Prepared in cooperation with the
U.S. FISH AND WILDLIFE SERVICE

Real-Time Water-Quality Monitoring for Protection of Wildlife at Quivira National Wildlife Refuge, South-Central Kansas

—*Victoria G. Christensen*

Stream stage and discharge and the quality of water flowing from Rattlesnake Creek into the Quivira National Wildlife Refuge in south-central Kansas are being monitored by the U.S. Geological Survey in cooperation with the U.S. Fish and Wildlife Service using an innovative, real-time monitoring approach. Continuously recorded data and data from periodic collection of water-quality samples are being used to develop surrogate relations between certain physical properties of water and chemical constituents of concern. These relations will allow resource managers to protect wildlife at the refuge by reacting quickly to significant changes in water quality.

Introduction

The Quivira National Wildlife Refuge is a wetlands area located in the Rattlesnake Creek Basin of south-central Kansas (fig. 1). The refuge is managed by the U.S. Fish and Wildlife Service. Established as a National Wildlife Refuge in 1959, the area provides food, water, cover, and protection for many species of birds, fish, and wildlife. Several species of waterfowl take advantage of the refuge in their annual migration, including the endangered Whooping Crane. Since 1959, the refuge has been managed through regulation of water levels in more than 30 marshes and ponds covering about 22,000 acres in Stafford, Rice, and Reno Counties.

The importance of maintaining an adequate water supply to preserve valuable wildlife habitat was recognized early on. A channel was constructed by local duck clubs in the late 1920's or early 1930's to permit Rattlesnake Creek to flow directly into the Little Salt Marsh, one of two large saline marshes in the refuge. Additional canals and ponds have been constructed since, providing the entire area with a more dependable water supply. However, in the late summer of dry years, an adequate water supply is still a problem as upstream water demands reduce the inflow from Rattlesnake Creek to the Quivira National Wildlife Refuge. To assist the U.S. Fish and Wildlife Service in determining the outcome of possible management options with respect to water supply, the U.S. Geological Survey (USGS) developed a computer-based, water-budget model (Jian, 1998).

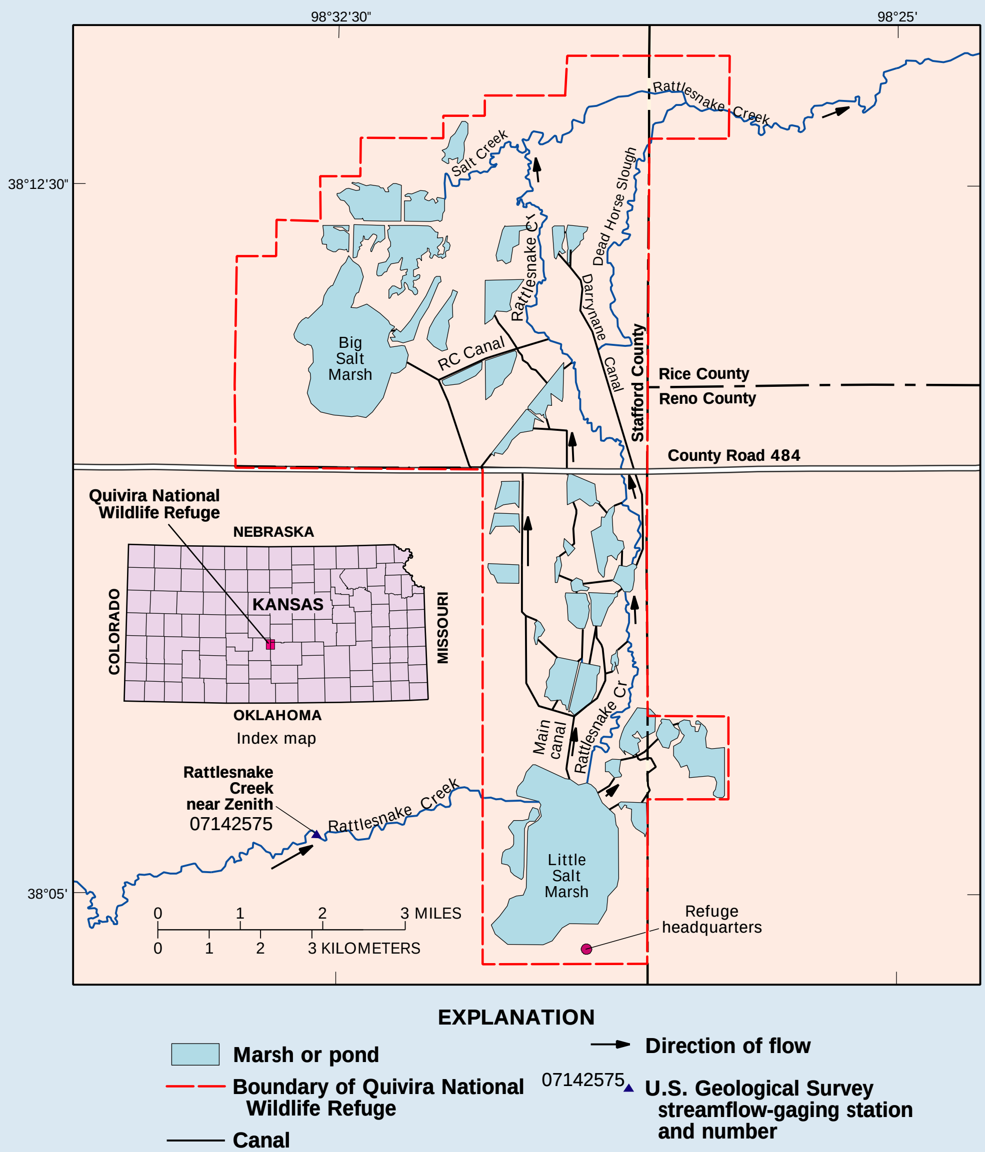

Figure 1. Location of marshes, ponds, and canals at Quivira National Wildlife Refuge in south-central Kansas.

Real-Time Water-Quality Monitoring

Not only is there a desire to provide a dependable water supply to Quivira National Wildlife Refuge, but because of the considerable wildlife benefits offered by the refuge, there also is a strong desire to provide good water quality. Stream stage and discharge and the quality of water flowing into the refuge are being monitored by the USGS at a streamflow-gaging station on Rattlesnake Creek near Zenith, Kansas (station 07142575, fig. 1). Two different methods of water-quality data collection are used: (1) continuous, real-time water-quality monitoring, which records physical properties of the water and (2) periodic, manual collection of water samples that are analyzed at the USGS National Water-Quality Laboratory (NWQL) in Denver, Colorado, for selected chemical constituents.

Real-time water-quality monitoring began at the Zenith station in November 1998 and will continue through September 2000 for selected physical properties—specific conductance, pH, water temperature, turbidity, and dissolved oxygen. Physical properties of water can be related to concentrations of dissolved ions. A notable example is the water's ability to conduct electricity (specific conductance), which is affected by the concentration of chloride ions (Hem, 1992). The pH and temperature of water can be useful indicators of chemical equilibrium, and turbidity can be an indicator of the amount of sediment and related constituents transported by the stream. Dissolved oxygen often is used to evaluate the biochemistry of water because oxygen is required for the survival of fish and other aquatic life (Hem, 1992) and, therefore, could affect wildlife populations at the refuge.

Because hydrologic conditions within a watershed may affect the variability of many chemical constituents, water samples also are collected manually throughout a range of streamflow conditions. These periodic and event-related water-quality samples are analyzed at the NWQL for selected chemical constituents, including major ions, nutrients, total and dissolved metals, selected pesticides, and bacteria. The continuous and periodic monitoring enable identification of seasonal trends in selected physical properties and chemical constituents and estimation of chemical mass transported into Quivira National Wildlife Refuge.

Because the real-time monitor does not record data on metals, pesticides, or other constituents that may have health implications for wildlife, but rather data on physical properties only, there is a need to develop surrogate relations between the physical properties monitored continuously and those chemical constituents of concern that are analyzed periodically. The surrogate relations being developed include the relation between specific conductance and chloride. Specific conductance values typically increase when there is a lack of freshwater inflow (low streamflow). This corresponds to times when chloride concentrations also increase, allowing for the development of a surrogate relation between specific conductance and chloride. The surrogate relations developed may be used by resource managers to understand the changing quality of water entering the refuge and to quickly adjust water-management operations in the event that a significant change in constituent concentrations would affect wildlife health or habitat.

Water Data on the Internet

Real-time streamflow and water-quality data currently are available on the Internet for Rattlesnake Creek near Zenith, Kansas. Available information includes graphs of continuous streamflow, specific conductance (fig. 2), and pH, water temperature, turbidity, and dissolved oxygen. Data are updated every 6 hours or more often during flooding. The connecting address for access to streamflow and water-quality information for Rattlesnake Creek near Zenith is:

http://ks.water.usgs.gov/

Choose "Water Resources Research and Studies in the Kansas District," then "Quality of Water Flowing into the Quivira National Wildlife Refuge."

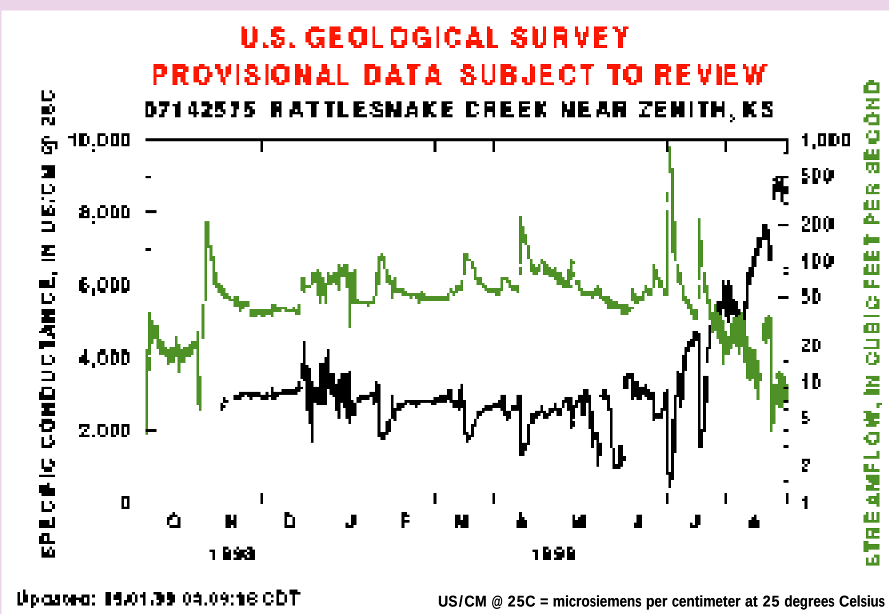

Figure 2. Example of real-time streamflow and water-quality data available on the Internet.

References

Hem, J.D., 1992, Study and interpretation of chemical characteristics of natural water (3d ed.): U.S. Geological Survey Water-Supply Paper 2254, 263 p.

Jian, Xiaodong, 1998, Simulation of canal and control-pond operation at the Quivira National Wildlife Refuge, south-central Kansas: U.S. Geological Survey Water-Resources Investigations Report 97–4289, 183 p.

For more information contact:

District Chief
U.S. Geological Survey
4821 Quail Crest Place
Lawrence, Kansas 66049–3839
(785) 842–9909
email: waucott@usgs.gov