DETERMINATION OF RIVER BED CONDUCTANCE BY MONITORING DATA. NUCLEAR ENERGY CONSTRUCTION SITE, HUNGARY

Client: Government of Hungary

Issue: River bed conductance is required for numerical model to predict inflow into excavations

Solution: The required parameters were determined from analysis of long-term records of shallow water table in monitoring wells and Danube River hydrograph

ANSDIMAT+ was applied to determine the hydraulic connection between the Danube River and the underlying aquifer at a Nuclear Power Plant construction site in Hungary (Fig. 1.). The aquifer and river bed properties were required as inputs in numerical models to predict inflows in excavations during construction of a nuclear station.

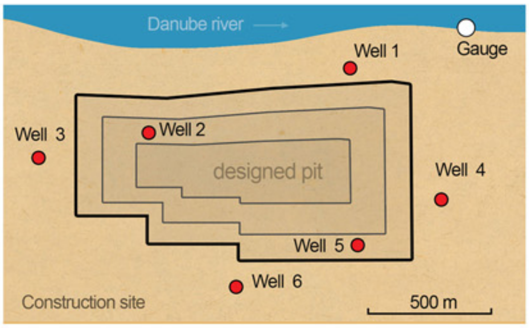

Fig. 1. Location map of the construction site.

The site conceptual model is presented on Fig.2: it consists of two hydrogeological units hydraulically connected with each other and with the river. In this conceptual model, surface-groundwater interactions are essential and, therefore, interpreted parameters include:

- The retardation factor of river bed ΔL
- Hydraulic diffusivity of the river bed ***a*** (or ***a = k * saturated thickness / specific yield***)
- Hydraulic conductivity of the aquifer ***k***
- Leakage factor ***B***

The retardation factor ΔL can be directly converted to River Bed Conductance, that is required to simulate aquifer-river interactions by groundwater flow numerical models (such as MODFLOW or FEFLOW).

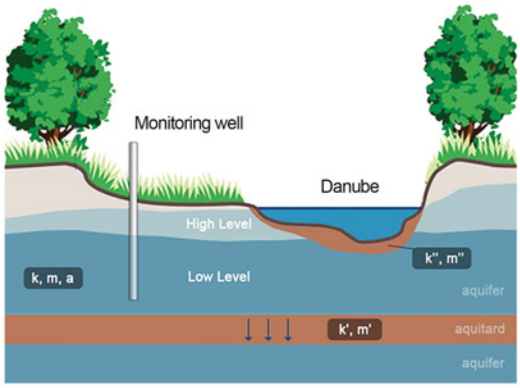

Fig. 2. NPP site conceptual model.

Interpretation was conducted through the "Matching parameters" dialog window in ANSDIMAT+ (Menu "Aquifer test analysis > Direct solution> Matching parameters"). Assigning the conceptual model "Monitoring" enabled interpretation of parameters using the Hantush solution with accounting for surface-groundwater interactions.

The water level changes in Danube River was approximated in ANSDIMAT by a step-wise function as illustrated by Fig. 3.

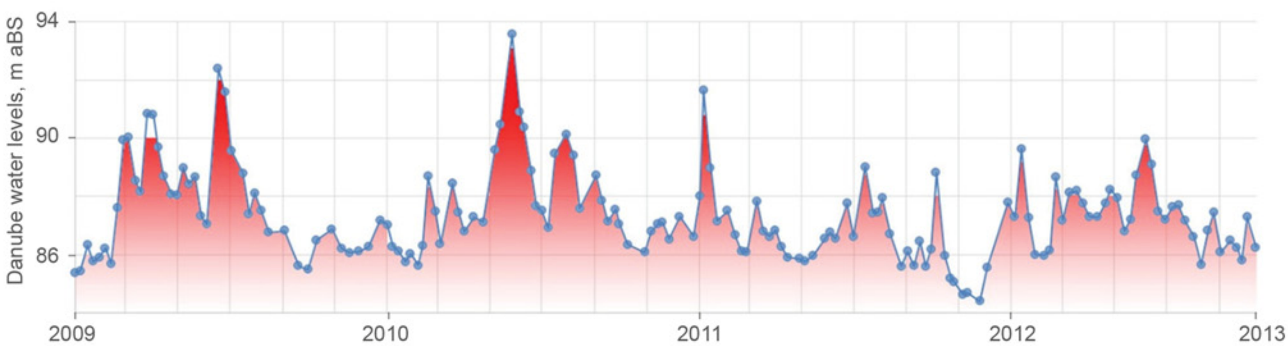

Fig. 3. Recorded Danube River hydrograph and approximating step-function.

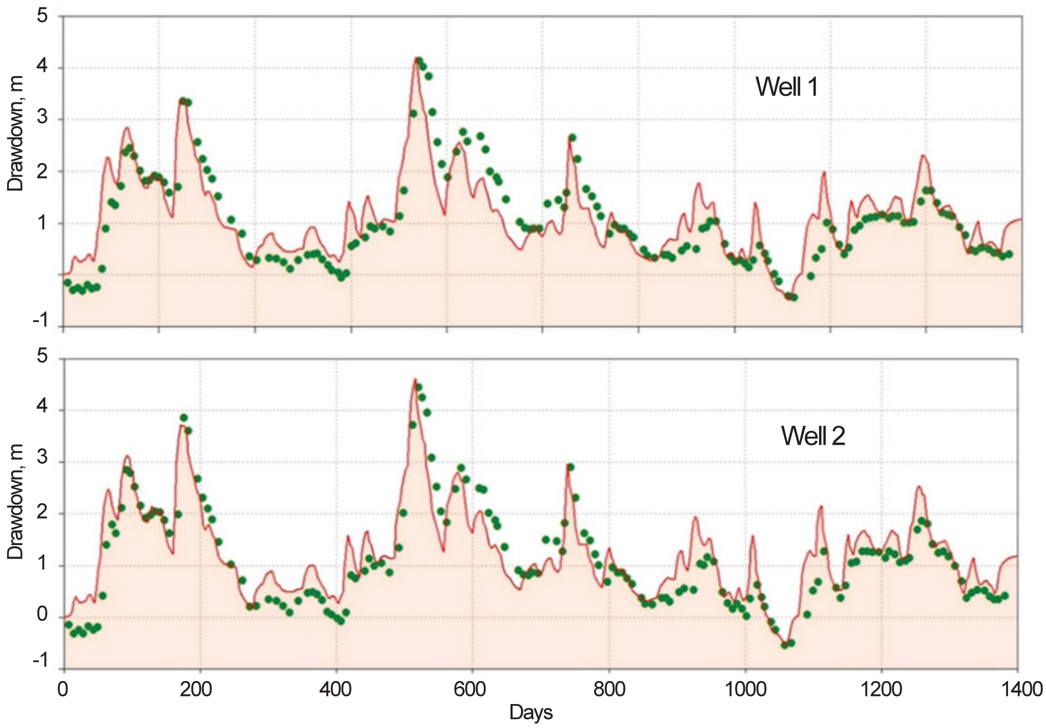

Fig. 4. Examples of calculated and measured hydrographs (Wells 1 and 2) in time interval between January 13, 2009 and November 25, 2012; green dots – measured drawdown data; red line – calculated drawdown.

Table. NPP site interpretation results

Borehole	Distance to the river/channel, m	Flow parameters		
		a, m^2/d	ΔL , m	*B*, m
Well 1	272	25000	200	1000
Well 2	338	25000	170	900
Well 3	397	35000	100	2000
Well 4	816	15000	200	1200
Well 5	912	40000	200	1500
Well 6	1039	45000	170	2500

A good match was obtained between theoretical curves and monitoring data (**Fig. 4**), confirming the validity of fitted parameters. Interpretation results (**Table**) indicate a relatively good and homogeneous hydraulic connection between ground- and surface water in the vicinity of the Danube River. These parameters were later used in a numerical model to predict groundwater inflows into the excavation pit during construction and prepare a mitigation plan.