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Current Developments in Thermal NSZD Monitoring: Application at an LNAPL Research Site

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Background/Objectives. Thermal monitoring for measuring natural source zone depletion (NSZD) rates and for general site monitoring is an emerging technology that is now being evaluated by several key researchers from energy companies, the U.S. Geological Survey, and Colorado State University (CSU). Here, heat generated by biodegradation is measured continuously via a vertical series of thermocouples in the LNAPL zone. These temperature data are then converted to a rate of degradation using a heat balance approach developed by CSU (patent pending), subsequently providing continuous NSZD rates over time. Work on thermal monitoring to date has led to a practical set of hardware and computational methods that are sufficient to drive broad use of thermal monitoring. At the same time, the explosive advancement of the wireless communications, low cost sensors, and automated management of big data ("the Internet of Things" or IoT) offer the promise of an impressive next generation of hardware and computational tools. The objective of this project is to employ side-by-side application of current and emerging thermal monitoring methods using various hardware and sensors. Given success with emerging methods, these experimental designs may enable NSZD monitoring costs to be driven even lower, and data quality to take another leap forward as compared to other conventional methods.

Approach/Activities. At an LNAPL site in Texas, NSZD at six locations is now being measured using various experimental designs consisting of the following technologies and hardware: i) conventional thermal monitoring using thermocouple sticks and data loggers, ii) alternate thermal monitoring using new technology with higher-resolution temperature measurements, iii) thermal monitoring in existing wells, and iv) heat flux plates and Peltier coolers. Data from all stations and points are being continuously recorded on a daily basis for approximately one year. Results of this research project will: 1) provide measurement of NSZD rates over time at each location; 2) allow a direct evaluation of proven, alternative, and new temperature measurement methods that may provide lower cost monitoring as well as better data quality, and 3) allow a detailed evaluation of seasonal temperature and moisture impacts on NSZD rates.

Results/Lessons Learned. The pilot test will be conducted for one year starting in January 2017. Continuous temperature measurement data, as well as NSZD rates and data quality comparisons amongst various experimental designs will be presented.