Addendum 2 to Alterra Report 983
"Prediction of Nitrogen and Phosphorus leaching to groundwater and surface waters; Process descriptions of the animo4.0 model. by P. Groenendijk, L.V. Renaud and J. Roelsma, 2005"

Page 75 second part, is replaced by:

9.2.2 ANIMO3.5 limited aeration concept

Since one of the model aims is to evaluate the environmental impacts of water management for a wide range of soil types and a wide range of hydrological conditions, a detailed sub-model describing oxygen diffusion in the soil gas phase and in soil aggregates has been implemented. In this sub-model the aerated fraction per soil compartment depends on:

- oxygen demand, as a result of organic transformations and nitrification. Oxidation of other reduced components (e.g. sulphur) has been ignored.
- soil physics.
- hydrological conditions (partitioning between soil moisture and soil air).

The aeration factor fae has been formulated as an multiplicative factor where f_{ae} = 1 at optimal conditions. For sub-optimal conditions (where f_{ae} < 1), either the diffusive capacity of the unsaturated zone is insufficient to fulfill the oxygen requirement or the top soil layers are too wet by intensive rainfall for diffusive transport during a part of the time step considered.

The impact of temporal anaerobiosis is estimated by multiplying the oxygen demand rate by 1-f_{tae}, where f_{tae} is fraction of the timestep where anaerobic conditions occurs due to moisture saturation. f_{tae} for compartment *i* is calculated according to:

$$f_{tae,i} = 1 - \min\left[1, \max\left(0, \frac{\sum_{j=1}^{i\max} k_{sat,j} - (q_p^n + q_{irr} - q_{es} - q_{ep})}{k_{sat,i}}\right)\right]$$

where k_{sat} is the saturated conductivity, *imax* is the compartment number with its bottom at 0.3 m below soil surface and q_p^n, q_{irr}, q_{es} and q_{ep} or input and output fluxes at *z*=0 as indicated in Par. 3.1.

In situations where partial anaerobiosis occurs, the oxygen demand for the organic transformations is met by atmospheric oxygen as well as by nitrate-oxygen (Fig. 9.2). The nitrification rate will be sub-optimal. Under these conditions, the available nitrate will be reduced partial or complete (denitrification). Under unfavorable wet conditions the upper compartments consume all oxygen which can enter the soil profile by diffusion and no atmospheric oxygen will penetrate into the lower part of the unsaturated zone. The partitioning between the aerobic soil fraction and the anaerobic soil fraction is determined by the equilibrium between oxygen demand for organic conversion processes plus nitrification and the oxygen supply capacity of the soil air and soil water system. Both the vertical diffusion in air filled pores and the lateral oxygen diffusion in the soil moisture phase have been taken into account. Fig. 9.3 shows the two diffusive transport mechanisms schematically.