Demonstrating a Market-Based Approach to the
Reclamation of Mined Lands in West Virginia

Quarterly Report
April 1, 2004—June 30, 2004

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DE-FC26-03NT41899R02

July 19, 2006

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ABSTRACT

This is the second quarter progress report of Phase II of a three phase project to develop and evaluate the efficacy of developing multiple environmental market trading credits on a partially reclaimed surface mined site near Valley Point, Preston County, WV. This quarter's work focused on satisfying landowner concerns regarding the project site access agreement and developing a conceptual design for the passive acid mine drainage (AMD) treatment system. The agreement was executed on April 2, 2004 (Appendix A). Additionally, we continued to collect baseline quality data from the Conner Run AMD seeps that will serve as a basis for the design of the AMD passive treatment system. Triad Engineering was contracted to perform a survey and prepare engineering drawings for the AMD passive treatment system.

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EXECUTIVE SUMMARY

This is the second quarter progress report of work accomplished to develop and evaluate the efficacy of developing multiple environmental trading credits on mined land to encourage enhanced reclamation, more quickly and at less public cost. Objectives are to develop hypothetical carbon sequestration and water quality trading credits by reforesting a 12-hectare area with five species of commercial hardwood tree seedlings and designing and constructing a passive AMD treatment system to improve water quality. The project site is located on a partially reclaimed surface mine near Valley Point, Preston County, WV.

Landowner objections and concerns regarding certain provisions in the site access agreement have been resolved and the agreement was signed on April 2, 2004. As a result of the landowner's objection to the proposed location of the passive AMD treatment system on Sovern Run, the system was moved to the Conner Run drainage to address another AMD seep. This caused several problems that were resolved by the project team in consultation with the DOE Project Manager.

1. AMD passive treatment system: The original system was to be a simple open limestone channel for a single AMD discharge from the old Bull Run Mine known as seep 72. NMRLC had over 10 years of data on this site and the design was straightforward. This design was the basis for AMD system costing in the project budget. However, moving the AMD treatment location to the backside of the landowner's property forced us to work on the only other AMD site: Headwaters of Connor Run. This site was much more complex with multiple, discharges. Some were discrete and others were diffuse seeps. Also, the Connor Run site had much less flow than seep 72 and roughly one tenth the acid load.
2. AMD characterization period: Between March and the finalization of AMD system designs in July 2004 we had the opportunity to sample the Connor Run site two times: March and June. Note that the sampling interval was further constrained by the need to survey and develop drawings for the site bid package and to develop construction subcontracts. While less than desirable, the interval was the longest sampling interval that we could use for the conceptual AMD system design.

Based on the preliminary water quality data, a conceptual AMD passive treatment system design was developed. The rationale and the design for this system are included herein. Triad Engineering, Inc. was contracted to conduct a survey and develop the engineering drawings for construction of the passive treatment system based on the conceptual design.

EXPERIMENTAL

Baseline AMD quality sampling was conducted at both the former sedimentation pond and an AMD seep (Figure1) using methodologies described in the first quarter report. A conceptual design for the passive AMD treatment system was developed in the following manner:

Conceptual Design Rationale

The pre-construction project site located in the Headwaters of Connor Run consisted of a series of seeps that emanate at the toe of a spoil fill slope that is semi-circular in shape. AMD was clearly generated in the spoil and flowed down dip along the mine pavement to discharge around the head of the uppermost reach of Connor Run. These toe drainages emptied into an existing channel that conveyed surface flow from the upper portion of the site during the wetter parts of the year. The project site also had a pond that was fed by a series of subsurface springs located further south of the seeps. Baseline samples were collected at various locations throughout the project area (Figure 1). The site constraints included diffuse AMD seeps and AMD upwelling in the stream channel.

Figure 1 Sample locations for the Conner Run site

When conceptually designing the passive treatment system for the Clark farm site on Connor Run we used the following baseline chemical and physical parameters (Table 1). These data, collected during March 23, 2004, are from the seeps identified on Figure 1. We also considered Connor Run monitoring data immediately downstream of the Sediment Pond indicated on Figure 1 to estimate total subsurface AMD (flow) inputs to Connor Run in the project area.

Table 1 Baseline Parameters Used in Conceptual Design/Sizing of Passive Treatment System

Flo (L/Min)	pH	Calculated	Iron	Aluminum	Manganese
13.76	3.5	211	28.6	11.3	9.56

Flow in the upper reach of Connor Run increased by a factor of between 1.2 and 6.2 between the upper seep and the lowermost stream sample. There were no other surface sources reaching Connor Run along this reach indicating significant subsurface flow. Our goal was to intercept and treat this AMD. For design purposes we used the seep AMD (from Table 1) as the best representation of AMD quality. The data indicate that the AMD is acidic, with low pH significant iron, aluminum and manganese. Our treatment objective was to remove acidity in the form of H protons, iron and aluminum ions. We did not intend to affect manganese concentrations since its precipitation involves a slow oxidation step subsequent to neutralization. Our plans were developed around AMD capture, alkalinity addition and oxidation of ferrous to ferric ion. Ferric hydroxide precipitate would form above pH 3.2 while aluminum hydroxide would precipitate above pH 4.2.

AMD Sources: Pre construction sampling and site inspection identified three apparent sources of AMD, as follows:

1. The surface seep and ephemeral stream originating in the pine trees;
2. Subaerial, diffuse seepage along the pit floor at the headwaters of Connor Run; and
3. Subaerial, subaqueous seeps feeding the sediment pond.

Since it was impossible to isolate subaerial flows and measure its water quality we used the seep water to estimate AMD quality throughout the property and used the downstream flows to estimate loadings.

AMD Treatment Site Evaluation and Identification of Treatment Alternatives:

The following describes the process by which NMLRC evaluates a site's AMD treatment needs, treatment alternatives and the basis for designing the treatment system. The process we follow includes: conducting a field reconnaissance and collecting samples; evaluating treatment alternatives in consideration of AMD quality, flow, and site constraints, and budget; and, developing the final system design.

It is critical to determine project objectives and to articulate a project outcome within the constraints of budget, time and technology. It is also important to recognize that AMD treatment under field conditions is not an exact science. Flows vary seasonally and over multiple yearly cycles. Pollutant concentrations also vary. Where possible, it is useful to phase in treatments until water quality targets are achieved. Otherwise, the tendency is to over build the systems. The following checklist is used to focus effort on maximum information gain while simplifying the process of selecting treatment options.

Phase I Watershed Evaluation: This represents the initial watershed sampling. Often, the local sponsors invest considerable effort toward water sampling prior to identifying and prioritizing at-source control needs. Collation of this information, along with data QA/QC is an important initial step. Phase I identifies the total pollutant loads in the watershed and the proportion contributed by each source. This highlights the 'hot spots' in the watershed and helps to focus more intensive follow-on sampling in phase II.

- Mapping
- Stream quality
 - *pH, acidity, alkalinity, Fe^{2+} , Fe^{3+} , Al, Mn, sulfate, conductivity
 - *As needed: Sb, As, Ba, Be, Cd, Cr^{6+} , Pb, Hg, Ni, Se, Ag, Tl
- Hydrologic survey:
 - *Flow, annual cycle, mass balance
- Identify high load stream segments:
 - *Display high load stream segments on watershed map

Phase II Site Evaluation: While phase I sampling indicates the priority pollutant sources in the watershed, phase II sampling characterizes them to allow for treatment system design.

- Treatment site water quality
 - *pH, acidity, alkalinity, Fe^{2+} , Fe^{3+} , Al, Mn, sulfate, conductivity
 - *As needed: Sb, As, Ba, Be, Cd, Cr^{6+} , Pb, Hg, Ni, Se, Ag, Tl
- Hydrologic survey:
 - *Flow, annual cycle, mass balance impact
- Prioritize treatment sites
- Identify treatment needs
 - *Alkalinity, oxidation, metal floc handling

Phase III Identify Treatment needs. Evaluation of phase II data allows development of initial designs and costs. The following questions are to be addressed during phase III:

- Is alkalinity required?
 - *Quantity needed (tons/year)
 - *Alkalinity options
 - Limestone
 - Steel slag
 - Kiln dust
- Is oxidation required?
 - *Fe²⁺ load (tons/year)
- Is floc removal needed?
- Amount of floc handling needed (tons/solid/year)

Phase IV Treatment technology selection. The following decision process (Table 2) is used to identify treatment needs and their cost implications.

Table 2 Decision Document for Determining Proper AMD Treatment

Decision Process for Determining Proper AMD Treatment							
Decision	Site Criteria	Yes/No	Chemical Constraints	Treatment Options	Residence Time	Max Output	Cost
Add Alkalinity	Is Fresh Water Present	Yes	none	Limestone Leachbed	11 Hrs.	70 mg/l alkalinity	\$50-100/ton/yr*
		Yes	Fe, Al, & Mn < 1mg/L If possible, place sediment retention structure above bed	Steel Slag Leachbed	1-3 Hrs.	2,000 mg/L alkalinity	\$50-100/ton/yr*
		No	Fe ³⁺ , Al and DO <1 mg/L	ALD	11 Hrs.	100 mg/L alkalinity	\$50-100/ton/yr*
		No	none	OLC	5-10 Hrs.	50-95% acid load removed	\$50-100/ton/yr*
		No	none	Limestone Leachbed	1.5 Hrs. Max	50% of acid load removed	\$50-100/ton/yr*
		No	none	Open Limestone Channel	.25 hrs.	oxidation	\$40 - 150/ft
Oxidize	Slope > 10%	Yes	none	Aerobic Wetland	1 - 2 hrs.	oxidation	\$5000/ac.ft.
Settle Floccs	Slope > 10%	Yes	none	Open Limestone Channel	4 - 6 hrs. 35 to 80 days	99% removal	\$40 - 150/ft
		No	none	Aerobic Wetland	(500t Fe/ac/yr)	99% removal	\$5000/ac.ft.

* Denotes dollars per ton of acid load removed per year

If one year after construction and commissioning, the system meets water treatment expectations then the design and construction process is complete. Otherwise, return to phase II above.

Critical Parameters in Watershed Planning and Remediation

The following parameters are critical in assessing design needs of an AMD remediation project:

pH

- Hydrogen ion concentration

Acidity (mg/L)

- Concentration of base needed to neutralize a volume of water
- $50 \times ((V_o \times ([Me_1]/A_1)) + (V_o \times ([Me_2]/A_2 + \dots + (1000 \times 10^{-pH}))$
- Where: V_o = valence at treatment oxidation state
 $[Me]_{1 \text{ to } n}$ = metal ion concentration (mg/L)
 $A_{1 \text{ to } n}$ = atomic weight of metal ion
- Acidity is given in mg/L (Calcium Carbonate Equivalent)
- Flow: liters per minute (lpm)* 0.00059 = cubic ft/second (cfs)

Acid load

- Mass of base needed to neutralize a given mass of acid
- Based on concentration (mg/L) and flow (gallons per minute (gpm)*0.00059 = cubic ft/second (cfs)

*Dynamic:

$$\text{flow (gpm)} \times \text{acidity (mg/L)} \times 0.0022 = \text{tons/year}$$

$$\text{flow (gpm)} \times \text{acidity (mg/L)} \times 86.4 = \text{lbs/day}$$

*Static

$$\text{volume (ft}^3\text{)} \times \text{acidity (mg/L)} \times 3.11485 \times 10^{-10} = \text{tons}$$

$$\text{volume (gpm)} \times \text{acidity (mg/L)} \times 4.16383 \times 10^{-11} = \text{tons}$$

- The same formulas can be used to estimate the mass of alkalinity

Mass of chemical

- To calculate the mass of treatment chemical multiply the acid load by:

CaCO ₃	100%
Ca(OH) ₂	74%
CaO	56%
NaOH	40%

Na ₂ CO ₃	106%
NH ₃	17%

Acid/base mass balance

- Tons of acid-tons of alkalinity = net acid load

Residence time (T)

- $T_{\text{hours}} = \text{cross sectional area (ft}^2\text{)} \times \text{length (ft)} \times \% \text{ voids/flow (cfs)} \times 3600$
- Where: Voids = 40 to 50% for rip-rap sized limestone

Hydraulic considerations

- Many passive treatment systems put AMD in direct contact with limestone.
- Most passive systems fail due to filling of the void spaces with metal flocs.
- Ferric hydroxide flocs will form above pH 3.2 and aluminum flocs above pH 4.2.
- When treating AMD it is critical to minimize opportunities for floc accumulation.
- It is always better to use large dimension limestone (> 6 in.).
- Place a six inch bed of 0" to 1" crusher run limestone or steel slag below sized limestone.
- Only use crusher run limestone as a bedding material.
- Ensure that there is a good hydraulic connection between the source of AMD and the treatment structure.
- If the AMD can find a way around the treatment structure, it generally will.
- With ALDs, avoid discharges with widely varied flows. Low flow periods will create an air space in the ALD, encouraging ferric hydroxide formation. Steady flows work best.
- Open Limestone Channels (OLC) operate over a wide variety of flows and chemical conditions
- Make sure your ponds do not LEAK!

Cost estimation

- Excavation
*Cross sectional area x length /27 x \$3.00
- Limestone
*Should be between \$15 and \$30 /ton delivered
- Organics
*Vary widely in availability and cost. Straw bales, manure and peat can be used. Where permeability is critical as in a vertical flow wetland, avoid peat.
- Other costs
*Access, clearing, reclamation and other items too site specific to permit generalization

Fe sludge formation

- $\text{Fe}^3 + 3\text{H}_2\text{O} = \text{Fe}(\text{OH})_3 + 3\text{H}^+$
*56 g/g mole => 107 g/g mole
- Inflow Fe = 1.0 mg/L x 43.53 L/min x (1/1000)g/mg x (1/1000)kg/g x 2.205 lb/kg x 60 min/hr x 24 hr/day = 0.138 lb/day x 107/56 = 0.264 lb/day
- Sludge volume (sludge weight = water weight)
- $0.264 \text{ lb/day} \times (1/62.4) \text{ Lb/ft}^3 = 0.00423 \text{ ft}^3/\text{day}$

Mn and Al sludge formation

- Use same equation as Fe but correct for molecular weight
- Al = 27 g/g mole
- $\text{Al}(\text{OH})_3 = 78 \text{ g/g mole}$
- Mn = 55 g/g mole
- $\text{Mn}(\text{OH})_2 = 89 \text{ g/g mole}$

Alkaline amendment

- Where: A = required amendment (tons)
W = amount of waste rock: spoil or refuse (tons)
%S = % sulfur in waste rock
%NNP = % Net Neutralization Potential

$$A = \frac{W \times \%S \times 3.125}{\%NNP} \times 1.1$$

- Example:
- Where: W = 1,000,000 tons
%S = 2
%NNP = 30

$$A = \frac{1,000,000 \times 2 \times 3.125}{30} \times 1.1 = 229,167 \text{ tons}$$

Table 3 Common Alkaline Amendments

Amendment	Typical % NNP
Limestone fines <1/4"	70-95
Waste lime	70-95
Kiln dust	70-80

Steel Slag <1/4"	60-70
Class C coal ash	10 to 30
Alkaline spoil	1 to 30

AMD treatment cost vs. change in pH

Many AMD impaired streams have a pH in the range of 2.7 to 5.0. Improvement of stream pH to the neutral range (6.0-7.5) is often seen as the target for remediation projects. Since the relationship between pH and acidity is not linear, neither is the relationship between acid load reductions and pH. It is useful to think in terms of titration of a highly buffered solution. The primary buffers in AMD treatment are ferric iron and aluminum. Figure 2 illustrates the change in stream pH with increasing investments in acid load reduction. The curve illustrates a flattening of the line between pH 3 and 4 reflecting the consumption of hydroxide ions by $\text{Fe}(\text{OH})_3$ formation. The slope of the curve also decreases between pH 4 and 5 accounting for the precipitation of $\text{Al}(\text{OH})_3$. This has serious implications when dealing with public expectations. In highly impaired watersheds, a great deal of investment is normally required before the stream pH will rise into the neutral range. Thereafter, with metal buffering gone, pH will rise with very modest alkalinity inputs.

Figure 2 Ph Change with Increasing Investment in Acid Load Reductions

We selected four AMD treatment technologies:

1. Alkaline Recharge Trench (ART). This method was developed in the Midwest to address AMD running along surface mine pit floors with shallow gradients. An ART consists of a trench dug through spoil to the pit floor normal to the groundwater flow path. Lime or kiln dust is placed on the floor and covered on three sides with coarse limestone. The limestone creates a preferred flow path so that AMD remains in contact with the lime as it moves down gradient. ART are sized primarily to reach the pit floor and to intercept all AMD flow pathways.
2. Open Limestone Channel (OLC). Open limestone channels were designed for steep gradients (>10%) and low iron concentrations. They work best in low pH water. Although the channel gradients were much less than 10% we used OLCs because they have proven to be one of the most reliable and cost effective means for acidity reduction over a wide range of conditions. Unlike anoxic limestone drains and vertical flow wetlands, they tolerate a wide range in ferric/ferrous ratios and high aluminum concentrations. Two OLCs were used in the project.
3. Limestone Foundation Drain (LFD). This method is a French drain used to collect below ground AMD and direct it to a treatment area. Using limestone results in acid neutralization. However, since subaerial flows are difficult to measure we had no way to predetermine the effect of the LFD.
4. Impoundments. Sometimes called aerobic wetlands, impoundments are open water bodies that encourage oxidation of ferrous to ferric ion while capturing resulting ferrihydrite and gibbsite precipitates. We had room to install two impoundments on the project site. The stream gradient and pre-construction landscape facilitated installation of two impoundments in series.

The following sections detail the rationale and sizing for the passive treatment technology applied in this project.

Passive Treatment System Components

Alkaline Recharge Trench (ART)

The valley area at the head of the passive treatment system is predominantly acidic mine spoil remaining from the abandoned surface mining operation. The ground water flows through this unconsolidated material and picks up acidity. An ART is planned to be excavated along the toe of the valley fill down to the pavement (a slang term for the bedrock typically found at the base of the coal seam) and backfilled with a mixture of cement kiln dust and limestone in an effort to treat the groundwater before it surfaces. The following illustration demonstrates how the trench functions (Figure 3):

Figure 3 Alkaline Recharge Trench (ART) Cross Section

The ART will be built to collect and neutralize a number of AMD seeps present throughout the head of the valley. The ART is designed to collect acidic subsurface flow from the spoil, take up little area and is relatively inexpensive to construct compared to other AMD treatment modules. For example, it would have been more expensive and problematic to construct a vertical flow wetland due to constrained area and shallow depth of bedrock.

Based on field measurements, two ARTs are to be constructed 150 feet on either side of the small tributary totaling approximately 300 feet in length. We anticipate constructing the ARTs approximately 2-3 meters wide and approximately 2.5 meters deep.

Impoundments

We have designed two retention structures for the purpose of precipitating and retaining metals. The first retention structure (Impoundment A, Figure 4) will be located below the confluence of seeps from the ARTs. This impoundment will also collect water from the limestone foundation drain. The second impoundment (Impoundment B, Figure 4) will be

located just above the project outfall to provide precipitation and retention for any metals remaining in the effluent. The second impoundment will be constructed by building an earthen dam across a lower section of the existing channel.

Figure 4 Conceptual Design for Passive Treatment System on Connor Run

Open Limestone Channel

At this site, the installation of open limestone channels act as a means of conveyance from one treatment cell to the next. They are also designed to act as retention/treatment structures. There will be two open limestone channels constructed at this project site. The first OLC conveys the water from Impoundment A collecting the seeps from the ARTs. The second channel will convey the AMD springs that feed the former sedimentation pond that will be collected by the limestone foundation drain (see below) to Impoundment A.

Open limestone channels are commonly used for AMD treatment because they are inexpensive to construct, and even though they eventually fill with metal sludge, still convey and treat water.

Limestone Foundation Drain

The project site contains a former sedimentation pond that is fed by a series of subsurface springs. In order to treat these discharges, it is necessary to construct a limestone foundation drain to collect the springs and channel them as high into the treatment system as possible. To ensure proper operation and construction of the limestone foundation drain, the pond is to be drained and compacted/backfilled in an effort to ensure preferential infiltration flow into the drain.

The limestone foundation drain was incorporated because of the unknown depth of the AMD springs within the sedimentation pond.

Design Considerations

When designing passive treatment systems, NMLRC employs its own proprietary software package (AMDzine) to size passive treatment systems. It sizes and estimates costs of passive treatment systems based on AMD flow and acidity. Since flow was not known in most cases since it was subaerial, sizings were based on the maximum dimensions achievable given the project budget, the requirement to achieve 20 years of treatment and suitability to site conditions (see decision table above).

Table 4 Estimated Construction Costs for the Various Treatment Units

Item	Cost
Mobilization /Demobilization	\$ 3,000
ART Trench	\$ 26,711
OLC/Foundation Drain	\$ 5,463
Impoundment "A"	\$ 5,086
Impoundment "B"	\$ 5,086
Excavation (1,650 cy @3.50 cy)	\$ 5,654
TOTAL	\$ 51,000

RESULTS AND DISCUSSION

This quarter's activities involved water quality sampling undertaken on the Connor Run drainage. Table 5 shows the water quality data that was collected from the two AMD sources: sedimentation pond and seeps. Another sample was collected approximately 15 m downstream of the confluence of the seeps and pond on Connor Run (see Figure 1 for sampling locations). No sampling was conducted during April and May due to scheduling difficulties. These data are similar to the data collected during the previous quarter.

Table 5 Baseline Water Quality Analysis Results: Connor Run Drainage

Quarter 2 Sampling				
Sampling Station	Units	Pond	Seep	Confluence
date		06/18/04	06/18/04	06/18/04
Flow	gpm	NM	4	20.08
Flow	L/Min	NM	15.1	76.0
Field pH		3.7	3	3.5
pH		3.7	3	3.4
acidity	mg/L	135	197	58
est. acidity	mg/L	104.47	222.67	67.88
alkalinity	mg/L	0	0	0
acid-alk	mg/L	135	197	58
acid load	kg/yr	NM	1573.07	2324.95
Mg	mg/L	17.4	37	11
Ca	mg/L	18.9	39.5	24.2
Fe	mg/L	0.59	17.6	5.17
Al	mg/L	15.9	15.7	4.15
Mn	mg/L	3.99	12.9	3.59
SO4	mg/L	251	509	159
Cond	µs/cm	489	1460	480

The pond sample was collected from a seep emanating on the downslope side of a former sedimentation pond that collects drainage from a series of subsurface seeps emanating from the toe of the surface mine spoil. The seep sample was collected in the toe of the valley that drains a large portion of the former surface mine. Depending on antecedent precipitation conditions the pond and seep samples can represent a combination of both surface runoff and subsurface flow. The data indicates water quality typical of AMD contamination associated with the Freeport coal seam: relatively low pH and high acidity and metal concentrations. The low iron concentration in the pond reflects the results of oxidation causing precipitation.

The landowner agreed to sign the access agreement on April 2, 2004 after it was modified by eliminating the 30-year conservation easement and substituting a provision granting site access for five-years (Appendix A). The delay in obtaining the access agreement resulted in the need to reschedule the tree seedling planting to the spring of 2005.

Based on preliminary AMD quality data the conceptual design for the passive AMD treatment system was developed as described above.

Triad Engineering, Inc. was contracted to perform a land survey as well as to develop engineering drawings for the purpose of constructing the AMD passive treatment system in the Connor Run drainage.

CONCLUSIONS

Final execution of the landowner access agreement proved to be difficult due to landowner concerns over the location of the reforestation site and AMD treatment system as well as the duration of the conservation agreement. The problems encountered with satisfying the landowner concerns may be an indication of the difficulty of achieving workable landowner access agreements for furthering environmental credit development on private property. It is anticipated that when and if environmental credit markets develop and associated risks and environmental and financial benefits become better understood private landowners may be more amenable to entering into long-term conservation and management agreements on their lands.

The conceptual AMD design employs an innovative “Alkaline Recharge Trench” filled with kiln dust and limestone that intercepts and neutralizes subsurface AMD emanating from the mine spoil toe. The remainder of the system design employs more traditional passive treatment technology, such as open limestone channels, a limestone foundation drain and two precipitation/retention ponds.

Engineering drawings are being developed based on the conceptual design.

Appendix A
Landowner Access Agreement

ACCESS AGREEMENT

THIS ACCESS AGREEMENT is made this 2nd day of April, 2004 by and between Jeffrey A. Clark and Diane M. Clark of Valley Point, Preston County, West Virginia, BEING THE OWNERS of certain real estate that they acquired by deed recorded on December 29, 1997 in Deed Book 600 at Page 388 recorded among the land records of Preston County, West Virginia, (Grantor) and the Electric Power Research Institute, Inc. (EPRI) and its agents, contractors or employees, referred to as the ("Grantees").

WITNESSETH:

A. That the Grantees have been awarded a grant by the U.S., Department of Energy and the U.S. Department of Interior to demonstrate the efficacy of a market based approach for the reclamation of former mine lands in West Virginia. The project emphasis is on developing water quality and carbon trading credits by reforestation and treatment of acid mine impacted streams. The result to be achieved will include enhanced habitat for wildlife. Water quality credits will be developed through passive treatment technology and carbon credits will be developed through carbon sequestration in planted hardwood trees. Grantor owns land which they are willing to allow the implementation of improvements as contemplated by this program.

B. That for and in consideration of the sum of One Dollar (\$1.00) and other good and valuable consideration, the receipt of which is hereby acknowledged and the improvements to be received to their property, the Grantor hereby agrees as follows:

1. Grantor dedicates and grants to the Grantees the right to access for the use and purposes and under the terms and conditions described below in, along and across their land to a certain parcel of land owned by the Grantor in Valley Point, West Virginia acquired by Grantor on December 29, 1997 in Deed Book 600 Page 388 and known as Parcel II in Tax Map 24 and as more specifically identified in the Site Plan prepared by Triad Engineering Incorporated dated October 22, 2003 covering the area containing 34.28 acres as specifically delineated by a metes and bounds description attached hereto as Ex. A.

2. Grantor further grants to Grantee, its contractors and agents the ability to make the proposed improvements on the 34.28 acres identified in Exhibit A. The right of access shall lead from West Virginia County Route 15 known as Hudson Road and run for approximately 2,177 lineal feet as more clearly depicted on the Triad Engineering Site Plan map dated October 23, 2003. This Agreement will be subject to the following terms and conditions:

3. Grantee shall have the right to design, grade, provide soil amendments, till, restore, maintain and monitor and otherwise install a passive acid mine drainage treatment system in an effort to improve water quality and to plant the 34.28 acres with trees in an attempt to restore the acreage into a forested system. These efforts will result

in the improved restoration of an abandoned mining site. The forest as it matures will help preserve wildlife and capture carbon as well as help aid in the treatment of acid impacted streams resulting from mining operations conducted on the property in the past. The purpose of this program as well as the approvals given by Grantor to Grantee is to lay the framework for development of mine land reclamation and the creation of ecological credits under certain Federal and State rules, regulations and laws either currently in force and effect or to be enacted in the future. The location and scope of all improvements shall be with the cooperation and coordination of the Grantor, however, EPRI shall have the sole right to finalize and implement the design and planting of the project so long as the final product does not conflict with other local or state requirements with regard to the land use practices in Valley Point, West Virginia.

4. The Grantee shall have the right, at any time and from time to time, to clear and keep clear the access area as well as the 34.28 acres of unwanted trees, shrubs, roots, undergrowth, buildings, structures, and other obstructions not consistent with the program of planting trees and grasses to maximize the absorption of carbon. The Grantees shall not be responsible for the replacement or reimbursement cost of any trees, shrubbery or landscaping material.

5. The Grantee shall have the right of ingress to and egress from the Property for the purpose of constructing, inspecting, maintaining and monitoring its carbon mitigation and water quality enhancement project for a period of five (5) years from the date of this Agreement. If there are no public or private roads reasonably convenient to the Property Grantee shall have such right of ingress and egress over the Property adjacent to the access area in such manner as shall occasion the least practicable damage and inconvenience to the Grantor, its successors and assigns. Each such Grantee shall be liable for all damages resulting from its own exercise of the right of ingress and egress. Except in the event of any emergency, each Grantee will make a reasonable attempt to notify the Grantor or property owner/occupant prior to ingress upon the property for the purpose of constructing or maintaining its carbon mitigation project.

6. The Grantee shall have the right to inspect, rebuild, remove, repair, improve, maintain and monitor the improvements within the Property boundaries and make such changes, alterations, substitutions, additions to or extensions of its project as Grantee may from time to time deem advisable. The Grantee may build an access road within the Property which improvement shall not be removed but shall be abandoned in favor of the Grantor as the termination of this Agreement.

7. Grantor, its successors and assigns, may use the surface of the ground of the Property for any purpose not inconsistent with any of the rights granted to any of the Grantees provided that (1) no buildings, structures or other obstructions may be constructed within the Property boundaries. Grantor shall have the rights to all trees on the Property whether planted by Grantee or not at the end of the five year term of this

Agreement. Grantor shall comply with all State and Federal laws, rules and regulations relating to the environment as it apply to the subject Property

8. The terms of this Agreement shall be for five (5) years from the date of this Agreement and be binding on any successor or assign of Grantor during such term.

9. Grantee shall indemnify, protect, save harmless and insure the Grantor from and against any and all claims and demands for damages to Property, and for injury or death to persons, including payments made under any Workers' Compensation Law or under any plan for employees' demands, which may arise out of or be caused by its contemplated activities under this Access Agreement. Grantee shall be fully responsible and hold harmless Grantor for all costs associated with all work contemplated under this Agreement except that the Grantor shall remain responsible for any real estate taxes it is required to pay as the owner of fee simple title of all land within the easement area.

10. The failure of any party to enforce or insist upon compliance with any of the terms or conditions of this instrument shall not constitute a general waiver or relinquishment of any such terms or conditions, but such conditions and terms shall be and remain at all times in full force and effect.

11. Grantor shall have a say in types of trees to be planted
Also, Grantor would prefer to have warm weather grass in part
of the 34 acres.

IN WITNESS WHEREOF, Grantor has caused their names to be signed this
2nd Day of April, 2004.

GRANTOR

By: Jeffrey A. Clark
Jeffrey A. Clark

By: Diane M. Clark
Diane M. Clark

State Of West Virginia

COUNTY OF Preston, to wit:

I, the undersigned, a Notary Public in and for the County and State aforesaid, do hereby certify that Jeffrey A. Clark and Diane M. Clark whose names as are subscribed above have signed the foregoing Access and Deed of Easement, have personally acknowledged, subscribed and sworn to the same before me in my aforesaid jurisdiction.

GIVEN under my hand and seal this 2 day of April, 2004

My commission expires:

July 23, 2007

Kathy L Fullmer
Notary Public

EXHIBIT 'A'

Exhibit "A"