**GEOTHERMAL for College of engineering Campus Instructional facility aT UIUC CamPUS**

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**Proposal Title:** Establish a geothermal characterization/monitoring station on John Bardeen Quad

**1. Project summary.**

The project team will construct a borehole located west of the planned geothermal exchange borefield on the John Bardeen Quad south of Grainger Library. The borehole will contain a fiber-optic cable that will be connected to a distributed temperature system to detect changes in the Earth's thermal profile.

As part of drilling a 450-foot borehole, a continuous core will be collected of the glacial sediment and bedrock. Thermal property, sedimentological, and geotechnical analyses will be performed on core samples. Geophysical logs will be taken after drilling to provide additional insight on the geology and geotechnical properties. Also, a thermal response test (DTRT) will be conducted that will return information critical for the project team to model heat flow in the borehole using COMSOL multiphysics software. In addition, representative core samples from each formation will be used to characterize the thermal conductivities at different scales (i.e. pore scale) with advanced testing devices.

**2. Purpose of work.**

The monitoring station with fiber-optic cable is an early warning system to the movement of a thermal plume outside of the borefield. A similar methodology is being used to monitor the largest geothermal exchange system at Epic Systems Corporation located in Verona, Wisconsin. Although, the monitoring wells were installed after the geothermal exchange system was running and heating and cooling load imbalances were experienced.

Data from the laboratory, DTRT and wellbore modeling will be provided to the P3 (public-private partnership) consultants designing the geothermal borefield to assist them in determining the optimal borehole depth and spacing.

**3. Future use station**

The monitoring station will be active throughout the time period the geothermal system is used. Temperature data will continually be collected from the fiber-optic cable while the geothermal system is in use. The continual temperature data stream along with the geological, geophysical, and geotechnical data obtained for the site characterization will provide numerous opportunities for students and faculty to study the geoexchange. We consider this a “living laboratory” that is accessible to all of campus.

**4. Potential cost.**

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| --- | --- | --- | --- |
| **Installation of Monitoring Station** | Cost/Day | Unit | Total Cost |
| Drilling Test Hole by Prairie Research Institute: Approximately 2 weeks are required to drill one borehole in John Bardeen Quad and collect core samples for laboratory testing. | $2,950.00 | 11 | $32,450.00 |
| Borehole Geophysics: Conduct logging of the borehole with different geophysical sondes to collect continuous measurements of the subsurface geologic materials. | $2,000.00 | 1 | $2,000.00 |
| U-Bend Geothermal Pipe: Purchase 1000 feet of HDPE pipe to install in the borehole for DTRT testing. | $360.00 | 1 | $360.00 |
| Fiber-Optic Cable: Purchase an armored fiber-optic cable for installation in the borehole for DTRT testing. A steel-wrapped cable is required to protect the fiber optics from “darkening” when in the ground for more than 20 years. | $3,000.00 | 1 | $3,000.00 |
| **Prairie Research Institute Costs** |  |  | $37,810.00 |
| **Logistical Support from F&S** |  |  |  |
| Metal Fence: Rental and installation of fencing around the drill site on the John Bardeen Quad (Estimate) | $500.00 | 12 | $6,000.00 |
| Vacuum Truck: Drilling cuttings and fluids will be removed from the drill site daily by F&S Vacuum Truck (Estimate) | $900.00 | 12 | $10,800.00 |
| Restoration of Ground: Restoration and redesign work of grounds. Depending upon damage from heavy equipment, grass and concrete path may need replacing (Estimate) | $10,000.00 | 1 | $10,000.00 |
| Small vault or utility box: A drop-down box will be installed to store the fiber optic cable and provide access to the U-bend tubing in the borehole. No above-ground structures can be built at the site. | $1,000.00 | 1 | $1,000.00 |
| **F&S Costs** |  |  | $27,800.00 |
| **TOTAL COST** |  |  | $65,610.00 |

**5. Schedule of implementation.**

Following the issuance of the drilling permit, we expect the borehole to be completed approximately 2 weeks (11 business days). An additional day will be required to obtain the downhole geophysical logs. The following day, the geothermal U-bend tubing and fiber-optic cable will be installed in the borehole, and then the borehole will be sealed closed with grout. A drop-down vault will be installed at the site to store the fiber-optic cable and provide access to the tubing for the DTRT.

Concurrent to the drilling and following completion of the borehole, the thermal and sedimentological properties of core samples will be determined in the laboratory. Following the DTRT, this testing data along with laboratory data will be inputted analyzed into the simulation software to model heat transfer along the borehole. The modeling should be completed within a week. At this point, all the data and models will be provided to the team designing the geothermal borefield.