

**PROPERTIES OF AND FACTORS INFLUENCING INFILTRATION  
RATES A RECLAIMED LIGNITE MINE,  
FREESTONE COUNTY, TEXAS**

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Over the last 30 years, lignite has become an important energy resource for the State of Texas. Production of lignite involves strip mining large areas of land in the Texas Gulf Coast region. Lignite as the Big Brown Mine, Freestone County, Texas, is produced from fluvial-deltaic sediments of the Calvert Bluff Formation of the Paleocene-Eocene Wilcox Group. Mining processes mix overburden material resulting in a spoil that is more homogeneous than the original unmined material over the area of the mine. The effects of mining on the environment are wide and varied, but mining is especially disruptive to the groundwater system. Groundwater recovery begins immediately after the spoil is placed, but occurs at highly variable rates. Hydrogeologic properties change rapidly in the first few years after the mining and much of the groundwater recovery is dependent on the infiltration capacity of the spoil material. Resaturation of shallow spoil aquifers at the Big Brown Mine occurs at rates ranging from 0.6 to 3.0 m/yr (2-10 ft/yr). Recharge to the groundwater system is principally from direct infiltration of precipitation with variable resaturation rates attributed to variations infiltration.

For this study, four sites at the Big Brown mine were chosen for characterization. Three sites, designated fields C-13, C-24 and C-32, are located in reclaimed areas of the mine and range in age from 9 to 14 years old, while the fourth site is located in an unmined area (UM) between the two active mining pits. Infiltration rates were quantified using a drip infiltrometer to simulate rainfall. Results show that mining and reclamation processes can reduce infiltration rates by as much as 53 percent from the unmined values. Unmined areas show infiltration rates ranging from 12 to 30 cm/hr(4.7-11.8 in/hr) with a mean value of 20 cm/hr(7.9 in/hr). Mined areas show infiltration rates ranging from 3 to 33 cm/hr (1.2-8.7 in/hr) with a mean value of 9 cm/hr (3.5 in/hr). These rates vary significantly over the area of a single field resulting in high standard deviations, but a comparison of mean infiltration rates between the three mined areas show much less variation. It is unlikely that the small variations seen in the infiltration rates of fields C-13 and C-24 can, by themselves, account for the large variations in resaturation rates for these fields.

Infiltration rates vary in response to changes in soil moisture content, spoil heterogeneity, soil mineralogy, and method of spoil placement. Higher values of infiltration occur when the soils are dry, generally from late spring to early fall. Differences in soil texture had less effect on infiltration rates than was hypothesized, with both coarse and fine grained soils showing similar values.

Tracer tests, using sodium bromide as a conservative tracer and the red dye Rhodamine WT, were performed to determine if channeling of water occurs in the reclaimed soils. Trenches, cut in the dyed areas, were inspected for fractures and macropores and sampled at regular intervals for analysis of bromide concentration. Rhodamine WT showed some fractures in the soil structure, but due to a chemical reaction, sorbed strongly to the soil surface with little movement into the soil column. Concentration plots of bromide proved much more useful in determining mechanisms of flow and show good vertical flow paths in fields C-13 and C-32. Lateral flow dominates in field C-24. Differences in flow mechanisms may best account of the variable resaturation rates seen in these fields.