Trail Ridge: A critical hydrologic interface protecting the Okefenokee Swamp

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Abstract

Trail Ridge is a one mile-wide and 100-mile-long topographic ridge that separates the Okefenokee Basin and Swamp from the coastal plain of Georgia. It represents the crest of a former beach complex and was formed as inland sand dunes. The ridge is composed of fine-grained to medium-grained quartzose sand. The hydrogeology of the southern portion of Trail Ridge has been extensively characterized at a proposed mine site in southeastern Georgia. In the study area, the ridge is underlain by a shallow aquifer, locally known as the Surficial Aquifer, and forms a hydrologic divide between the Okefenokee swamplands to the west and the Saint Mary's River to the east. Trail Ridge is a classic example of a topographically-driven hydrologic system. The water table is shallow and mimics the ground surface. Much of the precipitation that falls on Trail Ridge is returned to the atmosphere by evaporation and transpiration. Precipitation that is not evaporated or transpired to the atmosphere infiltrates to recharge the Surficial Aquifer. Groundwater recharge on Trail Ridge causes the water table to mound close to the land surface. In the absence of recharge, water would flow from the Okefenokee Swamp in the west [where water levels are at an elevation of about 120 feet above mean sea level (amsl)] to the east (where water levels are at an elevation of 80 feet amsl) and the water table would linearly decline to the east. Groundwater mainly flows from the centerline of Trail Ridge to the west and to the east and small amounts of groundwater discharges to local streams, particularly on the eastern side of the study area. Along the western margin of the study area, groundwater flow provides water to the Okefenokee Swamp and related wetlands. On the eastern side, groundwater provides base flow to streams.

Trail Ridge: A critical hydrologic interface protecting the Okefenokee Swamp

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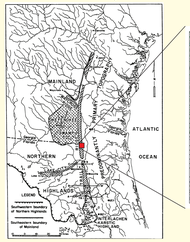
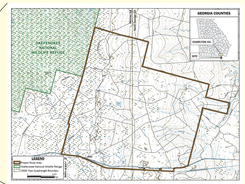
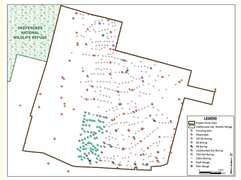
Introduction

Trail Ridge is a one mile-wide and 100-mile-long topographic ridge that separates the Okefenokee Basin and Swamp from the coastal plain of Georgia. It represents the crest of a former beach complex and was formed as inland sand dunes. The ridge is composed of fine-grained to medium-grained quartzose sand. The hydrogeology of the southern portion of Trail Ridge has been extensively characterized at a proposed mine site in southeastern Georgia. In the study area, the ridge is underlain by a shallow aquifer, locally known as the Surficial Aquifer, that forms a hydrologic divide between the Okefenokee swamplands to the west and the Saint Mary's River to the east.



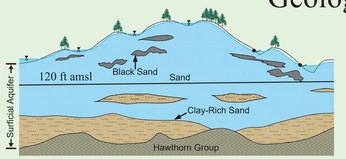


Study Area

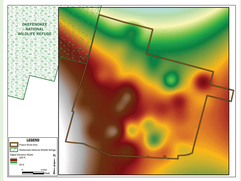


702 soil borings, wells, and piezometers

Geology



Clay-rich sediments occur below 120 ft amsl, and humate-rich sediments occur above 120 ft amsl



The surficial aquifer overlies an erosional surface on the Hawthorn Group

Hawthorn Group - The top of Hawthorn Group consists of very low-permeability calcareous sandy clays and lean to fat clays

Clay - Reworked Hawthorn Group, occurs mainly below 120 ft amsl, occupies 3.82% of the surficial aquifer, consists of silty clays, sandy clays, and fat clays

Clayey Sand - Occurs mainly below 120 ft amsl, occupies 7.85% of the surficial aquifer, consists of silty sands with clay content between 10% – 40% and fat clays

Silty-Clayey Sand - Occurs mainly below 120 ft amsl, occupies 8.52% of the surficial aquifer, consists of fine- to medium-grained sands with silt and < 5% clay

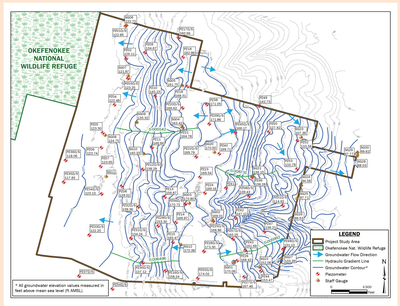
Unconsolidated Black Sand - Occurs mainly above 120 ft amsl, occupies 1.34% of the surficial aquifer, consists of silty sands and well sorted sands stained with secondary humate

Semi-Consolidated Sand - Occurs mainly above 120 ft amsl, occupies 10.27% of the surficial aquifer, consists of silty sands and well sorted sands, can contain secondary humate

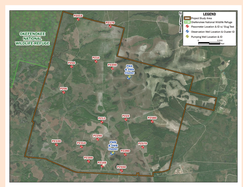
Consolidated Sand - Occurs mainly above 120 ft amsl, occupies 5.54% of the surficial aquifer, consists of humate-cemented silty sands and well sorted sands. Humate cements formed after the deposition of the sand due to circulating groundwater

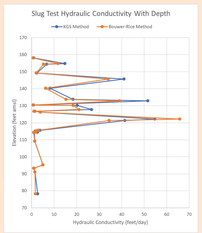
Unconsolidated Sand - The most abundant unit, occupies 58.33% of the surficial aquifer, consists of silty sands and well sorted sands

Hydrogeology



The water table is shallow and mimics the land surface

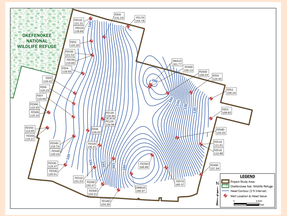




Aquifer Testing

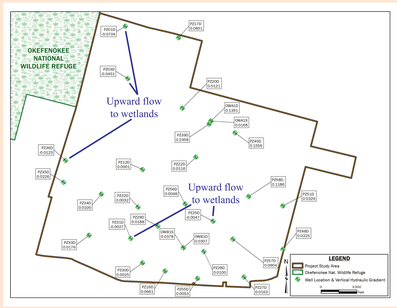
Two 24 hour pumping tests conducted in the north and the south. 11 observation wells were used for each test. Transmissivity ranged from 1,490 – 1,967 ft2/d in the north and 530 – 697 ft2/d in the south.

Slug tests were performed in 24 piezometers. The hydraulic conductivity ranged from 0.2 ft/d to 75 ft/d and averaged 12 ft/d. The hydraulic conductivity decreases below an elevation of 120 ft amsl, due to the presence of reworked Hawthorn clay.



Head in Wells Screened Below 120 ft amsl

A contour map of heads observed in wells screened below 120 ft amsl reveals that the hydrologic divide present at the water table is persistent with depth.

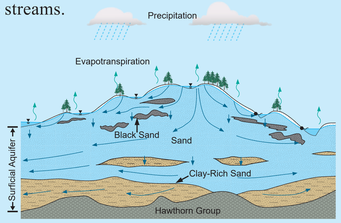


Vertical Hydraulic Gradients at Nested Piezometers

Observed vertical gradients are generally low (< 0.1), suggesting that most of the Surficial Aquifer is not hydraulically compartmentalized. High vertical gradients (< 0.1) are found locally in the eastern part of the study area where local confining conditions exist (e.g., local clay lenses and accumulations of humate). Most observed gradients are downward (positive), indicating recharge conditions. Upward gradients are observed near wetlands, indicating groundwater discharge into the wetlands.

Trail Ridge is a Topographically-Driven Hydrologic System

Trail Ridge is a classic example of a topographically-driven hydrologic system. The water table is shallow and mimics the ground surface. Much of the precipitation that falls on Trail Ridge is returned to the atmosphere by evaporation and transpiration. Precipitation that is not evaporated or transpired to the atmosphere infiltrates to recharge the Surficial Aquifer. Groundwater recharge on Trail Ridge causes the water table to mound close to the land surface. Groundwater mainly flows from the centerline of Trail Ridge to the west and to the east and small amounts of groundwater discharges to local streams, particularly on the eastern side of the study area. Along the western margin of the study area, groundwater flow provides water to the Okefenokee Swamp and related wetlands. On the eastern side, groundwater provides base flow to streams.



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This work was supported by Twin Pines Minerals, LLC