

Jewett Mine Solar Well Advancements



Texas Westmoreland Coal Company

Texas Railroad Commission / Interstate Mining Compact Commission

2015 Reclamation Awards Application

NOMINATION: COAL

General Information



Texas Westmoreland Coal Company's (TWCC) Jewett Mine is located seven miles west of the intersection of U.S. Highway 79 and FM 39 as shown in Exhibit 1, *Jewett Mine Location Map*. The mine occupies a stretch of land spanning 7.5 miles, from Interstate Highway 45 southwest to the eastern shore of Lake Limestone crossing portions of Limestone, Leon, and Freestone counties. Currently, 31,000 acres account for two adjoining mining permit areas. The larger of the two, Permit 32F, totals approximately 21,500 acres spanning southward from State Highway 164 to FM 1512. The remaining 9,500 acres of Permit 47A run south from Interstate Highway 45 where it meets

permit 32F just north of State Highway 164. The mine has been in operation since 1985 and employs approximately 335 full-time personnel and approximately 100 contract personnel. The Jewett Mine currently operates four open pits that supply lignite to the Limestone Electric Generating Station. The Jewett Mine is the one of the largest in Texas and produces approximately five million tons of lignite each year, representing about 9% of the total annual coal production in Texas. The active pits range from a depth of 20 to 200 feet and are being excavated by three Marion 8200 and one Marion 8750 draglines. Suitable Plant Growth Material (SPGM) is pre-stripped ahead of the draglines utilizing a CAT 6060 excavator and 200-ton Komatsu trucks and with two Komatsu PC2000 excavators and a mixed fleet of CAT 777F, 777D and 785 end dumps.)

To date, approximately 14,000 acres of the Jewett Mine are in various stages of the reclamation process. Since 2004, 6,202.8 acres have been initiated in the Extended Responsibility Period. Approval of Phase III release from performance bond obligations has been obtained on 3,551.2 acres and additional 2,107.7 have received Phase II release. Currently three multiphase bond release applications totaling 2,905.0 acres are under review with the Railroad Commission of Texas and a similar package is proposed for submittal in the summer of 2015.



Background

Central Texas is often subject to droughty climate conditions which makes large scale revegetation projects very difficult. Under a natural setting, the native herbaceous and woody plants of this region have had years or decades to establish. Unfortunately, during the reclamation phase of a surface mine operation, the quick establishment of vegetative cover is imperative. Revegetation is an ongoing process at the Jewett Mine and maximum success is key to minimizing erosion, flood prevention, increasing ground water recharge and reducing costs associated with replanting. Establishing a rigorous stand of permanent vegetation in a relatively short period of time is most difficult during the dry summer months. For much of the Jewett Mine area, these obstacles are accentuated due to the heavy presence of well drained sandy soils (see Exhibit 1). Even in the best of conditions, these soils can be difficult to establish cover due to low moisture retention potential and organic material content.



To minimize the effects of these factors at areas of increased slope, concentrated flows or woody stockings, TWCC began experimenting with a mobile irrigation scenario in 2011. In this approach, water was delivered to mobile irrigation units by tractors hauling 1,000 gallon water-filled nurse trailers. These nurse trailers were filled at the mines' limited water stations a great distance from the active reclamation areas. The trailers were equipped with gasoline powered pumps that would propelled water through the system's PVC pipes until the nurse trailer was empty. Once depleted, operators would return to the closest watering station and the process was repeated until all zones were adequately irrigated. During this, each cycle would involve approximately an hour of time to complete. Shortly after this approach was implemented, increased success in revegetation was observed in irrigated areas with reduced erosion and woody stocking mortality (see Appendix A). Unfortunately, the size of areas needing irrigation resulted in continual watering and heavy costs associated with labor and fuel consumption. Even with the reduced cost in erosion repair and minimized replanting another solution had to be possible.

Well Construction



The idea of a well installed specifically for these types of operations was discussed, yet a constant and reliable source of energy to power the well pump would be required. Traditional over-head transmission lines were not an option given the remote locations where irrigation is needed. This is when TWCC began to research the potential of a solar power. After a continued research, TWCC decided to construct a large Solar Powered Reclamation Well (SPRW) for placement in a strategic location. This objective was to construct a well that would provide adequate flow to meet the demands of an entire irrigation system which

would greatly reduce the need for heavy equipment, fuel requirements and labor hours.

In the spring of 2012 the first solar powered water well was constructed at the Jewett Mine to support the RP-F1 wetland and Wilkerson Springs Creek. The system captures solar energy through several large photovoltaic modules which then send the converted energy to electric water pumps. Groundwater is brought to the surface and temporarily held in large, onsite storage tanks until battery powered remote control valves open, allowing the water to flow through the irrigation system until the preprogrammed interval of time has expired. Each irrigation zone is synced allowing for a completely autonomous watering system with the exception of periodic maintenance and inspections.



The SPRW is technologically innovative by utilizing products from the advancing solar power industry in conjunction with a sophisticated temporary irrigation system for the purpose of post-mine reclamation. Twenty-two 65" x 40" x 1.4" photovoltaic modules, each made of 60 cells, and each producing 255 watts per module provide power to two pumps. The first is a constant pressure groundwater pump filling two 5,000 gallon reservoir tanks equipped with an automatic shutoff float valve. The second is an on-demand pump supplying 100 gpm of water at 55 psi to remote control valves that irrigate the vegetation at timed intervals.

Environmental Benefits

TWCC feels the SPRW project benefits the environment in more than one way. First, by cutting equipment usage, both fuel consumption and emissions are reduced. This approach also reduces vehicle traffic to newly planted areas and erosion potential from rutting. The project also benefits the environment as an educational tool to build awareness to one of many the potential uses of solar power. TWCC hosts several education programs annually. Of those, participants of the Texas Mining and Reclamation Association (TMRA) Teachers Workshop and students from the Jewett Mine Wetland Education Day are given a tour of the SPRW and the areas that are supported by it. There, teachers and young students alike are given a first-hand view of the benefits that can be obtained using the SPRW.



Results & Cost Savings



With an approximate 12,000 trees needing to be watered, 200,000 gallons of water per week is required. Using tractors and nurse trailers exclusively while assuming each 1,000 gallon trailer can irrigate 10,000 gallons per day, it would take at least four tractors, four nurse trailers, and four operators working ten hour days, five days a week to ensure sufficient irrigation. The SPRW automatically produces 21,600 gallons a day, seven days a week while requiring only one tractor/trailer working three days a week for ten hour days. That equates to an 85 percent reduction in

fuel consumption and valuable man-hours. Our specific goal with the solar-powered well was to lower costs. Our well installation, solar panel unit and labor costs amounted to \$37,000. Providing water with contractor nurse tanks cost TWCC that amount in 5 months. To best establish vegetative cover and trees, our water requirements are 8 months per year for two years.

This unit is portable for similar irrigation needs elsewhere once the RP-F1 and Wilkerson Springs wetland features are adequately vegetated. Ultimately, revegetation is our final measure in achieving success reclamation. Our solar-powered irrigation system has proven to greatly increase survivability of herbaceous and woody vegetation; therefore, providing the stability and vegetative diversity TWCC strives for. This approach was made possible through developments in technology, ongoing science and determined attitudes. The future for the Jewett Mine will serve as an example of how environmental excellence can be accomplished.



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APPENDIX A: Woody Plant Survivability in Irrigated Areas of the Jewett Mine

MINE CREEK Trees inventory at Fall 2012 (2 years after planting)

Species	Alive	Dead	Total Found	% Found Alive By Species
Bald Cypress	549	219	768	71.48%
River Birch	579	128	707	81.90%
Willow Oak	1048	103	1151	91.05%
Overcup Oak	339	35	374	90.64%
Live Oak	190	46	236	80.51%
Red Oak	244	36	280	87.14%
Bur Oak	206	70	276	74.64%
Chinquapin Oak	149	73	222	67.12%
Water Oak	60	10	70	85.71%
Cedar Elm	314	96	410	76.59%
Pecan	132	86	218	60.55%
Total	3810	902	4712	80.86%

*** Initial planting were all containerize from 1 - 30 gallon

WILKERSON BRANCH					
TREES inventory at fall 2012 (1 year after planting)					
SPECIES	TOTAL PER SPECIES	DISTRIBUTION %	Dead	Alive	Percent survivability
BUR OAK	208	6.00%	42	166	80%
CHINQUAPIN OAK	281	9.50%	59	202	72%
OVERCUP OAK	200	4.10%	30	170	85%
SOUTHERN RED OAK	364	7.50%	62	302	83%
WATER OAK	200	4.10%	90	110	55%
WILLOW OAK	200	4.10%	106	94	47%
LIVE OAK	500	10.30%	127	373	75%
RIVER BIRCH	400	8.20%	76	324	81%
BALD CYPRESS	208	4.00%	18	190	91%
CEDAR ELM	148	4.80%	53	95	64%
AMERICAN ELM	850	15.00%	383	467	45%
PECAN	100	2.10%	64	36	36%
GREEN ASH	851	15.00%	400	451	53%
AMERICAN BEAUTYBERRY	100	2.10%	43	57	57%
WAX MYRTLE	50	1.10%	23	27	54%
BUTTONBUSH	200	2.10%	114	86	43%
TOTAL NUMBER OF TREES	4860	100.00%	1690	3150	overall success rate 64.8%

Initial Planting				
GROUPINGS:	LINERS	1-3 GALLON	5-7 GALLON	30 GALLON
PERCENT	48%	30%	17%	5%
TOTAL QUANTITIES	2344	1458	815	243

*** mostly liner material that wasn't irrigated

JEWETT MINE SANDY SOILS

