [orders@wrc.org.za](mailto:orders@wrc.org.za) or Visit: [www.wrc.org.za](http://www.wrc.org.za) to download a free copy.