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Hydrology

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Introduction

Many challenges in natural resource management centre on hydrology. A good understanding of hydrology leads to better quality surveys of land resources because many aspects of soil formation and landscape evolution are controlled by hydrological processes. Land resource survey, in turn, has the potential to improve analyses of landscape hydrology by providing an integrating framework and primary data to support estimates of infiltration, water storage, deep drainage, groundwater flow, stream flow and water quality.

This chapter contains a broad overview of hydrological processes including an account of the hydrological significance of soil features commonly encountered during survey. Major classes of hydrological models are described along with their data needs. Land resource surveys can make a major contribution to hydrology in this regard by providing primary data across a range of scales.

Hydrological processes

Virtually all water enters the land phase of the hydrological cycle as precipitation. Soil, landform, vegetation and climate then control its fate and it affects both vegetation and flow in streams and groundwater. The pathways by which water moves through the landscape and returns to the atmosphere are known as the land phase of the hydrological cycle (Figure 7.1).

Before describing the components of the hydrological cycle and the properties affecting them, especially soil properties, some fundamental soil hydraulic properties are introduced.

Some fundamental soil hydraulic properties

Soil water potential

Soil water has potential energy, referred to as *water potential*, which determines the state and drives movement of water in soil. Water moves along potential gradients from where potential energy is high to where it is low. The water potential is taken to be zero at a 'free' water surface. Thus, a soil that is completely saturated has zero water potential at the height corresponding to the free water surface. In an unsaturated soil, water potential is negative. The total soil water potential is the sum of three components:

1. The *gravitational potential* is simply the height above a fixed datum. Above this datum, gravitational potential is positive and below it is negative.
2. The *matric potential* occurs as a result of the mutual attraction between water and soil particles. Water is held within soil pores by a negative potential (or suction). As the soil dries, water is extracted most easily from the large pores so that the largest pores empty first followed by successively smaller ones. As progressively smaller pores empty, the