



Hydrogeology

Groundwater is one of our country's most valuable natural resources, and for nearly two decades LimnoTech has provided client services in hydrogeology, the science dealing with groundwater occurrence, movement, and quality.

The science of hydrogeology is interdisciplinary in scope, involving the application of physical, chemical, and mathematical sciences. LimnoTech's staff of experienced scientists compose the diverse team of technical resources required to address the complex, and often misunderstood, issues of groundwater quality and dynamics, and associated surface water interactions. LimnoTech provides targeted site investigations, data interpretation, and modeling skills to address all aspects of hydrogeologic evaluations for remediation and management decision-making.

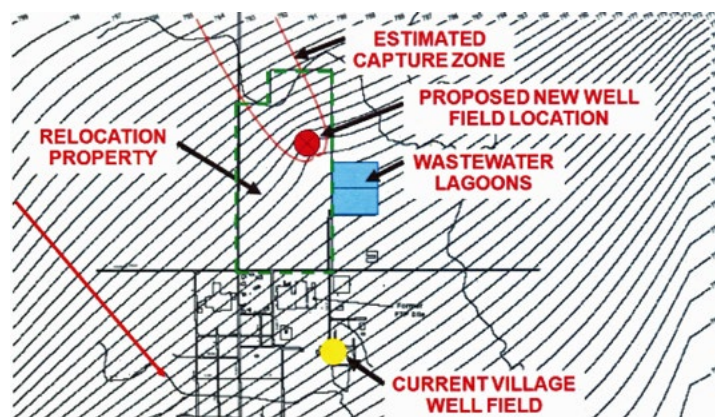
LimnoTech Services

- Geologic and hydrogeologic characterizations, including interpretation and modeling of complex glacial and bedrock systems.
- Field investigations.
- Aquifer pumping tests.
- Groundwater monitoring programs.
- Wellhead protection programs.
- Source water identification, assessment, and planning.
- Aquifer classifications.
- Drinking water regulatory support.
- Contaminant source identification.
- Groundwater/surface water interactions (GSI) assessments.
- Fate and Transport Modeling.
- Time-of-Travel Assessments.
- Watershed management.

LimnoTech Experience

- LimnoTech successfully located a groundwater resource to replace an existing municipal well field that was potentially threatened by contamination.
- LimnoTech's geologic and hydrogeologic evaluations of a groundwater solvent plume at a Superfund site in southwest Michigan resulted in a Record of Decision (ROD) that was the first in Michigan to recommend natural attenuation as the preferred remedy for groundwater impacts.

- LimnoTech staff have synthesized and interpreted large sets of soil and groundwater data to support environmental litigation projects, and provided expert technical evaluations and testimony concerning issues such as commingling of groundwater impacts; susceptibility of groundwater to dioxin, PCB and mirex contamination; fate and transport of groundwater impacts; and identification of Potentially Responsible Parties (PRPs).
- LimnoTech has designed and installed soil boring and monitoring well programs for dozens of CERCLA, RCRA, UST, and industrial facilities for source identification, to assess the extent and distribution of toxic compounds in soils and ground-water, and to develop groundwater treatment systems.
- LimnoTech staff have designed and implemented aquifer performance evaluations to characterize aquifers for remediation and municipal water supplies.
- LimnoTech is experienced in groundwater flow field and contaminant transport modeling of single- and multiple-aquifer systems using AQTESOLV, MODFLOW, Visual MODFLOW, and MT3D.
- LimnoTech staff specialize in computerized geologic/hydrogeologic data display and interpretation tools, which have been used to develop input and calibration parameters for groundwater and surface water models.



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These project descriptions offer a sample of LimnoTech's experience in helping our clients resolve the challenges of hydrogeological evaluations.

Remedial Investigation, Feasibility Study, Remedial Action for Chlorinated Solvent Impacts, Fayette, OH.

LimnoTech is involved in a remedial investigation and feasibility study for a former manufacturing site in Fayette, Ohio. Groundwater beneath the site was impacted by a release of chlorinated solvents, resulting in a plume of trichloroethylene and other chlorinated volatile organic compounds. The site is surrounded by non-industrial development, and the municipal water supply wells were located a short distance downgradient. LimnoTech has provided a range of services including remedial investigation activities; a human health risk assessment; completion of a feasibility study; hydrogeologic investigations for relocation of the municipal water supply wells; design and implementation of interim remedial actions for the site; and bench and pilot tests to evaluate the use of in situ chemical oxidation at the site.



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Donald C. Cook Nuclear Plant Cooling Water Intake Support Services. LimnoTech has performed numerous tasks supporting the potential extension and positioning of a cold water intake for the Donald C. Cook Nuclear Plant near Bridgeman, Michigan. This work has involved, at various times over the last decade, three-dimensional hydrodynamic modeling of the cooling water discharge plume and simulations of various factors affecting it to support NPDES permit requirements; deployment in southeastern Lake Michigan of a sophisticated scientific buoy to collect environmental nearshore data; and analyzing water temperature and bathymetry data offshore of the Cook Plant to investigate thermal trends offshore of the Cook Plant to support the possible placement of a new deep water intake structure for the Plant. A significant component of the project involved planning, staffing and managing large, complex offshore and onshore seismic and coring feasibility studies in the vicinity of the Plant to collect data on lakebed conditions and glacial and bedrock geology along a proposed tunnel expansion corridor. Offshore investigations included deploying a jack-up barge to provide a stable platform for geotechnical data collection at 21 offshore borings located in 12 to 69 feet of water between 1,000 and 12,500 feet of the shoreline in Lake Michigan.

Development of a Reservoir Water Quality Model to Address Water Supply Alternatives. A private water supplier planned to increase capacity of an existing reservoir located in southeastern Kentucky by enlarging it and pumping in water from the Kentucky River. To do this, the water supplier had to determine if thermal stratification would occur at the higher water levels, and how this might affect dissolved solids concentrations at the outlet structure; where the water intake would be with respect to the reservoir thermocline level during various periods of the year; if nutrients in Kentucky River water could lead to

algal growth in the reservoir and associated taste and odor problems; if the river would have sufficient capacity during periods of drought flow to maintain necessary reservoir water levels; and if significant water seepage loss from the reservoir could occur. To respond to these issues, LimnoTech applied the CE-QUAL-W2 reservoir model to address questions related to water levels and stratification. We then developed empirical eutrophication models to address nutrient enrichment

concerns. Finally, hydrogeologic analyses were conducted to determine future seepage rates after reservoir expansion.

Risk Assessment of Lubricating Oil for an Industrial Manufacturer in Support of a No Further Action Application to a State Environmental Agency. A new purchaser of an existing industrial manufacturing plant retained LimnoTech to obtain data to assist them in making a decision concerning remediation options. Oil release from equipment during previous operations was discovered at the site. After careful evaluation, it was recommended that the site could be closed with a proper assessment of the environmental risk associated with the oil. The risk assessment supports a letter to the Ohio Environmental Protection Agency under its Voluntary Action Program (VAP). The program allows for the redevelopment of contaminated property with reduced liability for the new property owners. The risk assessment will be the major supporting documentation for the recommendation of no further action as a remedial option. The application for no further action contains the investigations done to date and the assessment of the risk that leaving the oil in the ground will pose to the environment and the impact to possible receptors. A successful application indicates that the client can continue operations after taking steps to remove the source.