CHAPTER 6

RUNOFF AND RIVER FLOW

6.1. RUNOFF

6.1.1 Runoff process

The ground rain, i.e. the rain that reaches the ground surface, evaporates, infiltrates or lies in depression storage. Rainwater retained in puddles, ditches, and other depressions in the soil surface is termed ‘depression storage’. It does not always happen that some of the rainwater in every rain event is left on the land surface after evaporation and infiltration losses take place. However, if there is any water left, the land surface will become covered with a film of water known as ‘surface detention’. Besides, almost immediately after the beginning of rainfall excess occurs, the smallest and shallowest depressions become filled and ‘overland’ flow begins to move downslope toward the nearest stream channel. This water, upon entering a channel is referred to as ‘surface runoff’. The channels coalesce into rivers or wadis. Rivers eventually find their way down to the sea or ocean while wadis often disappear after some distance in the desert.

When the rainfall is intense or prolonged, or both, the network of stream channels in a certain catchment may not be able to carry the surplus surface runoff within the defined sections of these channels, and start to overflow and cause inundation as they become filled with water. After all, floods are not limited to humid areas only but can also happen in arid and semi-arid areas.

It should be noted that not all streamflows are a result of surface runoff alone. Streamflow may be the resultant of surface runoff and subsurface runoff (baseflow). “Since baseflow represents the discharge of aquifers, changes occur slowly and there is a lag between cause and effect that can easily extend to periods of days or weeks” [Wilson, 1983].” In arid and hyper-arid zones there is hardly any groundwater-generated baseflow, since the water table is generally below the streambed.

A distinction between arid and humid regions with regard to runoff and streamflow is illustrated schematically in Figure 1 [Margat, 1979].

It is customary to plot streamflow in units of discharge, e.g. m³ s⁻¹, as ordinate against time as abscissa. The resulting graph is known as discharge hydrograph or simply hydrograph. If, instead of the discharge, the water level in a stream is used the graph is then called the stage hydrograph. The water level and streamflow are linked by the so-called rating function.
A perennial stream or river is a stream that never stops flowing throughout the year, thus has a continuous hydrograph. The discharge in the low-flow season is to a large extent sustained by baseflow. In this case the river functions as influent stream in the high-flow season and as effluent stream in the low-flow season. A good example of this is the River Euphrates in Iraq. The hydrograph of such a stream that is fed by both surface and groundwater is shown in Figure 2(a). The perennial rivers in the Arab Region are limited in number. Most of the perennial rivers in northwest Africa are national rivers, with relatively small basin areas and moderate...