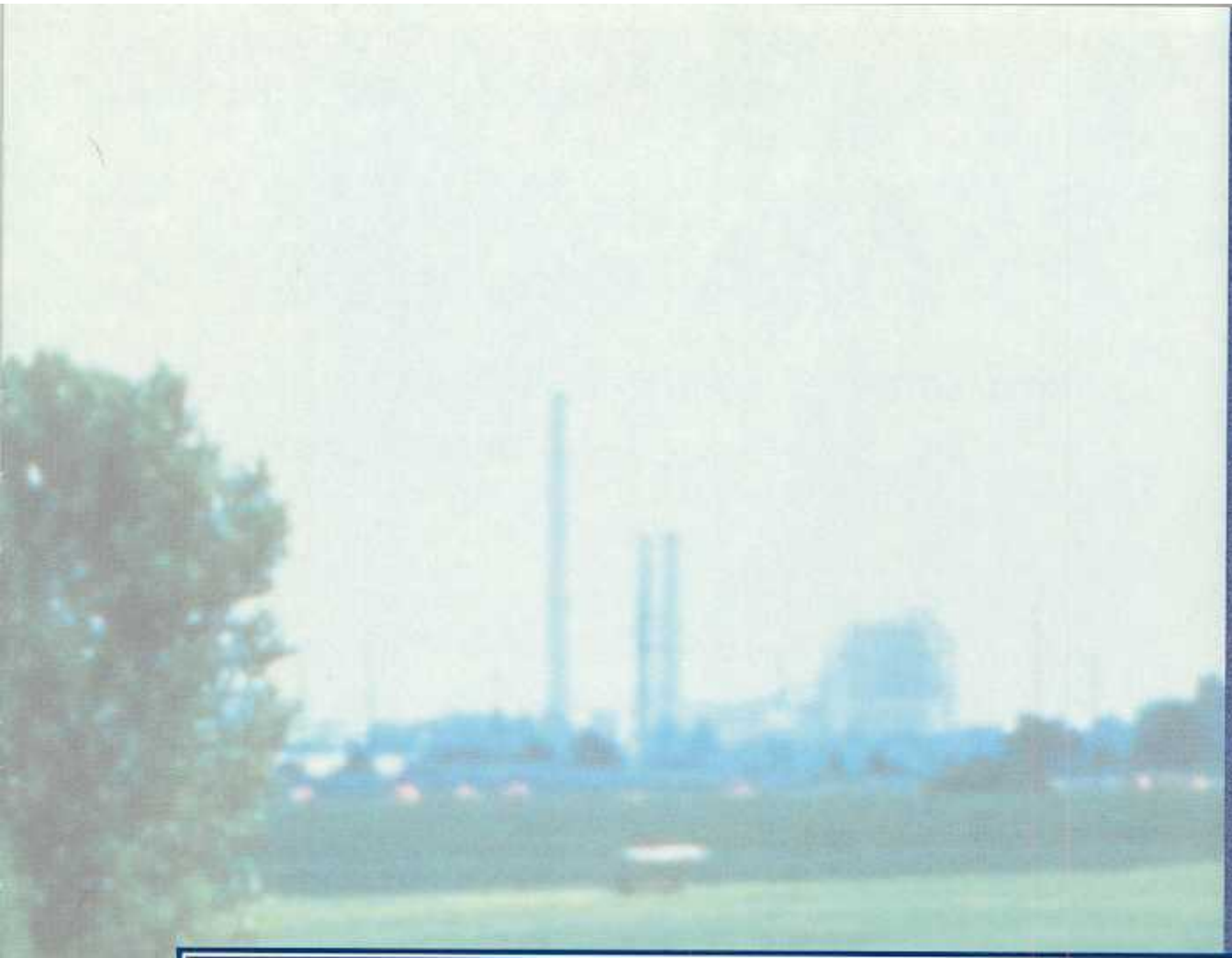


Texas Utilities Mining Company

FROM CLAYPANS/DEEP SANDS TO PRIME FARMLANDS

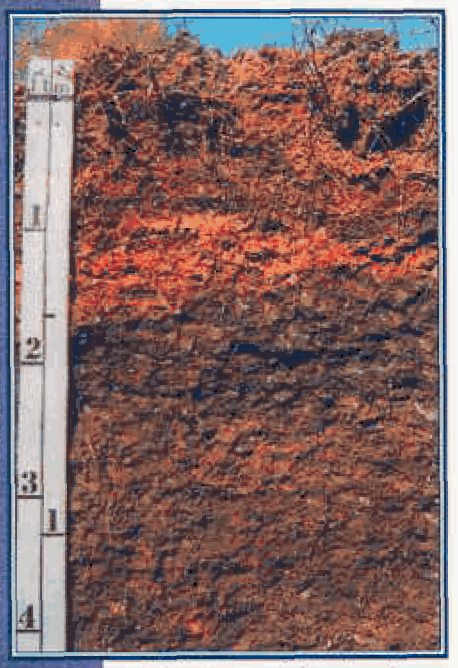
Big Brown Mine, Permit No. 3C - Fairfield, Texas

Monticello Winfield Mine, Permit No. 30C - Mt. Pleasant, Texas

Most native soils in East Texas are very low in quality because of either claypans at shallow depths or very deep sands. Very few of these native soils meet the criteria for prime farmland soils. However, lignite mining has led to a significant increase in soils meeting prime farmland criteria at two mine locations.

Background of the Mining Operations

Typical east Texas Claypan soil. Roots cannot go very deep in these soils.



Big Brown silty clay loam.

Texas Utilities Mining Company (TUMCO) began mining at the Big Brown Mine, near Fairfield, Texas in 1971. Approximately 10,500 acres have been reclaimed after mining with three draglines and one bucket-wheel excavator/cross pit spreader. Approximately 5 million tons of lignite are removed by mining each year at Big Brown.

Mining began at the Monticello Winfield Mine, near Mt. Pleasant, Texas in 1974. Since that time, approximately 11,900 acres have been reclaimed. Mining is conducted using four draglines and a bucket-wheel excavator/cross pit spreader. Approximately 10 million tons of lignite are mined annually at Monticello Winfield.

Both mines are mine-mouth operations, delivering the lignite to the power plant nearby. The electricity contributes to total generation for the Texas Utilities System, which provides power to approximately 6 million people in Texas, roughly one-third of the total population of the state.

TUMCO employs selective overburden handling as the mining and reclamation method at its mines. This approach is based on the results of research conducted during the past 28 years on east Texas overburden materials and their value for topsoil substitution. (White, etal, 1997.) Selection of overburden for placement in the top four feet of reclamation is refined by geologic and soils studies during the mine permitting process.

At Big Brown, the use of selected mixed overburden materials in the top four feet of postmine soils as compared to segregating, hauling, and returning native soils has improved postmine soils and saved Texas Utilities customers $57 million since 1971, with a continued estimated annual savings of $2 million. Additional savings have been realized from selective handling at Monticello Winfield which have not been quantified.

Beginning in 1983, Texas Utilities, cooperating with the Natural Resources Conservation Service (formerly Soil Conservation Service), developed a postmine soil mapping and classification program. Postmine soil mapping provides a valid procedure for comparing premine and postmine soil quality. The results of this program suggested that some minesoils developed from mixed overburden could potentially meet all the criteria for prime farmland soils. Several years of field trials and data collection went into the effort, and in 1991, the NRCS declared the first mixed overburden prime farmland minesoil in the United States at the Monticello Winfield Mine in northeast Texas.

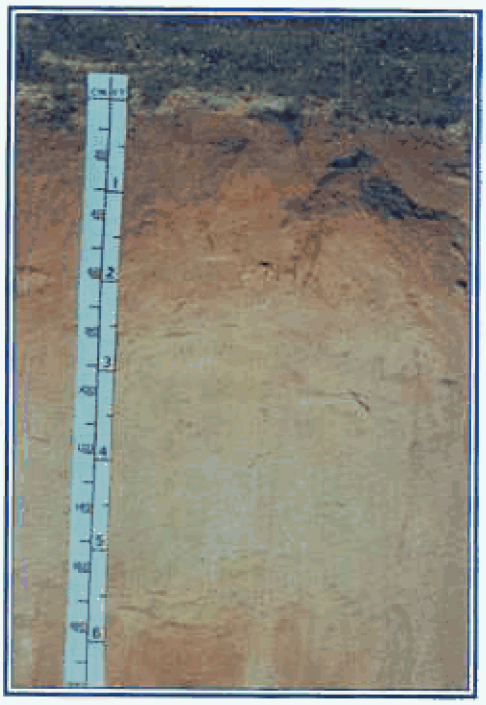
Reclamation Practice

The majority of native soils of east Texas are either deep sands (>40 inches of sand or very fine sand) or have a claypan at shallow depths (<20 inches). Both tend to be very droughty soils, either because of the high sand content throughout or because of the abrupt textural break at shallow depths causing a boundary across which water, air, and roots have difficulty passing. Most native soils in east Texas have low pH and low acid-base account (ABA) values (Smith and Sobek, 1978). Postmine soils where selective overburden handling is practiced tend to have higher mean values for these parameters and more consistent textures throughout the minesoil profile. (Table 1)

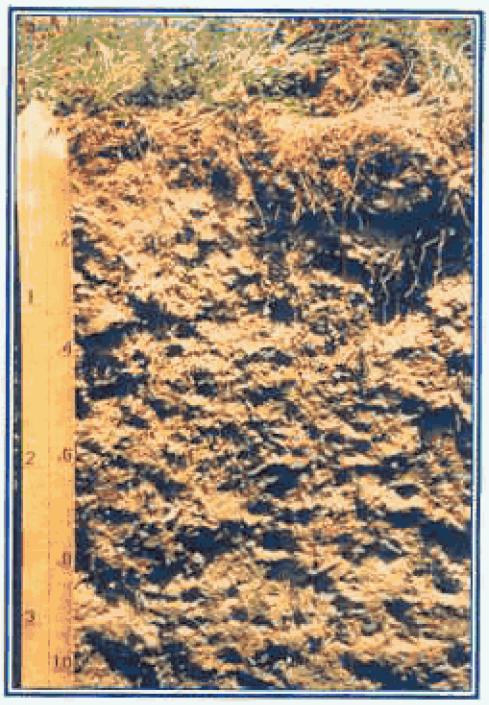
	Native Soils	Postmine Soils	Native Soils	Postmine Soils
	0-12"		12-48"	
Big Brown				
pH	5.6	6.5	5.4	6.4
ABA	0.5	3.2	-0.3	2.7
Sand	69	35	44	34
Clay	17	27	41	28
Monticello Winfield				
pH	4.9	6.9	4.9	7.0
ABA	-0.5	5.9	-2.7	5.3
Sand	72	31	54	30
Clay	12	28	30	28

Table 1. Mean values for premine and postmine soils

The mining operation, in which selected geologic materials are used in the top four feet of reclaimed soil, breaks up the claypan where it exists and removes the deep sand layer where it occurs. Postmine soils have a much more uniform texture than most of the native soils in east Texas. The surface of most of the reclaimed soils is more clayey, which allows for higher water-holding capacity and higher cation exchange capacity. The lower layers of these reclaimed soils are usually less clayey than the native soils, allowing freer movement of roots, water, and air.



Typical deep sand from east Texas. These soils are very droughty, so roots do not penetrate very deeply.



Grayrock silty clay loam.

At the Monticello Winfield Mine, the Grayrock soil series (fine-silty, mixed, nonacid, Typic Udorthents) on 1 to 5 percent slopes and the Grayvar soil series (fine-loamy, mixed, nonacid, thermic, Typic Udorthents) on 1 to 5 percent slopes were declared as prime farmland soils by the Natural Resources Conservation Service in 1991. At the Big Brown Mine, the Big Brown soil series (fine-silty, mixed, nonacid, Typic Ustorthents) on 1 to 5 percent slopes was declared a prime farmland soil by the NRCS in 1993. Table 2 presents a comparison of areal extent of prime farmland soils between premine and postmine areas.

Of the approximately 22,400 acres which have been reclaimed at both of these sites, about 5,100 acres of the premine area qualified as prime farmland soils, but approximately 14,000 acres meet the prime farmland qualifications as postmine soils, an increase in prime farmland soils of about 9,000 acres.

	% of Premine Area	% of Postmine Area
Big Brown	4.7	58.6
Monticello Winfield	38.8	65.9

Table 2. Percentage of prime farmland soils.

On-site Effectiveness

Postmine soils are very productive compared to native soils.

Estimated yield comparisons for major forage crops such as Coastal bermuda grass (Cynodon dactylon (L.) Pers.) and winter wheat (Triticum aestivum L.) are provided in Table 3 for the Grayrock soil series. Yields for Coastal bermuda grass for the Grayrock series come from production averages over a number of years in compliance with regulatory requirements (TUMCO, 1996). Estimated wheat yields were summarized in 1989 following three years of study on a 10-acre plot of Grayrock silty clay loam, 1 to 5 percent slopes. Management on the study area conformed to normal farming practices within the area. Due to variances in weather and damage from migratory geese, annual yields ranged from 29 to 59 bushels per acre. The estimated wheat yield shown in Table 3 is an average of the three-year study.

Native soil yield estimates were made by the Natural Resources Conservation Service (USDA-SCS, 1989) for a low level of management and are based mainly on the experience and records of farmers, conservationists and extension agents from the area. These can vary in any given year depending on weather, management practices and the presence or absence of disease and insects.

	YIELDS	
SOIL	C. BERMUDA	WHEAT
	(tons/ac)	(bu/ac)
Bernaldo	3.1	*
Freestone	3.1	35
Nahatche	2.9	*
Wolfpen	2.6	*
Woodtell	2.8	35
Grayrock**	3.4	39

Table 3. Premine/postmine yield comparisons - Monticello Winfield Mine.

** Not commonly grown. See text for source of estimates.*

*** Minesoil.*

Reforestation efforts are also successful on postmine soils.

In addition to the above information, a 10-acre plot of alfalfa (Medicago sativa L.) planted in 1989 continued to produce a healthy crop through the 1998 growing season, producing four hay cuttings per year. This is in an area of the state where native soils are not adapted to alfalfa production, providing a potential source of income in the major dairy region of Texas.

Table 4 provides the estimated yield information for the Big Brown soil series for Coastal bermuda grass (TUMCO, 1997) and wheat. The wheat yield is based on one year's data on the Big Brown soil series.

These studies have not received statistically valid testing but support the conclusions of the NRCS that the yield potential is equal to or greater than that of native soils of the area.

SOIL	C. BERMUDA	WHEAT
	(tons/ac)	(bu/ac)
Crockett	2.0	35
Edge	1.9	28
Gasil	2.2	28
Gredge	2.0	*
Nahatche-Hatliff	2.1	*
Padina	1.8	*
Silawa	1.9	*
Silstid	1.9	*
Big Brown**	3.0	52

Table 4. Premine/postmine yield comparison – Big Brown Mine.

**Not commonly grown. See text for source of estimates.*

***Minesoil.*

Transferability to Other Mining Operations

Other mining companies can take advantage of a similar approach if their geologic overburden is suitable for use as topsoil and subsoil. At these two TUMCO mines, the overburden must be cored, laboratory analyses procured, and an evaluation performed by a qualified soil scientist. Overburden and interburden thickness maps are prepared which depict thickness of the suitable strata. Dragline operators are

trained to recognize and properly handle the overburden materials so that unsuitable materials are placed low enough in the pit that they cannot become postmine soil materials.

Long-Term Benefits

Texas Utilities began reclaiming mined land even before mining regulations were promulgated in the mid-1970s. The reclamation work done to date is producing soils that are more productive than premine soils. It is also providing a valuable resource base for current and future users of the land. Recent estimates show that the increased potential production gained from Big Brown's postmine soils could conservatively boost Freestone County's agricultural economy by $21 million over the next 20 years as well as provide additional food products. For years, agricultural operators in east Texas have sought a method to break up the claypans so prevalent in that part of the state. Surface mining has resulted in just that, and has even increased the percentage of the landscape occupied by soils meeting the criteria for prime farmland soils. Where suitable overburden materials are present, and proper handling techniques are used, the results can be very beneficial for all concerned.

Agricultural operations co-exist with mining and power plants.

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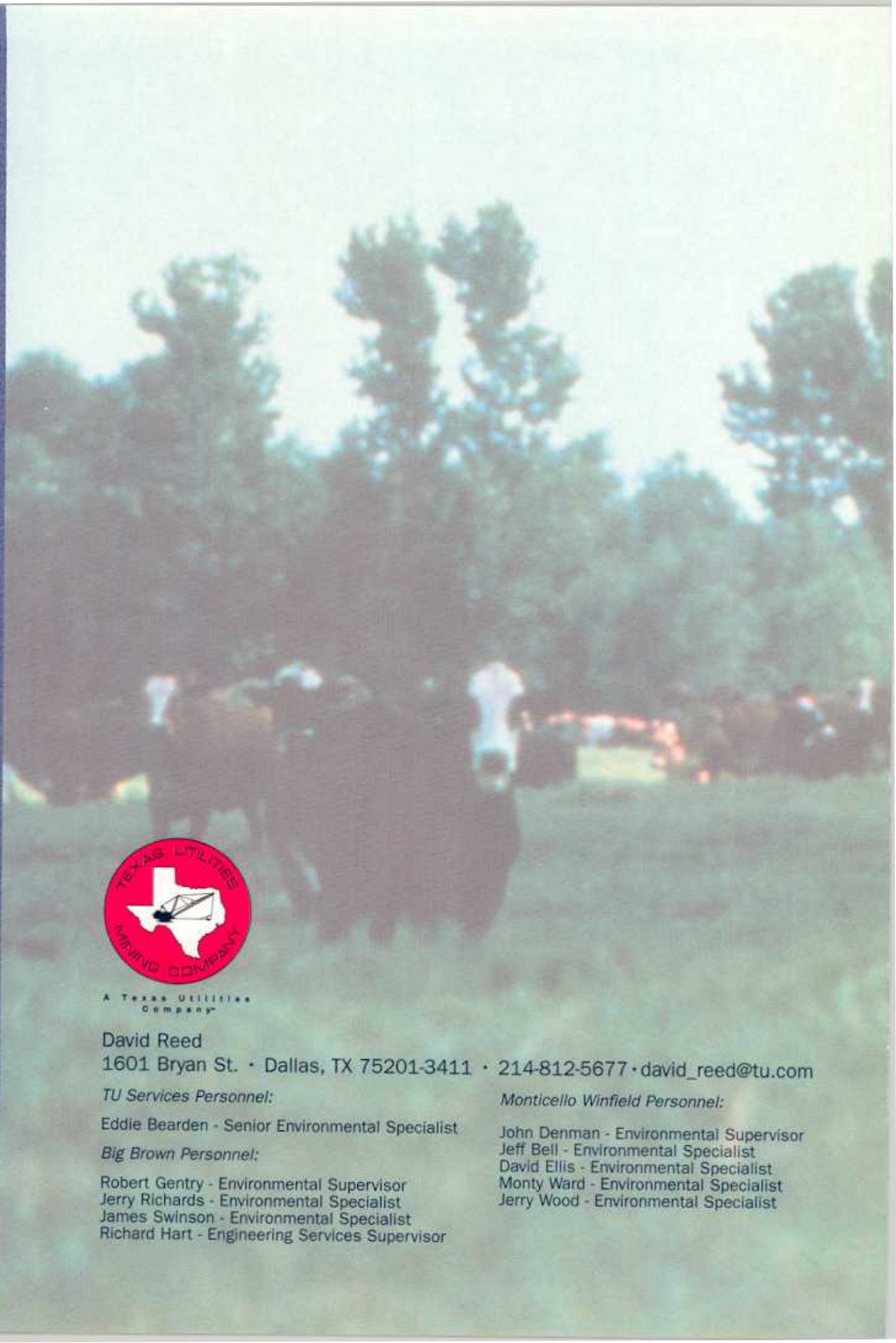

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