Infrastructure

As a result of several successful research and development projects in recent years, our equipment portfolio has been significantly upgraded with state-of-the-art laboratory instruments and field-testing devices.

The department operates three specialized laboratories covering the fields of **water chemistry, geotechnics, and soil testing**. These facilities enable us to perform a comprehensive range of laboratory analyses, several of which are uniquely available at our institution within Hungary. In addition, our extensive collection of field equipment supports a wide variety of in situ investigations.

Our **soil testing laboratories** are equipped to determine **Atterberg limits** and **particle size distribution**, using both **sieve analysis** and **hydrometer analysis**. Furthermore, we perform various **shear strength tests**, including **direct shear**, **simple shear**, and **rotational shear tests**, as well as **Brazilian tensile strength tests**. Direct shear box tests can be carried out using several different specimen sizes. Soil compaction characteristics are determined by means of the **Proctor test**, while consolidation behaviour can be investigated using both **small- and large-scale oedometer apparatuses**.

The laboratory is also capable of determining the **organic matter content, carbonate (lime) content, and moisture content** of soils, as well as their **cation exchange capacity (CEC)** and **water absorption capacity (Enslin test)**.

The **hydraulic conductivity (permeability)** of various soil types, including both granular and cohesive materials, can be measured using **rigid-wall** and **flexible-wall permeameters**.

Our **water chemistry laboratory** is equipped for the determination of a broad spectrum of chemical constituents. We routinely analyze the concentrations of numerous elements (Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cu, Cs, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Hg, Ho, In, Ir, K, La, Li, Lu, Mg, Mn, Mo, Na, Nb, Nd, Ni, Os, P, Pb, Pd, Pr, Pt, Rb, Re, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Th, Ti, Tl, Tm, U, V, W, Y, Yb, Zn, and Zr), together with the determination of major anions, including **nitrite, nitrate, chloride, sulfate, phosphate, and carbonate**. In addition, a comprehensive set of basic water quality parameters can be measured, including **temperature, pH, redox potential (Eh), electrical conductivity (EC), dissolved oxygen (DO), total dissolved solids (TDS), and chemical oxygen demand (COD)**.

Our field instrumentation supports both **manual and machine-assisted drilling operations**, soil and groundwater sampling, and the installation of **groundwater monitoring wells**. The geotechnical properties of soils can be assessed using **Light Weight Deflectometer (LWD) testing**, various **dynamic probing methods** (light, heavy, and **Standard Penetration Test – SPT**), **field vane shear testing**, and **penetrometer tests**.

We possess the necessary equipment to perform essential **pumping tests**, on-site **hydrochemical monitoring** (including field measurements of pH, electrical conductivity, dissolved oxygen, etc.), as well as both **continuous and periodic monitoring of groundwater levels and discharge rates**.

For laboratory investigations, we also provide **soil and water sampling services**. In addition, the verticality (inclination) of wells can be measured using our **digital inclinometer systems**.

To characterize infiltration properties, several types of infiltrometer tests are available, including tension infiltrometer, single-ring (tube) infiltrometer, and Guelph permeameter tests.

Geotechnical Soil Testing Laboratory

I. **Location:** Building C/2, Bay 1, Ground Floor, Laboratory 10
II. **Operating Institute:** Institute of Water and Environmental Management
III. **Head of the Laboratory:** Dr. Tamás Kántor, Associate Professor
IV. **Purpose and Activities in Education, Research, and Scientific Services**

The primary objective of the laboratory is to provide a comprehensive platform for **soil mechanics and geotechnical testing**, covering a broad spectrum of standardized laboratory investigations. The facility is equipped to perform tests in accordance with internationally recognized standards while also supporting the design, development, and implementation of innovative, custom-built testing devices and experimental methodologies. In addition, the laboratory serves as a center for coordinating geotechnical research and scientific collaborations.

From an educational perspective, the laboratory aims to familiarize students with the experimental determination of the **shear strength** and **compressibility characteristics** of soils. It also provides a dedicated research environment for carrying out laboratory investigations associated with **BSc and MSc theses, as well as PhD dissertations**.

V. **Laboratory Testing Capabilities and Services**

- Oedometer tests (small- and large-scale specimens)
- Shear strength tests (direct shear, annular ring shear, and large-scale shear box tests)
- Unconfined compression, triaxial, and dynamic triaxial tests
- Hydraulic conductivity (permeability) tests using rigid-wall and flexible-wall permeameters
- Soil compaction tests

VI. **Laboratory Equipment and Major Instrumentation**

- **TX 160 custom-developed triaxial loading frame**, equipped with a **CONTROLS pressure control panel**, proprietary control software, and a custom-designed volumetric measurement sensor.
- **Wykeham Farrance – Shearmatic Direct Shear Testing System**, supplied with interchangeable shear boxes of various dimensions.
- **Wykeham Farrance – TRITEC 100 kN Dynamic Triaxial Testing System** for advanced cyclic and dynamic loading applications.
- **Wykeham Farrance – Annular Ring Shear Apparatus** for residual and large-displacement shear strength determination.
- **Six-station oedometer testing system**, capable of accommodating specimens with different diameters.
- **Proctor compaction apparatus** for the determination of optimum moisture content and maximum dry density.
- **MTV07-GG Large-Scale Shear Testing Device**, designed as a versatile multi-purpose testing system.

- **Custom-built multi-purpose specimen preparation unit**, developed for the manufacture of laboratory specimens, including triaxial test samples.

Hydrogeological and Geotechnical Teaching Laboratory

I. **Location:** Building C/2, Bay 1, Ground Floor, Laboratory 23
II. **Operating Institute:** Institute of Water and Environmental Management
III. **Head of the Laboratory:** Dr. Tamás Kántor, Associate Professor
IV. **Purpose and Activities in Education, Research, and Scientific Services**

The primary purpose of the laboratory is to support the practical training activities associated with the courses offered by the Institute. To facilitate this mission, the laboratory has been designed to accommodate **12–18 students** and is organized into **six individual workstations**, enabling undergraduate and graduate students to gain hands-on experience in laboratory methods related to **soil mechanics, geotechnical engineering, and hydrogeology**. During practical sessions, students become familiar with the principles of laboratory testing, as well as the operation and application of the associated equipment.

In addition to its educational role, the laboratory also provides facilities for carrying out measurement and testing tasks related to industrial collaborations and scientific services, including **soil identification, soil description, permeability testing**, and other routine laboratory investigations.

V. **Laboratory Testing Capabilities and Services**

- Soil identification tests (particle size distribution and Atterberg limits)
- Hydraulic conductivity (permeability) tests using rigid-wall and flexible-wall permeameters
- Water absorption capacity tests (Enslin–Neff method)
- Pycnometer tests for the determination of particle density

VI. **Laboratory Equipment and Major Instrumentation**

- **Wille flexible-wall permeameter system (triaxial cell configuration)**
- **Rigid-wall permeameters** for laboratory hydraulic conductivity testing
- **Retsch sieve set**, equipped with an automatic sieve shaker
- **Equipment for Atterberg limits determination**, including **Casagrande liquid limit devices** and a **cone penetrometer**
- **Enslin–Neff apparatus** for water absorption capacity measurements
- **Hydrometer analysis set**
- **Laboratory drying oven**
- **Six fully equipped laboratory workstations**, providing a total capacity of **18 student places**
- **Precision balances** for laboratory measurements

Water and Soil Chemistry Laboratory

I. **Location:** Building C/2, Bay 1, Ground Floor, Laboratory 24
II. **Operating Institute:** Institute of Water and Environmental Management
III. **Head of the Laboratory:** Dr. Márton Tóth, Assistant Professor
IV. **Purpose and Activities in Education, Research, and Scientific Services**

The laboratory is primarily dedicated to **water chemistry and soil chemistry research**, and its instrumentation and facilities have been developed to support these specialized fields.

The laboratory mainly serves as a research facility for **undergraduate, graduate, and PhD students**, providing the infrastructure required for experimental work associated with their academic and scientific projects. In addition, the laboratory equipment and analytical methods are regularly incorporated into educational demonstrations linked to the Institute's teaching activities.

The facility can accommodate **4–8 individual research workstations**, which are also available for measurements and analytical tasks performed within the framework of industrial collaborations and scientific service activities.

A distinctive feature of the laboratory is its active involvement in the development and implementation of **novel and innovative experimental methods** related to soil and water chemistry.

V. **Laboratory Testing Capabilities and Services**

- Contaminant transport studies using the **DKS permeameter system**
- Water and soil chemistry analyses (including pH, water hardness, dissolved ions, and related parameters)
- Chemical elemental composition analyses
- Ozonation and ozone-based water treatment experiments

VI. **Laboratory Equipment and Major Instrumentation**

- **Agilent MP-AES (Microwave Plasma–Atomic Emission Spectrometer)** for elemental analysis and chemical composition determination
- **Muffle furnace** for high-temperature thermal treatments and ignition loss determinations
- **Eight fully equipped research workstations**, providing a total capacity of **16 users**
- **Analytical and precision balances**
- **DKS permeameter system** for contaminant transport and permeability investigations

Hydrogeological Field Station

I. **Location:** Area behind the Applied Earth Sciences Research Institute (AFKI)
II. **Operating Institute:** Institute of Water and Environmental Management
III. **Head of the Facility:** —
IV. **Purpose and Activities in Education, Research, and Scientific Services**

The primary objective of the **Hydrogeological Field Station** is to expand the range of demonstration facilities available for **well hydraulics and groundwater engineering education**, while providing a dedicated site where students can gain practical experience with the operation, monitoring, and maintenance of groundwater abstraction systems.

In addition to its educational role, the station serves as a field research facility supporting scientific investigations related to hydrogeology and geotechnical engineering. A secondary function of the site is the storage and maintenance of field equipment used for various in situ investigations.

The grassland area located between the **UV Hill** and the **FIEK Centre**, adjacent to the field station, regularly hosts educational demonstrations and research activities associated with **in situ geotechnical testing**, providing students and researchers with hands-on experience in field investigation techniques.

V. **Testing Capabilities and Services**

- Pumping tests
- Groundwater discharge measurements
- Interference tests between pumping and observation wells
- Artificial recharge (reinjection) tests
- Drilling and soil sampling operations
- Dynamic probing tests
- Light Weight Deflectometer (LWD) tests
- Penetrometer tests
- Groundwater level monitoring

VI. **Field Equipment and Major Instrumentation**

- **Two production wells and eight observation wells**
- **Well pumps**
- **Submersible pumps**
- **ZORN Light Weight Deflectometer (LWD)** for dynamic plate load testing
- **Groundwater level meters**
- **DATAQUA field monitoring instruments**
- **Dynamic probing equipment**

- **Surveying instruments**

Institute Library

I. **Location:** Building A/4, Ground Floor, Room 36
II. **Operating Institute:** Institute of Water and Environmental Management
III. **Head of the Library:** —
IV. **Purpose and Activities in Education, Research, and Scientific Services**

The Institute Library houses an extensive collection of **Hungarian and English-language professional literature** covering the fields of **hydrogeology, engineering geology, and geotechnical engineering**. In addition to textbooks and reference works, the library maintains an archive of **BSc and MSc theses** completed within the Institute.

The collection also includes a substantial number of volumes of the **Hungarian Hydrological Yearbooks (Vízrajzi Évkönyvek)**, as well as issues of the internationally recognized journal **Water Resources Research** and the Hungarian scientific periodical **Hidrológiai Közlöny**.

A selection of books is available for student borrowing, while rare and archival materials may be consulted exclusively on-site. Among the most frequently borrowed publications are those focusing on **landfill engineering, contaminated site remediation, environmental geotechnics, and water resources protection**.

V. **Library Services**

- Consultation of the *Hungarian Hydrological Yearbooks (Vízrajzi Évkönyvek)*
- Reading of Hungarian and English-language professional literature
- Access to the Institute's archive of BSc and MSc theses

VI. **Collection Highlights and Major Holdings**

- **János Urbancsek: Well Registers (Kútkataszterek)** – complete 11-volume series
- **Engineering Geological Atlas Series (Építésföldtani Atlasz-sorozat)**
- **Hungarian Hydrological Yearbooks (Vízrajzi Évkönyvek)**
- **Hidrológiai Közlöny (Hungarian Hydrological Bulletin)**
- **VITUKI Publications (VITUKI Közlemények)**
- **Annual Reports of the Bükk Karst Groundwater Monitoring System**, available from 1992 onwards

Institute Computer Laboratory

I. **Location:** Building C/2, Room 113
II. **Operating Institute:** Institute of Water and Environmental Management
III. **Head of the Computer Laboratory:** —
IV. **Purpose and Activities in Education, Research, and Scientific Services**

The primary function of the **Institute Computer Laboratory** is to support educational activities by providing students with practical experience in the application of modern engineering and scientific software packages. The laboratory enables undergraduate, graduate, and doctoral students to develop computational skills that are essential for solving complex problems in the fields of **hydrogeology, groundwater management, and geotechnical engineering**.

In addition to its educational role, the facility supports research and scientific service activities through the use of advanced numerical modelling and data visualization tools.

V. **Computational Capabilities and Services**

- Development and execution of groundwater flow and contaminant transport models
- Geotechnical calculations and numerical modelling
- Two- and three-dimensional visualization and graphical analysis of modelling results

VI. **Software Resources and Major Applications**

- **Golden Software Grapher** and **Golden Software Surfer** for scientific graphing, spatial data processing, and surface modelling
- **SoilVision** and **GEO5** software packages for geotechnical analysis and design
- **Processing MODFLOW** for groundwater flow modelling and hydrogeological simulations
- **Microsoft Office Suite**

Shared Research Equipment Pool

In addition to the laboratory-specific infrastructure, the Institute maintains a shared pool of specialized research equipment that supports educational, research, and scientific service activities across multiple disciplines.

I. Major Equipment

- **DJI Mavic 2 Enterprise Dual unmanned aerial vehicle (UAV)**, equipped with integrated visual and thermal imaging cameras for aerial surveying, infrastructure inspection, environmental monitoring, and field documentation.
- **Acoustic field leakage detection system with ground microphone**, designed for the detection and localization of subsurface water leaks and pipeline defects.
- **CraftBot Plus 3D printer** for rapid prototyping and the fabrication of custom laboratory components, research equipment, and educational demonstration models.
- **CraftBot Flow IDEX dual-extruder 3D printer**, enabling the production of complex multi-material prototypes and customized experimental accessories for research and teaching purposes.