The Cornell University Borehole Observatory

Earth Source Heat (ESH) is Cornell's version of a geothermal system that would use Earth's internal heat to warm the Ithaca campus without the use of fossil fuels. If successful, the system will not only revolutionize how Cornell heats its main campus and allow the university to achieve its campus carbon neutrality goal by 2035, but also create a new, scalable, renewable energy source capable of sustainably meeting complex heating challenges in cold-climate regions across the globe.

For more than a decade, Cornell researchers have been studying the subsurface conditions beneath the Ithaca campus. While analysis of data collected to date has been promising, Cornell scientists have reached a point where the technical feasibility of Earth Source Heat cannot be further evaluated without measurements of deep subsurface rock conditions by using an exploratory borehole.

Cornell University Borehole Observatory (CUBO)

The university is moving to the next phase of discovery through the Cornell University Borehole Observatory (CUBO), funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy. The borehole is not intended for heat production, but rather to enable researchers to more accurately understand the geologic conditions beneath the Ithaca campus and to allow the university to deploy monitoring systems for ongoing use during future ESH project stages, and also to ensure that the methods used to utilize heat from deep within the earth would not create unacceptable risks or unintended impacts. Cornell is committed to studying and addressing both benefits and risks in a thorough and transparent manner in order to develop best practices that will minimize risk for our campus and the greater community, and for others who might implement this technology to sustainably meet their heating needs.

What is the design of CUBO?

Using electric drilling rigs, the borehole will reach a depth of about 10,000 feet (1.89 miles). At the surface, the borehole will be approximately 36 inches in diameter, progressively narrowing to about 8.5 inches in diameter at the deepest point. The upper areas of the well (i.e., those in potential clean water zones and those through typical gas-bearing layers) will be cased with steel and cement for safety. Layers in the shallowest part of the subsurface which may contain fresh water (to 300 feet deep) will be sealed behind multiple thicknesses of casing and cement. The longest casing will extend 300 to 400 feet below the deepest rock unit that is known in this region to contain natural gas. The deepest portion of the borehole (greater than 7,650 feet or 1.45 miles below the surface) will be left uncased to allow a variety of tests to be conducted within the rock layers of interest for geothermal development.

Proper permitting was completed, and water-monitoring wells and a range of seismometers have been installed to provide background data regarding variations in ground water composition and local seismicity to ensure well casing integrity and safe operating conditions of CUBO. While there may be some noise and lights associated with the operation during the drilling and initial testing of CUBO, Cornell will seek to minimize these construction impacts. Following the first few months of drilling, the site may appear inactive but will be highly utilized for research.

Design of the Cornell University Borehole Observatory (CUBO)

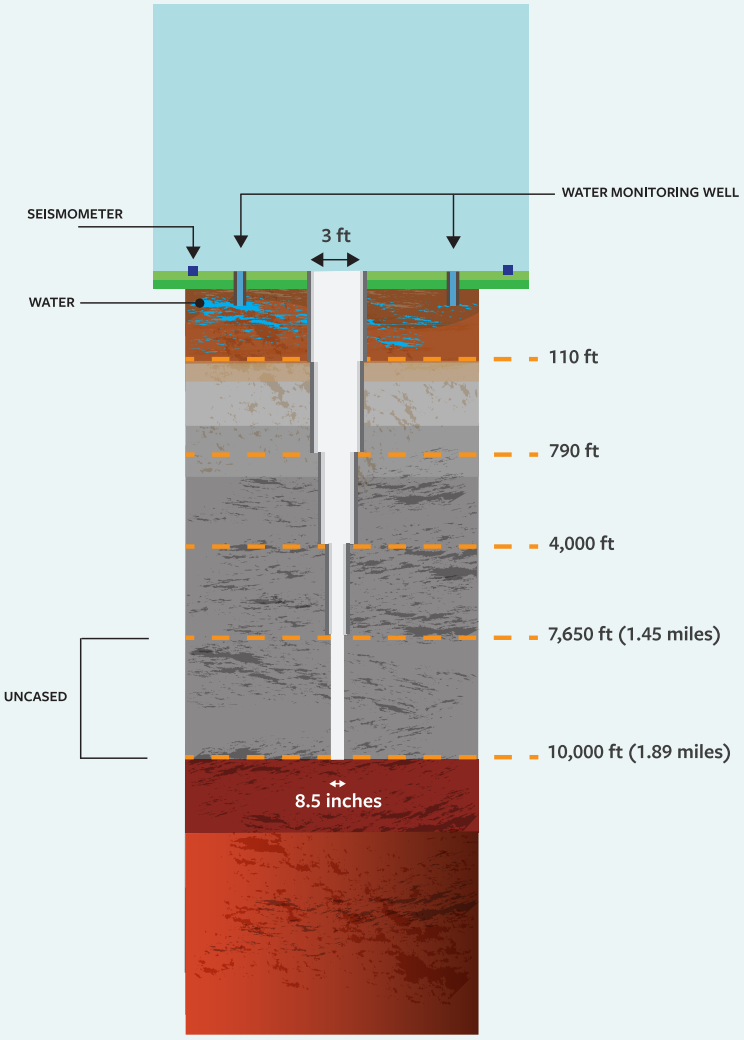
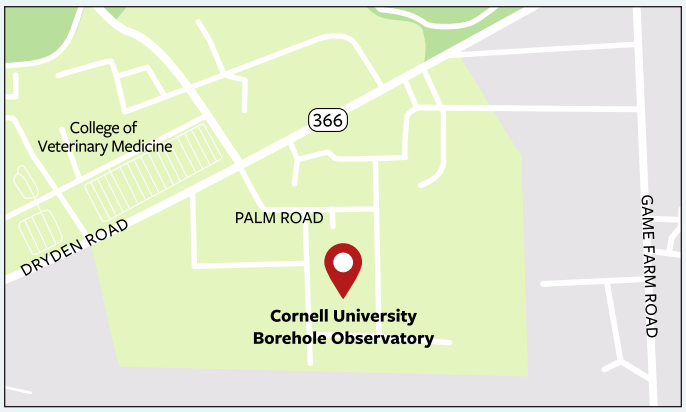


**Illustration not to scale*

Location of CUBO



CUBO will be located on Cornell-owned property near Palm Road

CUBO will be located on Cornell-owned property near Palm Road in the Town of Ithaca. This location was selected in part due to its distance away from residential housing. CUBO will be drilled during the summer of 2022. Drilling and well completion operations are expected to take place over several months while essential research into the viability of Earth Source Heat will continue for a year or more.

What do we expect to learn from CUBO?

CUBO will provide direct access to the subsurface allowing scientists to determine rock properties more precisely. Gathering data needed to make informed plans and decisions, including understanding and testing the geological conditions, and identifying the best target zone for future heat production wells, will improve knowledge and lower the technical risks for developing Earth Source Heat. From what is known of similar geological settings, researchers expect to find an existing network of natural fractures in the rock that can be used to establish connection for water to flow between future production wells, and CUBO will verify the character of these natural fractures.

An exploratory borehole like CUBO can only probe a small volume of rock near the borehole. Researchers plan to use rock samples and in-situ tests of the rock properties around the borehole to inform computer models that will be used to estimate the thermal and hydraulic performance and lifetime of future ESH wells. CUBO will investigate the quality of the geothermal resource at a range of depths between 7,500 and 10,000 feet, where it is anticipated that rock temperatures will be between 75 and 100 degrees Celsius, which is sufficient to be used for campus heating.

If data gathered through CUBO is promising for developing of a deep geothermal system, what are the next steps for exploring Earth Source Heat?

If it is determined that the project could safely and effectively advance, the next step would be to drill a separate demonstration well pair where water circulated through the wells would return to the surface as hot water and heat a portion of Cornell's Ithaca campus. If successful, the university would move to a phased approach that would create a full-scale system capable of heating the entire Ithaca campus within the next 8 to 10 years.

For more information, visit: earthsourceheat.cornell.edu