

## FEFLOW

Delineation of capture zones, determination of water origin and risk assessment

Guaranteeing the quantity and quality of available tap and service water is a common challenge in urban areas and for industrial installations. Numerous factors may put supply safety at risk – their identification and quantification are important tasks for groundwater modelling. Informed decisions on capture zone protection require particular insights into the groundwater flow system. For this, access to appropriate tools is essential. FEFLOW enables you to accurately and easily delineate capture zones in two-dimensional (2D) and three-dimensional (3D) groundwater models. It also helps you determine the water origin and proportions of the respective sources within each individual capture zone. This knowledge can then serve as a basis for detailed risk assessment.

### TYPICAL APPLICATIONS

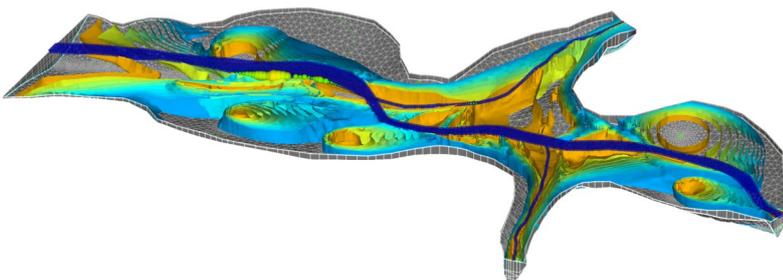
- Catchment zone delineation in 2D and 3D
- Analysis of water origin within each individual capture zone
- Analysis of travel times
- Spatio-temporal optimisation of water resources via pumping schemes and use of managed aquifer recharge (MAR) and aquifer storage and recovery (ASR) systems
- Water-availability estimation
- Analysis of hydraulic connections between different water systems, such as surface water and groundwater, or different groundwater systems
- Mixing processes of different water sources, for example fresh water and saline/brackish groundwater

### BENEFITS

- Easy workflows through groundwater age functionality
- Convenient delineation of capture zones in 2D and 3D with direct export functionality in different file formats
- Consideration of uncertainty for capture-zone delineation
- Capability of capture zone analysis for an individual outflow boundary
- Capability of using FePEST for impact analysis

### FEATURES

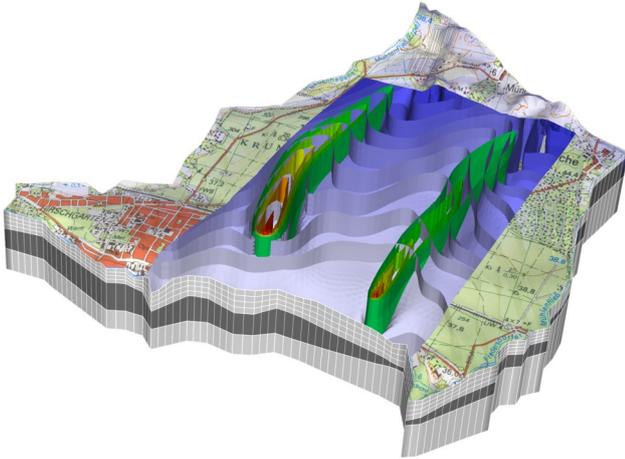
- Forward and backward particle tracking
- Random-walk particle tracking including dispersion
- Travel-time analysis based on particles
- Direct simulation of groundwater age (travel time since inflow)
- Direct simulation of lifetime expectancy (travel time until outflow)
- Direct simulation of exit probability, providing probabilistic information about the capture zone boundary in 3D



3D distribution of lifetime expectancy (LTE).

## CAPTURE ZONE AND TRAVEL TIME

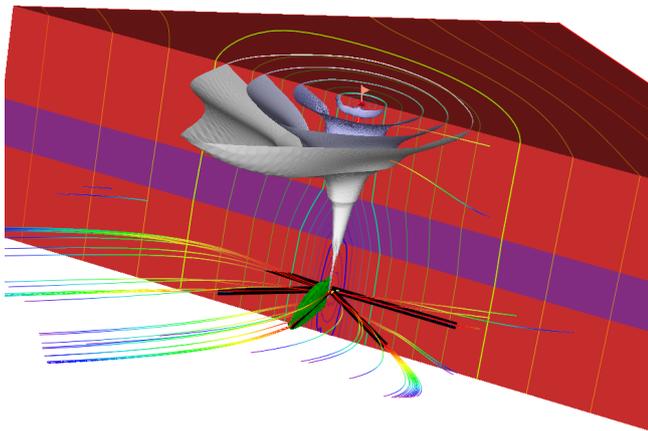
Groundwater-age based methods provide the means for a straight forward capture zone calculation for a single well, a number of wells or an entire well field. At the same time, they provide information about groundwater travel times. All of this is crucial for sound risk assessment regarding quantity and quality of the groundwater used for water supply.



3D well capture zone (red/green isosurfaces) and mean life time expectancy (blue isosurfaces).

## ATYPICAL COLLECTION STRUCTURES

Not all wells are standard vertical boreholes with a screened interval. This is why the FEFLOW capture zone analysis tools can work with the real structures – regardless of whether they are regular wells, horizontally screened ('Ranney') wells, drainage pipes, shafts or old Arabic qanats.



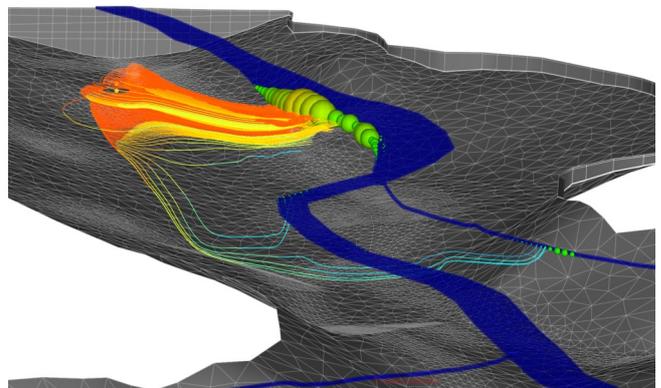
3D capture zone of a Ranney collector well (combination of vertical and horizontal well screens).

## PARAMETER UNCERTAINTY

No matter how thorough both data acquisition and simulation are done, some uncertainty will always remain in the model input data. FEFLOW has the means to transparently deal with parameter uncertainty – by providing a bandwidth of possible answers to a certain question, by supplying results in terms of probability, or by determining best-case and worst-case scenarios.

## WATER SOURCE ANALYSIS

Precise knowledge of the origins of water exiting the model at a well or well field is very valuable information, especially for risk assessment and water-quality considerations. Based on calculating the probability of water exiting at a certain location (exit-probability calculation), the sources of the water can be easily quantified and visually depicted.



Visualisation of water sources (bullets), flow traces and travel times for a pumping well.

## OPTIMISATION OF PUMPING SCHEMES

Capture zones highly depend on the hydrological and hydrogeological setting and pumping strategies, such as spatial and temporal distribution, depth of well screens, well diameters, and so on. To assure optimal use of the commonly scarce resource and to secure a sustainable production, the abovementioned factors can be optimised. The capture zone information obtained from FEFLOW simulations is invaluable knowledge for decision makers and stakeholders for improving well-field operation and design. By adjusting pumping rates, for example, the ratio of water originating from artificial infiltration, river bank filtration, and areal groundwater recharge can be adjusted to an optimum. In cases where certain wells show contamination beyond the legal limit, pumping can be optimised to reduce the concentrations in the mixed water to an acceptable amount.

Contact us: MIKE Powered by DHI Client Care - [mike@dhigroup.com](mailto:mike@dhigroup.com)

For more information visit: [www.mikepoweredbydhi.com](http://www.mikepoweredbydhi.com)