Hydrologic Data and Studies in Support of the TMDL Program in Kansas

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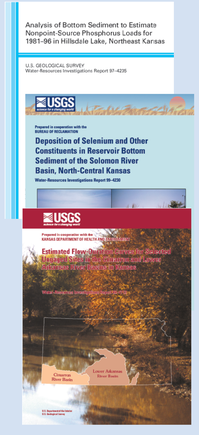
Summary

The State of Kansas is required by the Federal Clean Water Act of 1972 to develop a total maximum daily load (TMDL) for impaired waters in the State. A TMDL is an estimate of the maximum pollutant load (material transported during a specified time period) from point and nonpoint sources that a receiving water can accept without exceeding water-quality standards. The USGS is providing hydrologic data-collection and studies support to the Kansas Department of Health and Environment (KDHE), the agency tasked with implementing the TMDL process in Kansas. Specific USGS activities include the estimation of potential runoff-contributing areas, the estimation of streamflow-duration curves at ungaged sites, real-time water-quality monitoring, load estimation, and reservoir sediment studies. Many of these activities are funded in part through the Kansas State Water Plan Fund.

Nonpoint-source pollution.

Point-source pollution.

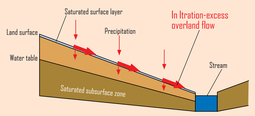


Potential Runoff-Contributing Areas

(http://ks.water.usgs.gov/Kansas/TMDL)

Overview

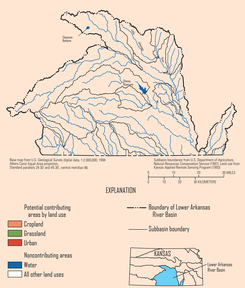
The development of TMDL's requires an understanding of potential source areas of storm runoff that are the most likely contributors of nonpoint-source pollution within a basin. Digital topographic, soil, and land-use information was used to estimate potential runoff-contributing areas in Kansas. Potential runoff-contributing areas were estimated collectively for the processes of infiltration-excess and saturation-excess overland flow using a set of environmental conditions that represented very high, high, moderate, low, very low, and extremely low potential for runoff (in relative terms). Various rainfall-intensity and soil-permeability values were used to represent the threshold conditions at which infiltration-excess overland flow may occur. Antecedent soil-moisture conditions and a topographic wetness index were used to represent the threshold conditions at which saturation-excess overland flow may occur. Together, the potential contributing areas for infiltration-excess and saturation-excess overland flows provide an understanding of how the spatial distribution of such areas may change in response to changes in environmental conditions statewide, regionally, and locally. The results were used to compare selected subbasins across the State. The ability to distinguish the subbasins as having relatively high, moderate, or low potential for runoff was possible mostly due to the variability of soil permeability across the State.



Applications

KDHE is using the potential runoff-contributing area information to:

- classify subbasins as having relatively high, moderate, or low potential for runoff; and
- prioritize subbasins, and areas within subbasins, for the implementation of best-management practices (BMP's) to reduce runoff and meet TMDL requirements.



Publications (most are available on the web)

Juracek, K.E., 1999a, Estimation of potential runoff-contributing areas in the Kansas-Lower Republican River Basin, Kansas: U.S. Geological Survey Water-Resources Investigations Report 99-4089, 24 p.

Juracek, K.E., 1999b, Estimation of potential runoff-contributing areas in Kansas using topographic and soil information: U.S. Geological Survey Water-Resources Investigations Report 99-4242, 29 p.

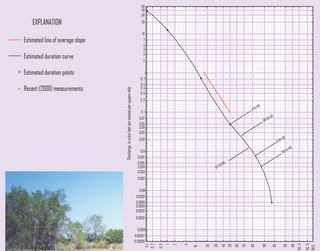
Juracek, K.E., 2000, Estimation and comparison of potential runoff-contributing areas in Kansas using topographic, soil, and land-use information: U.S. Geological Survey Water-Resources Investigations Report 00-4177, 55 p.

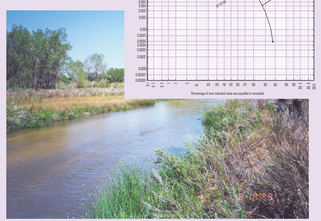
Streamflow-Duration Curves

(http://ks.water.usgs.gov/Kansas/TMDL)

Overview

Because pollutant loads vary directly with streamflow as well as pollutant concentration, KDHE has devised a plan to relate TMDL constituent criteria to streamflow duration. This approach yields the actual design load along with an estimate of the duration or percentage of time the load can be expected in any given year. KDHE develops TMDL curves for sites with USGS continuous-record stream-gaging information. For ungaged sites, the USGS is estimating the streamflow-duration curve using regionalized streamflow characteristics and several low- to medium-flow measurements.





Applications

KDHE is using the streamflow-duration curve information to:

- estimate contaminant loads in relation to streamflow duration and TMDL criteria; and
- project future streamflow frequencies for assessment of TMDL's and other water-quality constituents.

Publications (available on the web)

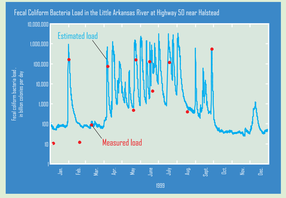
Studley, Seth E., 2000, Estimated flow-duration curves for selected ungaged sites in the Cimarron and Lower Arkansas River Basins in Kansas: U.S. Geological Survey Water-Resources Investigations Report 00-4113, 43 p.

Real-Time Water-Quality Monitoring and Load Estimation

(http://ks.water.usgs.gov/Kansas/equus)

Overview

A progressive approach is currently being used throughout Kansas to determine and monitor constituent concentrations in streams. Continuous in-stream water-quality monitors are installed at USGS streamflow-gaging stations to provide real-time measurement of specific conductance, pH, water temperature, dissolved oxygen, and turbidity. In addition, periodic water samples are collected manually throughout the range of expected hydrologic conditions and analyzed for constituents of concern, such as fecal coliform bacteria. Regression equations are developed on the basis of the relation between water-quality monitor parameters and chemical analysis.



Applications

KDHE and others will use the real-time water-quality monitoring information to:

- immediately identify undesirable levels of water-quality constituents in source water;
- more accurately estimate loads for TMDL development;
- optimize visits to water-quality sampling sites; and
- adjust management strategies rapidly when high concentrations of water-quality constituents may affect the quality of a water supply.

Publications (available on the web)

Christensen, V.G., 1999, Real-time water-quality monitoring for protection of wildlife at Quivira National Wildlife Refuge, south-central Kansas: U.S. Geological Survey Fact Sheet 182-99, 2 p.

Christensen, V.G., Jian, Xiaodong, and Ziegler, A.C., 2000, Regression and real-time water-quality monitoring to estimate constituent concentrations, loads, and yields in the Little Arkansas River, south-central Kansas, 1995-99: U.S. Geological Survey Water-Resources Investigations Report 00-4126, 36 p.

Reservoir Sediment Studies

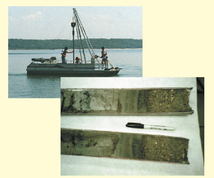
(http://ks.water.usgs.gov/Kansas/ressed)

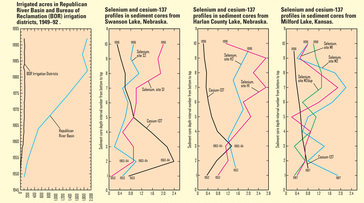
Overview

Reservoir sediment quality is an important environmental concern because sediment may act as both a sink and a source of water-quality constituents to the overlying water column and to biota. Once in the food chain, sediment-derived constituents may pose an even greater concern due to bioaccumulation.

An analysis of reservoir bottom sediment involves a combination of sediment coring and bathymetric surveying. Sediment coring is used to obtain samples to analyze for physical properties (for example, particle size, bulk density, percent moisture content) as well as the chemical makeup (for example, concentrations of nutrients and metals) of the deposited sediment. Bathymetric surveying is used to estimate the magnitude and spatial distribution of sediment deposition within a reservoir.

An analysis of reservoir bottom sediments can provide historical information on sediment deposition as well as magnitudes and trends in water-quality constituents in the basin that are associated with sediment and may be related to changes in human activity.





Applications

KDHE and others will use the sediment-derived information to:

- assist in the calculation of mass loadings;
- determine if water quality in a basin is changing;
- provide a warning of potential future water-quality problems; and
- provide a baseline against which to measure the effectiveness of implemented BMP's in a basin.

Publications (most are available on the web)

Mau, D.P., and Christensen, V.G., 2000, Comparison of sediment deposition in reservoirs of four Kansas watersheds: U.S. Geological Survey Fact Sheet 192-99, 4 p.

Pope, L.M., 1998, Watershed trend analysis and water-quality assessment using bottom-sediment cores from Cheney Reservoir, south-central Kansas: U.S. Geological Survey Water-Resources Investigations Report 98-4227, 24 p.

Christensen, V.G., 1999, Deposition of selenium and other consituents in reservoir bottom sediment of the Solomon River Basin, north-central Kansas: U.S. Geological Survey Water-Resources Investigations Report 99-4230, 46 p.

Juracek, K.E., 1997, Analysis of bottom sediment to estimate nonpoint-source phosphorous loads for 1981-96 in Hillsdale Lake, northeast Kansas: U.S. Geological Survey Water-Resources Investigations Report 97-4235, 55 p.

Juracek, K.E., and Ziegler, A.C., 1998, Selenium in reservoir sediment from the Republican River Basin: U.S. Geological Survey Fact Sheet 080-98, 4 p.