Grassland, Soil and Water Research Laboratory (GSWRL)

In the mid-1930s, the USDA Soil Conservation Service, now the Natural Resources Conservation Service, realized a need to analyze and understand hydrologic processes on agricultural fields and watersheds because of their impact on soil erosion, flood events, water resources, and the agricultural economy. To address this need, the Hydrologic Division was created within the Soil Conservation Service research program, and three experimental watersheds were established. One of these original watersheds, the Blacklands Experimental Watershed, was established in 1937 near Riesel, Texas. The Riesel experimental watershed facility later became part of the USDA Agricultural Research Service Grassland, Soil and Water Research Laboratory (GSWRL) with headquarters in Temple, Texas. The primary functions of the original three experimental watersheds (also located near Coshocton, Ohio and Hastings, Nebraska) were to collect hydrologic data (precipitation, percolation, evaporation, runoff, etc.) and to evaluate the hydrologic response from watersheds influenced by various agricultural land management practices.

Site Characteristics The GSWRL experimental watershed, which currently contains 340 ha of federally owned and operated land, was established on the 2372 ha Brushy Creek watershed in the heart of the Texas Blackland Prairie. The Blackland Prairie in Texas is a 4.45 million ha region of fertile agricultural land extending from San Antonio north to the Red River. The land is classified as gently rolling with slopes generally ranging from 1-3 %. Present day agricultural land use in the region consists of cattle production on pasture and rangeland, and corn, wheat, grain sorghum, and oat production under a wide range of tillage and management operations. This region is known for its Houston Black clay soils (fine, smectitic, thermic, udic Haplustert), which are commonly recognized as classic Vertisols. The Houston Black clay soil series consists of very deep, moderately well-drained soils formed from weakly consolidated calcareous clays and marls. These soils exhibit a strong shrink/swell potential due to the expansive nature of the clay present and are very slowly permeable when wet (approximate saturated hydraulic conductivity of 1.5 mm/hr); however, preferential flow associated with soil cracks contributes to high infiltration rates when the soil is dry.

Perhaps the most treasured natural resources at GSWRL watershed are several small tracts of remnant (never-plowed) tallgrass prairie. Remnant prairies are dominated by warm-season perennial grasses, including little bluestem and Indian grass, but also support a diverse mixture of perennial forb species that are absent from intensively-managed grasslands.

Hydrologic data have been collected continuously at GSWRL since 1937, and 35 runoff sites and 35 recording rain gauges were in operation during the height of activity. Currently, 17 runoff stations with automated water quality samplers are in operation on sub-watersheds ranging from 0.1 to 125 ha. Landuse on these sub-watersheds ranges from remnant prairie and improved pasture to cultivated cropland. Also in operation are 15 rain gauges, a weather station, a lateral flow station, and 7 shallow groundwater wells. Data from these stations are stored on dataloggers,

downloaded daily with radio telemetry equipment, and placed on the Internet. More recently, water quality data related to N and P transport have also been collected at each sub-watershed site. All historical data are available at: www.ars.usda.gov/spa/hydro-data.

Research Focus Traditionally, research at GSWRL focused on quantification of hydrologic and soil erosion process as affected by land management. Early research established the soil erosion reduction of conservation practices (e.g., terraces, grassed waterways, contour farming), which provided the scientific basis for the US conservation farming revolution. In the last 20 years, research has addressed the effects of tillage management alternatives on runoff water and transport of nutrients, sediment, and pesticides from sub-watershed sites. During this period, GSWRL also produced initial calibration and validation data sets for the EPIC, APEX, and SWAT watershed models, which were developed by GSWRL scientists. These models are now applied worldwide in the management of water quality at the field, farm, and basin scale.

Examination of the long-term hydrologic data record has resulted in a series of recently published manuscripts related to the hydrology of the Texas Blackland Prairie. This research analyzed temporal trends in precipitation, runoff, and soil erosion; established significant relationships between watershed size and annual peak flow rates for return intervals from 2-100 yr.; and created region-specific rainfall depth-duration-frequency data. The importance of soil-water phases to temporal runoff patterns in the Texas Blackland Prairie was also established. Little runoff occurs in the "dry" soil-water phase, but substantial surface runoff and lateral subsurface return flow occurs in the "saturated" phase. This temporal pattern drives the Vertisol shrink/swell behavior and soil crack formation, which also has implications related to structural integrity of building and road foundations.

Current research at GSWRL includes a long-term study of the impacts of land applying poultry litter as a fertilizer and soil amendment. The objective is to quantify the soil and water quality, crop production, and economic impacts of the repeated annual application of organic fertilizer over the long-term. Results of this study, which is the most comprehensive field-scale study of its kind, have received considerable attention from research, regulatory, and legal interests because of its integrated approach and the lack of similar data. Other research is examining the potential effects of changing rainfall patterns due to climate change such as global warming. Rain-exclusion shelters are being used to study effects of altering the timing and quantity of precipitation events on forage production and plant species composition on remnant prairies.