1.3 The water cycle

Most of the precipitation that does not evaporate percolates to the groundwater, drains and watercourses. This amount of water is termed the percolation (Figure 1.3.1). Part of the precipitation falls on paved areas, however, where it cannot percolate, but instead is conducted to watercourses (stormwater discharges). Total percolation in Odense River Basin amounts to an average of 298 mm (Table 1.3.1). The sum of percolation and estimated runoff from paved areas (306 mm in all) corresponds very well to the total riverine runoff (305 mm) calculated from measurements made in the watercourses in the basin (Table 1.3.1).

The riverine runoff consists of wastewater (30 mm) and of diffuse runoff to the watercourses (Table 1.3.1). The wastewater runoff consists of water that has been abstracted from the groundwater for various purposes (Table 1.3.2). The diffuse runoff can be roughly subdivided into two components:

- Groundwater runoff
- Near-surface runoff.

The groundwater runoff consists of water that has been underway for a long time from falling as precipitation to reaching the watercourses. The magnitude of this runoff can be assessed from the water flow in the watercourses during the "drought year" 1995/96 (91 mm), when the near-surface diffuse runoff – via drains etc. – was negligible. Assuming that the groundwater runoff is constant throughout the period, the difference between measured total diffuse runoff and the groundwater will correspond to the near-surface runoff, for example in the form of drain water runoff (i.e. 305 mm – 30 mm – 91 mm = 184 mm) (Table 1.3.1).

Most of the water that flows in the watercourses in Fyn County thus consists of water that reaches the watercourses relatively quickly. If this water is polluted – for example via nitrogen loss from cultivated land – the pollution will rapidly reach the watercourses. Conversely, measures that re-

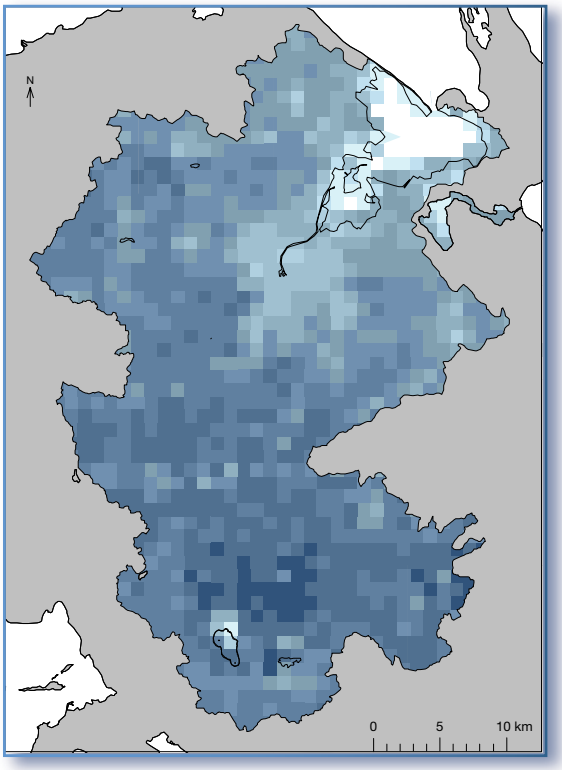

Figure 1.3.1 Percolation from land in Odense River Basin (1999/2000).

Category	Transport	Freshwater input to Odense Fjord
Precipitation	825 mm	
Evaporation	519 mm	
Percolation	298 mm	
Paved areas (stormwater)	8 mm	306 mm
Riverine runoff (measured)		305 mm
Groundwater (=1995/96)	91 mm	
Near-surface (diffuse)	184 mm	
Wastewater (WWTPs, industry)	30 mm	

Table 1.3.1 Water budget for Odense River Basin (1990/91–2000/01).

Table 1.3.2 Water abstraction in Odense River Basin (1998).

Category	mm
Public waterworks	19
Institutional wells	<1
Farm and market garden wells, etc.	4
Industrial wells	3
Minor waterworks (1–10 households)	1
Total abstraction	28

duce discharges from cultivated land will rapidly affect water quality in the watercourses.

A slightly different water balance for Fyn County as a whole has been published by Henriksen & Sonnenborg (2003). In this case, the groundwater runoff to watercourses is calculated to be relatively less and the near-surface runoff relatively greater than indicated in Table 1.3.1. A dynamic water balance model for Odense River Basin is currently being developed via cooperation between national sector research institutions and Fyn County together with associated consultants. The results of this work will be utilized in the future work on implementation of the Water Framework Directive in Odense River Basin, first and foremost to describe the temporal and spatial variation in water transport towards Odense Fjord, but also as a basis for assessing the magnitude and variation in nutrient loading and transport in the basin.

The water cycle in Odense River Basin is affected by a number of human activities, for example abstraction of water for various purposes (Table 1.3.2). Most of this abstraction is accounted for by waterworks (20 mm). The share of water abstraction accounted for by farms and market gardens is relatively modest. Compared with water abstraction for these purposes in the sandy areas in western Denmark, the water requirements of the agricultural sector in Fyn County are considerably less. The abstraction carried out affects water flow in watercourses. The effect is modest if assessed solely on the basis of the total annual runoff in watercourses, but water flow in certain watercourses can be significantly affected during the summer when water flow in the watercourses is least. This aspect is examined more closely in Section 4.2.1.

Finally, the water cycle has been considerably affected by drainage and channelization of watercourses in order to rapidly lead water away from the cultivated fields.