

**Carbon Sequestration Surface Mine Lands**

**Quarterly Report**

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## **DISCLAIMER**

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## **ABSTRACT**

Over 160 acres of tree seedlings were planted during the last quarter. This quarter marked the beginning of the installation of new instrumentation and the inspection and calibration of previously installed recording devices. Sampling systems were initiated to quantify initial seedling success as well as height measurements. Nursery seedlings have been inoculated to produce mycorrhizal treated stock for 2004 spring plantings to determine the effects on carbon sequestration. All planting areas in western Kentucky have been sampled with the recording cone penetrometer and the nuclear density gauge to measure soil density.

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## **EXECUTIVE SUMMARY**

Inventories of monitoring equipment was performed, organized and calibrated. Site visits were conducted to evaluate previously installed instrumentation and determine the needs for additional installations. The necessary equipment was assembled and taken to the research areas and installed. Appropriate training was conducted to acquaint the field workers with proper maintenance and data acquisitions technique.

Sample plots were established in the mixed species planting areas at both the western and eastern Kentucky reforestation sites. The samples are designed to adequately sample each species planted. These plots will also be utilized for measuring carbon pools within the sites.

Detailed studies to address specific questions pertaining to carbon flux are being initiated to examine the influence of spoil depth, mycorrhizae, chemical and mineralogical properties and the use of amendments. Since the current reforestation study intends to examine the potential for enhanced carbon sequestration efforts to maximize survival and growth will be further examined.

Sampling to determine soil density has been completed in western Kentucky. Eastern Kentucky sampling will begin during the next quarter at the 17 West Mining Company site. A new portable nuclear density gauge has been procured that will allow sampling on long steep slopes that were previously not accessible.

## **EXPERIMENTAL**

The experimental methods used to access this research will involve a multitude of sampling systems and equipment. These will include but are not limited to field sampling, monitoring devices, tree extractions, soil, water and tissue analysis, as well as habitat analysis for various wildlife species.

## **RESULTS AND DISCUSSION**

### **Agricultural Engineering Activities for 3<sup>rd</sup> Quarter**

#### **April 2003**

Monitoring equipment was inventoried and, the monitoring equipment in research laboratory was organized. Personnel were trained to operate, program and trouble shoot equipment, and necessary calibrations on pressure transducers were performed. The pressure transducers did not perform well during the calibration procedure, so the manufacturer was contacted. Several of the pressure transducers were suspected to have outlived their usefulness. As a courtesy, the manufacturer agreed to perform calibrations at their facilities. Five pressure transducers out of 15 were shipped to the manufacturer for testing. Results of the manufacturer's calibration indicated that three of the five tested units failed. At least three calibrations were performed on each pressure transducer before it was placed in the field to ensure readings were as consistent as possible.

We conducted site visits in eastern (Starfire Mine Site near Hazard, Kentucky and 17 West Mine Site near Inez, Kentucky) and western Kentucky (Peabody Mine Site near Central City, Kentucky) to evaluate previously monitored sites, identify new monitoring sites, and document site conditions with digital photos. We also installed monitoring equipment at two previously monitored locations in the 17 West Mine Site near Inez, Kentucky.

Prior to all monitoring site installations, the previous day was used to assemble equipment and purchase additional needed supplies. Flumes and stilling wells were already present, but additional concrete was used to ensure the stability of the flume. Stilling wells were checked for vertical alignment and were flushed to remove any accumulated debris. ISCO samplers (automatic samplers for water quality testing of total and settleable solids, particle size distribution and total organic carbon) were installed. Solar panels and liquid level actuators were

connected to the ISCO sampler to: 1) provide a constant power source and 2) to initiate sampling only when runoff was detected.

Pressure transducers and minilogger dataloggers were installed to provide continuous (10 minute interval) stage data for determination of flow rates. A weather station consisting of a tipping bucket style rain gauge was installed to monitor rainfall events. Data is recorded at five-minute intervals using a HOBO event datalogger. We evaluated previously installed tipping buckets, that measure seep berm performance by flushing sample lines, installing HOBO event dataloggers on three tipping buckets, and documenting installation with digital photos.

We trained the field worker to monitor the site and to collect samples and data. We installed appropriate programs on a laptop for downloading data. Training was conducted on the procedure for retrieving ISCO samples and filling out accompanying data sheets, and how to download data from minilogger dataloggers.

The minilogger download program is not compatible with Windows XP, so a procedure was devised to obtain data using a boot disk. This method also proved faulty, so data was periodically downloaded using a Biosystems and Agricultural Engineering laptop running Windows 95 by downloading data from HOBO eventlogger and performing routine maintenance.

We began training a student worker in the data entry method, location of equipment and supplies in Biosystems and Agricultural Engineering Department, the fundamentals to operating equipment, retrieval of samples and data from field personnel at mine sites, and the procedures for sediment analyses.

### **May 2003**

We installed monitoring equipment at two previously monitored locations in the Peabody Mine Site near Central City, Kentucky using similar methods described above. We revisited

the Peabody Mine Site near Central City, Kentucky to finalize locations of new monitoring sites and to identify the location of three new monitoring sites. One site will require diffusion of the outlet flow from the flume to prevent the formation of gulleys. We decided to use coconut rolls, and this was documented with digital photos. We evaluated the condition and performance of installations and adjusted the placement of the liquid level actuators in the stilling wells and collected the first set of data from the field worker.

We visited 17 West Mine Site near Inez, Kentucky to evaluate condition and performance of installations and changed out one ISCO sampler that was displaying a fatal error. We adjusted the placement of the liquid level actuators in the stilling wells, and collected the first set of data from the field worker.

We performed installations of three new monitoring sites at Peabody Mine Site near Central City, Kentucky. Prior to all monitoring site installations, the previous day was used to assemble equipment and purchase additionally needed supplies.

With both the eastern and western Kentucky mine sites, rain gauges were installed near each monitoring station. If monitoring stations are located within approximately 1000m of each other, a single rain gauge is used.

A job description was developed for personnel to perform sediment analyses of collected samples and the process was begun to create the position with the Human Resources Department at the University of Kentucky.

We developed a report of surface mining research activities for Office of Surface Mining visit to the Starfire Mine Site near Hazard, Kentucky and conducted initial data evaluation and analysis, with rain event data, pressure transducer data, tipping bucket data, and ISCO sampler data.

During the initial data evaluation process, it was noted that the pressure transducer data fluctuated erratically. Identification of storm events and thus subsequent runoff flow was difficult if not impossible. Based on these poor results, efforts were initiated to identify an improved method of monitoring stage in the stilling wells (i.e. Internet searches, conversations with various manufacturing representatives, testimonials from colleagues). Based on the provided information, the pressure transducers were replaced with MiniTrolls from In-Situ, Inc.

The MiniTrolls were ordered. We were trained in the procedure for operating MiniTrolls including downloading data and developed a procedure sheet for field workers. We also obtained a new particle size analyzer that a representative installed and provided training on.

### **June 2003**

Monitoring stations at Peabody mine site near Central City, Kentucky were visited to install miniTrolls, perform routine maintenance on sites and, downloaded data.

A review of procedures was conducted for laboratory sediment analyses of turbidity, settleable solids, suspended sediment concentrations, and particle size distribution.

The process of hiring individual for Research Analyst to perform sediment analyses was begun.

An evaluation of new monitoring sites was conducted. There are currently five in Western, Kentucky and four in Eastern, Kentucky we presently need one more in Western, Kentucky and two more in Eastern, Kentucky.

### **Forestry Activities for 3<sup>rd</sup> Quarter**

Sample plots were established in the mixed species planting areas at both western *and* eastern KY reforestation sites. Plots were designed in a manner to both adequately sample each species planted and to account for differences with respect to site preparation activities and

micro-topographic variability amongst planting units. As such, multiple 50 x 50 meter plots (8) were set within planting units that exceeded 8 hectares in area. This scenario was replicated within each reforestation site and for the differing reclamation practices employed (ripped vs. uncompacted vs. compacted). In addition, complete seedling inventories will be analyzed in several smaller plots (1-2 ha.) that present unique features in both reforestation areas. The sampling strategy will provide for a minimum of 100 seedlings per species per planting unit, which will allow for statistical comparison of the differing species within the differing planting conditions and sites. These plots will also be utilized for measuring carbon pools within the sites.

Detailed studies to address specific questions pertaining to carbon flux are being initiated with the development of additional manipulative plots to examine the influence of spoil depth, mycorrhizae, chemical and mineralogical properties, and use of amendments on forest establishment. Based upon earlier studies by UK and the USDA Forest Service, mycorrhizal fungi have been shown to play a major role in the survival, nutrient uptake and biomass development (above and below ground) of seedlings planted on mined sites and abandoned industrial areas. Given that the current reforestation study intends to examine the potential for enhanced carbon sequestration on mined sites via C accumulation in soil and forest biomass, then efforts to maximize seedling survival and growth should be further examined. As such, a factorial experiment using inoculated vs. non-inoculated species in non-fertilized, fertilized only, amended (organic mulch) only, and fertilized + amended plots will be examined. Seedlings used for the study are being grown at the Kentucky Division of Forestry Nursery. Currently, the Nursery does not inoculate their beds with mycorrhizae, so the mycorrhizal trees used for the study will be initially inoculated in the beds and later treated with root dip applied at the time of transplanting. As such, preparation of seedling beds was performed this quarter at the Morgan Co. Nursery for the experimental study. Beds were prepared using a tractor drawn-inoculator that

places a vegetative inoculum of *Pisolithus tinctorius* (Pt) and *Scleroderma cepa* (Sc) at a depth of approximately 10 cm between the seedling rows. Seedlings will be monitored in the beds throughout the summer and an inoculation index will be performed next Fall.

### **Mining Engineering Activities for 3<sup>rd</sup> Quarter**

All planting areas in western Kentucky have been sampled with the recording cone penetrometer to determine the relative level of compaction or depth of resistance. All areas are also sampled with a nuclear density gauge as another measure of soil density. Sampling is scheduled to begin in eastern Kentucky at 17 West Mining during the next quarter.

### **CONCLUSION**

There are no conclusions available at this time since it requires years of time to conclude results from a forest establishment. I can conclude that this project has the potential to establish values for areas that have not been fully assessed before because the evaluation of carbon sequestration potential has not been determinable since 1978. Values could be appraised on areas mined before SMCRA, but no baseline data exists for them.