Groundwater modelling tool for well flow in layered aquifer systems

MLU for Windows is an analytical groundwater modelling tool to compute heads and drawdowns, analyse a variety of aquifer test data and design well fields in layered aquifer systems.

The **UNESCO IHP edition of MLU for Windows** comprises a fully functional special edition with high capacities that are only slightly limited compared to the full version.

As a rule, present day computer codes for aquifer and slug test analysis still use the same solutions and techniques that were common several decades ago. Each type of aquifer test, characterized by a long list of conditions and assumptions, is associated with a particular analytical solution (e.g. Theis, Hantush) for only one aquifer. The related procedures to determine the aquifer properties (usually two or three) often require straight-line fitting or type curve matching with some part of the measured data. Unlike such traditional aquifer test software, MLU uses a unique single generalized solution technique for well flow.

MLU for Windows is based on:
- An innovative analytical solution technique for well flow in layered aquifer systems
- Stehfest's numerical method to convert the solution from the Laplace into the real domain
- The superposition principle, both in space (multiple wells) and time (variable discharges)
- The Levenberg-Marquardt algorithm for parameter optimization (automated curve fitting).

This unique combination of techniques allows for all tests to be analysed in a consistent way with a single user interface: recovery tests, variable discharge tests, step-drawdown tests, complex tests in well fields and slug tests. It also handles partially penetrating and large-diameter wells and double-porosity systems. Results are printed in ASCII files and plotted as time-drawdown graphs and animated contour plots.

Theoretical background information on the applied analytical solution techniques for multiple aquifer systems has been published in, e.g.: Journal of Hydrology, vol 90, pp 231–249 (1987) and vol 225, pp 1–18 and pp 19–44 (1999).
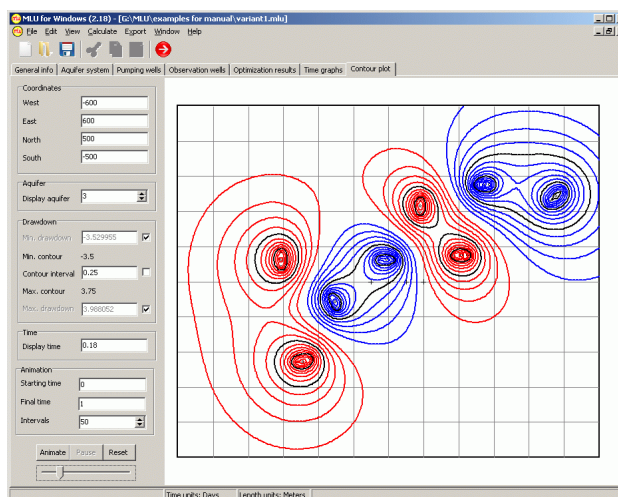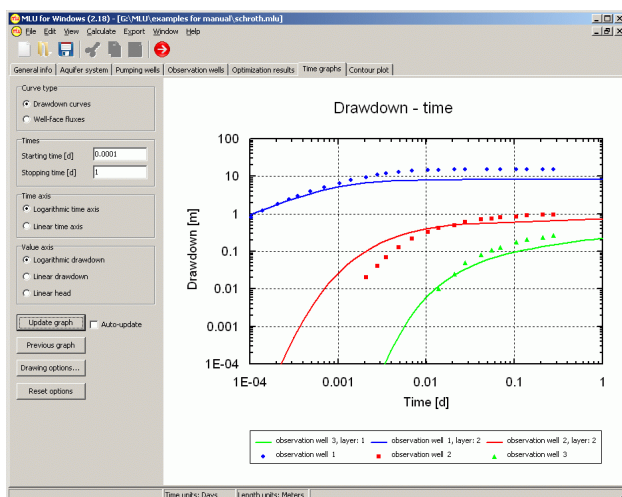
UNESCO IHP edition of MLU for Windows – capacities
- 1 or 2 aquifers (layers) and up to 3 aquitards
- 1 or 2 pumping and injection wells
- Up to 50 pumping periods per well
- Up to 5 observation wells
- Up to 100 measured drawdowns per observation well
- Up to 6 parameters to be optimized in one run
- Time conversion: seconds, minutes, hours, days and years
- Length conversion: meters, feet

Modelling features
- Layered aquifer systems, i.e. multi-aquifer systems (aquifers and aquitards) and layered (stratified) aquifers
- Confined, leaky and delayed yield aquifers
- Effects of aquifer and aquitard storativities
- Multiple pumping and injection wells
- Variable pumping rates for each well
- Multiple well screens in any selection of aquifer layers
- Finite diameter well screens
- Well bore storage and skin effect for each pumping well
- Delayed observation well response
- Individual and grouped parameters to be determined in one run

Input & output
- Data exchange with spreadsheets (copy and paste)
- ASCII data files
- Linear, semi/log-log time graphs of drawdown or head
- Time-variant aquifer discharge at a well screened over multiple aquifers
- Animated contour plots of drawdown and build-up cones
- Clipboard bitmap and vector-based metafile output
- Data files that contain computed heads of displayed time graphs or contour maps
- Conversion to Finite Element Model output file

▶ The UNESCO IHP edition of MLU for Windows is a contribution of the Netherlands to the International Hydrological Programme (IHP) of UNESCO.

▶ **Free download from www.hydrology.nl**

More information about MLU for Windows at www.microfem.nl