

RECLAMATION COSTS/BENEFITS FOR AREA MINING; OVERBURDEN PLACEMENT, GRADING, SITE PREPARATION, REFORESTATION AND MANAGEMENT

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Abstract

Black Beauty Coal Company has been a part of the coal mining industry in Indiana and Illinois for the past 25 years. Black Beauty utilizes hydraulic excavators, end dump trucks, and low ground pressure dozers for all soil removal and replacement operations. Final spoil grades are established with dumped shale or rock that is then graded by large dozers. Desirable soils are removed by the excavator ahead of the active pit and placed in end-dump trucks, which haul and dump the soils on the graded spoil behind the active pit. Depending on the approved soils handling plan for the particular site, the dumped soil may be final graded with low ground pressure dozers or graded for the placement of a layer of topsoil. Whether topsoil is removed and replaced separately, or whether it is removed and replaced as a single lift with the subsoil is determined by the dominant land use and soil characteristics of each individual mine site. Depending on the amount of desirable soil available on a mine site, the replaced soil thickness ranges from approximately 2 – 8 feet, with average depths being in the 5 – 6 foot range. In late winter, a legume or legume mixture is frost seeded into wheat sown the previous fall. Seedlings are planted into the standing wheat when ground conditions allow. Factors that determine the success of reforestation include: (1) seedling quality and species selection; (2) seedling care after leaving the nursery; (3) soil conditions; (4) weed control; (5) seedling placement; and (6) follow up competition control. Over the years, Black Beauty, as well as other area operators, tried many alternative methods of restoring forestlands. Some experimental methods proved successful under certain conditions while others were not so successful. Economic incentives and increased regulatory flexibility can be two very important factors that can improve and increase acreage of new forests on reclaimed coal mine lands.

Introduction

Black Beauty Coal Company has been a part of the coal mining industry in Indiana and Illinois for the past 25 years. Leiberling & Sons Woodland Management has been an independent forestry contractor since 1956 and plants over 1 million trees annually on reclaimed coal mine lands for numerous mining companies, including Black Beauty, in Indiana and Illinois. The collective methods of reforestation found to be most successful by Black Beauty and Leiberling on Black Beauty mines are discussed below.

Soils Handling, Replacement, and Initial Site Preparation

Black Beauty Coal Company utilizes hydraulic excavators, end dump trucks, and low ground pressure dozers for all soil removal and replacement operations. Final spoil grades are established with truck dumped shale or rock that is then graded by large dozers. Desirable soils are removed by the excavator ahead of the active pit and placed in end dump trucks, which haul and dump the soils on graded spoil behind the active pit. Depending on the approved soils handling plan for the particular site, the dumped soil may be final graded with low ground pressure dozers or graded for preparation of placement of a layer of topsoil. Generally, whether topsoil is removed and replaced separately or whether it is removed and replaced as a single lift with the subsoil is determined by the dominant land use and soil characteristics of each individual permitted mine site. If a mine site predominantly consists of prime farmland where topsoil must be segregated during removal and replacement, then the soil removal and replacement for the forest areas of this mine site are accomplished in a similar fashion. If on the other hand, a mine site consists primarily of forest and/or wildlife land uses then approval to use a soil horizon mixing plan is sought from the appropriate regulatory authority. Generally, once timber, stumps, and other woody debris are removed from a heavily wooded area, the remaining layer of topsoil is very thin and difficult to remove separately. A more favorable soil environment is created for tree survival and growth by removing and redistributing the topsoil and rooting media as a single lift. Depending on the amount of desirable soil available on a mine site, the replaced soil thickness ranges from approximately 2 – 8 feet, with average depths being in the 5 – 6 foot range on Black Beauty's mines. Soils are not only compacted during replacement, but they can also be greatly compacted during removal. There are many tillage tools available to alleviate compaction; however, the best practice is to minimize compaction during the necessary handling processes. Deep tillage has shown no apparent advantage on the sites where an A/B soil horizon mix has been utilized. The most successful tree plantings on Black Beauty mines, have occurred on sites where the single lift of A/B soil horizons have been used.

Benefits of Utilizing Soil Horizon Mixing Plans on Forest Lands

The benefits of utilizing soil horizon mixing plans on forestland are:

- More Efficient Utilization of Mining Equipment.
- Decreased Exposure Time of Bare Soils.
 - Less Sediment and Nutrient Loss.
- Decreased Compaction
 - Increased seedling survival rates.
 - Increased initial growth rates.
 - Timely Bond release.

Compared to other land uses and soil capabilities, Black Beauty's cost of soil removal and replacement for a non-prime or non-cropland capable forest is somewhat less than that for prime farmland or high capability land uses and similar to the cost of non-prime or non-cropland capable wildlife or pasture/hay land.

Once final grading of the replaced soils is accomplished, the reclaimed area is evaluated for erosion control needs. If permanent erosion control structures are needed, then design plans are developed and the structures are built. Fertility needs are determined and applied as needed. Depending on the season when the soil is replaced, a quick cover crop of oats, millet, or wheat is planted. If an oat or millet crop is sown in spring or summer, then wheat is no-tilled in the fall to provide a dense winter cover. In late winter, a legume or grass/legume mixture is frost seeded into the standing wheat. Seedlings are planted into the standing wheat when ground conditions allow. The wheat will, of course, die in June, but still provide erosion control and assist in moisture retention during the critical first months after seedling transplanting. The frost-seeded legumes generally do not become prevalent until late summer. Following this type of general plan has proven to be effective in balancing the needs for erosion control, moisture retention, and minimal vegetative competition to the seedlings during the first growing season. The costs of initial vegetative seeding and erosion control is similar to other land uses and soil capabilities with the costs associated with prime or high capability croplands being slightly higher, due to a more precise fertility program being implemented.

When considering the total costs of removing and replacing soils, erosion control, revegetation and proof of productivity until final bond release, prime cropland has been the most expensive land use for Black Beauty to reclaim. The next highest reclamation cost is re-establishing forest lands. Wildlife and pasture/hay land uses have been the least expensive land uses for Black Beauty to successfully re-establish. One important factor in minimizing the cost of reforestation is to plan for and implement adequate erosion control measures prior to seedling planting. The replanting of trees necessitated by grading of erosional areas is extremely expensive when compared to the replanting of herbaceous vegetation associated with other land uses under similar circumstances. Approximately 80 percent of the reforestation cost is associated with the initial tree planting. Re-planting would obviously double this cost.

Alternative Methods & Aids to Reforestation/Regulatory Assistance

Economic incentives and increased regulatory flexibility can be two very important factors that can assist the improvement and increased acreage of reforestation on reclaimed coal mine lands. Over the years, Black Beauty, as well as other area operators, have tried many alternative methods of restoring forestlands. Some have proved to be successful under certain conditions while others have been not so successful. Throughout the successes and the failures, many things have been learned that have changed the way sites are prepared and seedlings are planted. Direct seeding of acorns and smaller tree seeds, varying levels of ground cover, the influence of adjacent invasive seed sources and natural regeneration are all aspects that have the potential to change the methods of reforestation on reclaimed mine lands. As with the transplanting of seedlings, ground cover seems to have an immense, direct effect on the alternative methods of reforestation described above. As ground cover or competition increases, the success rate of establishing trees decreases. Promising results have been achieved with direct seeding of acorns and reliance on invasive species in areas where minimal ground cover or bare soils have been purposely created. With the current State and Federal requirements for ground cover and erosion control, it is difficult to implement any of these alternative methods in a substantial manner, but it should be noted that the use of methods that decrease the cost of reforestation, would serve as an incentive to increase reforestation acres. Additionally, added flexibility of where trees can be

planted on reclaimed lands would help to insure trees are kept and maintained after final bond release. Currently, many States do not allow planting of trees on prime farm land; however, many landowners with reclaimed prime farm land would prefer to have trees planted on all or a portion of their land. In States where test plots are allowed to prove productivity on prime farm land, trees could be planted on some of the areas represented by test plots without interfering with the prime farm land productivity requirements. On the other hand, where a State or Federal requirement limits the loss of forest acres, some acres are planted to trees when the landowner does not wish to have them and thus removes the trees immediately after final bond release. Increased flexibility should help to increase the number of acres of reforestation, as well as, increase the likelihood that reforested mine land will remain as such well beyond the time of final bond release.

Potential Aids to Increasing and Improving Reforestation on Mined Lands

Potential aids to increasing and improving reforestation of mined lands include:

- Reduce Tree Re-establishment Costs
 - Allowing decreased ground cover or bare ground.
 - Is a 450 live stems per acre standard necessary?
- Plant Trees Where They Are Wanted.
 - Allow trees on prime farmland.
 - Off site mitigation.
- Role of Carbon Sequestration Credits?
- More Research?

Reforestation Experience by Chris Leiberling Dealing With the Known, the Unknown, the Unfamiliar, and the Less Obvious

Allow me to discuss some known basic tree-planting principles and then ponder the unknowns.

1. **Seedling quality:** If there is one element in the whole process that is more important to survival than seedling quality I have yet to find it. A seedling with a large, healthy, fibrous root and as large a caliper of stem within reason is what we should be looking for. A desirable root to crown ratio cannot be over emphasized.

There are a limited variety of seedlings that do not respond well on reclaimed mine land planting and herbicide use, tulip poplar, and some of the wildlife shrubs come to mind. Since the more desirable species are often not available and you are compelled to use what is available, resulting in less than desirable seedling survival. **Competition from less desirable species and a penchant for regulators to require those less desirable species then becomes a problem.**

2. **Seedling Care After They Leave the Nursery:** I believe seedlings must be kept in refrigeration as soon as they leave the nursery until they are in the ground. We have two diesel refrigerator trailers; this allows us to have a load ready to go to the field as soon as soil conditions permit. On a rain out day or evenings we are back to the nursery or to our

shop to prepare another load for planting. **Unknown to our clients is the amount of time and effort needed for our crew to prepare your seedlings for planting, often times requiring another crew at the shop.** Competition for qualified part time labor to do the job is also a problem. Because the weather has been so wet and disagreeable this year our refrigerators have run since the last week in February. We have worked only two or three days each week. This is costly and is another one of the unknowns.

3. **Soil Conditions and soil placement:** Soil conditions are more critical for mechanical planting than for hand planting. Early in the season we can get by with somewhat more disagreeable soil conditions than later in the planting season when the temperature begins to heat up. Wet conditions later in the season become more intolerable because the wet compacted soil, after a day or two in the hot sun, begins to resemble brickbats, rip rap, or similar aggregates. Under such circumstances, soil to root contact is virtually impossible.
4. **Soil placement is equally important.** My experience with machine planting has been more satisfactory planting later in the season and waiting on favorable weather and soil conditions, rather than trying to mud them in too early. I would be the first to agree that, in a hand planting application, “the earlier the better.” It is nearly impossible to dig a hole large enough and deep enough for proper seedling placement when the reclaimed soil dries later in the season. **Here again we may need to change the social architecture, our way of thinking about our industry practices.** Extending the planting season would certainly be beneficial to the planting contractor. You are well aware of the fact that a good rain in July or August hides a lot of mistakes and has more of an impact on planting **than every thing else we do that is controllable.**
5. **Herbicide or Weed Control v/s no control:** The improper selection and **over use** of herbicides have destroyed many seedlings. Selecting the proper amount is the key to survival. **Equally important is the type of vegetative cover. Perhaps we may not need any cover on the more level sites.** Several years ago we made a mistake setting our electronic scales. We ended up using only one-third the suggested rate of herbicide. We watched the field with interest and by summers end could tell no difference in weed and grass control from where we were using nearly triple the amount of the recommended mixture. We did not see the usual herbicide damage to the seedling. Seedling damage in test plots is far more obvious as the rate of herbicide increases, **in many cases with no noticeable increase in weed control**, especially where unfriendly herbicides to seedlings are used. **Second year herbicide application** is another issue we must consider. In a dry summer with a heavy vegetative cover, many seedlings are lost. In many cases where we do second year spraying, many small seedlings that would have been lost are released and survive. Larger seedlings also respond favorably. Here again you reclamation managers must have accurate survival numbers and figure the cost effectiveness of second year herbicide control v/s replanting.
6. **Seedling placement and density:** The equipment we use to plant your tree seedlings is expensive. Less than desirable field conditions such as: rocks, wood, steel, discarded cable, steep inclines, and wash outs cause excessive wear and breakage of that

machinery. We attempt to upgrade and change our operation as your requirement mandates. The issue of safety and liability are always on our mind.

We started with a four-inch planting shoe to accommodate the largest root system possible. We could not get proper closure with that large shoe. We soon changed to a two and one half inch shoe and installed sod cutters on our press wheels to get better root to soil contact, this made a noticeable difference in our survival rate. We also cut two of our machines down and converted them to a heavy three-point hitch machine, with hydraulic leveling, for better maneuverability and placement. One of our machines is a split axle planter, pulled with a crawler track tractor. We use this on the steeper slopes and hard to plant areas.

As you can see, we have much more invested than a hoedad and tree bag, therefore a higher planting cost is also reflected in our higher cost of investment. **You too should expect better survival, resulting in earlier bond release.** I maintain it is better to do it right the first time and certainly more economical for our clients. There is always extreme competition for the dollars you have to invest, subsequently this is reflected on how effective the tree planting crew can be. I believe that larger blocks of forest plantings would be beneficial, thereby reducing the edge effect. By doing so, we create small microclimates, for we know that the woods are 10 degrees cooler in summer and 10 degrees warmer in winter.

7. **Carbon Sequestration:** Foresters are now learning to mark timber in a way to balance the carbon cycle. Most of you are aware of carbon sequestration. That equation will now enter into the reclamation process. This was **unknown** by most of us several years ago. We must always keep alert for beneficial changes based on accurate scientific information.

Summary

Some follow-up is necessary throughout the cycle. Competition from excessive rodent damage, animal browse, and keeping the center of the rows clean to conserve moisture may be of benefit to you. This could keep you from the necessity of replanting. Grass control is more crucial than broadleaf control. Often times though, the decaying plants you mowed earlier in the season provide hiding places for various rodents also highlighting the rows of seedlings for browse. **A different stroke for different folks is the name of the game.** Because of varying conditions, what works for you this year may not be in one's favor next year. What is successful on your mine may not be favorable on another mine. Periodic visits to the planting site could save you dollars in the future. The most effective methods of reforestation are still to be discovered. **There is always a better way. It is yet to be found. Most importantly, develop a good attitude about tree planting,** our planet will respond graciously, preventing a detrimental repeat of history experienced by ancient and more recent developing nations. Lead your group and expect something to happen. Do it right the first time, and help find the better way.

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