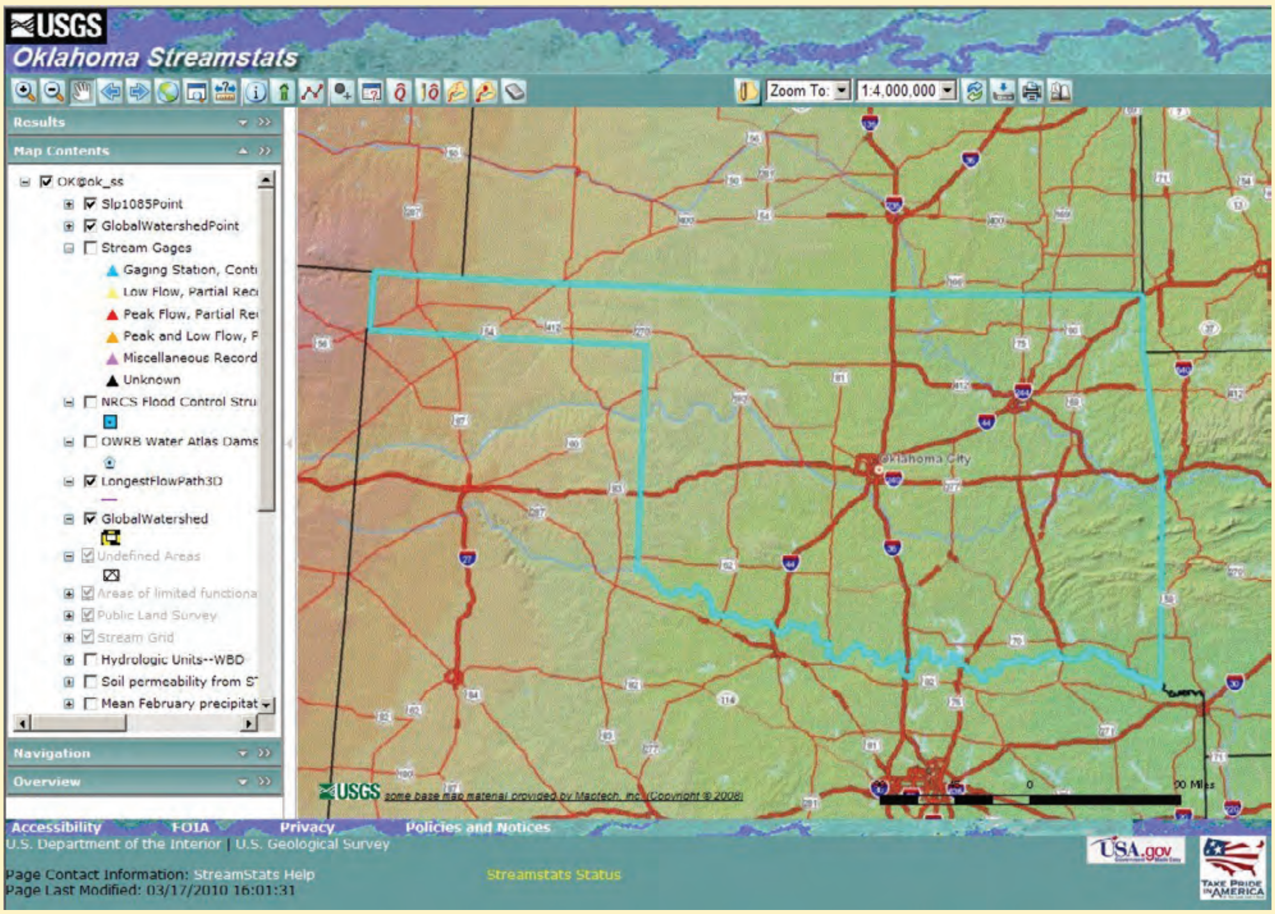
Prepared in cooperation with the Oklahoma Department of Transportation

StreamStats in Oklahoma—Drainage-Basin Characteristics and Peak-Flow Frequency Statistics for Ungaged Streams



Scientific Investigations Report 2009–5255

U.S. Department of the Interior
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On the cover: User interface for the Oklahoma StreamStats web applicaton.

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U.S. Department of the Interior
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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	Hydraulic gradient	
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)

Multiply	By	To obtain
	Length	
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
square kilometer (km^2)	247.1	acre
square kilometer (km^2)	0.3861	square mile (mi^2)

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

StreamStats in Oklahoma—Drainage-Basin Characteristics and Peak-Flow Frequency Statistics for Ungaged Streams

By S. Jerrod Smith and Rachel A. Esralew

Abstract

The USGS Streamflow Statistics (StreamStats) Program was created to make geographic information systems-based estimation of streamflow statistics easier, faster, and more consistent than previously used manual techniques. The StreamStats user interface is a map-based internet application that allows users to easily obtain streamflow statistics, basin characteristics, and other information for user-selected U.S. Geological Survey data-collection stations and ungaged sites of interest. The application relies on the data collected at U.S. Geological Survey streamflow-gaging stations, computer aided computations of drainage-basin characteristics, and published regression equations for several geographic regions comprising the United States. The StreamStats application interface allows the user to (1) obtain information on features in selected map layers, (2) delineate drainage basins for ungaged sites, (3) download drainage-basin polygons to a shapefile, (4) compute selected basin characteristics for delineated drainage basins, (5) estimate selected streamflow statistics for ungaged points on a stream, (6) print map views, (7) retrieve information for U.S. Geological Survey streamflow-gaging stations, and (8) get help on using StreamStats.

StreamStats was designed for national application, with each state, territory, or group of states responsible for creating unique geospatial datasets and regression equations to compute selected streamflow statistics. With the cooperation of the Oklahoma Department of Transportation, StreamStats has been implemented for Oklahoma and is available at *http://water.usgs.gov/osw/streamstats/*.

The Oklahoma StreamStats application covers 69 processed hydrologic units and most of the state of Oklahoma. Basin characteristics available for computation include contributing drainage area, contributing drainage area that is unregulated by Natural Resources Conservation Service floodwater retarding structures, mean-annual precipitation at the drainage-basin outlet for the period 1961–1990, 10–85 channel slope (slope between points located at 10 percent and 85 percent of the longest flow-path length upstream from the outlet), and percent impervious area. The Oklahoma StreamStats application interacts with the National Streamflow Statistics database, which contains the peak-flow regression equations in a previously published report. Fourteen peak-flow (flood) frequency statistics are available for computation in the Oklahoma StreamStats application. These statistics include the peak flow at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural, unregulated streams; and the peak flow at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural streams that are regulated by Natural Resources Conservation Service floodwater retarding structures. Basin characteristics and streamflow statistics cannot be computed for locations in playa basins (mostly in the Oklahoma Panhandle) and along main stems of the largest river systems in the state, namely the Arkansas, Canadian, Cimarron, Neosho, Red, and Verdigris Rivers, because parts of the drainage areas extend outside of the processed hydrologic units.

Introduction

Planning, permitting, design, and operation of hydraulic structures (such as dams, bridges, and culverts) depend on reliable and accurate estimates of streamflow statistics, especially peak-flow frequency statistics. The U.S. Geological Survey (USGS) periodically publishes these streamflow statistics for gaged sites in and near Oklahoma with long-term record (Tortorelli, 2002; Lewis and Esralew, 2009). Regionalized regression methods have been used in Oklahoma to estimate peak-flow (flood) frequency statistics at ungaged sites as a function of measured physical and climatic drainage-basin characteristics (Tortorelli, 1997).

The USGS Streamflow Statistics (StreamStats) Program was created cooperatively by the USGS and Environmental Systems Research Institute, Inc. (ESRI) (2007, *http://www.esri.com*), to make geographic information systems (GIS)-based estimation of streamflow statistics easier, faster, and more consistent than previously used manual techniques (Koltun and others, 2006). Prior to the development of computerized GIS techniques, drainage-basin characteristics were measured or computed from paper maps. The measurement of drainage-basin characteristics by manual methods was time consuming, inconsistent, and can be prone to error. The precision of estimates for some drainage-basin characteristics, such as contributing drainage area and channel slope, varied with the basin size and the map scale used. In addition, some manual computations of these characteristics took hours to days for large basins. GIS techniques can be used to compute drainage-basin characteristics in seconds, with greater accuracy and reproducibility than manual techniques.

The StreamStats user interface is a map-based internet application that allows users to easily obtain streamflow statistics, basin characteristics, and other information for user-selected USGS streamflow-gaging stations and ungaged sites of interest (Ries and others, 2004; Ries and others, 2008). The application relies on the data collected at USGS streamflow-gaging stations, computer aided computations of drainage-basin characteristics, and published regression equations for several geographic regions comprising the United States. The StreamStats application interface allows the user to (1) obtain information on map layer features, (2) delineate drainage basins for ungaged sites, (3) download drainage-basin polygons to a shapefile, (4) compute selected basin characteristics for delineated drainage basins, (5) estimate selected streamflow statistics for ungaged points on a stream, (6) print map views, (7) retrieve information for USGS streamflow-gaging stations, including published streamflow statistics at stations with long-term streamflow data, and (8) get help on using StreamStats (Ries and others, 2004; Ries and others, 2008).

The USGS StreamStats Program was designed for national application, with each state, territory, or group of states responsible for creating unique geospatial datasets and regression equations to compute streamflow statistics. With the cooperation of the Oklahoma Department of Transportation, StreamStats has now been implemented for Oklahoma and is available at *http://water.usgs.gov/osw/streamstats/*. The primary purpose of the Oklahoma StreamStats application in the initial version is to provide estimates of drainage-basin characteristics and peak-flow frequency statistics for user-selected ungaged sites on Oklahoma streams. Basin characteristics and peak-flow frequency statistics are used by hydrologic scientists and engineers to appropriately design structures such as roads, dams, culverts, bridges, and levees, which interact with waterways. Estimates of basin characteristics and streamflow statistics also should be useful to water-resource managers, developers, and conservationists in daily planning activities.

The Oklahoma StreamStats application covers 69 processed hydrologic units (HUs) and most of the state of Oklahoma (fig. 1). Basin characteristics available for computation include contributing drainage area, contributing drainage area that is unregulated by Natural Resources Conservation Service (NRCS) floodwater retarding (FWR) structures, mean-annual precipitation at the drainage-basin outlet for the period 1961–1990, 10–85 channel slope (slope between points located at 10 percent and 85 percent of the longest flow-path length upstream from the outlet), and percent impervious area. Basin characteristics are valid only for drainage basins entirely in the processed area (fig. 2). Basin characteristics and streamflow statistics cannot be computed for locations in noncontributing areas (such as playa basins in the Oklahoma Panhandle) and along main stems of the largest river systems in the state, namely the Arkansas, Canadian, Cimarron, Neosho, Red, and Verdigris Rivers, because parts of the drainage basins extend outside of the processed hydrologic units (HUs) (fig. 2).

StreamStats uses a regionalized regression method to estimate streamflow statistics at ungaged sites. The regionalized regression method uses physical and climatic drainage-basin characteristics and streamflow data for gaged basins to construct regression equations relating selected basin characteristics to selected streamflow statistics. Multiple drainage-basin characteristics, such as contributing drainage area, mean-annual precipitation, and channel slope, are used as independent variables in the regression equation to estimate each streamflow statistic (dependent variable). The regression equations, created at gaged locations, then can be used to estimate streamflow statistics at ungaged stream locations in similar physical and climatic settings.

The multiple-linear regression equation takes the general form:

$$Y_i = 10^{\,b_o} * (X_1^{\,b_1}) * (X_2^{\,b_2}) \ldots (X_n^{\,b_n}) * 10^{\,\varepsilon_i} \qquad (1)$$

where

Y_i is the value of the dependent variable, or streamflow statistic, for station i,

X_1 to X_n are the n independent variables, or series of drainage-basin characteristics,

b_o to b_n are the n+1 regression-model coefficients, and

ε_i is the residual error (difference between the observed and estimated values of the dependent variables).

In regression analysis, a least-squares method can be used to estimate the regression-model coefficients. The coefficients are determined after minimizing the sum of the squared differences, or errors, of the measured and estimated data points. Each set of basin characteristics is selected to give the best estimate for each streamflow statistic and represent the unique landscape and hydrologic conditions of the region or state for which the regression equation was created.

The basic procedure for regression equation development and application in StreamStats is presented in figure 3. First, streamflow-gaging stations (gages) with sufficiently long streamflow record (typically 10 or more years) are identified, and selected basin characteristics are computed at each gage. Next, streamflow statistics are computed for the period of record at each gage. The most statistically significant independent variables (basin characteristics) are selected

Figure1. Processed hydrologic units (HUs) for the Oklahoma StreamStats applications.

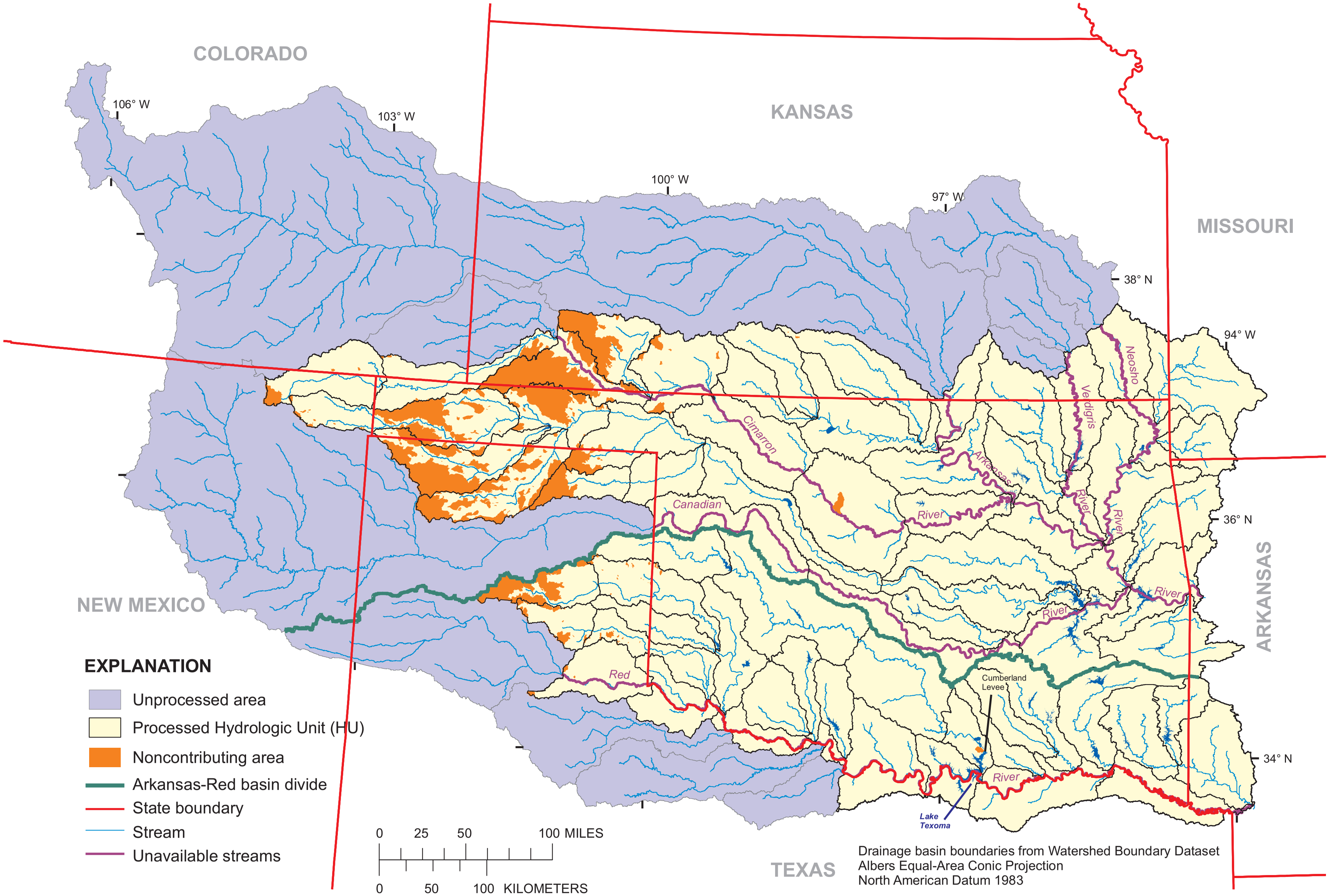


Figure 2. Processed hydrologic units and unprocessed areas for the Oklahoma StreamStats application, showing noncontributing areas and large rivers that are unavailable for computation of streamflow statistics.

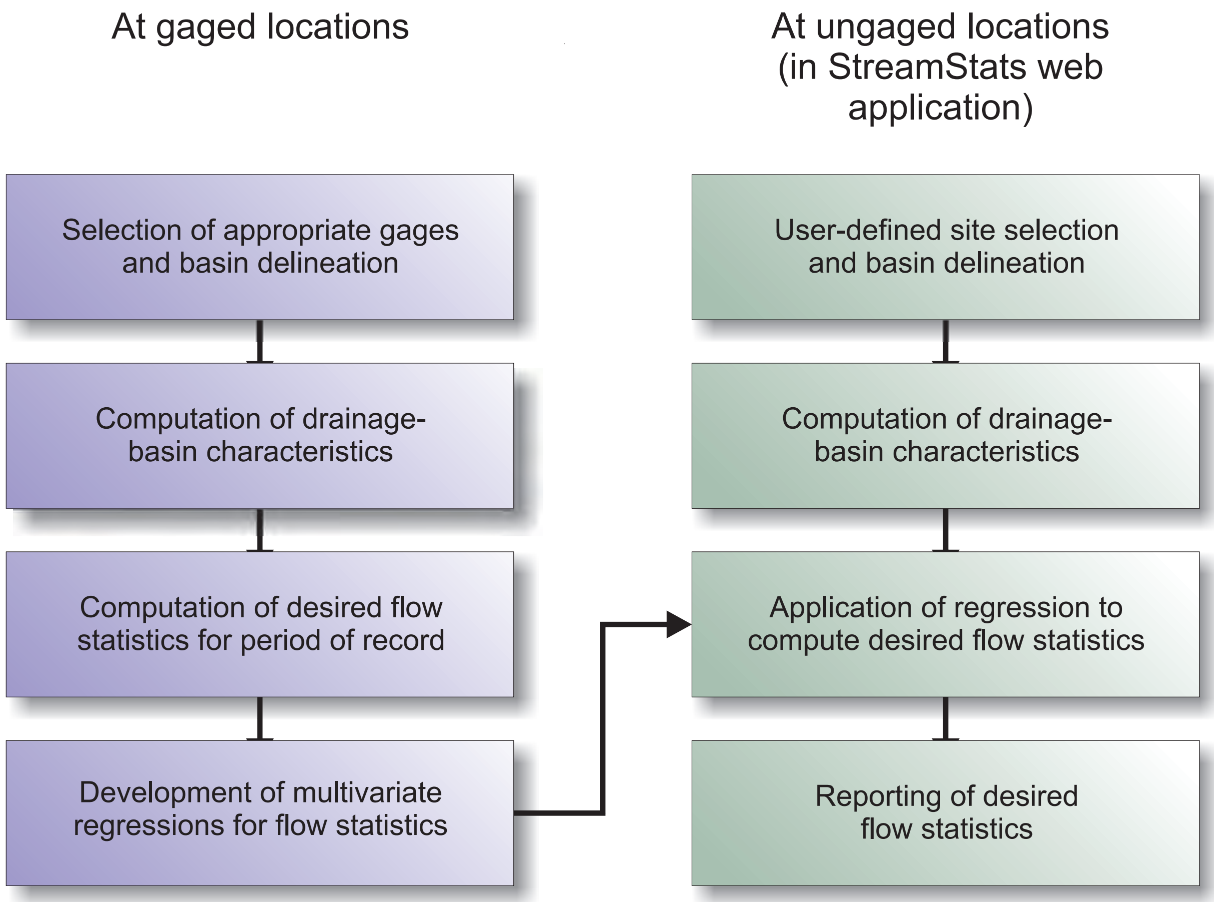


Figure 3. Flow chart illustrating the development and application of peak-flow regression equations in StreamStats.

for multivariate regression with each streamflow statistic by using sensitivity analysis and tests of collinearity. These multivariate regression equations are applied to ungaged sites in the StreamStats web application. When the StreamStats user clicks on an ungaged location on a stream, StreamStats delineates the contributing drainage basin. The application computes selected basin characteristics and applies selected regression equations to compute the user-requested streamflow statistics with a 90-percent confidence interval. The computed basin characteristics and flow statistics for the ungaged site are reported to the user.

Tortorelli (1997) created statewide regression equations for Oklahoma to estimate peak-flow frequency statistics for selected recurrence intervals (2, 5, 10, 25, 50, 100, and 500 years). Significant independent variables required to estimate peak-flow frequency statistics for rural unregulated streams in Oklahoma are (1) contributing drainage area, (2) mean-annual precipitation for the period 1961–1990 at the drainage-basin outlet[1], and (3) 10–85 channel slope (Tortorelli, 1997). The regression equations are intended for use in rural, unregulated drainage basins and rural drainage basins that are regulated by NRCS FWR structures. The Tortorelli (1997) regression equations were not intended for use in heavily urbanized drainage basins or drainage basins with other types of streamflow regulation. However, Tortorelli (1997) provided a method for adjusting peak-flow frequency statistics for some urbanization effects. For ungaged sites on urban streams, an urban adjustment of the statewide regression equations for rural streams can be used to estimate peak-flow frequency statistics. This urban adjustment is not applied by the StreamStats application; proper application of the urban adjustment is the responsibility of the StreamStats user.

[1] Area-weighted mean-annual precipitation did not substantially increase the accuracy of the regression equations (Tortorelli, 1997).

Purpose and Scope

The primary purpose of this report is to document the incorporation of procedures for estimating selected drainage-basin characteristics and peak-flow frequency statistics for ungaged streams from Tortorelli (1997) into the StreamStats application. The peak-flow estimation procedures created into the Oklahoma StreamStats application are optimized for rural, unregulated drainage basins entirely in Oklahoma and with less than 2,510 square miles (mi^2) of contributing drainage area. The peak-flow estimation procedures also can be used in basins regulated by small NRCS FWR structures with the understanding that results may be less accurate in those settings. This report also describes the development, functionality, and limitations of the USGS StreamStats application for Oklahoma, and a procedure for adjusting estimated peak-flow frequency statistics for urbanization effects.

Acknowledgments

Christine Dartiguenave, Environmental Systems Research Institute, Inc., provided software support and solutions throughout the project. The contributions of Jim Henley, Natural Resources Conservation Service, and Mike Sughru, Oklahoma Water Resources Board, were valuable in the production and refinement of digital datasets that incorporated dam locations in the state of Oklahoma.

The authors appreciate the efforts of Seth Tribbey, formerly of the U.S. Geological Survey, and Jason R. Masoner, U.S. Geological Survey, who assisted with data processing. The authors also greatly appreciate the help of Alan H. Rea and Kenneth D. Skinner, U.S. Geological Survey, who provided technical support and solutions to many problems throughout the project.

Data Processing Methods

A large part of the effort involved in implementing StreamStats surrounds creating, quality assuring, and processing geospatial datasets required to compute the independent variables (basin characteristics) used in regression equations (Koltun and others, 2006). Several publicly available national geospatial datasets were integrated, by using a process described by Rea and Skinner (2009), to compile a hydrologically correct topographic representation of the Oklahoma landscape. These national datasets included the USGS National Elevation Dataset (NED; U.S. Geological Survey, 2006), the Natural Resources Conservation Service (NRCS) Watershed Boundary Dataset (WBD; Natural Resources Conservation Service, 2006), and the USGS National Hydrography Dataset (NHD; U.S. Geological Survey, 2008) (fig. 4). Digital Elevation Models (DEMs) from the NED (fig. 4) are a combination of 10-meter (horizontal) resolution (where available) and resampled 30-meter resolution elevation data. Therefore, some areas of Oklahoma have better elevation control than others. Generally, the vertical accuracy of NED elevation data is about ± 7 to 15 meters (*http:\seamless.usgs.gov\faq\ned_faq.php*).

Two high-resolution datasets were integrated with the NED to limit hydrologic errors that might result from the coarse vertical resolution of NED elevation data. High-resolution NHD streams were used to reinforce the stream drainage network onto the DEM. The NHD streams are generated from streams (blue lines) on USGS 7.5-minute, 1:24,000 scale topographic maps that, in some areas, have been updated from aerial photograph inspection. Likewise, the WBD drainage divides were used to reinforce ridgelines on the DEM. Some modification of the NHD (editing stream loops) and WBD lines (adding divides to represent dams that were not built when the elevation data were collected) was necessary to more accurately represent the catchment and drainage network. All modifications to the DEM were made over a 1:24,000-scale topographic map base with occasional aerial photo verification. Rea and Skinner (2009) provide a more detailed review of processing steps.

Some areas of Oklahoma posed challenges for accurate representation in the topographic model. Though the WBD contains subbasin units based on the 8-digit HUs of the USGS (fig. 1), some of the area in these units is likely noncontributing, and does not contribute runoff to the main stem of the HU (fig. 2). For example, western Oklahoma, Kansas, and Texas have numerous playa lakes that accumulate runoff during precipitation. Accumulated runoff is slowly released from these lakes by infiltration and evapotranspiration. These lakes do not, at least directly, contribute runoff to a stream. Therefore, noncontributing areas (fig. 2) were modeled in the StreamStats application by using drains (sinks) at playa lakes and large depressions (greater than about 0.16 square kilometer in area) to subtract drainage areas from the main stem drainage area. Noncontributing areas also are excluded during computation of basin characteristics. Playa lakes or large depressions accounted for all but one of the noncontributing areas modeled in the StreamStats application; a special case was made for the area (about 12 mi^2) behind Cumberland levee on Lake Texoma in HU 11130304 (figs. 1–2). Areas behind manmade dams were not modeled as noncontributing areas because these features provide outlet works and spillways that can allow runoff to flow downstream.

The U.S. Army Corps of Engineers National Inventory of Dams (NID) dataset was modified to place NRCS FWR structures and other major Oklahoma dams (Oklahoma Water Resources Board, 2007) on the drainage network. These structure locations were verified by using National Agriculture Imagery Program (NAIP) 2003 or 2006 color aerial photography.

The processed areas of Oklahoma, Texas, Arkansas, Missouri, and Kansas contained 2,352 NRCS FWR structures when the StreamStats application for Oklahoma was designed (2007; fig. 5). Most of the FWR structures were constructed in the late 1950s and 1960s and about half are in the Washita River Basin (fig. 5). The FWR structures were constructed in small headwater catchments (as much as about 90 mi^2 in contributing drainage area) and were intended to protect vulnerable basins from soil erosion and flooding. The structures were designed to temporarily impound storm runoff from small headwater catchments, and slowly release the impounded water through a drop-inlet spillway over a period of several days. If the design capacity of the FWR structures is exceeded during a storm, an uncontrolled emergency spillway releases the excess storm water. When several of these structures are

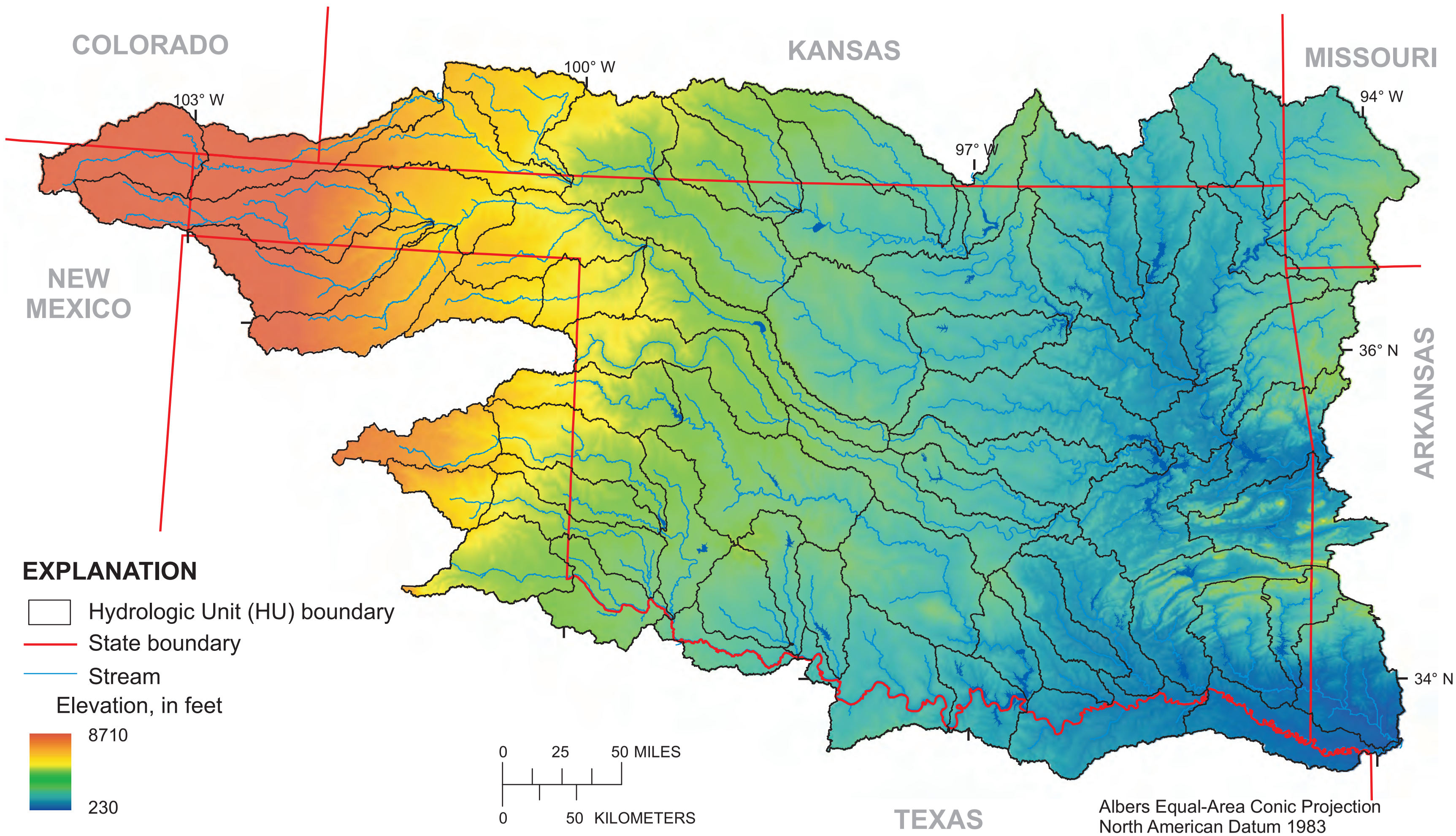


Figure 4. Elevation (National Elevation Dataset) across the Oklahoma StreamStats processed area showing selected streams from National Hydrography Dataset and selected hydrologic units from Watershed Boundary Dataset.

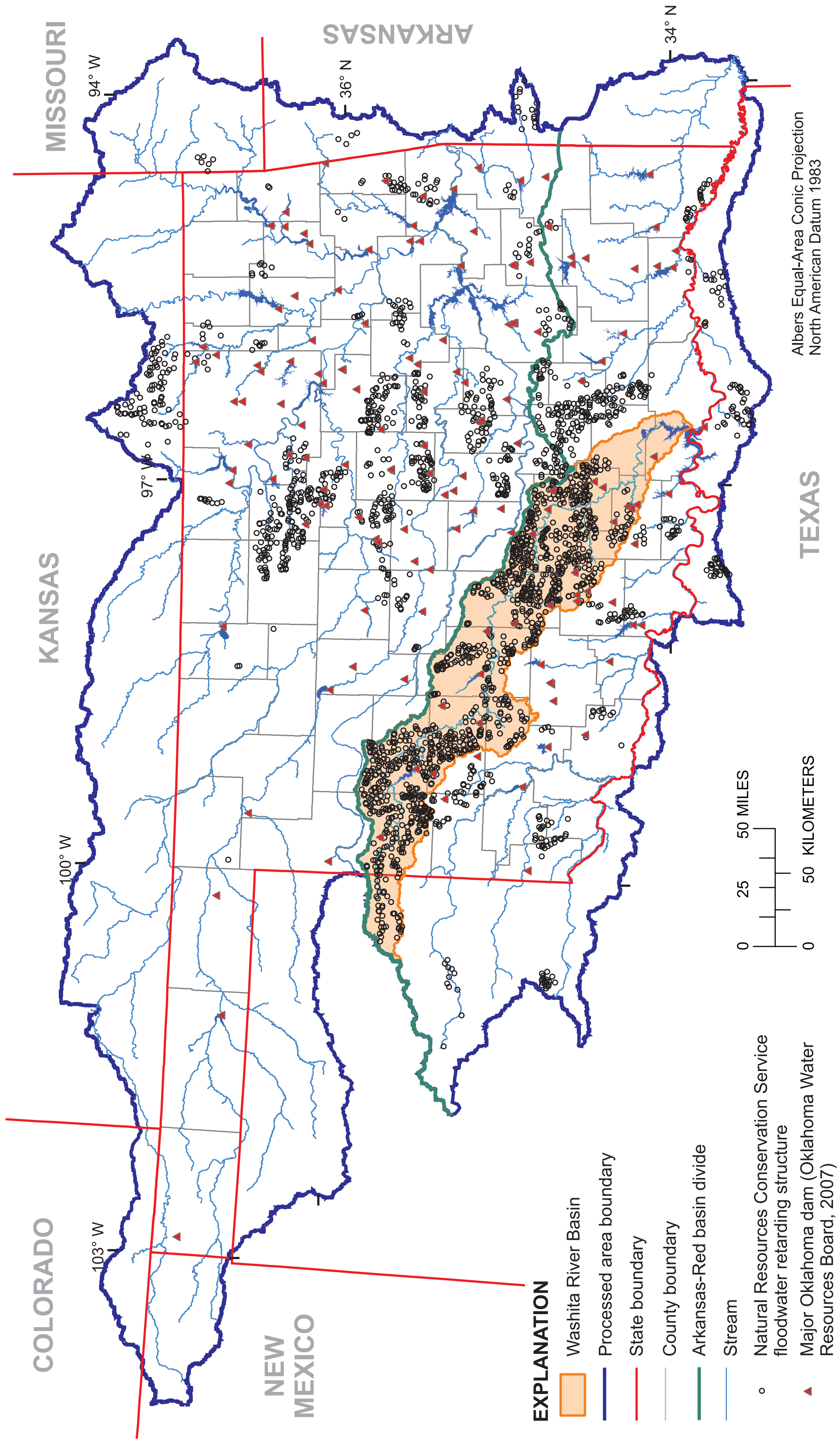


Figure 5. Location of Natural Resources Conservation Service floodwater retarding structures in processed areas and major dams in Oklahoma.

constructed as part of a basin conservation and flood-control project, the net result is a delayed and reduced peak flow downstream. However, the efficiency of these structures during any given storm is dependent on the amount of available storage.

Contributing drainage area is calculated in the GIS by using a flow-accumulation grid, which is a raster in which the number in each cell is equal to the number of upstream or upgradient cells that flow into that cell. The automated flow-accumulation function requires input of a flow-direction grid, which describes the direction of flow from each cell to the next downstream cell. A weighted flow-accumulation function was used to create a grid describing NRCS FWR structure-adjusted contributing drainage area. The function uses the same flow-direction grid, but allows weighted accounting of upstream or upgradient cells on the basis of a weight grid input. The weight grid used in calculation of NRCS FWR structure-adjusted contributing drainage area contained mostly zeroes (indicating that the cell was not to be counted), but cells representing NRCS FWR structures were assigned a number equal to the upstream contributing drainage area. Because some structures were nested within the drainage area of other structures, only non-nested areas were reflected in the weight grid to avoid double counting areas. The resulting weighted flow-accumulation grid contains cell values that represent the contributing drainage area that is regulated by (upstream from) NRCS FWR structures. To obtain the contributing drainage area that is unregulated by NRCS FWR structures, this grid was simply subtracted from the unweighted contributing drainage area grid.

Other datasets were added to the Oklahoma StreamStats application to allow computation of mean-annual precipitation at the drainage-basin outlet and percent impervious area over a drainage basin. Mean-annual precipitation data for the period 1961–1990 were downloaded from the Oregon State University PRISM Climate Group as a 2-kilometer ASCII grid file (PRISM Climate Group, 2008). The impervious area NLCD data (2001) were downloaded from the Multi-Resolution Land Characteristics Consortium (2008) as a 30-meter grid. The precipitation and impervious land cover data were merged and clipped to the processed area (fig. 2) prior to inclusion into the StreamStats application.

Computing Drainage-Basin Characteristics

The Oklahoma StreamStats application was designed to automatically compute selected drainage-basin characteristics (table 1) that may influence peak-flow frequency statistics. These characteristics include contributing drainage area (in square miles) (CONTDA), mean-annual precipitation at the drainage-basin outlet for the period 1961–1990 (in inches) (PRCOUT61), and the 10–85 channel slope (in feet per mile (ft/mi)) (CSL10_85fm). Other states have recognized the utility of these particular characteristics in estimating peak-flow frequency statistics by using the regionalized regression method. Peak-flow regression equations have been created for all 50 U.S. states and Puerto Rico; all 51 sets of regression equations use drainage area, 27 use channel slope, and 19 use mean-annual precipitation as independent variables in computations of peak-flow frequency statistics (Kernell Ries, USGS, written commun., 2002).

Other drainage-basin characteristics available for computation in the Oklahoma StreamStats application include the contributing drainage area that is unregulated by NRCS FWR structures (DAUNREG), which can be used in the estimation of peak-flow statistics for streams regulated by NRCS FWR structures, and percent impervious area (IMPNLCD01), which can be used to determine if an urban adjustment of peak-flow frequency statistics is necessary.

Contributing Drainage Area (CONTDA)

Drainage basins can be defined by a point on a stream, the basin outlet, to which all areas in the drainage basin contribute runoff. The StreamStats application takes a user-defined outlet on a stream and identifies, or delineates, the drainage basin of the stream at that location. Contributing drainage area is a conservative estimate of the runoff contributing area, in square miles, upstream from the user-selected basin outlet. In reality, the runoff contributing area is dependent on the duration and intensity of precipitation, the antecedent soil moisture and depression storage, and the permeability of earth materials over a drainage basin. Modeling these factors is beyond the current scope and capability of the Oklahoma StreamStats application.

The drainage-basin outlet and delineated drainage basin are used as the templates for estimating basin characteristics. StreamStats allows the user to download shapefiles of the drainage-basin outlet and the drainage-basin polygon with basin characteristics as attributes.

Contributing Drainage Area That Is Unregulated by Natural Resources Conservation Service Floodwater Retarding Structures (DAUNREG)

Oklahoma has more than 2,100 NRCS-managed FWR structures that were built in small headwater catchments to protect vulnerable land from soil erosion and flooding. A system of upstream FWR structures in a drainage basin protects land by reducing the magnitude (and frequency) of floods downstream from the FWR structures. The amount of reduction is related to the percentage of the drainage basin that is regulated by (upstream from) FWR structures (Tortorelli, 1997)

To illustrate the effectiveness of NRCS FWR structures in reducing peak flows, Oklahoma NRCS FWR structure-regulated peak-flow regression equations use an adjusted con-

Table 1. Description of basin characteristics used in the Oklahoma StreamStats application.

[NED, National Elevation Dataset; NHD, National Hydrography Dataset; WBD, Watershed Boundary Dataset; PRISM, Parameter-Elevation Regressions on Independent Slopes Model; NRCS, Natural Resources Conservation Service; FWR, floodwater retarding]

Basin characteristic (identifier)	Description	Data Source
Contributing drainage area (***CONTDA***)	Contributing drainage area, in square miles	NED 10-meter resolution elevation data (*http://seamless.usgs.gov/index.php*), NHD (*http://nhdgeo. usgs.gov/viewer.htm*, accessed July 2006) and WBD (source: *http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/*, accessed July 2006)
NRCS FWR structure-unregulated contributing drainage area (***DAUNREG***)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles	NED 10-meter resolution elevation data (*http://seamless.usgs.gov/index.php*), NHD (*http://nhdgeo. usgs.gov/viewer.htm*, accessed July 2006) and WBD (source: *http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/* , accessed July 2006)
Percentage NRCS FWR structure-regulated contributing drainage area (***NRCSPCT***)	Contributing drainage area that is regulated by NRCS FWR structures, in percent	Derived; [(CONTDA – DAUNREG) / CONTDA]
10-85 channel slope (***CSL10_85fm***)	Channel slope between points 10 percent and 85 percent of the longest flow-path length measured from the basin outlet, in feet per mile	NED 10-meter resolution elevation data (*http://seamless.usgs.gov/index.php*), and high-resolution NHD (*http://nhdgeo.usgs.gov/viewer.htm*, accessed July 2006)
Mean-annual precipitation at basin outlet (***PRCOUT61***)	Mean-annual precipitation (1961-1990) at the basin outlet, in inches	1,600-meter resolution data layer created from PRISM dataset. Source: *http://www.prism.oregonstate.edu/*, accessed July 2008
Percent impervious area (***IMPNLCD01***)	Percentage of basin surface area containing impervious cover	30-meter resolution data layer from the Multi-Resolution Land Characteristics Consortium, accessed August 2008.

tributing drainage area that excludes area regulated by FWR structures. The contributing drainage area that is unregulated by NRCS FWR structures (DAUNREG) is reported in units of square miles. Other basin characteristics used to estimate NRCS FWR structure-regulated peak-flow frequency statistics, such as 10–85 channel slope and percent impervious area, are estimated over the contributing drainage area (CONTDA), which includes areas regulated by NRCS FWR structures. Area regulated by NRCS FWR structures also is reported by the StreamStats application. This basin characteristic (NRCSPCT), reported as percent, is computed as the contributing drainage area regulated by NRCS FWR structures divided by the contributing drainage area,

$$NRCSPCT = [(CONTDA - DAUNREG) / CONTDA]$$

where contributing drainage area (CONTDA) and contributing drainage area that is unregulated by NRCS FWR structures (DAUNREG) are in units of square miles. The data used to compute DAUNREG and NRCSPCT were current as of 2006. The user should be aware that NRCS FWR structures constructed or removed since 2006 may not be represented in StreamStats.

Mean-Annual Precipitation at Drainage-Basin Outlet (PRCOUT61)

Tortorelli (1997) found the mean-annual precipitation at the drainage-basin outlet (PRCOUT61) to be as useful as mean-annual area-weighted basin precipitation as an independent variable in peak-flow regressions. Mean-annual precipitation data for the period 1961 to 1990 (Daly and others, 1994; PRISM Climate Group, 2008) were used to define precipitation at the drainage-basin outlet. The computed mean-annual precipitation at the drainage-basin outlet is reported in units of inches (fig. 6).

10-85 Channel Slope (CSL10_85fm)

Channel slope can be computed in several ways. The Oklahoma StreamStats application computes channel slope by using the 10–85 channel slope method described in Tortorelli (1997). This method first identifies the longest flow path from the basin outlet to the drainage divide (fig. 7). The total length of this flow path (L) is measured from the outlet, and reference points are placed at locations that are 10 and 85 percent of the length of the flow path (fig. 7). The 10–85 channel slope

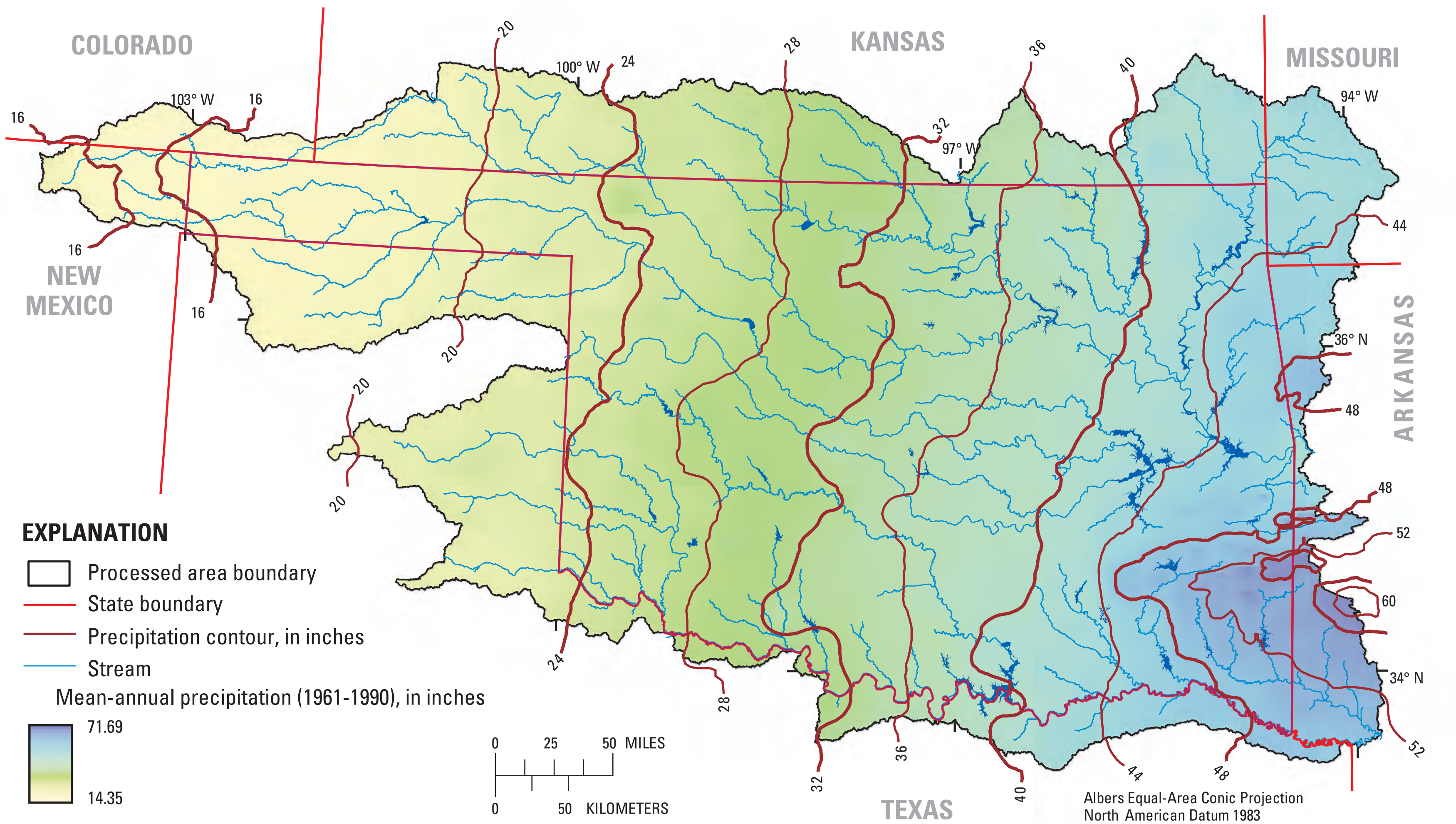


Figure 6. Mean-annual precipitation for the period 1961–1990 in processed area.

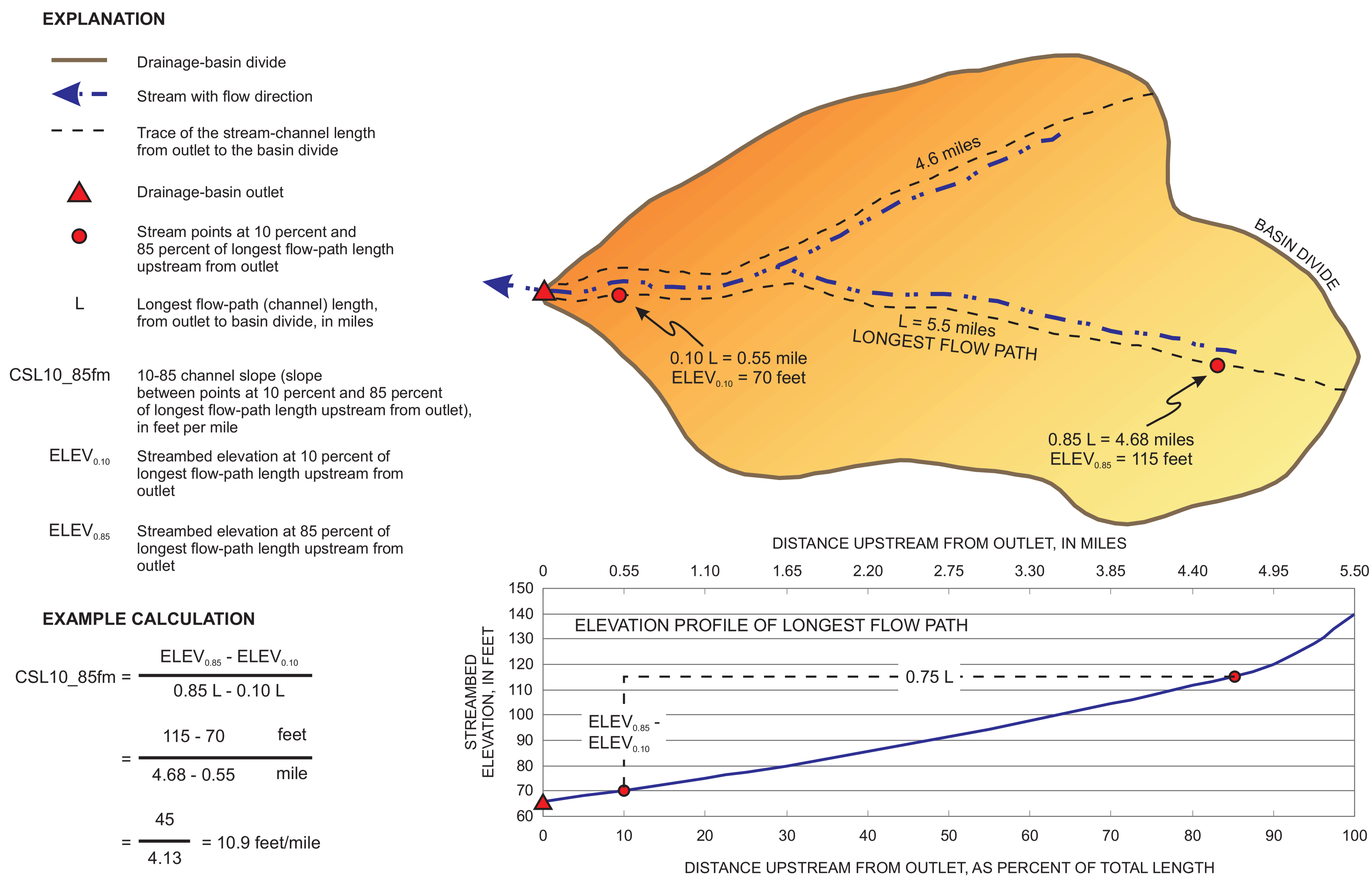


Figure 7. Example computation of 10–85 channel slope in a hypothetical drainage basin (modified from Tortorelli, 1997).

(CSL10_85fm) is then computed by dividing the difference in elevation (ΔELEV) between the two points by the stream length (0.75L) between the two points (fig. 7). The computed slope is reported in units of feet per mile. StreamStats allows the user to download shapefiles of the longest flow path and the 10 percent and 85 percent points used to compute the 10-85 channel slope.

The 10–85 channel slope is more sensitive to map scale effects than are other basin characteristics used in the estimation of Oklahoma peak-flow frequency statistics. When 10–85 channel slope is computed from paper maps, the length of the longest flow path is usually underestimated. The estimation bias is a result of the loss of stream sinuosity (and stream length) that typically occurs at smaller (zoomed-out) ratio map scales (Mandelbrot, 1983). Tortorelli (1997) computed 10-85 channel slopes by hand on paper maps ranging in scale from 1:24,000 to 1:250,000. The automated slope computation procedures used in StreamStats are based on the manual computation procedures used by Tortorelli (1997). However, the automated computations generally should be more precise than manual measurements (Tortorelli, 1997) because the Oklahoma StreamStats slope computations are performed exclusively on 1:24,000-scale data.

Percent Impervious Area (IMPNLCD01)

Peak flows can be augmented by urbanization in the drainage area of a stream. Urbanization tends to increase the amount of impervious surface and decrease the amount of small depression storage. The net effect is an earlier and increased peak flow downstream (Konrad, 2003). The Oklahoma StreamStats application, to support a documented procedure for adjusting peak-flow frequency statistics for urbanized areas (Tortorelli, 1997), allows computation of percent impervious area (IMPNLCD01) as a drainage-basin characteristic. Percent impervious area was not used as an independent variable in the peak-flow regressions, but this basin characteristic is useful when performing urban adjustments of peak-flow frequency statistics (see Urban Adjustment section).

The computation of percent impervious area uses the 2001 National Land Cover Database (NLCD) Impervious Surface derivative (Multi-Resolution Land Characteristics Consortium, 2008; fig. 8). The 2001 NLCD Impervious Surface derivative is a 30-meter resolution raster dataset classified into integer percent values (0–100) representing the percentage of each cell that is impervious (fig. 8). These values are simply averaged over a delineated drainage basin to compute the percentage of the basin that is impervious. Most drainage basins in Oklahoma will contain less than 1 percent impervious area, but percent impervious area can exceed 60 percent for small urban drainage basins in downtown Oklahoma City and Tulsa (fig. 8).

Computing Peak-Flow Frequency Statistics

The Oklahoma StreamStats application interacts with the National Streamflow Statistics database (U.S. Geological Survey, 2009), which contains the peak-flow regression equations published by Tortorelli (1997). Fourteen peak-flow (flood) frequency statistics are available for computation in the Oklahoma StreamStats application. These statistics include the peak flow at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural, unregulated streams; and the peak flow at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural streams that are regulated by NRCS FWR structures. When a user selects one or more statistics for computation, the required basin characteristics (independent variables) are computed automatically. All 14 peak-flow frequency statistics require the computation of (1) contributing drainage area (CONTDA) or contributing drainage area that is unregulated by NRCS FWR structures (DAUNREG), (2) outlet mean-annual precipitation (PRCOUT61), and (3) 10-85 channel slope (CSL10_85fm).

Rural, Unregulated Streams

The following regression equations, based on Tortorelli (1997), are used to estimate peak-flow statistics in rural, unregulated Oklahoma streams:

$$PK2 = 0.075\,(CONTDA)^{0.615}(CSL10\_85fm)^{0.159}(PRCOUT61)^{2.103}$$

$$PK5 = 0.799\,(CONTDA)^{0.616}(CSL10\_85fm)^{0.173}(PRCOUT61)^{1.637}$$

$$PK10 = 2.62\,(CONTDA)^{0.615}(CSL10\_85fm)^{0.181}(PRCOUT61)^{1.404}$$

$$PK25 = 8.80\,(CONTDA)^{0.614}(CSL10\_85fm)^{0.190}(PRCOUT61)^{1.171}$$

$$PK50 = 18.6\,(CONTDA)^{0.614}(CSL10\_85fm)^{0.197}(PRCOUT61)^{1.029}$$

$$PK100 = 35.6\,(CONTDA)^{0.614}(CSL10\_85fm)^{0.202}(PRCOUT61)^{0.907}$$

$$PK500 = 126\,(CONTDA)^{0.612}(CSL10\_85fm)^{0.213}(PRCOUT61)^{0.674}$$

The estimated peak-flow statistics at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural, unregulated streams (PK2 – PK500) are reported in units of cubic feet per second. Contributing drainage area (CONTDA) is in units of square miles, 10–85 channel slope (CSL10_85fm) is in units of feet per mile, and mean-annual precipitation for the period 1961–1990 at the outlet (PRCOUT61) is in units of inches.

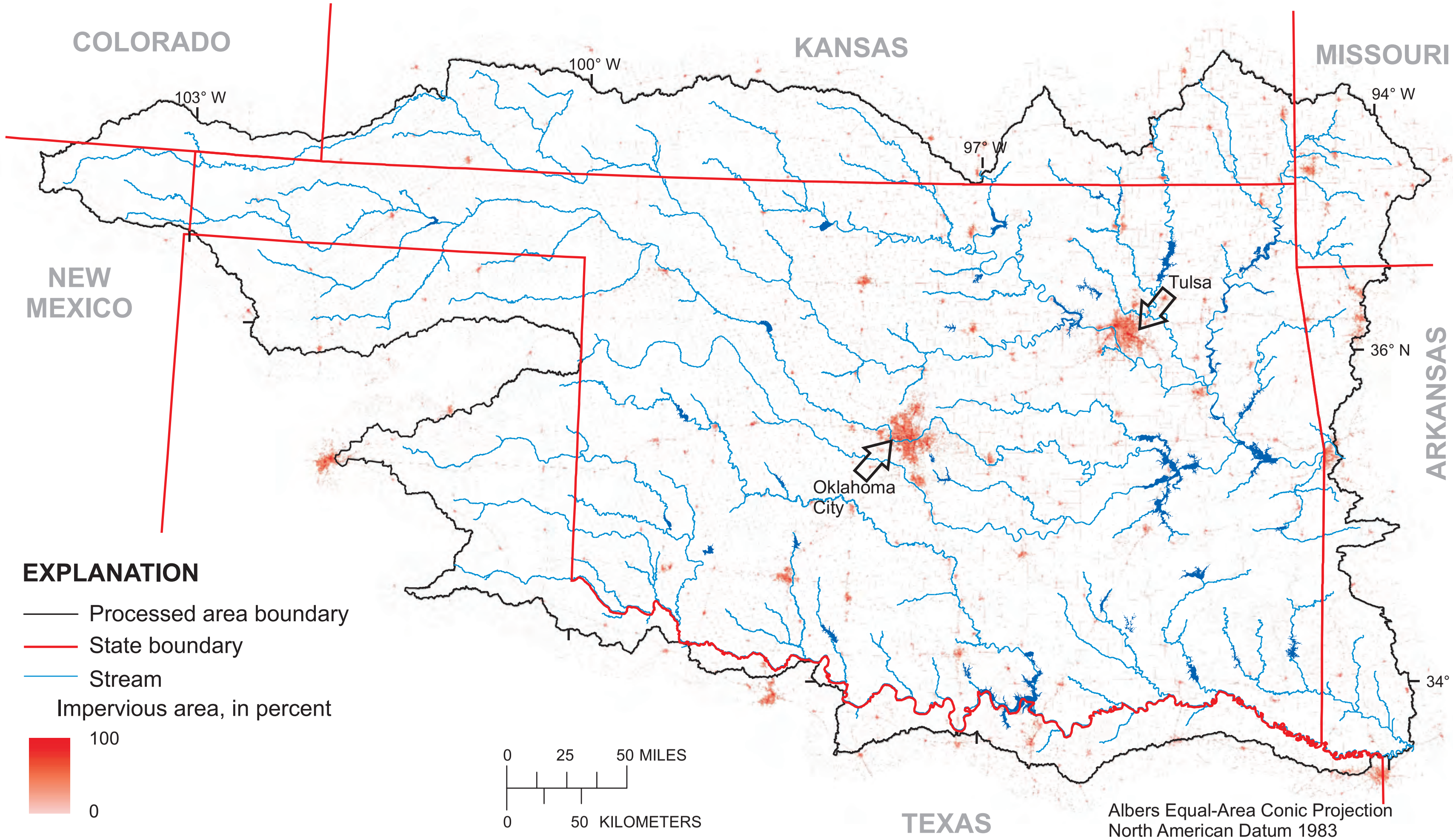


Figure 8. Impervious areas (Multi-Resolution Land Characteristics Consortium, 2008), in percent, in the Oklahoma StreamStats processed area.

Rural, Natural Resources Conservation Service Floodwater Retarding Structure-Regulated Streams

For rural streams that are partially regulated by NRCS FWR structures, only the unregulated contributing drainage area (that which is downstream from FWR structures) is likely to contribute to peak flows ($PK2_{(FWR)}$ – $PK500_{(FWR)}$). The peak-flow regression equations for rural streams regulated by NRCS FWR structures are the same as for rural, unregulated streams, except the contributing drainage area that is unregulated by NRCS FWR structures (DAUNREG) is substituted for the contributing drainage area (CONTDA). This substitution is only valid (1) if the percentage of contributing drainage area regulated by NRCS FWR structures (NRCSPCT) is less than 86 percent (Tortorelli and Bergman, 1985; Tortorelli, 1997), and (2) under the assumption that drainage areas upstream from NRCS FWR structures do not substantially contribute to the magnitude of peak flows downstream.

The following regression equations, based on Tortorelli (1997), are used to estimate peak-flow statistics in rural Oklahoma streams regulated by NRCS FWR structures:

$$PK2_{(FWR)} = 0.075\ (DAUNREG)^{0.615}(CSL10\_85fm)^{0.159}(PRCOUT61)^{2.103}$$

$$PK5_{(FWR)} = 0.799\ (DAUNREG)^{0.616}(CSL10\_85fm)^{0.173}(PRCOUT61)^{1.637}$$

$$PK10_{(FWR)} = 2.62\ (DAUNREG)^{0.615}(CSL10\_85fm)^{0.181}(PRCOUT61)^{1.404}$$

$$PK25_{(FWR)} = 8.80\ (DAUNREG)^{0.614}(CSL10\_85fm)^{0.190}(PRCOUT61)^{1.171}$$

$$PK50_{(FWR)} = 18.6\ (DAUNREG)^{0.614}(CSL10\_85fm)^{0.197}(PRCOUT61)^{1.029}$$

$$PK100_{(FWR)} = 35.6\ (DAUNREG)^{0.614}(CSL10\_85fm)^{0.202}(PRCOUT61)^{0.907}$$

$$PK500_{(FWR)} = 126\ (DAUNREG)^{0.612}(CSL10\_85fm)^{0.213}(PRCOUT61)^{0.674}$$

The estimated peak-flow statistics at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural streams regulated by NRCS FWR structures ($PK2_{(FWR)}$ – $PK500_{(FWR)}$) are reported in units of cubic feet per second. Contributing drainage area that is unregulated by NRCS FWR structures (DAUNREG) is in units of square miles, 10–85 channel slope (CSL10_85fm) is in units of feet per mile, and mean-annual precipitation for the period 1961–1990 at the outlet (PRCOUT61) is in units of inches.

Urban Adjustment

The percent impervious area and percentage of area served by storm sewers can be used to estimate an urban adjustment factor (R_L) for peak streamflow by using a graphical method developed by Leopold (1968) (fig. 9). The R_L is the ratio of the mean-annual flood in urban basins to the mean-annual flood in rural basins. Sauer (1974) created equations to adjust peak-flow frequency statistics for urban effects in Oklahoma basins by using the R_L:

$$PK2_{(urban)} = (R_L)PK2$$

$$PK5_{(urban)} = 1.60(R_L-1)PK2 + 0.167(7-R_L)PK5$$

$$PK10_{(urban)} = 1.87(R_L-1)PK2 + 0.167(7-R_L)PK10$$

$$PK25_{(urban)} = 2.21(R_L-1)PK2 + 0.167(7-R_L)PK25$$

$$PK50_{(urban)} = 2.46(R_L-1)PK2 + 0.167(7-R_L)PK50$$

$$PK100_{(urban)} = 2.72(R_L-1)PK2 + 0.167(7-R_L)PK100$$

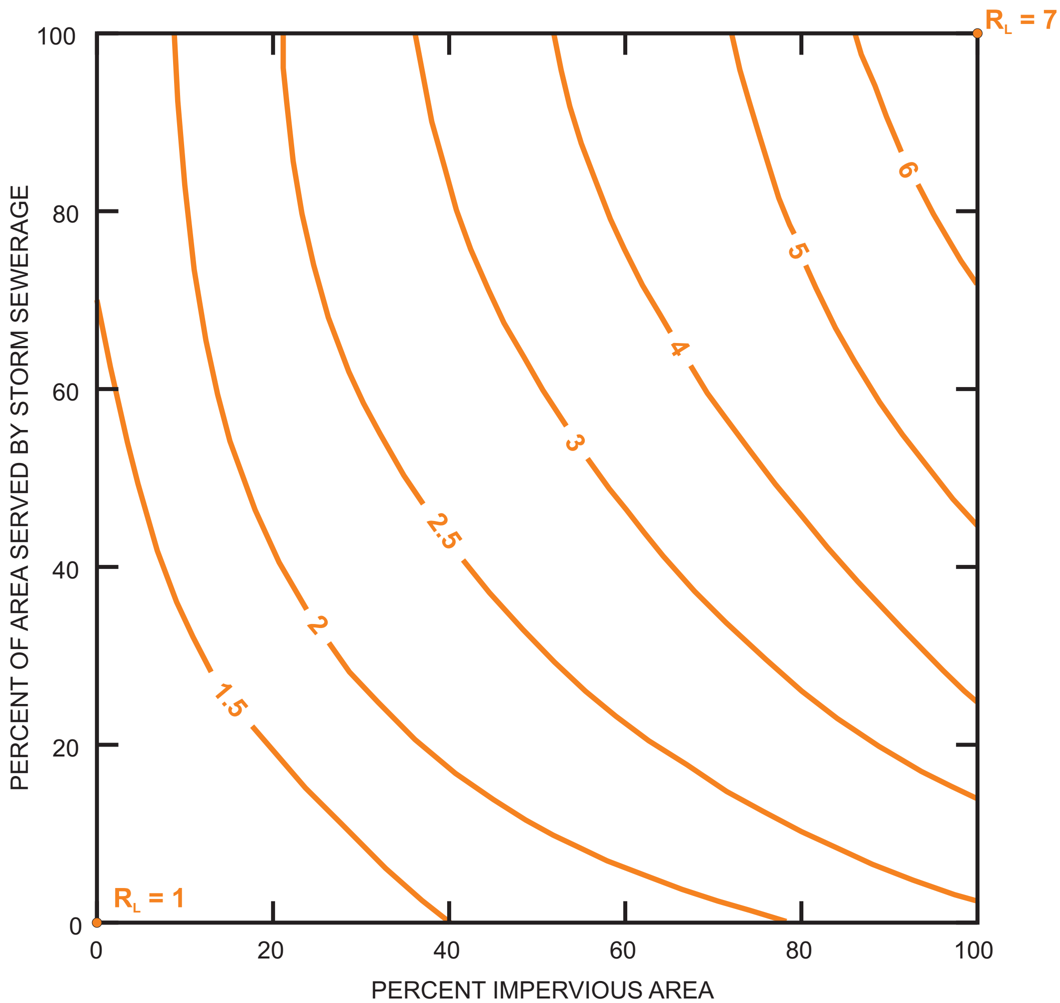
$$PK500_{(urban)} = 3.30(R_L-1)PK2 + 0.167(7-R_L)PK500$$

The estimated peak-flow statistics at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for urban ($PK2_{(urban)}$ – $PK500_{(urban)}$) and rural streams (PK2 – PK500) are reported in cubic feet per second.

StreamStats can be used to compute an estimate of the percent impervious area in each delineated drainage basin, but computation of the percentage of area served by storm sewers requires local knowledge in a basin and cannot easily be estimated by using current GIS techniques. Currently (2010), urban adjustments were not applied by the Oklahoma StreamStats application. Proper estimation and application of the urban adjustment factor are the responsibility of the StreamStats user.

Accuracy and Limitations

The regression equations incorporated into StreamStats can be used to estimate peak-flow frequency statistics, but the true values of those statistics are unknown. The following sections describe the uncertainty, accuracy, and constraints associated with peak-flow frequency statistics estimated by using the Oklahoma StreamStats application.



EXPLANATION

$$R_L = \frac{\text{discharge after urbanization}}{\text{discharge before urbanization}}$$

Figure 9. Urban adjustment factor (R_L) showing effect of urbanization on mean-annual flood for a 1-square-mile drainage area (modified from Leopold, 1968).

Regression Accuracy

The accuracy of regression equations can be evaluated by using performance metrics such as the adjusted R-squared and the standard error. Performance metrics from regression equations used to estimate peak-flow frequency statistics are listed in table 2 and are from Tortorelli (1997). The adjusted R-squared, or the adjusted coefficient of determination, is a measure of the percentage of the variation explained by the independent variables of the regression and ranges from 0 to 1.0. The adjusted R-squared is adjusted on the basis of the degrees of freedom in the regression and penalizes regressions that use an excess number of independent variables. Adjusted R-squared evaluates the random error of the estimates. The greater the R-squared, the greater the probability that the regression equation will accurately estimate the dependent variable

The standard error of the estimate, which can be expressed in original units, log units, or as a percent, measures the deviation between the measured and estimated data points used to build the regression equation. The standard error of the estimate is the average of all the residual values (the distance between the measured data point and the estimated data point from the regression) divided by the degrees of freedom of the regression. The standard error also can be expressed in terms of equivalent years of record, which is the number of years of

Table 2. R-squared and standard error of regression equations for unregulated streams (Tortorelli, 1997).

[equivalent years of record, the number of years of streamflow record that is needed at an ungaged site to provide an estimate equal in accuracy to the standard error of the regression equation]

Recurrence interval in years	Adjusted R-squared	Weighted standard error of estimate (log10 units)	Weighted standard error of estimate (percent)	Equivalent years of record
2	0.8780	0.2373	59	3
5	0.9099	0.1937	47	5
10	0.9141	0.1846	45	8
25	0.9108	0.1864	45	11
50	0.9035	0.1929	47	13
100	0.8933	0.2026	49	14
500	0.8605	0.2331	58	14

streamflow record that is needed at an ungaged site to provide an estimate equal in accuracy to the standard error of the regression equation (Tortorelli, 1997).

Scope of Valid Application

The Tortorelli (1997) peak-flow regression equations for rural, unregulated streams are only valid for drainage basins with characteristics that are in the range of characteristics used to create the regressions. For example, the regression equations should not be applied in basins where drainage area is greater than 2,510 mi^2 or less than 0.144 mi^2 (table 3). Constraints on other basin characteristics appear in table 3.

Comparison of Basin Characteristics Computed by Using Manual and Automated Techniques

Forty-three of the 251 gages used by Tortorelli (1997) to construct the 14 peak-flow regression equations were outside of the StreamStats processed HUs (fig. 2). For the remaining 208 gages (fig. 10), basin characteristics computed by using StreamStats were compared to basin characteristics computed manually by Tortorelli (1997) (appendix 1). For contributing drainage area (CONTDA), which is generally the most influential variable in the regression equations, the two estimates were nearly equal at most sites (fig. 11); 53 percent of the StreamStats computed contributing areas were greater and 47 percent were lesser than variables computed by Tortorelli (1997). Computations of mean-annual precipitation at the drainage-basin outlet (PRCOUT61) in StreamStats also were in close agreement with computations of Tortorelli (1997) (fig. 11); 53 percent of the StreamStats computed precipitation values were greater and 47 percent were lesser than computations done by Tortorelli (1997).

StreamStats automated computations of 10–85 channel slope (CSL10_85fm) tend to be slightly less than the manual computations of Tortorelli (1997); 24 percent of the StreamStats computed 10–85 channel slope values (CSL10_85fm) were greater and 76 percent were lesser than computations done by Tortorelli (1997). Most of the overestimation of Tortorelli (1997) 10–85 channel slopes relative to StreamStats estimates seems to be the result of map-scale effects on measurements of the basin longest flow-path length. Tortorelli (1997), who measured 10–85 channel slopes by using several map scales ranging from 1:24,000 to 1:250,000, tends to underestimate the basin longest flow-path length by about 20 percent as compared to StreamStats computations of longest flow-path length (L, fig. 11). Maps, by definition, are simplified representations of the earth's surface, and lose detail with decreasing map scale. Therefore, a stream represented at 1:250,000 scale is less detailed than the same stream represented at 1:24,000 scale. If the stream length was measured at both scales, the 1:250,000-scale stream would be shorter than the 1:24,000-scale stream. Also, more sinuous streams generally will be "shortened" to a greater degree than straighter streams in any map representation. Likewise, more sinuous segments of a given stream, mostly at downstream locations, are more simplified than straighter upstream segments and will receive greater "shortening" because of map-scale effects. Additional "shortening" could happen when using manual measurement techniques, as compared to automated methods at the same scale, because planimeters and map wheels are subject to some mechanical error.

Manual computations of the 10–85 change in elevation (Tortorelli, 1997) generally are greater than StreamStats automated computations of the 10–85 change in elevation. Because the placement of the 10–85 reference points is dependent on the measurement of stream length and because the measurement of stream length is dependent on map scale, the 10–85 change in elevation is dependent on map scale. The 10–85 reference points placed by using 1:24,000-scale maps will tend to be farther downstream than the corresponding 10–85 reference points placed by using 1:250,000-scale maps. The effect of this shift on the 10–85 change in elevation will vary with the sinuosity, length, and profile shape of each

Table 3. Ranges of validity for basin characteristics (independent variables) used in computation of peak-flow frequency statistics in Oklahoma (modified from Tortorelli, 1997).

[mi^2, square miles; ft/mi, feet per mile; in., inches; %, percent; NRCS, National Resources Conservation Service; FWR, floodwater retarding; 10–85 channel slope, slope between points at 10 percent and 85 percent of longest flow-path length upstream from the outlet]

Independent variable	Minimum	Maximum
Contributing area (CONTDA) or contributing drainage area that is unregulated by NRCS FWR structures (DAUNREG)	0.144 mi^2	2,510 mi^2
10–85 channel slope (CSL10_85fm)	1.89 ft/mi	288* ft/mi
Mean-annual precipitation at drainage-basin outlet (PRCOUT61)	15.0 in.	55.2 in.
Percentage of contributing drainage area regulated by NRCS FWR structures (NRCSPCT)	0.0 %	86 %

*The station with the maximum 10–85 channel slope (Tortorelli, 1997) does not appear in appendix 1 because it was outside of the StreamStats processed area.

stream. However, the difference between 10–85 change in elevation measured at successive map scales will be greatest for streams in small basins with steep headwater reaches and gently sloping, highly sinuous downstream reaches (fig. 11).

Underestimation of longest flow-path length and overestimation of the 10–85 change in elevation result in overestimation of the 10–85 channel slope. The difference in slopes computed by manual (Tortorelli, 1997) and automated methods (StreamStats) should not cause a large difference in estimated peak-flow frequency statistics because the statistical significance of 10–85 channel slope as an independent variable in the regression is less than that of contributing drainage area or mean-annual precipitation at the drainage-basin outlet.

Comparison of Peak-Flow Frequency Statistics Computed by Using Manual and Automated Computations of Basin Characteristics

The differences in values for 10–85 channel slope and longest flow-path length have some effect on estimates of peak-flow frequency statistics, but these differences tend to be small because 10–85 channel slope (CSL10_85fm) is generally the least influential term in the peak-flow regression equation for most sites. On average, the StreamStats computed peak-flow frequency statistics tend to be slightly less than peak-flow frequency statistics computed by Tortorelli (1997) for 208 gages (appendix 2); about 60-67 percent of StreamStats peak-flow values for each statistic were less than peak-flow values computed by Tortorelli (1997). However, a graphical comparison of PK5, PK50, and PK500 computed by using StreamStats basin characteristics as compared to Tortorelli (1997) basin characteristics shows that all peak-flow values computed at the 208 gages fall within the weighted standard error of estimate reported by Tortorelli (1997) (table 2; fig. 12) for each regression equation. In other words, the error because of differences in basin characteristic computation between Tortorelli (1997) and StreamStats is expected to be small compared to the error associated with the regionalized regression method for estimating peak-flow frequency statistics at ungaged sites.

Because the peak-flow regressions of Tortorelli (1997) were performed by using basin characteristic computation methods and streamflow data that were available in 1995, the peak-flow frequency statistics may not be optimized for use today (2010). The computational accuracy of methods for determining contributing drainage area and 10–85 channel slope have improved since the publication of Tortorelli (1997). Also, as more streamflow data become available each year, additional gages qualify for inclusion in statistical studies, and previously included gages have longer and more representative periods of record. Therefore, the Oklahoma peak-flow regressions should be periodically reevaluated and updated to ensure that the regressions remain accurate and relevant.

Summary

The USGS Streamflow Statistics (StreamStats) Program was created to make geographic information systems (GIS)-based estimation of streamflow statistics easier, faster, and more consistent than previously used manual techniques. The StreamStats user interface is a map-based internet application that allows users to easily obtain streamflow statistics, basin characteristics, and other information for user-selected USGS data-collection stations and ungaged sites of interest. The application relies on the data collected at U.S. Geological Survey streamflow-gaging stations, computer aided computations of drainage-basin characteristics, and published regression equations for several geographic regions comprising the United States. The StreamStats application interface allows the user to (1) obtain information on features in selected map layers, (2) delineate drainage basins for ungaged sites, (3) download drainage-basin polygons to a shapefile, (4) compute selected basin characteristics for delineated drainage basins,

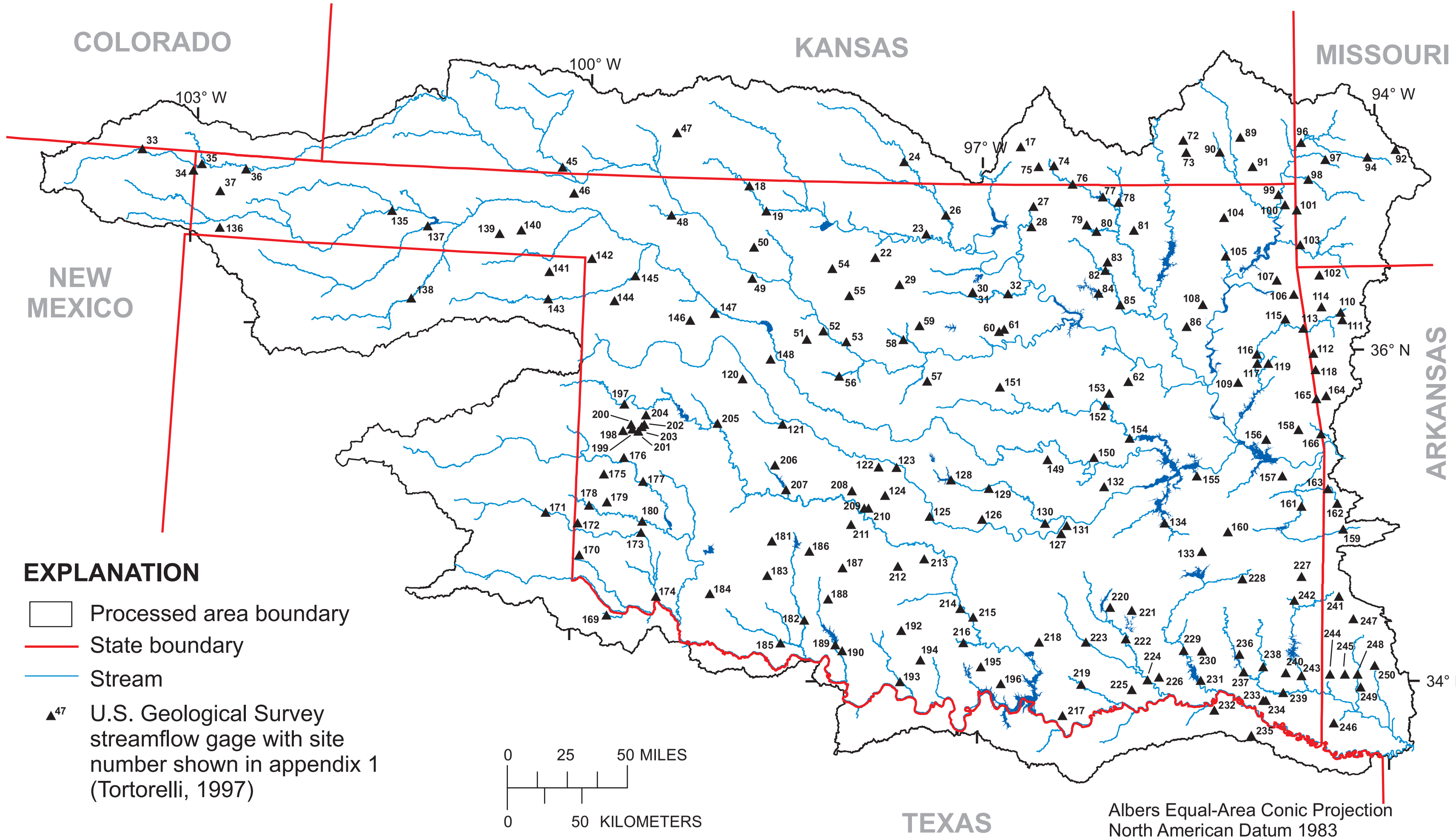


Figure 10. Location of 208 of 251 gages (Tortorelli, 1997) used to construct peak-flow regression equations. Forty-three of the 251 gages were outside of the StreamStats processed area.

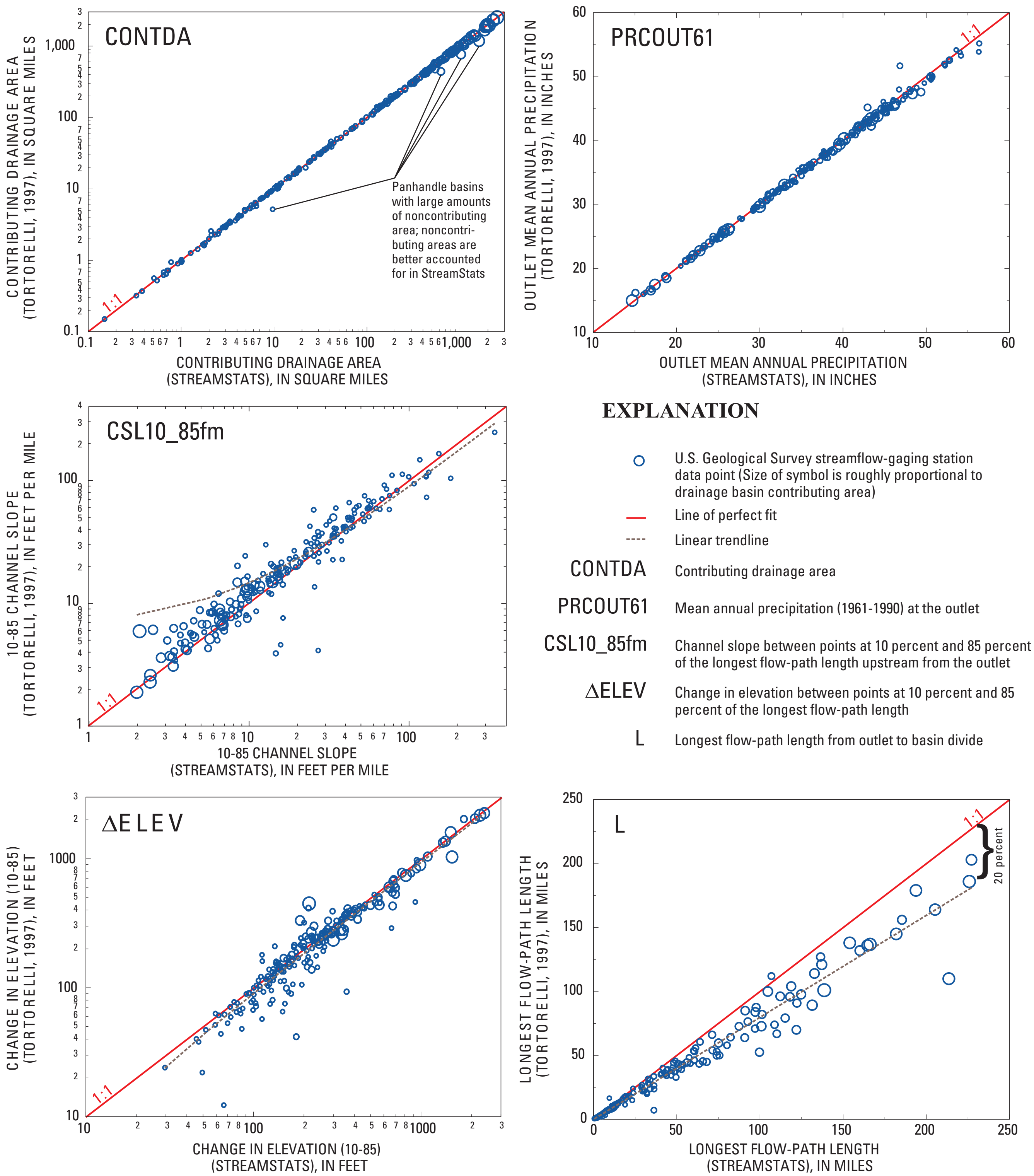


Figure 11. Comparison of basin characteristics from Tortorelli (1997), which were mostly computed by using manual techniques at a variety of map scales, and StreamStats, which were computed by using automated techniques on 1:24,000 scale data.

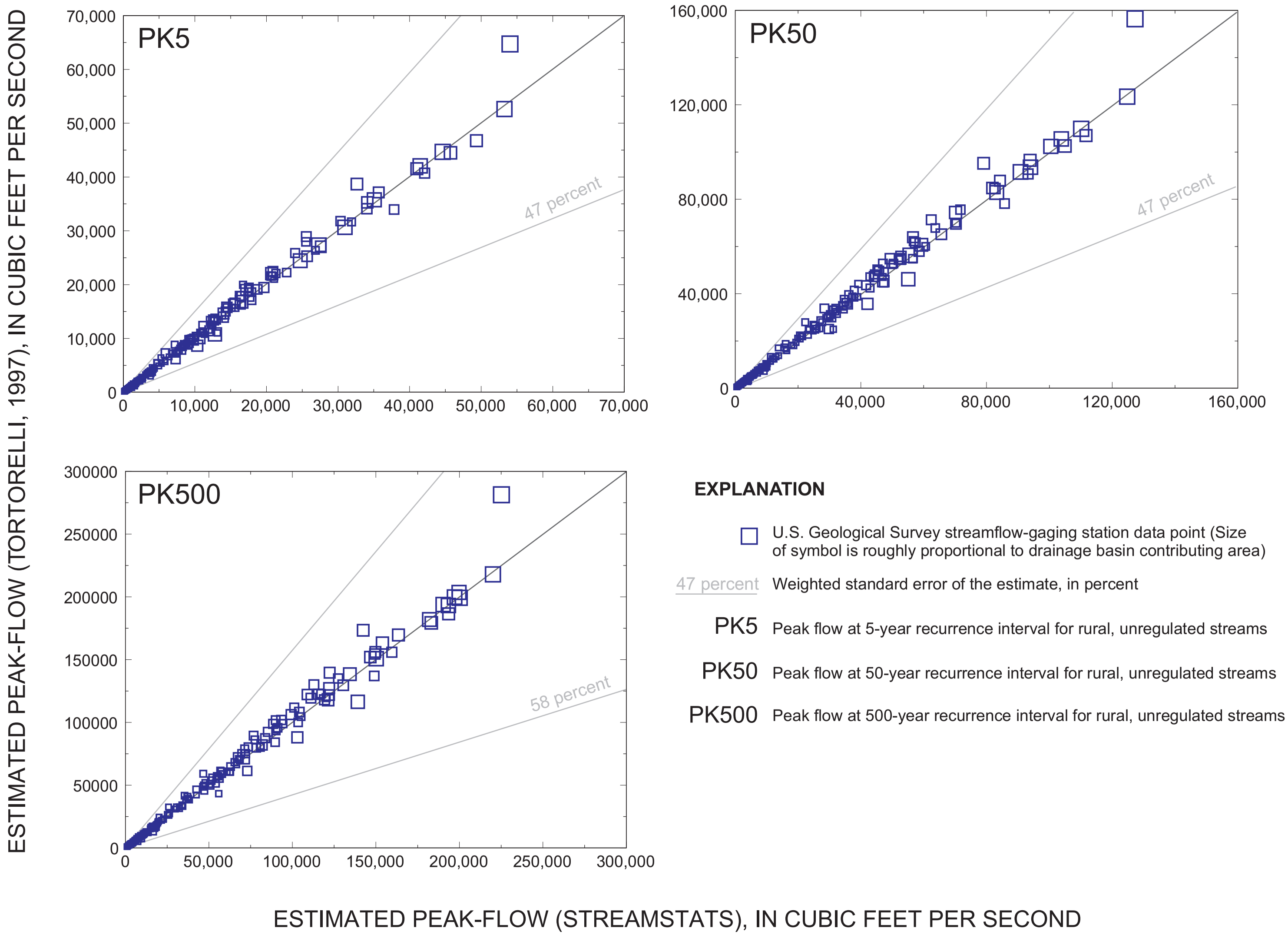


Figure 12. Comparison of peak-flow frequency statistics estimated by using basin characteristics at gaged sites.

(5) estimate selected streamflow statistics for ungaged points on a stream, (6) print map views, (7) retrieve information for USGS streamflow-gaging stations, and (8) get help on using StreamStats.

StreamStats was designed for national application, with each state, territory, or group of states responsible for creating unique geospatial datasets and regression equations to compute selected streamflow statistics. With the cooperation of the Oklahoma Department of Transportation, StreamStats has been implemented for Oklahoma and is available at *http://water.usgs.gov/osw/streamstats/*.

The primary purpose of the Oklahoma StreamStats application is to provide estimates of drainage-basin characteristics and automatic estimation of streamflow statistics for user-selected ungaged sites on Oklahoma streams. The procedures created into the Oklahoma StreamStats application are optimized for rural, unregulated drainage basins in Oklahoma and with less than 2,510 square miles of contributing drainage area. The peak-flow estimation procedures also can be used in basins regulated by small floodwater retarding structures with the understanding that results may be less accurate in those settings. This report also describes a procedure for adjusting estimated peak-flow frequency statistics for urbanization effects.

The Oklahoma StreamStats application covers 69 processed hydrologic units and most of the state of Oklahoma. Basin characteristics available for computation include contributing drainage area, contributing drainage area that is unregulated by Natural Resources Conservation Service floodwater retarding structures, mean-annual precipitation at the drainage-basin outlet for the period 1961–1990, 10–85 channel slope (slope between points located at 10 percent and 85 percent of the longest flow-path length upstream from the outlet), and percent impervious area. In addition to these basin characteristics, 14 peak-flow (flood) frequency statistics are available for computation in the Oklahoma StreamStats application: the peak flow at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural, unregulated streams; and the peak flow at 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals for rural streams that are regulated by Natural Resources Conservation Service floodwater retarding structures. Basin characteristics and streamflow statistics cannot be computed for locations in playa basins (mostly in the Oklahoma Panhandle) and along main stems of the largest river systems in the state, namely the Arkansas, Canadian, Cimarron, Neosho, Red, and Verdigris Rivers, because parts of the drainage areas extend outside of the processed hydrologic units.

Forty-three of the 251 gages used in a previous report to construct the 14 peak-flow regression equations were outside of the StreamStats processed hydrologic units. For the remaining 208 gages, basin characteristics computed by using StreamStats were compared to characteristics computed manually in a previous report. For contributing area, which is generally the most influential variable in the regression equations, the two estimates were nearly equal at most sites; 53 percent of the StreamStats computed contributing areas were greater and 47 percent were lesser than contributing areas computed in a previous report. Computations of mean-annual precipitation at the drainage-basin outlet in StreamStats were also in close agreement with computations in a previous report; 53 percent of the StreamStats computed precipitation values were greater and 47 percent were lesser than precipitation values computed for a previous report.

StreamStats automated computations of 10–85 channel slope tend to be slightly less than the manual computations done in a previous report; 24 percent of the StreamStats computed slope values were greater and 76 percent were less than slope values computed manually. The differences in values for 10–85 channel slope have some effect on estimates of peak-flow frequency statistics, but these differences tend to be small because 10–85 channel slope is generally the least influential term in the peak-flow regression equation for most sites. On average, the StreamStats computed peak-flow frequency statistics tend to be slightly less than peak-flow frequency statistics computed in a previous report for 208 gages; about 60–67 percent of StreamStats peak-flow values for each statistic were less than peak-flow values computed in a previous report. However, the error because of differences in basin characteristic computation between a previous report and StreamStats is expected to be small compared to the error associated with the regionalized regression method for estimating peak-flow frequency statistics at ungaged sites.

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Appendix

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
17	07148100	Grouse Creek near Dexter, Kans.	170	34.5	35.2	8.16	40.2	246.02	9.51
18	07148350	Salt Fork Arkansas River near Winchester, Okla.	856	24.9	24.5	15.10	52.5	594.56	3.22
19	07148400	Salt Fork Arkansas River near Alva, Okla.	1,009.00	26.3	24.6	14.80	70	777.00	4.86
22	07150580	Sand Creek Trib. near Kremlin, Okla.	7.21	31.7	31.6	19.30	6.9	99.88	6.6
23	07150870	Salt Fork Arkansas River Trib. near Eddy, Okla.	2.35	32.9	32.9	19.80	2.7	40.10	3.1
24	07151500	Chikaskia River near Corbin, Kans.	794	31.2	28.9	7.79	90.9	531.08	10.41
26	07152000	Chikaskia River near Blackwell, Okla.	1,859.00	33.1	30.0	7.25	136	739.50	9.95
27	07152360	Elm Creek near Foraker, Okla.	18.2	35.7	36.1	17.50	9.4	123.38	4.85
28	07152410	Rock Creek near Shidler, Okla.	9.13	35.9	35.9	35.80	5.4	144.99	3.19
29	07152520	Black Bear Creek Trib. near Garber, Okla.	0.97	32.6	32.6	42.30	1.2	38.07	1.48
30	07152842	Subwatershed W-4 near Morrison, Okla.	0.32	33.5	33.5	74.90	0.84	47.19	2.21
31	07152846	Subwatershed W-3 near Morrison, Okla.	0.14	33.5	33.4	104.00	0.66	51.48	3.03
32	07153000	Black Bear Creek at Pawnee, Okla.	576	35.8	33.7	4.05	71	215.66	8.75
33	07153500	Dry Cimarron River near Guy, N. Mex.	545	16.2	17.1	50.00	54	2,025.00	5.35
34	07154400	Carrizozo Creek near Kenton, Okla.	111	16.7	16.8	38.00	34.2	974.70	10.54
35	07154500	Cimarron River near Kenton, Okla.	1,038.00	16.6	17.0	26.20	104	2,043.60	10.42
36	07155000	Cimarron River above Ute Creek near Boise City, Okla.	1,879.00	15.0	17.1	21.00	138	2,173.50	10.14
37	07155100	Cold Springs Creek near Wheeless, Okla.	11	16.3	16.3	29.10	8.1	176.78	5.96
45	07157500	Crooked Creek near Nye, Kans.	813	21.6	21.2	4.23	127	402.91	19.84
46	07157550	West Fork Creek near Knowles, Okla.	4.22	21.7	21.7	59.20	3.9	173.16	3.6
47	07157900	Cavalry Creek at Coldwater, Kans.	39	24.5	24.5	8.61	17.5	113.01	7.85
48	07157960	Buffalo Creek near Lovedale, Okla.	408	25.0	25.2	12.76	38.7	370.36	3.67
49	07158020	Cimarron River Trib. near Lone Wolf, Okla.	4.26	26.4	26.3	37.10	5.3	147.47	6.59
50	07158080	Sand Creek Trib. near Waynoka, Okla.	1.61	25.9	25.9	62.40	2.2	102.96	3.01
51	07158180	Salt Creek Trib. near Okeene, Okla.	8.23	29.2	29.1	30.00	8	180.00	7.78

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Sub-watershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

		StreamStats							
Site no. (Tortorelli, 1997)	Station no.	Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (∆ELEV)	Impervious area, in percent (IMPNLCD01)
17	07148100	171.34	162.10	5.40	35.00	8.63	41.62	269.35	0.22
18	07148350	827.23	827.23	0.00	25.13	9.40	99.66	702.85	0.10
19	07148400	982.09	982.09	0.00	26.45	8.43	121.85	770.13	0.21
22	07150580	7.13	7.13	0.00	31.76	14.76	9.08	100.49	0.39
23	07150870	2.51	2.51	0.00	32.96	19.55	3.11	45.63	0.25
24	07151500	812.58	812.58	0.00	31.17	7.67	122.22	703.24	0.32
26	07152000	1,873.05	1,873.05	0.00	32.95	6.58	164.58	812.61	0.38
27	07152360	18.34	18.34	0.00	36.19	14.65	12.13	133.33	0.17
28	07152410	9.06	9.06	0.00	36.20	33.19	6.58	163.89	0.16
29	07152520	1.02	1.02	0.00	32.51	24.01	2.62	47.09	1.49
30	07152842	0.33	0.33	0.00	34.14	52.70	1.31	51.92	0.24
31	07152846	0.08	0.08	0.00	34.32	182.11	0.43	59.09	0.45
32	07153000	538.32	279.66	48.05	35.67	3.39	97.05	246.72	0.78
33	07153500	527.58	527.58	0.00	15.05	33.60	71.49	1801.48	0.08
34	07154400	112.28	112.28	0.00	16.95	26.94	46.66	942.91	0.06
35	07154500	1,111.58	1,111.58	0.00	16.90	23.56	118.75	2097.87	0.09
36	07155000	1,966.87	1,966.69	0.00	14.65	19.48	153.95	2249.54	0.08
37	07155100	10.70	10.70	0.00	16.28	27.54	11.47	236.85	0.05
45	07157500	821.97	821.97	0.00	21.71	3.98	136.41	407.59	0.18
46	07157550	4.44	4.44	0.00	21.70	55.00	5.14	211.97	0.23
47	07157900	41.54	41.54	0.00	24.85	11.08	18.38	152.70	0.29
48	07157960	401.31	401.31	0.00	24.40	11.77	44.51	392.81	0.22
49	07158020	4.20	4.20	0.00	26.11	28.55	6.82	145.95	0.53
50	07158080	1.77	1.77	0.00	25.64	57.50	2.53	109.20	0.40
51	07158180	8.37	8.37	0.00	29.13	12.71	11.80	112.51	0.56

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
52	07158400	Salt Creek near Okeene, Okla.	196	29.5	28.8	20.15	27.4	414.08	3.83
53	07158500	Preacher Creek near Dover, Okla.	14.5	30.6	30.7	14.80	9.3	103.23	5.96
54	07158550	Turkey Creek Trib. near Goltry, Okla.	5.08	29.0	28.7	19.50	5.3	77.51	5.53
55	07159000	Turkey Creek near Drummond, Okla.	248	30.8	29.6	5.70	39	166.73	6.13
56	07159200	Kingfisher Creek near Kingfisher, Okla.	157	29.9	29.0	12.00	23.7	213.30	3.58
57	07159810	Watershed W-IV near Guthrie, Okla.	0.15	33.2	33.2	116.20	0.68	59.26	3.14
58	07160500	Skeleton Creek near Lovell, Okla.	410	31.5	31.3	8.40	43.4	273.42	4.59
59	07160550	West Beaver Creek near Orlando, Okla.	13.9	32.4	32.7	23.80	6.4	114.24	2.95
60	07163000	Council Creek near Stillwater, Okla.	31	35.3	35.2	17.30	9	116.78	2.61
61	07163020	Corral Creek near Yale, Okla.	2.89	35.4	35.4	53.90	2.4	97.02	1.99
62	07165550	Snake Creek near Bixby, Okla.	50	39.8	40.0	24.30	11.5	209.59	2.65
72	07170700	Big Hill Creek near Cherryvale, Kans.	37	41.9	41.0	9.10	24.2	165.17	15.83
73	07170800	Mud Creek near Mound Valley, Kans.	4.22	42.6	42.6	25.67	3.48	67.00	2.87
74	07171700	Spring Branch near Cedar Vale, Kans.	3.1	35.0	35.0	50.05	3.25	122.00	3.41
75	07171800	Cedar Creek Trib. near Hooser, Kans.	0.56	35.4	35.4	165.00	1.53	189.34	4.18
76	07172000	Caney River near Elgin, Kans.	445	38.0	35.9	7.39	60.6	335.88	8.25
77	07173000	Caney River near Hulah, Okla.	736	35.6	36.4	6.73	72.7	366.95	7.18
78	07174200	Little Caney River below Cotton Creek near Copan, Okla.	502	36.6	37.7	8.80	50.1	330.66	5
79	07174570	Dry Hollow near Pawhuska, Okla.	1.67	37.6	37.6	83.00	1.8	112.05	1.94
80	07174600	Sand Creek at Okesa, Okla.	139	37.7	37.6	13.50	37	374.63	9.85
81	07174720	Hogshooter Creek Trib. near Bartlesville, Okla.	0.94	38.4	38.4	58.20	1.1	48.02	1.29
82	07176500	Bird Creek at Avant, Okla.	364	38.3	38.1	6.22	55.8	260.31	8.55
83	07176800	Candy Creek near Wolco, Okla.	30.6	38.5	38.9	17.60	10.98	144.94	3.94
84	07177000	Hominy Creek near Skiatook, Okla.	340	38.0	37.2	7.20	46.3	250.02	6.3
85	07177500	Bird Creek near Sperry, Okla.	905	38.9	37.8	4.14	85	263.93	7.98

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

Site no. (Tortorelli, 1997)	Station no.	StreamStats: Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (△ELEV)	Impervious area, in percent (IMPNLCD01)
52	07158400	181.49	181.49	0.00	29.30	8.45	33.62	213.14	0.64
53	07158500	14.33	14.33	0.00	30.09	14.47	11.25	122.08	0.50
54	07158550	4.82	4.82	0.00	29.22	15.13	6.75	76.67	0.57
55	07159000	254.76	252.26	0.98	30.86	4.31	52.90	170.85	0.59
56	07159200	165.14	165.14	0.00	30.24	6.44	36.39	175.65	0.35
57	07159810	0.15	0.15	0.00	32.98	132.65	0.74	73.16	0.05
58	07160500	412.05	412.05	0.00	31.02	5.67	63.49	270.05	2.36
59	07160550	13.58	13.58	0.00	32.16	19.55	8.93	130.96	0.08
60	07163000	30.03	30.03	0.00	35.17	13.88	11.42	118.86	0.39
61	07163020	3.01	3.01	0.00	35.33	45.65	3.19	109.19	0.21
62	07165550	47.69	47.69	0.00	39.58	9.45	18.93	134.14	0.15
72	07170700	36.84	36.84	0.00	42.42	8.80	23.74	156.70	0.58
73	07170800	4.40	4.40	0.00	43.16	27.39	4.02	82.63	0.44
74	07171700	3.08	3.08	0.00	34.78	42.41	3.48	110.78	0.49
75	07171800	0.51	0.51	0.00	34.61	153.63	1.56	179.66	0.03
76	07172000	428.50	245.51	42.70	37.85	7.02	64.02	336.99	0.37
77	07173000	710.78	527.79	25.74	35.30	5.45	87.39	357.01	0.29
78	07174200	503.37	276.73	45.02	36.49	4.92	75.67	279.24	0.51
79	07174570	1.72	1.72	0.00	37.43	84.08	2.30	144.76	0.32
80	07174600	137.83	137.83	0.00	37.44	9.67	48.74	353.64	0.17
81	07174720	0.78	0.78	0.00	37.68	65.71	1.73	85.20	0.65
82	07176500	368.55	368.55	0.00	38.66	6.05	61.29	278.27	0.50
83	07176800	31.35	31.35	0.00	38.45	15.15	13.42	152.51	0.15
84	07177000	340.11	340.11	0.00	38.04	4.50	60.54	204.41	0.31
85	07177500	906.98	906.98	0.00	39.31	4.09	91.08	279.34	0.53

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
86	07178640	Bull Creek near Inola, Okla.	10.7	40.9	40.8	12.20	5.8	53.07	3.14
89	07184000	Lightning Creek near McCune, Kans.	197	41.3	42.3	3.43	45.8	117.82	10.65
90	07184500	Labette Creek near Oswego, Kans.	211	41.5	40.8	4.74	34.2	121.58	5.54
91	07184600	Fly Creek near Faulkner, Kans.	27	42.0	41.9	7.80	10.6	62.01	4.16
92	07185500	Stahl Creek near Miller, Mo.	3.86	43.6	43.6	4.13	3	9.29	2.33
94	07185700	Spring River at LaRussell, Mo.	306	43.2	43.5	9.84	32.9	242.80	3.54
96	07186000	Spring River near Waco, Mo.	1,164.00	42.2	43.3	6.08	72.8	331.97	4.55
97	07186400	Center Creek near Carterville, Mo.	232	42.9	43.1	8.90	48.4	323.07	10.1
98	07187000	Shoal Creek above Joplin, Mo.	410	42.9	43.2	8.34	57.9	362.16	8.18
99	07188000	Spring River near Quapaw, Okla.	2,510.00	43.4	43.1	5.93	101	449.20	4.06
100	07188140	Flint Branch near Peoria, Okla.	4.9	43.5	43.5	59.50	3.6	160.65	2.64
101	07188500	Lost Creek at Seneca, Mo.	42	42.9	43.2	25.20	14	264.60	4.67
102	07188900	Butler Creek Trib. near Gravette, Ark.	0.96	45.1	45.1	109.00	2	163.50	4.17
103	07189000	Elk River near Tiff City, Mo.	872	42.3	43.8	8.05	59.7	360.44	4.09
104	07190600	Big Cabin Creek near Pyramid Corners, Okla.	71.1	42.1	41.9	8.00	15	90.00	3.16
105	07191000	Big Cabin Creek near Big Cabin, Okla.	450	42.7	42.5	5.52	43.5	180.09	4.21
106	07191220	Spavinaw Creek near Sycamore, Okla.	133	44.3	45.2	20.00	22	330.00	3.64
107	07191260	Brushy Creek near Jay, Okla.	16	44.0	44.4	31.20	8.6	201.24	4.62
108	07192000	Pryor Creek near Pryor, Okla.	229	40.9	41.6	5.52	37.5	155.25	6.14
109	07194515	Mill Creek near Park Hill, Okla.	2.57	44.2	44.6	107.00	2.9	232.73	3.27
110	07195000	Osage Creek near Elm Springs, Ark.	130	45.0	45.2	16.90	18.2	230.69	2.55
111	07195200	Brush Creek Trib. near Tontitown, Ark.	0.37	44.9	44.9	107.00	1	80.25	2.7
112	07195450	Ballard Creek at Summers, Ark.	14.6	46.4	46.8	41.00	7.2	221.40	3.55
113	07195500	Illinois River near Watts, Okla.	635	45.4	45.4	8.50	44.5	283.69	3.12
114	07195800	Flint Creek at Springtown, Ark.	14.2	45.5	45.5	22.70	6.2	105.56	2.71

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

Site no. (Tortorelli, 1997)	Station no.	StreamStats							
		Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (∆ELEV)	Impervious area, in percent (IMPNLCD01)
86	07178640	10.83	10.83	0.00	41.21	13.30	7.02	70.04	1.13
89	07184000	195.94	195.94	0.00	41.07	3.43	49.11	126.48	0.71
90	07184500	213.21	213.21	0.00	41.73	3.71	43.91	122.23	1.63
91	07184600	27.16	27.16	0.00	42.05	8.27	10.83	67.19	0.34
92	07185500	4.02	4.02	0.00	43.54	27.03	4.11	83.37	0.76
94	07185700	305.59	305.59	0.00	43.19	6.04	49.51	224.11	1.43
96	07186000	1,158.12	1,158.12	0.00	41.87	2.51	100.88	189.56	1.01
97	07186400	228.93	228.93	0.00	42.74	7.75	57.41	333.75	0.92
98	07187000	427.45	427.45	0.00	42.95	5.83	80.14	350.52	1.35
99	07188000	2,515.63	2,515.63	0.00	43.41	2.07	138.62	214.78	1.72
100	07188140	4.88	4.88	0.00	43.35	34.84	4.32	113.00	0.50
101	07188500	40.75	28.67	29.65	43.20	22.59	15.90	269.47	0.82
102	07188900	0.99	0.99	0.00	45.59	128.02	2.18	209.11	1.81
103	07189000	850.68	850.68	0.00	43.39	6.81	75.12	383.74	0.80
104	07190600	71.06	71.06	0.00	41.97	9.61	23.30	167.88	0.21
105	07191000	450.31	450.31	0.00	42.52	4.45	50.76	169.36	0.62
106	07191220	131.55	131.55	0.00	45.27	14.18	29.49	313.56	0.69
107	07191260	16.51	16.51	0.00	44.06	26.63	11.20	223.71	0.35
108	07192000	227.41	217.95	4.16	41.48	3.71	49.15	136.92	0.64
109	07194515	2.10	2.10	0.00	43.99	99.43	3.38	251.93	0.75
110	07195000	129.96	129.96	0.00	44.96	15.77	19.35	228.90	7.78
111	07195200	0.38	0.38	0.00	44.85	127.96	1.04	99.48	1.91
112	07195450	14.31	14.31	0.00	46.04	43.10	7.54	243.83	1.21
113	07195500	629.77	601.19	4.54	45.46	6.59	56.06	277.28	3.26
114	07195800	14.72	14.72	0.00	45.71	38.21	6.78	194.28	0.31

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
115	07196000	Flint Creek near Kansas, Okla.	110	45.1	45.4	19.40	23.4	340.47	4.98
116	07196380	Steely Hollow near Tahlequah, Okla.	3.59	45.2	45.2	110.00	2.6	214.50	1.88
117	07196500	Illinois River near Tahlequah, Okla.	959	44.9	45.4	5.33	96.2	384.56	9.65
118	07196900	Baron Fork at Dutch Mills, Ark.	46	46.9	47.6	40.20	11.6	349.74	2.93
119	07197000	Baron Fork at Eldon, Okla.	307	44.9	46.2	13.40	38.2	383.91	4.75
120	07228290	Rough Creek near Thomas, Okla.	10.4	27.8	27.6	41.00	6.3	193.73	3.82
121	07228450	Deer Creek Trib. near Hydro, Okla.	2.31	29.0	29.0	59.00	1.7	75.23	1.25
122	07228930	Worley Creek near Tuttle, Okla.	11.2	33.7	33.7	19.20	6.3	90.72	3.54
123	07228960	Canadian River Trib. near Newcastle, Okla.	3.32	33.8	33.8	49.10	3.8	139.94	4.35
124	07229220	Walnut Creek near Blanchard, Okla.	1.26	33.8	33.8	70.80	1.3	69.03	1.34
125	07229300	Walnut Creek near Purcell, Okla.	202	36.9	34.6	7.72	7.2	41.69	0.26
126	07229420	Julian Creek Trib. near Asher, Okla.	2.28	37.6	37.6	35.00	2.4	63.00	2.53
127	07229430	Arbeca Creek near Allen, Okla.	2.26	39.6	39.6	26.60	2.2	43.89	2.14
128	07230000	Little River below Lake Thunderbird near Norman, Okla.	257	36.2	35.1	5.50	24	99.00	2.24
129	07230500	Little River near Tecumseh, Okla.	456	37.8	35.9	4.30	42.8	138.03	4.02
130	07231000	Little River near Sasakwa, Okla.	865	38.4	36.9	3.66	95.9	263.25	10.63
131	07231320	Leader Creek Trib. near Atwood, Okla.	0.72	39.9	39.9	75.20	1.15	64.86	1.84
132	07231560	Middle Creek near Carson, Okla.	7.4	40.6	40.6	21.70	4.6	74.86	2.86
133	07231950	Pine Creek near Higgins, Okla.	9.99	48.1	48.1	62.40	5.1	238.68	2.6
134	07232000	Gaines Creek near Krebs, Okla.	588	43.6	45.4	4.98	45.4	169.57	3.51
135	07232500	Beaver River near Guymon, Okla.	1,175	17.5	16.6	14.80	203	2,253.30	35.07
136	07232650	Aqua Frio Creek near Felt, Okla.	31	16.0	15.6	23.00	15.4	265.65	7.65
137	07233000	Coldwater Creek near Hardesty, Okla.	767	18.5	17.1	11.40	156	1,333.80	31.73
138	07233500	Palo Duro Creek near Spearman, Tex.	440	18.8	17.6	9.83	74	545.57	12.45
139	07234050	North Fork Clear Creek near Balko, Okla.	4.22	20.4	20.4	29.10	4.06	88.61	3.91

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

Site no. (Tortorelli, 1997)	Station no.	StreamStats							
		Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (△ELEV)	Impervious area, in percent (IMPNLCD01)
115	07196000	115.59	115.59	0.00	45.78	15.33	29.36	337.60	2.08
116	07196380	3.84	3.84	0.00	44.83	78.25	3.25	190.51	0.28
117	07196500	950.25	921.68	3.01	44.72	4.54	112.15	381.96	2.50
118	07196900	41.09	41.09	0.00	47.47	39.02	12.36	361.75	0.37
119	07197000	311.58	307.95	1.16	44.93	10.28	46.86	361.20	0.36
120	07228290	10.19	10.19	0.00	27.91	39.26	7.07	208.14	0.17
121	07228450	2.32	2.32	0.00	29.16	62.25	3.30	154.13	1.17
122	07228930	11.22	11.22	0.00	33.89	17.11	7.38	94.65	0.86
123	07228960	3.27	3.27	0.00	33.99	44.15	4.21	139.35	2.23
124	07229220	1.27	1.27	0.00	34.03	67.78	1.70	86.26	0.09
125	07229300	202.13	202.13	0.00	37.23	6.61	36.29	179.92	0.93
126	07229420	2.30	2.30	0.00	37.69	27.35	2.89	59.32	0.22
127	07229430	2.12	2.12	0.00	39.52	30.67	2.78	63.98	0.37
128	07230000	257.09	257.09	0.00	36.23	6.15	34.08	157.26	3.89
129	07230500	462.50	462.50	0.00	37.72	5.54	53.54	222.53	2.26
130	07231000	888.35	834.30	6.08	38.80	3.30	117.99	292.42	1.31
131	07231320	0.73	0.73	0.00	40.29	75.47	1.40	79.09	0.47
132	07231560	7.34	7.34	0.00	40.48	27.16	6.17	125.75	0.12
133	07231950	10.83	10.83	0.00	47.97	48.66	6.24	227.77	0.08
134	07232000	585.08	529.04	9.58	43.91	3.07	65.72	151.51	0.41
135	07232500	1,611.74	1,611.74	0.00	17.39	14.03	227.04	2389.03	0.24
136	07232650	31.52	31.52	0.00	16.00	17.89	19.08	255.92	0.37
137	07233000	1,028.81	1,028.81	0.00	18.79	9.71	185.31	1349.31	0.32
138	07233500	624.68	624.68	0.00	18.66	8.27	108.73	674.44	0.49
139	07234050	4.30	4.30	0.00	20.50	25.53	5.25	100.56	0.14

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
140	07234100	Clear Creek near Elmwood, Okla.	170	21.2	20.6	15.24	26.42	301.98	4.11
141	07234150	White Woman Creek Trib. near Darrouzett, Tex.	4.03	22.6	22.6	7.59	2.16	12.30	1.16
142	07234290	Clear Creek Trib. near Catesby, Okla.	8.57	22.3	22.3	34.70	4.1	106.70	1.96
143	07235000	Wolf Creek at Lipscomb, Tex.	475	21.2	20.9	10.30	50	386.25	5.26
144	07235700	Little Wolf Creek Trib. near Gage, Okla.	17.8	21.7	22.0	23.00	8	138.00	3.6
145	07236000	Wolf Creek near Fargo, Okla.	1,386.00	22.8	21.7	8.96	89.3	600.10	5.75
146	07237750	Cottonwood Creek near Vici, Okla.	11.8	25.4	25.6	38.30	7.2	206.82	4.39
147	07237800	Bent Creek near Seiling, Okla.	139	25.6	25.4	16.50	20	247.50	2.88
148	07239050	North Canadian River Trib. near Eagle City, Okla.	0.52	27.9	27.9	112.00	0.92	77.28	1.63
149	07241880	Sand Creek near Cromwell, Okla.	9.48	38.2	38.2	30.60	5.8	133.11	3.55
150	07242160	Alabama Creek near Weleetka, Okla.	16.5	39.6	39.4	26.80	7.8	156.78	3.69
151	07243000	Dry Creek near Kendrick, Okla.	69	35.3	35.5	11.90	9	80.33	1.17
152	07243500	Deep Fork near Beggs, Okla.	2,018.00	39.5	36.4	2.60	145	282.75	10.42
153	07243550	Adams Creek near Beggs, Okla.	5.9	39.6	39.5	32.20	4.4	106.26	3.28
154	07244000	Deep Fork near Dewar, Okla.	2,307.00	40.3	36.8	1.89	186	263.66	15
155	07244790	Brooken Creek near Enterprise, Okla.	5.66	43.7	44.4	40.50	5	151.88	4.42
156	07245500	Sallisaw Creek near Sallisaw, Okla.	182	44.3	45.1	15.20	35	399.00	6.73
157	07246610	Pecan Creek near Spiro, Okla.	0.9	44.5	44.3	42.00	2	63.00	4.44
158	07246630	Big Black Fox Creek near Long, Okla.	5.32	45.7	45.8	68.50	3.3	169.54	2.05
159	07247000	Poteau River at Cauthron, Ark.	203	51.7	51.7	9.79	33.6	246.71	5.56
160	07247500	Fourche Maline near Red Oak, Okla.	122	48.0	48.4	3.91	31.8	93.25	8.29
161	07249000	Poteau River at Poteau, Okla.	1,240.00	45.5	49.2	3.60	100	270.00	8.06
162	07249300	James Fork near Midland, Ark.	44	46.1	49.3	46.50	13	453.38	3.84
163	07249400	James Fork near Hackett, Ark.	147	44.4	46.6	14.20	26.9	286.49	4.92
164	07249500	Cove Creek near Lee Creek, Ark.	35.3	48.3	48.8	37.00	13.4	371.85	5.09

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

		StreamStats							
Site no. (Tortorelli, 1997)	Station no.	Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (∆ELEV)	Impervious area, in percent (IMPNLCD01)
140	07234100	161.87	161.87	0.00	21.08	11.38	36.39	310.56	0.23
141	07234150	4.10	4.10	0.00	22.59	16.30	5.44	66.46	0.26
142	07234290	8.56	8.56	0.00	22.31	34.18	4.86	124.65	0.11
143	07235000	543.99	543.94	0.00	21.12	7.58	74.06	421.16	0.25
144	07235700	17.53	17.53	0.00	21.40	17.90	10.55	141.68	0.20
145	07236000	1,473.01	1,472.96	0.00	22.80	6.54	131.35	644.61	0.29
146	07237750	11.65	11.65	0.00	25.13	40.31	8.78	265.55	0.50
147	07237800	129.00	129.00	0.00	25.40	9.77	32.07	234.89	0.19
148	07239050	0.55	0.55	0.00	27.60	90.87	1.42	96.79	1.25
149	07241880	9.52	9.52	0.00	38.37	24.37	7.07	129.29	0.11
150	07242160	16.21	16.21	0.00	39.84	19.12	9.79	140.39	0.26
151	07243000	68.37	65.66	3.97	35.40	13.76	12.60	129.99	0.26
152	07243500	2,004.26	1,563.16	22.01	39.59	2.41	181.83	328.98	1.51
153	07243550	5.69	5.69	0.00	39.41	37.72	6.08	171.95	0.82
154	07244000	2,295.99	1,814.56	20.97	40.14	1.98	225.74	335.89	1.45
155	07244790	5.95	5.95	0.00	43.73	34.94	6.20	162.56	0.65
156	07245500	181.11	69.60	61.57	45.07	13.25	40.45	401.93	0.30
157	07246610	0.92	0.92	0.00	44.67	44.53	2.51	83.93	0.42
158	07246630	5.51	5.51	0.00	45.08	55.79	4.43	185.33	0.57
159	07247000	203.56	120.10	41.00	46.84	8.89	36.20	241.33	0.80
160	07247500	120.35	50.86	57.74	46.74	14.67	32.70	359.91	0.70
161	07249000	1,250.72	1,011.33	19.14	46.19	2.82	104.71	221.12	0.53
162	07249300	43.81	43.81	0.00	44.85	52.27	14.47	567.18	0.32
163	07249400	146.67	146.67	0.00	45.01	16.23	29.06	353.85	0.66
164	07249500	34.84	34.84	0.00	48.85	34.01	15.25	388.93	0.14

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
165	07249650	Mountain Fork near Evansville, Ark.	8.15	47.9	48.9	72.80	5.3	289.38	3.45
166	07250000	Lee Creek near Van Buren, Ark.	426	45.2	47.6	17.40	53.2	694.26	6.64
169	07299670	Groesbeck Creek at S.H. 6 near Quannah, Tex.	303	24.6	23.2	7.54	44.2	249.95	6.45
170	07299705	Bitter Creek near Hollis, Okla.	11.1	23.3	23.2	40.80	6.6	201.96	3.92
171	07300000	Salt Fork Red River near Wellington, Tex.	1,013.00	22.1	22.1	16.50	84	1,039.50	6.97
172	07300150	Bear Creek near Vinson, Okla.	7.24	23.1	23.1	41.90	5	157.13	3.45
173	07300500	Salt Fork Red River at Mangum, Okla.	1,357.00	25.9	22.3	13.80	132	1,366.20	12.84
174	07301110	Salt Fork Red River near Elmer, Okla.	1,669.00	25.7	23.1	13.00	164	1,599.00	16.12
175	07301455	Turkey Creek near Erick, Okla.	19.8	24.6	24.7	17.70	7	92.92	2.47
176	07301480	Short Creek near Sayre, Okla.	9.12	24.2	24.2	31.10	6.7	156.28	4.92
177	07301500	North Fork Red River near Carter, Okla.	1,938.00	26.1	22.8	12.50	110	1,031.25	6.24
178	07303400	Elm Fork of North Fork Red River near Carl, Okla.	416	23.5	22.8	19.40	53	771.15	6.75
179	07303450	Deer Creek near Plainview, Okla.	27.8	24.2	24.5	34.00	10.2	260.10	3.74
180	07303500	Elm Fork of North Fork Red River near Mangum, Okla.	838	26.0	23.8	14.10	79.2	837.54	7.49
181	07309480	Canyon Creek near Medicine Park, Okla.	3.35	30.1	30.3	59.10	3	132.98	2.69
182	07311000	East Cache Creek near Walters, Okla.	675	33.3	30.4	6.75	66.9	338.68	6.63
183	07311200	Blue Beaver Creek near Cache, Okla.	24.6	29.6	30.1	36.40	16.2	442.26	10.67
184	07311420	Deadman Creek Trib. at Manitou, Okla.	2.57	27.7	27.7	46.70	3.25	113.83	4.11
185	07311500	Deep Red Creek near Randlett, Okla.	617	30.7	28.8	8.51	64.2	409.76	6.68
186	07312850	Nine Mile Beaver Creek near Elgin, Okla.	6.29	31.0	31.1	42.20	4.2	132.93	2.8
187	07312950	Little Beaver Creek near Marlow, Okla.	35.4	33.1	33.2	23.80	8.1	144.59	1.85
188	07313000	Little Beaver Creek near Duncan, Okla.	158	32.8	32.9	12.10	23	208.73	3.35
189	07313500	Beaver Creek near Waurika, Okla.	563	31.9	32.4	4.79	66.2	237.82	7.78
190	07313600	Cow Creek near Waurika, Okla.	193	31.7	33.1	5.00	38.6	144.75	7.72
192	07315680	Cottonwood Creek Trib. near Loco, Okla.	1.74	35.1	35.1	50.60	2	75.90	2.3

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Sub-watershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

		StreamStats							
Site no. (Tortorelli, 1997)	Station no.	Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (ΔELEV)	Impervious area, in percent (IMPNLCD01)
165	07249650	8.40	8.40	0.00	48.23	128.70	6.91	666.79	0.15
166	07250000	437.97	437.97	0.00	42.94	15.12	60.64	687.45	0.18
169	07299670	320.00	320.00	0.00	24.44	7.10	48.08	256.15	0.50
170	07299705	11.48	11.48	0.00	23.28	34.08	7.74	197.80	0.09
171	07300000	979.49	979.43	0.00	22.00	15.06	97.15	1097.15	0.13
172	07300150	7.18	7.18	0.00	23.06	38.79	5.59	162.58	0.04
173	07300500	1,319.45	1,319.39	0.00	25.68	11.66	160.00	1399.73	0.16
174	07301110	1,847.90	1,757.42	4.89	25.66	9.77	205.21	1504.22	0.25
175	07301455	21.87	21.87	0.00	24.66	17.30	8.85	114.75	0.76
176	07301480	9.28	9.28	0.00	24.27	31.62	8.46	200.59	0.15
177	07301500	2,072.51	1,834.19	11.50	26.19	9.57	213.45	1531.73	0.26
178	07303400	437.96	437.96	0.00	23.34	15.76	74.04	875.21	0.30
179	07303450	26.78	26.78	0.00	24.23	25.58	13.26	254.29	0.06
180	07303500	846.33	846.33	0.00	25.72	10.87	115.17	939.18	0.21
181	07309480	3.39	3.39	0.00	30.31	56.74	3.56	151.58	0.19
182	07311000	693.50	693.50	0.00	33.57	5.07	110.08	418.56	2.40
183	07311200	24.67	24.67	0.00	29.41	35.58	17.37	463.50	0.35
184	07311420	2.58	2.58	0.00	27.82	31.93	4.47	107.04	0.81
185	07311500	604.08	485.49	19.63	30.79	5.92	82.29	365.15	0.36
186	07312850	6.36	6.36	0.00	31.09	39.94	4.93	147.77	2.17
187	07312950	34.86	34.86	0.00	33.39	22.37	8.96	150.40	0.29
188	07313000	156.58	156.58	0.00	32.99	9.11	29.34	200.51	0.64
189	07313500	564.36	564.36	0.00	31.58	3.98	71.25	212.64	0.38
190	07313600	192.66	144.17	25.17	31.00	6.32	44.09	209.11	2.21
192	07315680	1.81	1.81	0.00	34.90	56.06	2.45	103.06	0.02

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
193	07315700	Mud Creek near Courtney, Okla.	572	34.2	33.5	6.50	45	219.38	3.54
194	07315880	Demijohn Creek near Wilson, Okla.	5.74	35.5	35.4	43.40	3.2	104.16	1.78
195	07316130	Wilson Creek near McMilllian, Okla.	2.97	38.2	38.2	47.50	3.6	128.25	4.36
196	07316140	Brier Creek near Powell, Okla.	12	39.7	39.9	13.60	6.4	65.28	3.41
197	07316500	Washita River near Cheyenne, Okla.	794	24.0	22.6	10.90	82.1	671.17	8.49
198	07317500	Sandstone Creek SWS 16A near Cheyenne, Okla.	5.16	24.8	24.7	57.60	3.33	143.86	2.15
199	07318500	Sandstone Creek SWS 14 near Cheyenne, Okla.	1.02	25.0	25.0	147.00	1.35	148.84	1.79
200	07319000	Sandstone Creek SWS 17 near Cheyenne, Okla.	10.13	24.8	24.4	53.20	5.8	231.42	3.32
201	07320000	Sandstone Creek SWS 10A near Elk City, Okla.	2.87	25.4	25.2	58.00	2.13	92.66	1.58
202	07321500	Sandstone Creek SWS 3 near Elk City, Okla.	0.62	25.4	25.4	94.10	1.35	95.28	2.94
203	07322000	Sandstone Creek SWS 9 near Elk City, Okla.	3.5	25.3	25.3	67.40	4.45	224.95	5.66
204	07324000	Sandstone Creek SWS 1 near Cheyenne, Okla.	5.33	25.3	25.3	60.70	3.8	173.00	2.71
205	07325000	Washita River near Clinton, Okla.	1,977.00	29.7	24.5	6.68	179	896.79	16.21
206	07325850	Lake Creek near Eakly, Okla.	52	29.6	29.5	21.50	12.8	206.40	3.15
207	07326000	Cobb Creek near Fort Cobb, Okla.	313	29.6	29.4	8.03	36.5	219.82	4.26
208	07327150	Salt Creek near Chickasha, Okla.	23.76	32.0	32.6	15.90	11.6	138.33	5.66
209	07327420	West Bitter Creek near Tabler, Okla.	60.4	31.9	33.1	12.30	17.5	161.44	5.07
210	07327440	East Bitter Creek near Tabler, Okla.	35.2	32.4	33.2	17.40	12.25	159.86	4.26
211	07327490	Little Washita River near Ninnekah, Okla.	208	32.0	31.6	6.80	30.8	157.08	4.56
212	07329000	Rush Creek at Purdy, Okla.	145	35.8	34.2	10.50	28.5	224.44	5.6
213	07329500	Rush Creek near Maysville, Okla.	206	36.2	34.8	9.00	40.4	272.70	7.92
214	07329810	Honey Creek near Davis, Okla.	18.7	37.3	37.6	49.80	11.5	429.53	7.07
215	07329900	Rock Creek near Dougherty, Okla.	138	37.3	38.6	20.90	25	391.88	4.53
216	07330500	Caddo Creek near Ardmore, Okla.	298	36.3	36.3	8.39	39.8	250.44	5.32
217	07332070	Rock Creek near Achille, Okla.	0.72	41.0	41.0	35.60	0.9	24.03	1.13

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

		StreamStats							
Site no. (Tortorelli, 1997)	Station no.	Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (ΔELEV)	Impervious area, in percent (IMPNLCD01)
193	07315700	574.41	574.41	0.00	34.00	3.89	67.94	198.22	0.16
194	07315880	6.44	6.44	0.00	35.39	30.34	4.57	103.91	0.39
195	07316130	2.95	2.95	0.00	37.88	43.67	4.08	133.52	0.22
196	07316140	11.99	11.99	0.00	39.81	25.65	7.75	149.18	0.26
197	07316500	762.59	246.53	67.67	23.95	8.96	101.27	680.73	0.17
198	07317500	9.68	0.00	99.99	24.67	45.39	7.08	241.04	0.15
199	07318500	1.01	0.07	92.58	24.95	116.64	2.01	175.58	0.04
200	07319000	11.11	0.02	99.83	24.84	51.32	7.10	273.20	0.25
201	07320000	2.79	0.00	99.90	25.25	75.30	2.87	161.92	0.05
202	07321500	0.65	0.00	99.45	25.44	107.51	1.59	127.92	0.02
203	07322000	3.36	0.00	99.86	25.44	60.09	5.78	260.35	0.02
204	07324000	5.39	0.06	98.80	25.56	46.93	4.61	162.27	0.04
205	07325000	1,948.58	836.48	57.07	29.99	6.79	193.68	986.94	0.20
206	07325850	52.46	52.46	0.00	29.72	15.90	14.61	174.23	0.18
207	07326000	310.72	262.43	15.54	29.50	7.23	42.81	232.22	0.25
208	07327150	23.79	23.79	0.00	31.92	13.17	12.57	124.18	0.50
209	07327420	59.70	41.85	29.90	31.87	10.89	20.69	168.98	0.52
210	07327440	35.38	28.82	18.54	32.41	12.23	14.90	136.60	0.20
211	07327490	207.96	106.23	48.92	32.19	8.52	33.98	217.25	0.64
212	07329000	139.68	46.96	66.38	35.07	9.97	32.90	246.02	0.36
213	07329500	201.75	101.88	49.50	35.87	8.78	47.53	312.88	0.34
214	07329810	18.75	18.75	0.00	37.89	41.48	13.81	429.61	0.91
215	07329900	136.76	96.75	29.26	38.16	13.71	28.85	296.73	1.21
216	07330500	296.30	164.87	44.36	36.08	5.81	51.07	222.71	0.60
217	07332070	0.71	0.71	0.00	41.22	27.10	1.46	29.60	0.36

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
218	07332400	Blue River at Milburn, Okla.	203	40.9	39.6	12.80	43.7	419.52	9.41
219	07332500	Blue Creek near Blue, Okla.	476	42.2	40.8	5.99	112	503.16	26.35
220	07333500	Chickasaw Creek near Stringtown, Okla.	32.7	41.9	43.6	24.20	10.6	192.39	3.44
221	07333800	McGee Creek near Stringtown, Okla.	86.6	44.9	46.1	8.33	22.3	139.32	5.74
222	07334000	Muddy Boggy Creek near Farris, Okla.	1,087.00	43.1	42.2	3.73	97.7	273.32	8.78
223	07335000	Clear Boggy Creek near Caney, Okla.	720	42.2	40.1	6.26	63.9	300.01	5.67
224	07335300	Muddy Boggy Creek near Unger, Okla.	2,273.00	43.9	41.7	2.29	136.8	234.95	8.23
225	07335310	Rock Creek near Boswell, Okla.	0.94	43.8	43.8	22.60	1.3	22.04	1.8
226	07335320	Bokchito Creek near Soper, Okla.	16.6	44.9	45.4	4.60	16.6	57.27	16.6
227	07335700	Kiamichi River near Big Cedar, Okla.	40.1	53.9	56.2	58.90	11.9	525.68	3.53
228	07335760	Kiamichi River Trib. near Albion, Okla.	1.43	49.5	49.6	246.00	2.5	461.25	4.37
229	07336500	Kiamichi River near Belzoni, Okla.	1,423.00	45.8	48.8	3.08	121	279.51	10.29
230	07336520	Frazier Creek near Oleta, Okla.	19.4	47.2	49.1	57.60	7.4	319.68	2.82
231	07336710	Rock Creek near Sawyer, Okla.	3.39	45.9	45.8	34.40	2.6	67.08	1.99
232	07336750	Little Pine Creek near Kanawha, Tex.	75.4	46.4	46.3	5.82	20.83	90.92	5.75
233	07336780	Perry Creek near Idabel, Okla.	7.53	47.6	47.6	31.60	3.2	75.84	1.36
234	07336785	Bokchito Creek near Garvin, Okla.	2.96	47.6	47.6	26.30	3.6	71.01	4.38
235	07336800	Pecan Bayou near Clarksville, Tex.	100	46.2	46.9	4.58	20.9	71.79	4.37
236	07337220	Big Branch near Ringold, Okla.	1.99	49.0	49.0	84.80	2.2	139.92	2.43
237	07337500	Little River near Wright City, Okla.	645	47.6	50.3	7.50	76.4	429.75	9.05
238	07337900	Glover River near Glover, Okla.	315	49.9	51.6	14.30	42.5	455.81	5.73
239	07338500	Little River below Lukfata Creek near Idabel, Okla.	1,226.00	47.3	50.5	5.13	114	438.62	10.6
240	07338520	Yanubbee Creek near Broken Bow, Okla.	9.1	50.0	50.9	66.00	4.9	242.55	2.64
241	07338700	Twomile Creek near Hatfield, Ark.	16.1	54.2	54.9	48.90	9.5	348.41	5.61
242	07338780	Mountain Fork Trib. near Smithville, Okla.	0.68	53.8	53.8	91.40	2.2	150.81	7.12

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

		StreamStats							
Site no. (Tortorelli, 1997)	Station no.	Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is unregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (∆ELEV)	Impervious area, in percent (IMPNLCD01)
218	07332400	203.19	201.52	0.82	41.02	10.26	58.16	447.57	0.21
219	07332500	477.45	475.78	0.35	42.14	6.98	106.84	559.43	0.63
220	07333500	32.62	32.62	0.00	41.44	25.39	13.71	261.18	0.09
221	07333800	88.76	88.76	0.00	45.24	6.10	30.64	140.30	0.09
222	07334000	1,088.92	987.26	9.34	42.89	3.18	124.69	297.73	0.28
223	07335000	713.37	406.83	42.97	41.94	3.37	90.84	229.77	0.38
224	07335300	2,261.85	1,844.45	18.45	44.08	2.40	166.16	299.44	0.29
225	07335310	1.01	1.01	0.00	43.64	33.38	1.98	49.51	0.07
226	07335320	17.48	17.48	0.00	45.01	15.74	9.52	112.39	0.21
227	07335700	39.63	39.63	0.00	56.32	54.89	12.79	526.40	0.13
228	07335760	1.51	1.51	0.00	50.58	342.93	3.60	924.74	0.22
229	07336500	1,415.94	1,391.77	1.71	46.23	3.35	137.13	344.84	0.27
230	07336520	18.54	18.54	0.00	47.45	25.32	10.57	200.69	0.13
231	07336710	3.33	3.33	0.00	46.68	33.06	4.01	99.36	0.45
232	07336750	75.27	75.27	0.00	47.21	5.24	23.93	94.01	0.71
233	07336780	7.60	7.60	0.00	48.09	22.72	4.70	80.08	1.13
234	07336785	2.89	2.89	0.00	48.09	22.67	4.28	72.70	0.51
235	07336800	98.91	98.91	0.00	46.04	4.30	32.12	103.60	0.50
236	07337220	1.99	1.99	0.00	49.77	72.35	2.42	131.36	0.48
237	07337500	648.22	648.22	0.00	49.37	9.74	92.73	677.61	0.31
238	07337900	320.28	320.28	0.00	50.42	13.52	52.57	533.05	0.57
239	07338500	1,228.14	1,228.14	0.00	48.35	5.67	132.74	564.37	0.46
240	07338520	9.03	9.03	0.00	50.64	42.27	6.05	191.64	0.68
241	07338700	16.22	16.22	0.00	53.59	44.03	10.78	355.87	0.28
242	07338780	0.65	0.65	0.00	54.05	69.96	2.67	140.12	3.25

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

			Tortorelli (1997)						
Site no. (Tortorelli, 1997)	Station no.	Station name	Contributing drainage area in square miles	Outlet mean annual precipitation (1961-1990), in inches	Area-weighted mean annual precipitation (1961-1990), in inches	10–85 channel slope, in feet per mile	Stream length, in miles	10–85 change in elevation of stream, in feet	Stream shape factor, dimensionless
243	07339000	Mountain Fork near Eagletown, Okla.	787	50.0	53.7	6.63	87.5	435.09	9.73
244	07339500	Rolling Fork near DeQueen, Ark.	182	52.0	53.4	18.60	35.1	489.65	6.77
245	07339800	Pepper Creek near DeQueen, Ark.	6.41	52.7	52.7	47.70	6.4	228.96	6.39
246	07340200	West Flat Creek near Foreman, Ark.	10.6	50.0	50.1	12.00	6.78	61.02	4.34
247	07340300	Cossatot River near Vandervoort, Ark.	89.6	55.2	58.4	29.90	18.4	412.62	3.78
248	07340500	Cossatot River near DeQueen, Ark.	360	52.6	56.0	15.50	53.7	624.26	8.01
249	07340530	Mill Slough Trib. near Locksburg, Ark.	0.64	51.7	51.7	60.50	1.97	89.39	6.06
250	07341000	Saline River near Dierks, Ark.	121	53.3	56.9	21.50	35.9	578.89	10.65
		MAXIMUM	787.00	55.20	58.40	60.50	87.50	624.26	10.65
		MINIMUM	0.64	50.00	50.10	6.63	1.97	61.02	3.78

Appendix 1. Basin characteristics computed by Tortorelli (1997) and StreamStats.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed; NRCS FWR, Natural Resources Conservation Service floodwater retarding]

		StreamStats							
Site no. (Tortorelli, 1997)	Station no.	Contributing drainage area, in square miles (CONTDA)	Contributing drainage area that is uregulated by NRCS FWR structures, in square miles (DAUNREG)	Contributing drainage area that is regulated by NRCS FWR structures, in percent (NRCSPCT)	Outlet mean annual precipitation (1961-1990), in inches (PRCOUT61)	10–85 channel slope, in feet per mile (CSL10_85fm)	Length of longest flow path, in miles (L)	10–85 change in elevation of longest flow path, in feet (ΔELEV)	Impervious area, in percent (IMPNLCD01)
243	07339000	799.80	799.80	0.00	50.57	6.82	97.69	499.58	0.46
244	07339500	183.37	183.37	0.00	52.19	17.52	42.87	563.25	0.65
245	07339800	6.27	6.27	0.00	52.74	41.72	7.49	234.34	0.61
246	07340200	10.65	10.65	0.00	50.34	10.62	7.80	62.12	0.26
247	07340300	89.10	89.10	0.00	56.37	28.55	21.41	458.41	0.11
248	07340500	361.22	361.22	0.00	52.79	15.46	60.11	696.82	0.39
249	07340530	0.69	0.69	0.00	52.25	55.83	2.16	90.62	5.62
250	07341000	120.21	120.21	0.00	54.17	20.90	40.78	639.09	0.47
		799.80	799.80	0.00	56.37	55.83	97.69	696.82	5.62
		0.69	0.69	0.00	50.34	6.82	2.16	62.12	0.11

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed]

Site no. (Tortorelli, 1997)	Station no.	Station name	Tortorelli (1997) Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
17	07148100	Grouse Creek near Dexter, Kans.	4,225	8,946	13,006	19,408	25,178	31,616	49,669
18	07148350	Salt Fork Arkansas River near Winchester, Okla.	6,342	15,794	24,856	40,177	54,828	71,861	122,238
19	07148400	Salt Fork Arkansas River near Alva, Okla.	7,847	19,049	29,589	47,205	63,911	83,202	139,659
22	07150580	Sand Creek Trib. near Kremlin, Okla.	581	1,290	1,932	2,973	3,928	5,005	8,146
23	07150870	Salt Fork Arkansas River Trib. near Eddy, Okla.	316	690	1,026	1,568	2,061	2,614	4,229
24	07151500	Chikaskia River near Corbin, Kans.	8,758	19,454	28,897	44,057	57,959	73,659	118,037
26	07152000	Chikaskia River near Blackwell, Okla.	16,545	35,745	52,296	78,524	102,386	129,140	203,604
27	07152360	Elm Creek near Foraker, Okla.	1,297	2,726	3,964	5,923	7,687	9,649	15,234
28	07152410	Rock Creek near Shidler, Okla.	962	2,036	2,976	4,472	5,828	7,337	11,676
29	07152520	Black Bear Creek Trib. near Garber, Okla.	203	450	675	1,041	1,377	1,755	2,875
30	07152842	Subwatershed W-4 near Morrison, Okla.	119	262	393	606	802	1,022	1,678
31	07152846	Subwatershed W-3 near Morrison, Okla.	75	167	251	388	515	657	1,085
32	07153000	Black Bear Creek at Pawnee, Okla.	8,652	17,855	25,560	37,531	48,198	60,038	92,567
33	07153500	Dry Cimarron River near Guy, N. Mex.	2,353	7,279	12,790	23,109	33,802	46,970	89,565
34	07154400	Carrizozo Creek near Kenton, Okla.	903	2,738	4,773	8,556	12,438	17,195	32,562
35	07154500	Cimarron River near Kenton, Okla.	3,322	10,074	17,499	31,236	45,327	62,594	117,689
36	07155000	Cimarron River above Ute Creek near Boise City, Okla.	3,733	11,838	21,005	38,291	56,283	78,604	150,776
37	07155100	Cold Springs Creek near Wheeless, Okla.	198	605	1,061	1,912	2,784	3,855	7,354
45	07157500	Crooked Creek near Nye, Kans.	3,721	9,728	15,666	25,878	35,715	47,328	82,069
46	07157550	West Fork Creek near Knowles, Okla.	225	606	1,000	1,699	2,387	3,203	5,772
47	07157900	Cavalry Creek at Coldwater, Kans.	839	2,082	3,284	5,318	7,246	9,489	16,202
48	07157960	Buffalo Creek near Lovedale, Okla.	3,947	9,783	15,372	24,804	33,790	44,229	75,137
49	07158020	Cimarron River Trib. near Lone Wolf, Okla.	317	774	1,217	1,967	2,679	3,502	5,998
50	07158080	Sand Creek Trib. near Waynoka, Okla.	182	451	716	1,168	1,601	2,103	3,647
51	07158180	Salt Creek Trib. near Okeene, Okla.	568	1,321	2,023	3,185	4,270	5,508	9,181
52	07158400	Salt Creek near Okeene, Okla.	3,830	8,837	13,420	20,936	27,948	35,932	59,116
53	07158500	Preacher Creek near Dover, Okla.	794	1,789	2,693	4,166	5,520	7,055	11,528
54	07158550	Turkey Creek Trib. near Goltry, Okla.	389	900	1,378	2,165	2,896	3,731	6,206
55	07159000	Turkey Creek near Drummond, Okla.	3,965	8,812	13,111	20,016	26,323	33,454	53,711
56	07159200	Kingfisher Creek near Kingfisher, Okla.	3,166	7,204	10,863	16,820	22,329	28,586	46,637

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed]

Site no. (Tortorelli, 1997)	Station no.	Station name	StreamStats: Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
17	07148100	Grouse Creek near Dexter, Kans.	4,415	9,293	13,471	20,046	25,962	32,553	50,999
18	07148350	Salt Fork Arkansas River near Winchester, Okla.	5,873	14,468	22,634	36,352	49,378	64,492	108,903
19	07148400	Salt Fork Arkansas River near Alva, Okla.	7,142	17,156	26,494	41,998	56,592	73,414	122,311
22	07150580	Sand Creek Trib. near Kremlin, Okla.	554	1,227	1,832	2,812	3,706	4,715	7,649
23	07150870	Salt Fork Arkansas River Trib. near Eddy, Okla.	330	719	1,068	1,630	2,142	2,716	4,392
24	07151500	Chikaskia River near Corbin, Kans.	8,842	19,647	29,187	44,503	58,548	74,411	119,246
26	07152000	Chikaskia River near Blackwell, Okla.	16,215	35,060	51,306	77,051	100,461	126,720	199,782
27	07152360	Elm Creek near Foraker, Okla.	1,304	2,717	3,933	5,847	7,565	9,471	14,875
28	07152410	Rock Creek near Shidler, Okla.	963	2,027	2,956	4,430	5,764	7,246	11,498
29	07152520	Black Bear Creek Trib. near Garber, Okla.	190	418	625	959	1,265	1,608	2,619
30	07152842	Subwatershed W-4 near Morrison, Okla.	120	259	386	591	778	988	1,608
31	07152846	Subwatershed W-3 near Morrison, Okla.	64	140	211	327	434	553	914
32	07153000	Black Bear Creek at Pawnee, Okla.	8,005	16,505	23,616	34,654	44,471	55,372	85,292
33	07153500	Dry Cimarron River near Guy, N. Mex.	1,855	5,905	10,522	19,272	28,407	39,749	76,774
34	07154400	Carrizozo Creek near Kenton, Okla.	888	2,662	4,613	8,214	11,886	16,375	30,784
35	07154500	Cimarron River near Kenton, Okla.	3,538	10,624	18,361	32,604	47,156	64,943	121,437
36	07155000	Cimarron River above Ute Creek near Boise City, Okla.	3,611	11,566	20,621	37,770	55,673	77,946	150,197
37	07155100	Cold Springs Creek near Wheeless, Okla.	193	588	1,031	1,858	2,704	3,744	7,141
45	07157500	Crooked Creek near Nye, Kans.	3,750	9,773	15,712	25,910	35,718	47,289	81,850
46	07157550	West Fork Creek near Knowles, Okla.	229	617	1,018	1,728	2,426	3,255	5,861
47	07157900	Cavalry Creek at Coldwater, Kans.	935	2,314	3,646	5,897	8,032	10,514	17,940
48	07157960	Buffalo Creek near Lovedale, Okla.	3,665	9,175	14,490	23,497	32,103	42,128	71,914
49	07158020	Cimarron River Trib. near Lone Wolf, Okla.	295	720	1,133	1,831	2,492	3,258	5,579
50	07158080	Sand Creek Trib. near Waynoka, Okla.	187	464	738	1,207	1,655	2,176	3,778
51	07158180	Salt Creek Trib. near Okeene, Okla.	498	1,145	1,743	2,725	3,633	4,667	7,711
52	07158400	Salt Creek near Okeene, Okla.	3,137	7,172	10,834	16,798	22,309	28,582	46,657
53	07158500	Preacher Creek near Dover, Okla.	758	1,721	2,601	4,038	5,363	6,867	11,263
54	07158550	Turkey Creek Trib. near Goltry, Okla.	367	845	1,287	2,015	2,688	3,455	5,721
55	07159000	Turkey Creek near Drummond, Okla.	3,871	8,562	12,704	19,338	25,374	32,195	51,504
56	07159200	Kingfisher Creek near Kingfisher, Okla.	3,030	6,799	10,174	15,622	20,615	26,273	42,452

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed]

Site no. (Tortorelli, 1997)	Station no.	Station name	Tortorelli (1997) Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
57	07159810	Watershed W-IV near Guthrie, Okla.	79	175	264	409	544	696	1,152
58	07160500	Skeleton Creek near Lovell, Okla.	6,023	13,325	19,774	30,121	39,592	50,277	80,561
59	07160550	West Beaver Creek near Orlando, Okla.	941	2,078	3,099	4,750	6,264	7,969	12,919
60	07163000	Council Creek near Stillwater, Okla.	1,754	3,708	5,403	8,088	10,514	13,215	20,892
61	07163020	Corral Creek near Yale, Okla.	491	1,051	1,549	2,346	3,073	3,883	6,242
62	07165550	Snake Creek near Bixby, Okla.	3,197	6,424	9,124	13,316	17,058	21,164	32,628
72	07170700	Big Hill Creek near Cherryvale, Kans.	2,532	4,898	6,822	9,754	12,319	15,115	22,791
73	07170800	Mud Creek near Mound Valley, Kans.	814	1,581	2,216	3,193	4,053	4,989	7,612
74	07171700	Spring Branch near Cedar Vale, Kans.	495	1,064	1,570	2,383	3,125	3,953	6,364
75	07171800	Cedar Creek Trib. near Hooser, Kans.	214	464	691	1,059	1,399	1,777	2,901
76	07172000	Caney River near Elgin, Kans.	9,209	18,635	26,441	38,507	49,241	61,076	93,532
77	07173000	Caney River near Hulah, Okla.	10,778	22,465	32,325	47,733	61,565	76,937	119,383
78	07174200	Little Caney River below Cotton Creek near Copan, Okla.	9,423	19,453	27,881	41,021	52,800	65,848	101,897
79	07174570	Dry Hollow near Pawhuska, Okla.	426	892	1,301	1,952	2,542	3,196	5,095
80	07174600	Sand Creek at Okesa, Okla.	4,873	9,969	14,257	20,939	26,919	33,522	51,893
81	07174720	Hogshooter Creek Trib. near Bartlesville, Okla.	296	609	882	1,314	1,702	2,130	3,370
82	07176500	Bird Creek at Avant, Okla.	8,050	16,189	22,902	33,246	42,415	52,514	80,153
83	07176800	Candy Creek near Wolco, Okla.	2,094	4,252	6,074	8,911	11,443	14,233	22,056
84	07177000	Hominy Creek near Skiatook, Okla.	7,772	15,717	22,303	32,481	41,527	51,502	78,890
85	07177500	Bird Creek near Sperry, Okla.	13,651	27,123	38,072	54,818	69,583	85,813	129,684
86	07178640	Bull Creek near Inola, Okla.	1,176	2,307	3,242	4,680	5,943	7,324	11,170
89	07184000	Lightning Creek near McCune, Kans.	5,883	11,320	15,670	22,247	27,963	34,202	51,021
90	07184500	Labette Creek near Oswego, Kans.	6,527	12,588	17,450	24,816	31,241	38,250	57,192
91	07184600	Fly Creek near Faulkner, Kans.	2,046	3,943	5,484	7,828	9,873	12,100	18,216
92	07185500	Stahl Creek near Miller, Mo.	605	1,133	1,557	2,195	2,742	3,335	4,961
94	07185700	Spring River at LaRussell, Mo.	10,025	19,179	26,483	37,544	47,237	57,763	86,190
96	07186000	Spring River near Waco, Mo.	20,105	38,675	53,418	75,711	95,254	116,534	173,447
97	07186400	Center Creek near Carterville, Mo.	8,201	15,713	21,721	30,824	38,793	47,454	70,884
98	07187000	Shoal Creek above Joplin, Mo.	11,520	22,066	30,469	43,188	54,329	66,438	99,056
99	07188000	Spring River near Quapaw, Okla.	34,074	64,722	88,728	124,814	156,380	190,638	281,384

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

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Site no. (Tortorelli, 1997)	Station no.	Station name	StreamStats: Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
57	07159810	Watershed W-IV near Guthrie, Okla.	80	179	271	422	562	719	1,194
58	07160500	Skeleton Creek near Lovell, Okla.	5,495	12,177	18,079	27,540	36,179	45,939	73,555
59	07160550	West Beaver Creek near Orlando, Okla.	885	1,955	2,917	4,471	5,895	7,499	12,152
60	07163000	Council Creek near Stillwater, Okla.	1,648	3,478	5,065	7,573	9,835	12,353	19,501
61	07163020	Corral Creek near Yale, Okla.	489	1,045	1,538	2,327	3,045	3,846	6,173
62	07165550	Snake Creek near Bixby, Okla.	2,642	5,251	7,412	10,740	13,678	16,903	25,825
72	07170700	Big Hill Creek near Cherryvale, Kans.	2,578	4,955	6,880	9,806	12,360	15,140	22,756
73	07170800	Mud Creek near Mound Valley, Kans.	866	1,675	2,342	3,366	4,266	5,244	7,982
74	07171700	Spring Branch near Cedar Vale, Kans.	473	1,018	1,503	2,281	2,990	3,782	6,088
75	07171800	Cedar Creek Trib. near Hooser, Kans.	191	417	625	962	1,273	1,622	2,660
76	07172000	Caney River near Elgin, Kans.	8,847	17,924	25,448	37,080	47,425	58,839	90,147
77	07173000	Caney River near Hulah, Okla.	10,022	20,908	30,093	44,441	57,304	71,609	111,082
78	07174200	Little Caney River below Cotton Creek near Copan, Okla.	8,549	17,533	25,030	36,660	47,016	58,487	89,993
79	07174570	Dry Hollow near Pawhuska, Okla.	431	904	1,320	1,983	2,585	3,252	5,190
80	07174600	Sand Creek at Okesa, Okla.	4,532	9,257	13,225	19,396	24,902	30,985	47,867
81	07174720	Hogshooter Creek Trib. near Bartlesville, Okla.	258	536	781	1,169	1,520	1,908	3,037
82	07176500	Bird Creek at Avant, Okla.	8,237	16,487	23,267	33,695	42,922	53,074	80,806
83	07176800	Candy Creek near Wolco, Okla.	2,070	4,197	5,989	8,778	11,263	14,000	21,664
84	07177000	Hominy Creek near Skiatook, Okla.	7,230	14,519	20,520	29,752	37,907	46,896	71,447
85	07177500	Bird Creek near Sperry, Okla.	13,948	27,572	38,604	55,442	70,263	86,535	130,438
86	07178640	Bull Creek near Inola, Okla.	1,220	2,388	3,354	4,836	6,138	7,560	11,520
89	07184000	Lightning Creek near McCune, Kans.	5,796	11,181	15,499	22,032	27,716	33,923	50,672
90	07184500	Labette Creek near Oswego, Kans.	6,393	12,256	16,934	23,997	30,135	36,827	54,843
91	07184600	Fly Creek near Faulkner, Kans.	2,078	4,007	5,573	7,957	10,037	12,304	18,529
92	07185500	Stahl Creek near Miller, Mo.	834	1,604	2,239	3,211	4,064	4,990	7,581
94	07185700	Spring River at LaRussell, Mo.	9,265	17,605	24,216	34,179	42,858	52,282	77,595
96	07186000	Spring River near Waco, Mo.	17,119	32,645	44,854	63,186	79,093	96,427	142,392
97	07186400	Center Creek near Carterville, Mo.	7,894	15,123	20,900	29,648	37,298	45,615	68,094
98	07187000	Shoal Creek above Joplin, Mo.	11,193	21,321	29,348	41,452	52,006	63,475	94,234
99	07188000	Spring River near Quapaw, Okla.	28,867	54,024	73,435	102,321	127,251	154,308	225,121

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

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Site no. (Tortorelli, 1997)	Station no.	Station name	Tortorelli (1997) — Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
100	07188140	Flint Branch near Peoria, Okla.	1,065	2,074	2,913	4,208	5,356	6,604	10,118
101	07188500	Lost Creek at Seneca, Mo.	3,383	6,565	9,167	13,153	16,675	20,504	31,087
102	07188900	Butler Creek Trib. near Gravette, Ark.	464	895	1,255	1,810	2,302	2,834	4,349
103	07189000	Elk River near Tiff City, Mo.	17,689	34,114	47,212	67,066	84,515	103,511	154,545
104	07190600	Big Cabin Creek near Pyramid Corners, Okla.	3,745	7,219	10,027	14,294	18,024	22,087	33,177
105	07191000	Big Cabin Creek near Big Cabin, Okla.	11,312	21,592	29,747	42,049	52,779	64,445	95,737
106	07191220	Spavinaw Creek near Sycamore, Okla.	7,087	13,523	18,686	26,525	33,420	40,888	61,230
107	07191260	Brushy Creek near Jay, Okla.	2,039	3,918	5,454	7,802	9,870	12,112	18,333
108	07192000	Pryor Creek near Pryor, Okla.	6,820	13,272	18,482	26,407	33,349	40,935	61,507
109	07194515	Mill Creek near Park Hill, Okla.	813	1,584	2,228	3,225	4,113	5,076	7,808
110	07195000	Osage Creek near Elm Springs, Ark.	7,032	13,288	18,270	25,802	32,398	39,528	58,872
111	07195200	Brush Creek Trib. near Tontitown, Ark.	255	492	692	999	1,272	1,566	2,410
112	07195450	Ballard Creek at Summers, Ark.	2,250	4,235	5,836	8,266	10,399	12,696	19,042
113	07195500	Illinois River near Watts, Okla.	17,035	31,801	43,325	60,588	75,617	91,843	135,049
114	07195800	Flint Creek at Springtown, Ark.	1,933	3,640	5,015	7,098	8,918	10,881	16,289
115	07196000	Flint Creek near Kansas, Okla.	6,516	12,323	16,956	23,967	30,114	36,757	54,818
116	07196380	Steely Hollow near Tahlequah, Okla.	1,051	2,028	2,838	4,086	5,196	6,395	9,783
117	07196500	Illinois River near Tahlequah, Okla.	19,911	37,136	50,514	70,498	87,837	106,579	156,189
118	07196900	Baron Fork at Dutch Mills, Ark.	4,647	8,711	11,956	16,872	21,189	25,834	38,552
119	07197000	Baron Fork at Eldon, Okla.	11,443	21,594	29,625	41,736	52,338	63,799	94,664
120	07228290	Rough Creek near Thomas, Okla.	622	1,486	2,307	3,684	4,984	6,478	10,955
121	07228450	Deer Creek Trib. near Hydro, Okla.	286	671	1,037	1,647	2,220	2,876	4,850
122	07228930	Worley Creek near Tuttle, Okla.	865	1,869	2,758	4,182	5,476	6,926	11,103
123	07228960	Canadian River Trib. near Newcastle, Okla.	478	1,045	1,554	2,378	3,132	3,979	6,457
124	07229220	Walnut Creek near Blanchard, Okla.	279	613	915	1,406	1,857	2,363	3,858
125	07229300	Walnut Creek near Purcell, Okla.	5,363	11,001	15,735	23,100	29,671	36,943	57,080
126	07229420	Julian Creek Trib. near Asher, Okla.	450	931	1,347	2,005	2,596	3,250	5,128
127	07229430	Arbeca Creek near Allen, Okla.	478	961	1,371	2,012	2,580	3,205	4,982
128	07230000	Little River below Lake Thunderbird near Norman, Okla.	5,660	11,661	16,705	24,553	31,548	39,305	60,746
129	07230500	Little River near Tecumseh, Okla.	8,482	17,077	24,156	35,050	44,684	55,310	84,298

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Site no. (Tortorelli, 1997)	Station no.	Station name	StreamStats: Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
100	07188140	Flint Branch near Peoria, Okla.	968	1,875	2,624	3,775	4,789	5,891	8,980
101	07188500	Lost Creek at Seneca, Mo.	3,311	6,395	8,908	12,748	16,133	19,811	29,953
102	07188900	Butler Creek Trib. near Gravette, Ark.	497	956	1,339	1,929	2,453	3,018	4,627
103	07189000	Elk River near Tiff City, Mo.	17,893	34,022	46,747	65,918	82,672	100,857	149,428
104	07190600	Big Cabin Creek near Pyramid Corners, Okla.	3,829	7,411	10,316	14,741	18,620	22,847	34,412
105	07191000	Big Cabin Creek near Big Cabin, Okla.	10,838	20,665	28,449	40,176	50,382	61,485	91,212
106	07191220	Spavinaw Creek near Sycamore, Okla.	6,976	13,113	17,978	25,314	31,720	38,638	57,353
107	07191260	Brushy Creek near Jay, Okla.	2,033	3,896	5,414	7,731	9,767	11,975	18,087
108	07192000	Pryor Creek near Pryor, Okla.	6,568	12,628	17,472	24,794	31,162	38,110	56,827
109	07194515	Mill Creek near Park Hill, Okla.	703	1,370	1,928	2,793	3,563	4,398	6,769
110	07195000	Osage Creek near Elm Springs, Ark.	6,942	13,110	18,018	25,436	31,928	38,945	57,970
111	07195200	Brush Creek Trib. near Tontitown, Ark.	264	512	720	1,043	1,328	1,638	2,526
112	07195450	Ballard Creek at Summers, Ark.	2,204	4,166	5,753	8,168	10,291	12,579	18,912
113	07195500	Illinois River near Watts, Okla.	16,325	30,349	41,250	57,536	71,667	86,920	127,415
114	07195800	Flint Creek at Springtown, Ark.	2,167	4,103	5,670	8,054	10,149	12,409	18,661
115	07196000	Flint Creek near Kansas, Okla.	6,677	12,499	17,105	24,043	30,096	36,625	54,285
116	07196380	Steely Hollow near Tahlequah, Okla.	1,020	1,965	2,747	3,951	5,018	6,172	9,424
117	07196500	Illinois River near Tahlequah, Okla.	19,138	35,681	48,518	67,680	84,279	102,231	149,697
118	07196900	Baron Fork at Dutch Mills, Ark.	4,427	8,246	11,285	15,877	19,901	24,224	36,044
119	07197000	Baron Fork at Eldon, Okla.	11,085	20,836	28,519	40,076	50,158	61,056	90,315
120	07228290	Rough Creek near Thomas, Okla.	615	1,466	2,274	3,626	4,901	6,365	10,749
121	07228450	Deer Creek Trib. near Hydro, Okla.	292	686	1,059	1,681	2,265	2,933	4,942
122	07228930	Worley Creek near Tuttle, Okla.	860	1,851	2,726	4,123	5,390	6,808	10,887
123	07228960	Canadian River Trib. near Newcastle, Okla.	471	1,025	1,522	2,323	3,055	3,876	6,275
124	07229220	Walnut Creek near Blanchard, Okla.	282	617	920	1,411	1,861	2,366	3,854
125	07229300	Walnut Creek near Purcell, Okla.	5,334	10,871	15,498	22,673	29,054	36,108	55,579
126	07229420	Julian Creek Trib. near Asher, Okla.	437	899	1,299	1,927	2,490	3,112	4,896
127	07229430	Arbeca Creek near Allen, Okla.	468	943	1,348	1,981	2,544	3,162	4,927
128	07230000	Little River below Lake Thunderbird near Norman, Okla.	5,773	11,908	17,071	25,111	32,287	40,245	62,263
129	07230500	Little River near Tecumseh, Okla.	8,871	17,940	25,440	37,014	47,285	58,618	89,630

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Site no. (Tortorelli, 1997)	Station no.	Station name	Tortorelli (1997) Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
130	07231000	Little River near Sasakwa, Okla.	12,670	25,280	35,560	51,301	65,181	80,462	121,811
131	07231320	Leader Creek Trib. near Atwood, Okla.	283	575	828	1,225	1,581	1,972	3,103
132	07231560	Middle Creek near Carson, Okla.	1,011	2,006	2,839	4,128	5,268	6,517	10,027
133	07231950	Pine Creek near Higgins, Okla.	2,055	3,824	5,244	7,398	9,286	11,311	16,914
134	07232000	Gaines Creek near Krebs, Okla.	13,707	25,879	35,441	49,796	62,273	75,806	111,880
135	07232500	Beaver River near Guymon, Okla.	3,659	10,740	18,341	32,169	46,147	63,137	116,495
136	07232650	Aqua Frio Creek near Felt, Okla.	348	1,066	1,873	3,380	4,926	6,829	13,023
137	07233000	Coldwater Creek near Hardesty, Okla.	3,035	8,645	14,550	25,143	35,720	48,477	88,117
138	07233500	Palo Duro Creek near Spearman, Tex.	2,178	6,144	10,294	17,709	25,075	33,938	61,427
139	07234050	North Fork Clear Creek near Balko, Okla.	176	484	806	1,381	1,947	2,624	4,760
140	07234100	Clear Creek near Elmwood, Okla.	1,676	4,491	7,351	12,356	17,253	23,062	40,863
141	07234150	White Woman Creek Trib. near Darrouzett, Tex.	172	441	710	1,172	1,614	2,133	3,724
142	07234290	Clear Creek Trib. near Catesby, Okla.	338	893	1,458	2,448	3,414	4,554	8,095
143	07235000	Wolf Creek at Lipscomb, Tex.	2,962	7,904	12,882	21,555	30,015	40,042	70,500
144	07235700	Little Wolf Creek Trib. near Gage, Okla.	469	1,248	2,043	3,435	4,795	6,404	11,388
145	07236000	Wolf Creek near Fargo, Okla.	6,522	16,810	26,878	44,117	60,740	80,261	138,427
146	07237750	Cottonwood Creek near Vici, Okla.	550	1,369	2,170	3,536	4,843	6,362	10,976
147	07237800	Bent Creek near Seiling, Okla.	2,229	5,477	8,586	13,825	18,804	24,573	41,723
148	07239050	North Canadian River Trib. near Eagle City, Okla.	117	281	441	712	969	1,265	2,175
149	07241880	Sand Creek near Cromwell, Okla.	1,094	2,245	3,230	4,777	6,165	7,696	12,049
150	07242160	Alabama Creek near Weleetka, Okla.	1,625	3,273	4,663	6,828	8,758	10,879	16,847
151	07243000	Dry Creek near Kendrick, Okla.	2,704	5,689	8,259	12,312	15,963	20,026	31,480
152	07243500	Deep Fork near Beggs, Okla.	21,439	42,053	58,555	83,592	105,532	129,601	193,855
153	07243550	Adams Creek near Beggs, Okla.	889	1,793	2,561	3,760	4,829	6,004	9,336
154	07244000	Deep Fork near Dewar, Okla.	23,081	44,658	61,725	87,445	109,836	134,344	199,259
155	07244790	Brooken Creek near Enterprise, Okla.	1,106	2,137	2,989	4,297	5,451	6,704	10,213
156	07245500	Sallisaw Creek near Sallisaw, Okla.	8,228	15,645	21,563	30,525	38,386	46,898	69,975
157	07246610	Pecan Creek near Spiro, Okla.	373	714	996	1,429	1,809	2,220	3,382
158	07246630	Big Black Fox Creek near Long, Okla.	1,271	2,424	3,369	4,817	6,094	7,473	11,335
159	07247000	Poteau River at Cauthron, Ark.	11,355	19,969	26,454	35,978	44,125	52,787	75,594

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed]

Site no. (Tortorelli, 1997)	Station no.	Station name	StreamStats: Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
130	07231000	Little River near Sasakwa, Okla.	12,948	25,676	35,999	51,762	65,625	80,866	121,987
131	07231320	Leader Creek Trib. near Atwood, Okla.	291	589	846	1,248	1,609	2,005	3,147
132	07231560	Middle Creek near Carson, Okla.	1,036	2,064	2,929	4,270	5,461	6,766	10,442
133	07231950	Pine Creek near Higgins, Okla.	2,063	3,832	5,248	7,390	9,264	11,274	16,820
134	07232000	Gaines Creek near Krebs, Okla.	12,844	24,008	32,699	45,669	56,862	68,994	101,123
135	07232500	Beaver River near Guymon, Okla.	4,350	12,801	21,875	38,391	55,099	75,421	139,187
136	07232650	Aqua Frio Creek near Felt, Okla.	337	1,032	1,808	3,255	4,736	6,557	12,470
137	07233000	Coldwater Creek near Hardesty, Okla.	3,661	10,335	17,304	29,742	42,113	56,999	102,991
138	07233500	Palo Duro Creek near Spearman, Tex.	2,589	7,312	12,252	21,072	29,831	40,376	73,014
139	07234050	North Fork Clear Creek near Balko, Okla.	177	483	802	1,371	1,930	2,597	4,699
140	07234100	Clear Creek near Elmwood, Okla.	1,534	4,106	6,713	11,270	15,716	20,991	37,125
141	07234150	White Woman Creek Trib. near Darrouzett, Tex.	196	508	823	1,370	1,896	2,516	4,428
142	07234290	Clear Creek Trib. near Catesby, Okla.	337	890	1,454	2,440	3,401	4,537	8,063
143	07235000	Wolf Creek at Lipscomb, Tex.	3,042	8,099	13,178	22,006	30,593	40,771	71,584
144	07235700	Little Wolf Creek Trib. near Gage, Okla.	434	1,157	1,897	3,193	4,457	5,956	10,596
145	07236000	Wolf Creek near Fargo, Okla.	6,439	16,525	26,356	43,137	59,261	78,185	134,367
146	07237750	Cottonwood Creek near Vici, Okla.	538	1,347	2,141	3,499	4,801	6,317	10,932
147	07237800	Bent Creek near Seiling, Okla.	1,926	4,716	7,375	11,842	16,066	20,961	35,455
148	07239050	North Canadian River Trib. near Eagle City, Okla.	114	275	432	698	951	1,242	2,134
149	07241880	Sand Creek near Cromwell, Okla.	1,068	2,180	3,127	4,611	5,938	7,400	11,545
150	07242160	Alabama Creek near Weleetka, Okla.	1,543	3,085	4,378	6,381	8,158	10,109	15,575
151	07243000	Dry Creek near Kendrick, Okla.	2,768	5,829	8,466	12,629	16,383	20,561	32,351
152	07243500	Deep Fork near Beggs, Okla.	21,195	41,486	57,702	82,277	103,785	127,374	190,273
153	07243550	Adams Creek near Beggs, Okla.	882	1,787	2,559	3,766	4,846	6,034	9,409
154	07244000	Deep Fork near Dewar, Okla.	23,000	44,613	61,744	87,591	110,119	134,787	200,207
155	07244790	Brooken Creek near Enterprise, Okla.	1,115	2,151	3,004	4,313	5,465	6,716	10,213
156	07245500	Sallisaw Creek near Sallisaw, Okla.	8,324	15,669	21,486	30,256	37,917	46,197	68,548
157	07246610	Pecan Creek near Spiro, Okla.	386	737	1,028	1,475	1,867	2,291	3,489
158	07246630	Big Black Fox Creek near Long, Okla.	1,221	2,336	3,252	4,655	5,893	7,232	10,978
159	07247000	Poteau River at Cauthron, Ark.	9,100	16,735	22,668	31,519	39,176	47,412	69,403

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed]

Site no. (Tortorelli, 1997)	Station no.	Station name	Tortorelli (1997) Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
160	07247500	Fourche Maline near Red Oak, Okla.	6,137	11,025	14,759	20,265	24,957	29,990	43,303
161	07249000	Poteau River at Poteau, Okla.	22,530	41,543	56,143	77,817	96,507	116,681	169,643
162	07249300	James Fork near Midland, Ark.	4,463	8,450	11,659	16,541	20,846	25,488	38,253
163	07249400	James Fork near Hackett, Ark.	7,172	13,606	18,737	26,499	33,297	40,656	60,610
164	07249500	Cove Creek near Lee Creek, Ark.	4,146	7,654	10,430	14,611	18,263	22,177	32,856
165	07249650	Mountain Fork near Evansville, Ark.	1,842	3,441	4,730	6,690	8,411	10,259	15,388
166	07250000	Lee Creek near Van Buren, Ark.	14,796	27,947	38,348	54,052	67,842	82,739	122,848
169	07299670	Groesbeck Creek at S.H. 6 near Quannah, Tex.	2,923	7,242	11,378	18,347	24,959	32,648	55,384
170	07299705	Bitter Creek near Hollis, Okla.	446	1,157	1,873	3,115	4,322	5,739	10,111
171	07300000	Salt Fork Red River near Wellington, Tex.	5,551	14,635	23,694	39,403	54,724	72,810	127,423
172	07300150	Bear Creek near Vinson, Okla.	338	881	1,429	2,384	3,312	4,404	7,783
173	07300500	Salt Fork Red River at Mangum, Okla.	9,016	22,029	34,311	54,883	74,432	97,045	163,255
174	07301110	Salt Fork Red River near Elmer, Okla.	9,979	24,454	38,131	61,059	82,865	108,110	182,003
175	07301455	Turkey Creek near Erick, Okla.	625	1,564	2,480	4,041	5,531	7,266	12,509
176	07301480	Short Creek near Sayre, Okla.	410	1,041	1,666	2,742	3,775	4,984	8,680
177	07301500	North Fork Red River near Carter, Okla.	11,230	27,313	42,416	67,642	91,572	119,221	199,843
178	07303400	Elm Fork of North Fork Red River near Carl, Okla.	3,749	9,619	15,386	25,282	34,847	46,054	79,737
179	07303450	Deer Creek near Plainview, Okla.	826	2,101	3,361	5,528	7,617	10,059	17,499
180	07303500	Elm Fork of North Fork Red River near Mangum, Okla.	6,781	16,535	25,747	41,176	55,820	72,752	122,425
181	07309480	Canyon Creek near Medicine Park, Okla.	388	897	1,373	2,162	2,900	3,739	6,246
182	07311000	East Cache Creek near Walters, Okla.	8,885	19,103	27,922	41,882	54,535	68,710	108,311
183	07311200	Blue Beaver Creek near Cache, Okla.	1,183	2,741	4,188	6,577	8,811	11,358	18,871
184	07311420	Deadman Creek Trib. at Manitou, Okla.	267	639	995	1,594	2,160	2,810	4,776
185	07311500	Deep Red Creek near Randlett, Okla.	7,352	16,470	24,580	37,657	49,683	63,294	101,960
186	07312850	Nine Mile Beaver Creek near Elgin, Okla.	577	1,309	1,984	3,091	4,118	5,282	8,720
187	07312950	Little Beaver Creek near Marlow, Okla.	1,749	3,827	5,675	8,646	11,368	14,424	23,224
188	07313000	Little Beaver Creek near Duncan, Okla.	3,866	8,428	12,438	18,848	24,696	31,264	49,921
189	07313500	Beaver Creek near Waurika, Okla.	6,875	15,006	22,097	33,381	43,627	55,160	87,528
190	07313600	Cow Creek near Waurika, Okla.	3,536	7,738	11,427	17,312	22,653	28,670	45,680
192	07315680	Cottonwood Creek Trib. near Loco, Okla.	350	750	1,107	1,681	2,203	2,786	4,489

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

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Site no. (Tortorelli, 1997)	Station no.	Station name	StreamStats: Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
160	07247500	Fourche Maline near Red Oak, Okla.	7,102	13,158	17,913	25,045	31,248	37,922	55,905
161	07249000	Poteau River at Poteau, Okla.	22,477	41,017	55,130	75,978	93,866	113,142	163,481
162	07249300	James Fork near Midland, Ark.	4,281	8,222	11,428	16,335	20,684	25,389	38,399
163	07249400	James Fork near Hackett, Ark.	7,529	14,219	19,540	27,582	34,622	42,232	62,853
164	07249500	Cove Creek near Lee Creek, Ark.	4,155	7,622	10,352	14,453	18,025	21,849	32,257
165	07249650	Mountain Fork near Evansville, Ark.	2,084	3,913	5,395	7,656	9,655	11,800	17,780
166	07250000	Lee Creek near Van Buren, Ark.	13,216	25,515	35,389	50,415	63,676	78,090	117,149
169	07299670	Groesbeck Creek at S.H. 6 near Quannah, Tex.	2,952	7,332	11,531	18,612	25,332	33,154	56,286
170	07299705	Bitter Creek near Hollis, Okla.	442	1,144	1,848	3,070	4,254	5,645	9,927
171	07300000	Salt Fork Red River near Wellington, Tex.	5,305	14,001	22,676	37,723	52,392	69,715	122,027
172	07300150	Bear Creek near Vinson, Okla.	331	863	1,399	2,334	3,241	4,308	7,611
173	07300500	Salt Fork Red River at Mangum, Okla.	8,471	20,733	32,315	51,719	70,145	91,476	153,924
174	07301110	Salt Fork Red River near Elmer, Okla.	10,116	24,714	38,460	61,447	83,244	108,472	182,076
175	07301455	Turkey Creek near Erick, Okla.	666	1,663	2,635	4,290	5,868	7,705	13,252
176	07301480	Short Creek near Sayre, Okla.	418	1,060	1,696	2,789	3,840	5,067	8,821
177	07301500	North Fork Red River near Carter, Okla.	11,293	27,324	42,308	67,252	90,832	118,054	197,129
178	07303400	Elm Fork of North Fork Red River near Carl, Okla.	3,690	9,472	15,148	24,883	34,281	45,297	78,363
179	07303450	Deer Creek near Plainview, Okla.	773	1,959	3,126	5,126	7,049	9,294	16,113
180	07303500	Elm Fork of North Fork Red River near Mangum, Okla.	6,397	15,622	24,337	38,928	52,759	68,765	115,678
181	07309480	Canyon Creek near Medicine Park, Okla.	394	907	1,386	2,177	2,917	3,757	6,263
182	07311000	East Cache Creek near Walters, Okla.	8,779	18,730	27,262	40,710	52,842	66,417	104,167
183	07311200	Blue Beaver Creek near Cache, Okla.	1,164	2,706	4,140	6,510	8,728	11,258	18,729
184	07311420	Deadman Creek Trib. at Manitou, Okla.	254	603	936	1,493	2,016	2,617	4,425
185	07311500	Deep Red Creek near Randlett, Okla.	6,893	15,342	22,815	34,815	45,797	58,216	93,342
186	07312850	Nine Mile Beaver Creek near Elgin, Okla.	579	1,312	1,986	3,090	4,114	5,274	8,696
187	07312950	Little Beaver Creek near Marlow, Okla.	1,747	3,804	5,626	8,551	11,223	14,221	22,836
188	07313000	Little Beaver Creek near Duncan, Okla.	3,720	8,056	11,846	17,881	23,363	29,514	46,917
189	07313500	Beaver Creek near Waurika, Okla.	6,543	14,312	21,094	31,889	41,683	52,720	83,684
190	07313600	Cow Creek near Waurika, Okla.	3,498	7,759	11,540	17,613	23,159	29,425	47,250
192	07315680	Cottonwood Creek Trib. near Loco, Okla.	361	777	1,149	1,747	2,294	2,904	4,690

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Site no. (Tortorelli, 1997)	Station no.	Station name	Tortorelli (1997) Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
193	07315700	Mud Creek near Courtney, Okla.	8,437	17,903	26,002	38,754	50,259	63,105	98,851
194	07315880	Demijohn Creek near Wilson, Okla.	728	1,553	2,280	3,443	4,500	5,679	9,088
195	07316130	Wilson Creek near McMilllian, Okla.	575	1,185	1,713	2,546	3,296	4,124	6,503
196	07316140	Brier Creek near Powell, Okla.	1,206	2,402	3,403	4,951	6,318	7,819	12,019
197	07316500	Washita River near Cheyenne, Okla.	5,321	13,419	21,246	34,539	47,273	62,137	106,242
198	07317500	Sandstone Creek SWS 16A near Cheyenne, Okla.	336	849	1,358	2,236	3,082	4,068	7,101
199	07318500	Sandstone Creek SWS 14 near Cheyenne, Okla.	146	373	601	997	1,381	1,830	3,232
200	07319000	Sandstone Creek SWS 17 near Cheyenne, Okla.	502	1,269	2,027	3,332	4,590	6,058	10,551
201	07320000	Sandstone Creek SWS 10A near Elk City, Okla.	246	616	981	1,606	2,206	2,904	5,047
202	07321500	Sandstone Creek SWS 3 near Elk City, Okla.	104	260	417	687	947	1,250	2,191
203	07322000	Sandstone Creek SWS 9 near Elk City, Okla.	283	710	1,132	1,858	2,556	3,369	5,869
204	07324000	Sandstone Creek SWS 1 near Cheyenne, Okla.	360	903	1,439	2,358	3,242	4,271	7,424
205	07325000	Washita River near Clinton, Okla.	13,504	30,653	45,960	70,719	93,585	119,562	193,126
206	07325850	Lake Creek near Eakly, Okla.	1,723	3,968	6,033	9,422	12,577	16,169	26,670
207	07326000	Cobb Creek near Fort Cobb, Okla.	4,444	10,112	15,223	23,525	31,186	39,896	64,863
208	07327150	Salt Creek near Chickasha, Okla.	1,196	2,641	3,937	6,026	7,939	10,094	16,321
209	07327420	West Bitter Creek near Tabler, Okla.	2,024	4,466	6,641	10,141	13,341	16,948	27,294
210	07327440	East Bitter Creek near Tabler, Okla.	1,585	3,488	5,185	7,918	10,419	13,234	21,340
211	07327490	Little Washita River near Ninnekah, Okla.	3,966	8,678	12,818	19,430	25,445	32,217	51,383
212	07329000	Rush Creek at Purdy, Okla.	4,310	9,002	13,003	19,283	24,929	31,202	48,748
213	07329500	Rush Creek near Maysville, Okla.	5,343	11,081	15,939	23,537	30,348	37,903	58,922
214	07329810	Honey Creek near Davis, Okla.	1,708	3,569	5,180	7,733	10,048	12,611	19,933
215	07329900	Rock Creek near Dougherty, Okla.	5,085	10,519	15,134	22,370	28,891	36,103	56,299
216	07330500	Caddo Creek near Ardmore, Okla.	6,669	13,805	19,827	29,229	37,654	46,995	72,900
217	07332070	Rock Creek near Achille, Okla.	266	529	751	1,097	1,403	1,738	2,695
218	07332400	Blue River at Milburn, Okla.	7,239	14,253	19,984	28,773	36,551	45,055	68,343
219	07332500	Blue Creek near Blue, Okla.	11,573	22,237	30,738	43,600	54,848	67,096	100,027
220	07333500	Chickasaw Creek near Stringtown, Okla.	2,742	5,376	7,548	10,888	13,846	17,071	26,025
221	07333800	McGee Creek near Stringtown, Okla.	4,872	9,121	12,481	17,532	21,912	26,647	39,431
222	07334000	Muddy Boggy Creek near Farris, Okla.	18,644	35,270	48,291	67,815	84,774	103,193	152,039

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			PK2	PK5	PK10	PK25	PK50	PK100	PK500
193	07315700	Mud Creek near Courtney, Okla.	7,700	16,268	23,562	35,004	45,269	56,735	88,492
194	07315880	Demijohn Creek near Wilson, Okla.	733	1,558	2,283	3,438	4,485	5,651	9,012
195	07316130	Wilson Creek near McMilllian, Okla.	555	1,147	1,660	2,470	3,199	4,005	6,323
196	07316140	Brier Creek near Powell, Okla.	1,341	2,692	3,830	5,600	7,176	8,906	13,777
197	07316500	Washita River near Cheyenne, Okla.	5,011	12,613	19,949	32,390	44,283	58,164	99,288
198	07317500	Sandstone Creek SWS 16A near Cheyenne, Okla.	471	1,190	1,903	3,126	4,305	5,680	9,889
199	07318500	Sandstone Creek SWS 14 near Cheyenne, Okla.	139	354	570	944	1,307	1,730	3,050
200	07319000	Sandstone Creek SWS 17 near Cheyenne, Okla.	530	1,338	2,137	3,509	4,832	6,373	11,091
201	07320000	Sandstone Creek SWS 10A near Elk City, Okla.	249	627	1,001	1,646	2,267	2,991	5,221
202	07321500	Sandstone Creek SWS 3 near Elk City, Okla.	109	275	440	725	1,000	1,320	2,317
203	07322000	Sandstone Creek SWS 9 near Elk City, Okla.	274	684	1,090	1,784	2,451	3,226	5,606
204	07324000	Sandstone Creek SWS 1 near Cheyenne, Okla.	356	884	1,403	2,289	3,136	4,121	7,126
205	07325000	Washita River near Clinton, Okla.	13,699	30,962	46,324	71,128	94,008	119,969	193,384
206	07325850	Lake Creek near Eakly, Okla.	1,666	3,812	5,776	8,988	11,966	15,352	25,215
207	07326000	Cobb Creek near Fort Cobb, Okla.	4,322	9,833	14,803	22,871	30,312	38,772	63,013
208	07327150	Salt Creek near Chickasha, Okla.	1,155	2,549	3,795	5,803	7,637	9,704	15,667
209	07327420	West Bitter Creek near Tabler, Okla.	1,967	4,335	6,441	9,827	12,919	16,404	26,390
210	07327440	East Bitter Creek near Tabler, Okla.	1,505	3,295	4,883	7,432	9,755	12,368	19,865
211	07327490	Little Washita River near Ninnekah, Okla.	4,162	9,110	13,462	20,420	26,761	33,897	54,124
212	07329000	Rush Creek at Purdy, Okla.	4,001	8,430	12,230	18,217	23,611	29,619	46,475
213	07329500	Rush Creek near Maysville, Okla.	5,153	10,729	15,464	22,879	29,532	36,921	57,506
214	07329810	Honey Creek near Davis, Okla.	1,717	3,553	5,132	7,619	9,865	12,347	19,406
215	07329900	Rock Creek near Dougherty, Okla.	4,961	10,095	14,398	21,090	27,070	33,663	51,974
216	07330500	Caddo Creek near Ardmore, Okla.	6,189	12,783	18,331	26,973	34,688	43,246	66,910
217	07332070	Rock Creek near Achille, Okla.	256	504	714	1,038	1,324	1,637	2,528
218	07332400	Blue River at Milburn, Okla.	7,037	13,794	19,292	27,702	35,121	43,229	65,368
219	07332500	Blue Creek near Blue, Okla.	11,843	22,822	31,596	44,894	56,548	69,241	103,434
220	07333500	Chickasaw Creek near Stringtown, Okla.	2,696	5,317	7,486	10,832	13,800	17,041	26,061
221	07333800	McGee Creek near Stringtown, Okla.	4,783	8,885	12,107	16,927	21,088	25,581	37,657
222	07334000	Muddy Boggy Creek near Farris, Okla.	18,018	34,085	46,662	65,506	81,853	99,617	146,679

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed]

Site no. (Tortorelli, 1997)	Station no.	Station name	Tortorelli (1997)						
			Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
223	07335000	Clear Boggy Creek near Caney, Okla.	15,032	28,914	39,965	56,686	71,332	87,281	130,074
224	07335300	Muddy Boggy Creek near Unger, Okla.	28,228	52,623	71,410	99,341	123,438	149,556	217,909
225	07335310	Rock Creek near Boswell, Okla.	336	642	894	1,281	1,618	1,983	3,011
226	07335320	Bokchito Creek near Soper, Okla.	1,605	2,975	4,059	5,680	7,069	8,572	12,643
227	07335700	Kiamichi River near Big Cedar, Okla.	6,081	10,738	14,315	19,626	24,230	29,100	42,230
228	07335760	Kiamichi River Trib. near Albion, Okla.	821	1,534	2,117	3,010	3,799	4,643	7,029
229	07336500	Kiamichi River near Belzoni, Okla.	24,253	44,492	59,952	82,842	102,531	123,768	179,315
230	07336520	Frazier Creek near Oleta, Okla.	2,933	5,503	7,571	10,712	13,475	16,445	24,644
231	07336710	Rock Creek near Sawyer, Okla.	871	1,642	2,268	3,221	4,053	4,950	7,451
232	07336750	Little Pine Creek near Kanawha, Tex.	4,529	8,307	11,249	15,632	19,398	23,453	34,315
233	07336780	Perry Creek near Idabel, Okla.	1,516	2,808	3,840	5,398	6,754	8,210	12,221
234	07336785	Bokchito Creek near Garvin, Okla.	829	1,530	2,092	2,938	3,672	4,459	6,637
235	07336800	Pecan Bayou near Clarksville, Tex.	5,139	9,417	12,737	17,674	21,909	26,471	38,646
236	07337220	Big Branch near Ringold, Okla.	832	1,539	2,109	2,976	3,733	4,545	6,811
237	07337500	Little River near Wright City, Okla.	18,624	33,952	45,701	63,138	78,204	94,378	137,062
238	07337900	Glover River near Glover, Okla.	14,666	26,374	35,319	48,577	60,037	72,272	104,699
239	07338500	Little River below Lukfata Creek near Idabel, Okla.	25,682	46,736	62,771	86,497	106,948	128,922	186,483
240	07338520	Yanubbee Creek near Broken Bow, Okla.	2,124	3,884	5,282	7,388	9,227	11,190	16,595
241	07338700	Twomile Creek near Hatfield, Ark.	3,408	5,981	7,958	10,888	13,415	16,085	23,307
242	07338780	Mountain Fork Trib. near Smithville, Okla.	529	937	1,260	1,742	2,158	2,597	3,820
243	07339000	Mountain Fork near Eagletown, Okla.	22,890	40,720	54,122	73,823	90,723	108,765	155,882
244	07339500	Rolling Fork near DeQueen, Ark.	11,902	21,061	28,009	38,266	47,104	56,492	81,382
245	07339800	Pepper Creek near DeQueen, Ark.	1,816	3,225	4,323	5,957	7,368	8,863	12,948
246	07340200	West Flat Creek near Foreman, Ark.	1,779	3,177	4,261	5,869	7,243	8,709	12,672
247	07340300	Cossatot River near Vandervoort, Ark.	9,412	16,293	21,466	29,066	35,595	42,481	60,753
248	07340500	Cossatot River near DeQueen, Ark.	18,017	31,653	41,893	56,949	69,899	83,637	119,760
249	07340530	Mill Slough Trib. near Locksburg, Ark.	439	788	1,065	1,481	1,839	2,221	3,282
250	07341000	Saline River near Dierks, Ark.	9,980	17,487	23,159	31,512	38,693	46,299	66,475

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

[Ark., Arkansas; Kans., Kansas; Mo., Missouri; N. Mex., New Mexico; Okla., Oklahoma; Tex., Texas; Trib., Tributary; S.H., State Highway; SWS, Subwatershed]

Site no. (Tortorelli, 1997)	Station no.	Station name	StreamStats: Estimated rural, unregulated peak-flow statistic (PKx), in cubic feet per second, for recurrence interval in years (x)						
			PK2	PK5	PK10	PK25	PK50	PK100	PK500
223	07335000	Clear Boggy Creek near Caney, Okla.	13,370	25,569	35,219	49,750	62,390	76,161	112,899
224	07335300	Muddy Boggy Creek near Unger, Okla.	28,599	53,251	72,223	100,422	124,751	151,110	220,086
225	07335310	Rock Creek near Boswell, Okla.	371	714	999	1,436	1,820	2,237	3,414
226	07335320	Bokchito Creek near Soper, Okla.	2,025	3,815	5,253	7,428	9,322	11,370	16,987
227	07335700	Kiamichi River near Big Cedar, Okla.	6,547	11,315	14,922	20,237	24,818	29,636	42,538
228	07335760	Kiamichi River Trib. near Albion, Okla.	938	1,744	2,401	3,405	4,295	5,244	7,927
229	07336500	Kiamichi River near Belzoni, Okla.	24,995	45,707	61,498	84,858	104,950	126,597	183,186
230	07336520	Frazier Creek near Oleta, Okla.	2,531	4,683	6,393	8,968	11,207	13,613	20,193
231	07336710	Rock Creek near Sawyer, Okla.	887	1,657	2,280	3,224	4,046	4,931	7,389
232	07336750	Little Pine Creek near Kanawha, Tex.	4,614	8,384	11,298	15,622	19,323	23,301	33,915
233	07336780	Perry Creek near Idabel, Okla.	1,478	2,711	3,689	5,158	6,429	7,793	11,531
234	07336785	Bokchito Creek near Garvin, Okla.	815	1,494	2,035	2,848	3,549	4,302	6,378
235	07336800	Pecan Bayou near Clarksville, Tex.	5,017	9,200	12,448	17,277	21,418	25,881	37,789
236	07337220	Big Branch near Ringold, Okla.	837	1,534	2,092	2,937	3,672	4,458	6,646
237	07337500	Little River near Wright City, Okla.	21,030	37,829	50,594	69,469	85,757	103,168	148,984
238	07337900	Glover River near Glover, Okla.	15,008	26,838	35,838	49,147	60,629	72,871	105,246
239	07338500	Little River below Lukfata Creek near Idabel, Okla.	27,354	49,342	65,985	90,544	111,682	134,336	193,535
240	07338520	Yanubbee Creek near Broken Bow, Okla.	2,023	3,654	4,937	6,858	8,522	10,296	15,151
241	07338700	Twomile Creek near Hatfield, Ark.	3,288	5,792	7,720	10,581	13,047	15,658	22,721
242	07338780	Mountain Fork Trib. near Smithville, Okla.	498	877	1,175	1,620	2,001	2,405	3,523
243	07339000	Mountain Fork near Eagletown, Okla.	23,779	42,096	55,817	75,953	93,210	111,608	159,581
244	07339500	Rolling Fork near DeQueen, Ark.	11,936	21,067	27,979	38,172	46,944	56,258	80,920
245	07339800	Pepper Creek near DeQueen, Ark.	1,757	3,114	4,168	5,737	7,088	8,520	12,426
246	07340200	West Flat Creek near Foreman, Ark.	1,775	3,155	4,221	5,797	7,141	8,575	12,440
247	07340300	Cossatot River near Vandervoort, Ark.	9,730	16,671	21,848	29,427	35,919	42,747	60,806
248	07340500	Cossatot River near DeQueen, Ark.	18,183	31,890	42,171	57,278	70,265	84,037	120,227
249	07340530	Mill Slough Trib. near Locksburg, Ark.	465	828	1,116	1,547	1,918	2,311	3,404
250	07341000	Saline River near Dierks, Ark.	10,239	17,798	23,476	31,816	38,969	46,530	66,533

Appendix 2. Peak-flow frequency statistics estimated by using basin characteristics from Tortorelli (1997) and StreamStats. The peak-flow statistics computed by using Tortorelli (1997) basin characteristics will not match those reported in Tortorelli (1997). The peak-flows reported in Tortorelli (1997) were computed from gaged data.—Continued

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Summary of comparison of statistics computed by Tortorelli (1997) and StreamStats	PK2	PK5	PK10	PK25	PK50	PK100	PK500
Number of statistics that are greater:							
using Tortorelli (1997) basin characteristics	124	131	133	136	138	139	140
using StreamStats basin characteristics	84	77	75	72	70	69	68
Average relative percent difference:							
of statistics that are greater in Tortorelli (1997)	5.32	5.23	5.30	5.35	5.41	5.48	5.67
of statistics that are greater in StreamStats	5.02	5.32	5.42	5.64	5.82	5.92	6.05