

A Partial Summary of 2007 USGS Activities Related to the FHWA and State Highway Agencies

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Introduction

Part of the mission of the U.S. Geological Survey (USGS) is to assess the quantity, quality, and trends of the Nation's water resources, to advance the understanding of natural processes related to these resources, and to provide information that will assist resource managers and policymakers in making sound decisions. The USGS has a long history of jointly funded investigations with the Federal Highway Administration (FHWA) and State highway agencies to provide data and information to address various issues related to water resources and the Nation's transportation infrastructure. These issues cover a wide spectrum and include items such as regional flow statistics, flood documentation, regional stream characteristics, bridge scour, and water-quality assessments.

The following table and text provides a partial summary of current or recently completed USGS activities related to highway issues. Table 1 organizes the current and recent activities into categories and subcategories and gives a quick overview of the USGS programs and the State and (or) Federal agencies that are helping sponsor the programs. The text following table 1 provides more detailed information on the various activities. The text initially describes activities that have been, or are being conducted on a national level and is followed by state activities listed alphabetically by State. If you should have questions regarding this information, please contact Charles Berenbrock (ceberenb@usgs.gov).

Table 1. Partial summary of USGS activities related to the FHWA and State Highway Agencies

Project Type	Sponsoring Agencies/States
Regional Flow Frequency/Statistics Investigations	
- National Flood Frequency Program	USGS
- StreamStats Program/automated basin characteristics	AZ, CT, CO, DE, IL, ID, IN, KS, KY, MD, MN, MS, NJ, NM, NY, OH, OK, OR, PA, RI, SD, TN, UT, VT, WA, WI
- Investigation of rural flow-frequency	AL, AZ, DE, FL, HI, IL, IA, KS, MA, MS, NC, NM, NY, OK, OR, PA, SC, SD, TN, UT, VA, WI, WV
- Investigation of urban flow-frequency	KS
- Investigation of small watershed flow-frequency	IA, KS, ME, TX, VA
- Investigation of hydrograph timing, rainfall hyetographs, and rainfall-duration-frequency maps	TX
Bridge Scour and Sediment Transport	
- National Bridge Scour Project	
- Scour at Contracted Bridge Sites	NCHRP
- Near real time scour monitoring	AK, GA
- Data collection and analysis	AK, AL, ME, MS, MT, SC, FHWA
- Investigation of Scour in cohesive soils using the EFA	IL, SC
- Channel stability and scour assessment	AK, AZ, MO, MT, SD
- Investigation/modeling of sediment transport	TN, TX
- Investigation of bio-engineered bank protection and A-jacks scour countermeasures	OR, UT
Hydrologic and Hydraulic River Investigations	
- Investigation of bridge site hydrology and hydraulics	AL, GA, MN, MS, MO, NY, NC
- Investigation and modeling of multi-dimensional flows	NC, PA
- Flood documentation	DE, IA, MS, NV, NY, PA
Stream Characteristic Investigations	
- Regional channel characteristics/bankfull discharge	NY, OH, WV, PA, VA
- Investigation of Manning's roughness coefficients	AZ
Gages	
- Tidal gages	DE, NJ
- Crest stage gages to estimate annual peak flows	AK, GA, HI, IA, KS, LA, ME, MI, MN, MS, MO, MT, NV, NJ, NM, NY, ND, OH, SC, SD, TN, VT, VA, WV, WI
- Continuous-record discharge and stage gages	AK, FL, HI, IN, IA, LA, ME, MD, MI, MN, MS, MO, MT, NH, ND, PA, SC, TN, VT, WV
- Real time monitoring network on hurricane evacuation routes; monitors stage, rain, wind, and traffic count	LA
Water Quality/Environmental Investigations	
- Evaluation of Stormwater Runoff Models	FHWA, MA
- Monitor water quality/quantity at selected sites	HI, MA, MN, MT, NV, TN, VT, WI
- Investigation of wetland impact/remediation	DE, MT, PA
- Investigation of stream restoration	MD
- Investigation of the impact of deicing chemicals	VT
- Investigation of habit impact by bridge pier	PA
- Investigation of BMP	SC, WI
- Investigation of potential impacts of highway construction to the GW aquifer	AR

Partial Summary of USGS National Activities

Scour at Contracted Bridge Sites (NCHRP and University of Louisville)

The objective of NCHRP Project 24-14 was to collect field data from which processes affecting scour magnitude in contracted bridge openings could be identified, to support verification of physical and numerical model studies, and to improve guidelines for applying scour-prediction methods at contracted bridge sites. Detailed data were collected at 15 bridge sites and predicted scour based on one- and two-dimensional flow models were compared to measured scour. Results of this investigation are documented in report cited below and will be posted as an NCHRP web document in January 2006:

Wagner, C.R., Mueller, D.S., Parola, A. C., Hagerty, D. J., and S.T. Benedict, 2006, NCHRP Project 24-14 Scour at Contracted Bridges: Transportation Research Board, National Research Council, Washington D.C. [p. 288]. On-line at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w83.pdf

National Streamflow Information Program (NSIP)

NSIP—a USGS network effort to identify and fund only with Federal dollars those long-term streamgages that address Federal interests and to upgrade streamgaging technology—faired well in the 2008 budget. Congress increased NSIP appropriations by \$3.5M, or about 21%. The increase will be used to expand the network, speed implementation of StreamStats, and help pilot a hazards warning system for flood and debris flows and maintain a mobile storm-surge network for the Gulf Coast. The NSIP program description and list of proposed NSIP streamgages is on-line at <http://water.usgs.gov/nsip/>.

The National Water-Quality Monitoring Network

Another network effort is now taking form in response to recommendations of the Presidents Commission on Ocean Policy and the President's Ocean Action Plan. This is a coordinated effort led by the National Ocean and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), and the USGS working through the National Water Quality Monitoring Council (NWQMC) to develop an integrated system of long-term streamgages, water-quality and ecological monitoring sites with standardized monitoring techniques, parameters, and data-dissemination portals. The network will link elements of Federal, State, and local monitoring networks to reduce duplication and strengthen coverage. The network design will focus on water and ecological issues affecting coastal waters and ocean environments. Pilot projects are anticipated in FY2008. The NWQMC report describing the network is available at <http://acwi.gov/monitoring/network/index.html>.

Flood-Frequency Analysis Using Bulletin 17B Guidelines

Flood-frequency analysis provides information about the magnitude and frequency of selected flood discharges. Bulletin 17B of the Hydrology Subcommittee of the Interagency Advisory Committee on Water Data (1982) defines procedures recommended to provide a consistent approach for determining flood-flow frequency from peak-flow records. The procedures include methods for improving skew estimates using regional skew information, tests for high and low outliers, adjustments for low outliers and zero flows, and methods for incorporating historic peak-flow information. The Peak flow FreQuency analysis program (PeakFQ) implements the Bulletin 17B recommended procedures for flood-frequency analysis of streamflow records. The program has been updated and now provides an interactive Windows interface to PeakFQ. Also the program can be run from a batch-style processing on DOS, UNIX and Linux operating systems. The PeakFQ program is available at <http://water.usgs.gov/software/peakfq.html> and documentation is available at <http://pubs.usgs.gov/tm/2006/tm4b4/>. PeakFQ is being currently modified to include the Expected Moments Algorithm (EMA). EMA is a highly efficient approach for capturing the information contained in historical flood data, particularly paleoflood data. EMA provides a way to incorporate historical information, paleoflood information, truncated data sets, censored data, low and (or) high outliers, and zero flows into flood-frequency analysis.

National Streamflow Statistics

The National Streamflow Statistics (NSS) Program is a Microsoft Windows-based computer program¹ written in Visual Basic programming language that has been created by the USGS to provide an easily accessible graphical user interface (GUI) to estimate high and low streamflow statistics for ungaged sites across the United States. NSS is a replacement for the National Flood Frequency (NFF) Program. The name change from NFF to NSS is the direct result of enhancements to the program, which now provides estimates for low-flow duration/frequency in addition to flood-frequency estimates such as the 100-year flood.

The NSS program has four components—a GUI, an equation calculation routine, a database, and a help feature. The GUI allows users to control the operation of the software and present results. The equation calculation routine computes streamflow statistics using basin and climatic characteristics entered by the user and provides tabling and graphing capabilities that graph frequency and hydrographs. The database contains all the information needed, such as the regression coefficients and standard errors, to solve more than 3,000 regression equations. The help facility contains the NSS Program User's manual, a link to the NSS program Web page, and version information.

Regression equations for estimating flood-frequency statistics of peak flows for rural and naturally flowing rivers are available for all 50 U.S. States including the Commonwealth of Puerto Rico and the island of Tutuila, American Samoa. Regression equations for estimating flood-frequency statistics of peak flows for urban streams are available in NSS for 20 U.S. States. Regression equations for estimating low-flow duration and (or) frequency are also currently available in NSS for 23 U.S. States. All equations contained in NSS were reviewed by USGS and were generally prepared in cooperation with state and local transportation, environmental, and/or water resource management agencies in each state.

The NSS program and documentation can be downloaded from the Internet at <http://water.usgs.gov/software/nss.html>. A fact sheet that describes the NSS program was published in 2007 and can be downloaded at <http://pubs.usgs.gov/fs/2007/3010/>. If you should have questions regarding this information, please contact D. Phil Turnipseed (pturnip@usgs.gov)

StreamStats Program

StreamStats (<http://water.usgs.gov/osw/streamstats/>) is a Geographic Information Systems-based Web application that was developed by the U.S. Geological Survey (USGS) specifically the Office of Surface Water (OSW) that greatly reduces the time needed for users to obtain streamflow statistics, basin characteristics, and other information for USGS data-collection stations and for ungaged sites. This information is needed for use by engineers, land and water-resource managers, biologists, and many others to help guide decisions in their everyday work. Users can select data-collection station locations shown on a map interface in a Web browser window to obtain previously published information for the stations. Users can also select any location along a stream to obtain the drainage-basin boundary, basin and climatic characteristics, and estimated streamflow statistics for that location. The estimates for ungaged sites are determined from USGS regional regression equations and usually can be obtained in only a few minutes.

As of October, 2007, StreamStats was available to the public in 12 states, Washington, Oregon, Idaho, Colorado, Tennessee, Ohio, Pennsylvania, Maryland, Delaware, Connecticut, Massachusetts, and Vermont. The application also was implemented and undergoing quality assurance in preparation for public release in California, Illinois, Indiana, and Kentucky. Plans for fiscal year 2008 include implementing New York, New Jersey, Minnesota, North Carolina, Rhode Island, Hawaii, Mississippi, South Dakota, New Hampshire, and Iowa.

A new version of StreamStats is planned for release in early 2008 that will provide several enhancements over the currently available version. Major enhancements will allow users to (1) navigate the stream network to locate upstream or downstream streamgaging stations, dams, point discharges and other water-related features and get information about those features, (2) estimate flows at ungaged sites based on the flows at nearby streamgaging stations, and (3) access StreamStats functionality from other Web or desktop GIS applications remotely by use of Web services.

Evaluation and Update of the Federal Highway Administration (FHWA) Pollutant Loadings Model for Highway Stormwater Runoff

Valid, current, and technically defensible stormwater runoff models are needed to (1) interpret data collected by field studies, (2) support existing highway and urban runoff planning processes, (3) meet National Pollutant Discharge Elimination System (NPDES) requirements, and (4) provide methods for calculation of Total Maximum Daily Loads (TMDLs) in a systematic and economic manner. The FHWA formulated a model to predict pollutant loadings and impacts from highway stormwater runoff in 1990. Unfortunately, the 1990 FHWA model has several limitations that affect the use of the model; defensibility and representativeness of model results, and documentation of model results. The 1990 FHWA model was written for the DOS operating system, and does not always work on more recent (Windows 2000/XP) operating systems. The model was based on data collected from the mid 1970's through the mid 1980's. Changes in materials used to build roads and vehicles, the advent of vehicular emission controls, and changes in the formulation of fuels and lubricants have substantially changed the composition of runoff in the last 20 years. Research also indicates that water-quality monitoring methods may substantially effect measurements of concentrations, flows, and the resultant calculation of runoff loads.

The 1990 FHWA model was framed as a dilution model with the assumption that background concentrations were zero. This approach was chosen to examine the effects of highway runoff on receiving waters and to highlight the potential effects of best management practices (BMPs) on receiving waters. Currently (2006), however, regulators and decision makers will not accept a model with a background concentration of zero, and regulators are focusing on concentrations at low-flows such as the 7Q10 or 4B3, which are included in state and federal water-quality standards. This study will evaluate the 1990 FHWA model and update the model using new information and data. More specifically, the study will implement a Monte Carlo model in a new software platform as a prototype for a new national model, update the existing model with more recent streamflow and water-quality information, and expand the model to address regulatory concerns. This model will provide a "best estimate" (mean or median) and confidence intervals for expected EMCs. The model also will utilize this EMC estimate and estimates of precipitation, and runoff coefficients to produce a population of estimates for loads based on the location and site characteristics of highway sites of interest.

Standard tools and techniques for obtaining and processing information and data about highway runoff quality and quantity and the quality and quantity of upstream flow in the receiving waters were needed to support this new national FHWA model. The USGS in cooperation with the FHWA has developed and tested a highway runoff database as well as computer applications that can be used to automatically download and process water-quality and streamflow data from the USGS National Water Information System (NWIS) Web. The following is a brief summary of each product and its current status:

- **Highway-Runoff Database (HRDB v. 1.0): A Data Warehouse and Preprocessor for the Stochastic Empirical Loading and Dilution Model.**

Status: In Second Stage of Technical Review

The highway-runoff database application was developed to serve as a data warehouse for highway-runoff data-sets that can be used to facilitate estimation of statistical properties of runoff coefficients, runoff-quality statistics, and relations between water-quality variables in highway runoff. This highway runoff database currently includes over 39,000 event mean concentration values from analysis of more than 100 different water-quality constituents. These EMC values were collected at 100 highway-runoff monitoring sites in the conterminous United States during more than 2,600 storm

events as documented in 6 highway-runoff quality data sets. The user may select and export water-quality data in tab-delimited or comma-delimited format. The user may generate water-quality statistics for data with censored values by use of the robust Regression on Order Statistics (ROS) method. The user may export paired water-quality data in a format suitable for regression analysis. Finally, the user may export precipitation, runoff flow, and runoff coefficient data in tab-delimited format. In each case the user may select data from different sites and different data sets based on highway-runoff monitoring site characteristics.

- **Kendall-Theil Robust Line (KTRLLine--version 1.0)--A Visual Basic Program for Calculating and Graphing Robust-Nonparametric Estimates of Linear-Regression Coefficients Between Two Continuous-Variables.**

Status: Report Published

The Kendall-Theil robust line program was developed because this nonparametric method is resistant to the effects of outliers and nonnormality in residuals that commonly characterize water-quality data sets. A single-segment model or a multi-segment model may be specified. The program was developed to provide regression equations with an error component for stochastic data generation because nonparametric multi-segment regression tools are not available with the software that is commonly used to develop regression models. The report is available from <http://pubs.usgs.gov/tm/2006/tm4a7/>. Also a Visual Basic Program for calculating and graphing robust nonparametric estimates of linear-regression coefficients between two continuous variables is available from the report's Web site.

- **Methods for Compilation and Interpretation of Data for Development of Transport Curves for Planning-Level Estimates of Water-Quality at Unmonitored Sites in the Conterminous United States.**

Status: In Second Stage of Technical Review

This report documents methods for data compilation and analysis of water-quality-transport curves that meet data-quality-objectives for planning-level estimates of stream water-quality at unmonitored sites in the 84 U.S. EPA ecoregions in the conterminous U.S. Transport curves are regression relations used to estimate constituent concentrations from measured or estimated water discharge values. This national synthesis effort was based on data available on the USGS National Water Information System (NWIS) Web. A total of 24,581 surface-water-quality monitoring stations with drainage areas ranging from 0.002 to 1,040 square miles were identified throughout the conterminous U.S. and cataloged for retrieval of water-quality data. A total of 252 regional transport curves were developed for suspended sediment, total phosphorus, and total hardness. Four computer applications were developed to download, process, and build a database of about 1.2 million paired streamflow and water quality measurements for 14 water-quality constituents commonly measured in runoff studies. The user may utilize the regional regression models, or develop their own regional, local, or site-specific estimates with these data and methods.

- **Methods for Compilation and Interpretation of Data for Development of Transport Curves for Planning-Level Estimates of Streamflow at Unmonitored Sites in the Conterminous United States.**

Status: In Preparation

This report documents methods for data compilation and analysis of streamflow statistics that meet data-quality-objectives for planning-level estimates of streamflow at unmonitored sites in the 84 U.S. EPA ecoregions in the conterminous United States. This national synthesis effort was based on data available on the USGS National Water Information System (NWIS) Web. Streamflow statistics are

available in a database for 2,783 USGS streamflow-gaging stations within the conterminous United States that were selected because they have at least 24 years of daily discharge records during the period 1961-2004 and drainage areas ranging from 10-500 square miles. The streamflow statistics were calculated using standard methods. Four computer applications were developed to download, process, and build a database of summary statistics for USGS streamflow-gaging stations that may be used to estimate a population of streamflows by ecoregion or by using selected gaging stations. The user may choose regional statistics, or develop their own regional, local, or site-specific estimates with these data and methods.

- **Stochastic Empirical Loading and Dilution Model.**

Status: In Preparation

The stochastic empirical loading and dilution model is designed to use Monte Carlo methods to provide information on the probability distributions of: (1) precipitation characteristics, (2) highway-runoff volumes, (3) highway-runoff concentrations, (4) upstream flow, (5) upstream receiving-water concentrations, and (6) structural best management practice performance. This information will be used to: estimate the probability distributions of (7) concentrations and (8) loads in receiving waters downstream of the highway outfall. These estimates will provide the information necessary to estimate the probability of exceeding a water-quality standard. The stochastic empirical loading and dilution model is designed as a database application that will facilitate generation of local or regional planning-level estimates based on site-specific characteristics.

- **FHWA/USGS NDAMS web page (<http://ma.water.usgs.gov/fhwa/>)**

Status: On-line and active.

We have maintained the FHWA/USGS NDAMS web page (which receives about 130,000 visits per year) since 1996. In 2005 the Stochastic Empirical Loading and Dilution Model WEB page was developed. The Web page posts the 1990 FHWA model, documentation (which was scanned into PDF format), and data on-line.

Partial Summary of USGS Water Science Center Activities Supported by State Highway Agencies

Alabama

- Continuation of hydrologic and hydraulic analyses and data collection at various bridge sites.
- Currently updating the statewide flood-frequency equations for the Alabama DOT. This is an update of the 1985 Alabama flood depth frequency study.
- Currently updating the stateside urban flood-frequency equations. This is an update of the 1982 urban flood frequency study.
- **Recent publications**
Hedgecock, T.S., 2004, Magnitude and frequency of floods on small rural streams in Alabama: U.S. Geological Survey Scientific Investigations Report 2004 – 5135, 10 p.
(<http://pubs.usgs.gov/sir/2004/5135>)
Clear-water Contraction Scour at Selected Bridge Sites in the Black Prairie Belt of the Coastal Plain in Alabama, 2006, by K.G. Lee and T.S. Hedgecock - in this study we documented observed scour at the 25 sites having the worst (deepest) scour in the overbank portion of the bridge for this particular soil region. We developed envelop curves for clear-water contraction scour from this data and the hydraulic properties computed for the sites.

Alaska

A program with Alaska Department of Transportation and Public Facilities (ADOT&PF) that focuses on streambed scour monitoring and modeling had these accomplishments in 2007:

- Collected streambed scour data in response to 100+ year recurrence interval flooding in October 2006. Scour website was successfully utilized to monitor stage and bed elevation during flooding and to direct field personnel to areas of flooding. Auxiliary flood-data during this flooding in the Prince William Sound area was collected in cooperation with ADOT&PF. Two major highway bridges, dozens of local roads were damaged from Seward to Valdez.
- Monitored near real time pier scour at 18 sites around Alaska with pier-mounted sonars.
- Surveyed channel crossings at 44 scour-critical bridges.
- **Recent Publications**
Conaway, J.S., 2006, Comparison of Long-Term Streambed Scour Data with Modeled Values at the Knik River, Alaska: in Proceedings of the Third International Conference on Scour and Erosion, Amsterdam, Netherlands, p. 146-153.
Conaway, J.S., 2007, Analysis of Real-Time Streambed Scour Data from Bridges in Alaska: in Proceedings of the 2007 World Environmental and Water Resources Congress, May 15-19, 2007, Tampa, Florida, 11 p.
- Alaska streambed scour website: http://ak.water.usgs.gov/usgs_scour/
- Another study with ADOT&PF examines the geomorphology and river dynamics of the lower Copper River. Primary data activities in 2007 included:
 - Monitoring of scour and stage at three bridges that pass most of the flow of the Copper River; Bridges 339, 340, and 342.
 - Channel bathymetry for the entire lower Copper River was obtained using a multi-beam fathometer system integrated with a GPS-RTK system. The bathymetry data and LIDAR data (collected in 2005) were then combined to produce one DEM of the lower Copper River
 - ADCP measurements were made throughout the lower Copper River to assist in calibration of the MD_SWMS flow model.
 - Aerial photography was obtained in August 2007 to document channel changes.

Arizona

- The Arizona Department of Transportation provided funds to relocate the Oak Creek near Sedona (09504420) streamgaging station that was affected by highway construction.
- Currently engaged in a small channel morphology/bridge scour program with Maricopa County.
- In planning stages of a multi-year project for upgrading a portion of the State's flood-frequency equations and implementing StreamStats.

- Development of new guidelines for estimating Manning's roughness coefficient, and vegetation maintenance plan guidelines for vegetated urban channels in Maricopa County. This project has been completed and a report published. Phillips, J.V. and Tadayon, Saeid, Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona: U.S. Geological Survey Scientific Investigations Report 2006-5108, 49 p. (November 2006)
(<http://pubs.usgs.gov/sir/2006/5108/>)

Arkansas

- A 3-year study that began in 2006 is underway in cooperation with Arkansas State Highway and Transportation Department (AHTD). The study is located at Springs National Park in central Arkansas. AHTD and the National Park Service have concerns that the blasting of the hills to make a road in the park might cause cracks deep within the earth that will affect the flow system of the Hot Springs.
- In cooperation with AHTD, the AR WSC proposes to characterize the hydrology of an area located north of Interstate I-30 near Malvern, AR, that is subject to slope movement. The area referred locally as Social Hill consists of gentle hills that slope toward the Ouachita River. Just beneath the hills may be a buried landslide or slides that become activated by periodic rainfall events, causing the underlying clay sediments to become saturated and prone to failure. Such failure has caused the need for extensive repairs of I-30 and State highway 84. Characterization of the hydrology of the area is critical for designing effective remediation actions to minimize surface movement along the slope due to saturated conditions.

California

- No highway related projects at this time.
- However, as part of the Multi-Hazards Demonstration Project for Southern California, the USGS is producing debris-flow hazard maps for areas burned by wildfire in October-November 2007. Rapid-deployment streamflow gages and precipitation gages also were installed in burned areas for hazard-mitigation purposes.
- Also a proposal has been recently presented to Cal Trans for a cooperative effort in developing state-wide flood-frequency regression equations and to implement StreamStats in California.

Colorado

- The USGS Colorado Water Science Center (CWSC), in cooperation with the Colorado Department of Transportation (CDOT) and Colorado Water Conservation Board, is implementing StreamStats in Colorado during fiscal years 2007-2009. Implementation is occurring in a phased schedule. The central mountain region of Colorado is currently available at <http://water.usgs.gov/osw/streamstats/colorado.html>, and the remainder of the state will be operational by 2009. The StreamStats datasets are being developed at the 1:24,000 scale using high resolution National Hydrography Dataset (NHD), 10 meter digital elevation data, and the Watershed Basin Dataset developed by the USEPA.
- The regionalized streamflow equations for Colorado are being re-computed in conjunction with the development of StreamStats. Initial work with StreamStats identified bias in how previous studies computed the predictor variables such as drainage area, channel slope, mean-basin elevation, and mean-annual precipitation. In addition, one to two decades of additional streamflow data has been collected since the previous peak-flow and low-flow regionalized streamflow equations were computed and an update was needed.

Connecticut

- No highway related projects at this time.

Delaware

- Monitoring a remediated wetland created by DelDOT in a former borrow pit, along with an adjacent natural wetland. Monthly water level and rainfall data are reported to DelDOT annually.
- DelDOT partially funds two tide gages on Atlantic coastal bays.

- A 2-year study in cooperation with DeIDOT to update flood-flow frequency regression equations, and to implement StreamStats in Delaware was completed. The 100-year recurrence interval flood computed for streamgaging stations in Delaware was reduced by about 20 percent in the Coastal Plain region and by about 5 percent in the Piedmont region of Delaware, on average, compared to computations done for the previous study, published in 1996. A report that describes the study is available. Ries, K.G., III, and Dillow, J.A., 2006, Magnitude and frequency of floods on nontidal streams in Delaware: U.S. Geological Survey Scientific Investigations Report 2006-5146, 57 p. (<http://md.water.usgs.gov/publications/sir-2006-5146/index.html>)
- The StreamStats application for Delaware is on the Web at <http://water.usgs.gov/osw/streamstats/delaware.html>.
- An administrative letter was released to the Federal Emergency Management Agency to describe completed mapping of high-water marks throughout the Red Clay Creek basin in northern Delaware and indirect measurements of discharge at streamgaging stations in the basin to define water surface elevations and discharges for a new peak of record that occurred on Sept. 15, 2003, as a result of record rainfall generated by remnants of Hurricane Henri.

District of Columbia

- No highway related projects at this time.

Florida

- Updating flood frequencies for all gages and developing regional flood-frequency relations for streams in Florida for the 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-years. It has been more than 25 years since flood-frequency characteristics of streams were last evaluated and described. The length of the project is for 48 months.

Georgia

- Ongoing statewide flood and bridge-site studies at sites selected by GADOT. Open-File Reports publish as needed.
- Maintain a statewide network of 50 crest-stage gages as part of an ongoing flood-frequency study.
- Updating the flood-frequency estimates for ungaged rural sites in Georgia.
- **Bridge scour research project**

The overall investigation combines the field monitoring data of bridge scour with physical modeling in the Georgia Tech laboratory, and 3 dimensional numerical modeling also at Georgia Tech. USGS is monitoring scour at three bridges in Georgia that have been instrumented with an array of recording fathometers and Acoustic Velocity Meters on two of the bridges. The three sites transmit the scour data via satellite telemetry, and the data can be viewed near real-time via the web. This work ended in 2006. A document was published for the 2003 Georgia Water Resources Conference and can be access at <http://gwri.ce.gatech.edu/GAConf/Proceedings/Papers/2003/Gotvald.pdf>.

Hawaii

- Operates a network of 37 crest-stage gages to monitor peak stages and discharges at or near highway crossings on the islands of Kauai, Molokai, Maui, and Hawaii. The peak-flow data collected at these stations adds significantly to peak-flow data collected at continuous stations and improves regional coverage of peak-flow measurements in Hawaii.
- Monitors storm-water quality and quantity from a portion of the H-3 freeway near Aiea, and receiving water bodies. Water-quality samples are collected quarterly, during storms, at 5 stations, and streamflow is continuously monitored with telemetry at 3 of these stations. Two of the stream stations are now collecting suspended-sediment samples for daily sediment records, and turbidity monitoring equipment has been installed. Two telemetered raingages are also operated as part of this project.
- Monitors storm-water quality and quantity from a portion of the H-1 freeway near the University of Hawaii Manoa campus. A real-time storm-water monitoring station and raingage are now in operation.
- Updating flood-frequency estimating equations for ungaged streams in Hawaii. Results from this project will be incorporated into the Stream Stats package.

- Preparing a report analyzing water-quality data collected during the past 6 years at stations along the H-3 freeway. The report will compare water-quality data to state water-quality standards and to results of other studies of urban and highway runoff, compare constituent loads in highway runoff to those in receiving streams, and examine relations between constituent loads and related variables such as rainfall and traffic counts.
- **Recent Publications**

Presley, T.K., Jamison, M.T.J., and Young-Smith, S.T.M., 2006, Rainfall, Streamflow, and Water-Quality Data During Stormwater Monitoring, Halawa Stream Drainage Basin, Oahu, Hawaii, July 1, 2005 to June 30, 2006: U.S. Geological Survey Open-File Report 2006-1223, 26p.
(<http://pubs.usgs.gov/of/2006/1223/>)

Young-Smith, S.T.M, and Jamison, M.T.J., 2007, Rainfall, streamflow, and water-quality data during stormwater monitoring, Halawa Stream drainage basin, Oahu, Hawaii, July 1, 2006 to June 30, 2007: U.S. Geological Survey Open-File Report 2007-1213, 30p.
(<http://pubs.usgs.gov/of/2007/1213/>)

Idaho

- No highway related projects at this time.

Illinois

- Illinois StreamStats--The USGS Illinois Water Science Center (IWSC), in cooperation with Illinois Department of Transportation (IDOT), received funding through the Illinois Transportation Center to start the Illinois StreamStats project in FY2006. The Illinois Department of Natural Resources-Office of Water Resources is also a cooperating partner. The peak flood discharge results returned from the StreamStats website will be compared to the published values (Soong and others, 2004, Estimating Flood-Peak Discharge Magnitudes and Frequencies for Rural Streams in Illinois: U.S. Geological Survey Scientific Investigations Report 2004-5103, 147 p.), and corrections applied if necessary. IDOT has participated in testing at bridge sites. The StreamStats website is expected to be approved in FY2008.
- Field Verification of SRICOS-EFA for Illinois Streams--The Scour Rate In Cohesive Soils-Erosion Function Apparatus (SRICOS-EFA) Methodology outlined in the National Cooperative Highway Research Program Report 24-15, provides a potentially useful methodology for assessing scour in cohesive sediments, but field validation data for the method are limited. The overall objective of this study is to test the SRICOS-EFA method for estimating scour depth of cohesive soils in Illinois streams. The project is in progress with sites selected and data collection complete.

Indiana

- INDOT cooperatively funds 20 continuous-record gaging stations.
- The USGS Indiana Water Science Center, Geohydrologic Studies section had a cooperative project in FY 2005 with INDOT to evaluate the use of geophysical logs to evaluate trends in ground-water quality at a former deicer storage site. Preliminary comparisons of results from electromagnetic-induction logging of polyvinyl chloride cased observation wells in 2005 with data from previous years revealed decreased formation conductivity since the start of INDOT efforts to pump saline water from the aquifer. Future plans are to collect more data and document these findings.

Iowa

- Cooperatively funds 26 continuous-record gaging stations.
- Cooperatively funds 87 crest-stage gages.
- Cooperatively funds ongoing flood-profiles project to document water-surface profiles of significant flood events.
- Iowa StreamStats—A 2006-2008 investigation to develop and evaluate flood-frequency discharge estimation methods for rural, ungaged streams in Iowa with drainage areas less than 50 square miles identified several needs that, if addressed, would provide an easier implementation of the regression equations for users. First, there is a need to develop the same hydrologic regions for both small- and large-basin regression equations. Secondly, there is a need to reduce the transition zone between small- and large-basin regression equations. And lastly, there is a need to provide a Web-

based application that makes it easier for users to apply the various regression equations. The Project began in 2006.

Kansas

- The Kansas Water Science Center streamflow statistics project has provided improved estimates versus the ungaged regression equations for 5427 stream segments for flood frequency and various duration flows.
- The Kansas StreamStats is on the web at <http://ks.water.usgs.gov/Kansas/studies/strmstats/>.
- Cooperatively funds 32 crest-stage gages.
- The Kansas Water Science Center continues to verify theoretical stage-discharge ratings using direct measurement of flow at Flood Alert streamgages operated by Johnson County. Once the ratings for all stations are verified, peak-flow information can be used to develop flood-frequency equations for urban sites.
- Currently, there are few active streamgages with drainage areas less than 10 mi² used to compute flood frequency. National Weather Service precipitation estimates from significant events shortly after their occurrence will be used to determine areas where indirect measurements are needed. The relation between discharges per unit area (Q/DA) will be related to the probability of the precipitation event, the season of the year, and other basin characteristics. These relations will be tested to determine flood frequency at ungaged sites for streams less than 10 mi² and if successful will improve flood frequency estimates for ungaged sites in small watersheds. Initially data collection will focus on the Topeka NWS radar area.

Kentucky

- No highway related projects at this time.

Louisiana

- A cooperative program with the Louisiana Department of Transportation and Development (LA DOTD) to operate 10 continuous real-time streamflow data collection stations, 13 real-time stage stations, 17 non-recording crest-stage gages, and 7 non-recording flood-profile gages.
- Cooperative program with LA DOTD to operate 12 real-time monitoring network gages specifically located on major hurricane evacuation routes. These gages monitor water-levels, precipitation, and wind speed. The gage can eventually be used to transmit traffic volume and average speed data for LA DOTD. Wind speed information could be used to make informed decisions on bridge overpass closure, and water-level information would be used to make informed decisions on closing evacuation routes due to flooding. This network is expected to expand to 22 sites in the future.
- **Sustainable Yield of Selected Streams, Lakes, and Reservoirs in Louisiana**—Because of recent droughts, various government agencies, communities, and private groups are considering various streams, lakes, and reservoirs in Louisiana for alternate or emergency supplies of freshwater for municipal, industrial, or agricultural use. However, the amounts of available water required for local needs may be inadequate or unreliable from many of these sources, especially during drought conditions. In addition, excessive water withdrawals may result in adverse environmental, economic, or social impacts. The USGS in cooperation with the U.S. Department of Transportation is conducting a study to estimate the sustainable yield of selected streams, lakes, and reservoirs in Louisiana.
- **Watershed Response Monitoring on Bundicks Lake**—Bundick Lake was formed in 1961 when the dam was constructed on Bundick Creek. After construction, when the normal pool elevation was reached, private camps, piers, loading ramps, docks, and other structures were built along the perimeter of the Lake. The normal fluctuations in water level can interrupt the use of these features, and in some cases, result in damages to structures not designed to accommodate the changing water-levels. The users of these structures have generated interest in regulating the water level of the lake. Lake-side land owners are requesting that water levels in the lake be lowered prior to heavy rainfall events that increase lake levels. Monitoring of the Bundick Creek watershed is necessary to provide an estimate of potential increase in lake levels during rainfall events and trigger water releases to lower the lake level. This study is in cooperation with the U.S. Department of Transportation.

Maine

- **Abutment Scour**—The USGS is collecting abutment-scour information during low flows at 50 older bridges in Maine with vertical concrete abutments and wingwalls. The information collected at the bridges, along with hydraulic modeling, will provide the necessary data to test the computation of abutment scour predicted by several common methods against actual abutment scour. This project is in its final year.
- **The Effect of road-salt on bedrock wells**—USGS and MDOT are studying possible long-term effects of road-salting practices on the quality of bedrock ground water. USGS will use geophysical data, water-quality analyses, and continuously recorded water level, water temperature, and specific conductance data from 4 or more wells to understand the roles of fractures on the persistence of chloride in bedrock. The project, scheduled for 2 years, started in September 2007 with the selection of wells in West Gardiner and Sullivan. As of this update, data are being transmitted real time from one site and are being recorded continuously at another site. The rest of the sites should be instrumented by early November 2007.
- **Impact of peak-flow stationarity on bridge design**—The USGS will determine how peak flow estimates (such as the 50-year peak flow) vary when different periods are used for the computation of the peak flow estimates. Maximum annual streamflow-trend magnitudes will be investigated for approximately 45 regulated and unregulated streams in Maine that have at least 50 years of data. This project will start in FY2008.
- **Small watershed data collection**—Ongoing peak-flow data collection (crest-stage gages) on 15 streams, all basins less than one square mile. Nine sites have 7 complete years of data collection; three sites have 6 complete years of data collection. Three have less than three years of data.
- **Continuous streamflow data collection**—Ongoing data-collection at 10 USGS streamflow gages and one tide gage.
- **Recent Publications**
Hodgkins, G. A., Hebson, C., Lombard, P. J., Mann, A., 2007, Comparison of Peak-Flow Estimation Methods for Small Drainage Basins in Maine, SIR2007-5170 32 p.
(<http://pubs.usgs.gov/sir/2007/5170/>)

Maryland

- MDSHA provided about 50 percent funding for 13 streamgaging stations during fiscal year 2007
- Streamstats was implemented for the Patapsco and Gunpowder watersheds in Maryland during FY-2007. (<http://water.usgs.gov/osw/streamstats/maryland.html>)

Massachusetts

- Continued to evaluate and updated the Federal Highway Administration (FHWA) pollutant loadings model for highway stormwater runoff for the continuous US (cooperator— FHWA).
- Continued assessment of stormwater discharges for state highways in Massachusetts for use in a statewide predictive loading model (cooperator— Massachusetts Highway Department). The purpose of the project is to document current concentrations of suspended sediment, particle size, selected dissolved ions, total nutrients, selected total-recoverable metals, and semivolatile compounds in highway runoff discharge from common highway-drainage conveyance structures in Massachusetts from eight highways during a two-year period. This study will also evaluate the potential transferability of these data to other highway sites by relating constituent concentrations to average daily traffic volumes. These data will be used to populate a statewide version of the new national highway-runoff model (developed by the USGS under agreement with FHWA), which will be used for estimating highway-runoff concentrations and loads throughout Massachusetts. Four additional sites were added, and the sampling strategy was modified. Data were collected and analyzed in 2007. A report is planned for publication in 2009.
- Updating equations for estimating the magnitude and frequency of floods for streams in Massachusetts (cooperator— Massachusetts Highway Department). Project is pending final approval.

Michigan

- The Michigan Water Science Center operates 10 continuous record streamgages and 5 crest-stage gages for the Michigan Department of Transportation.

Minnesota

- Operating a network of 77 crest-stage gages and one continuous discharge gage for flood frequency analysis. Updated data are being analyzed for a new Flood Frequency Report on Small Streams for MN. This report is planned for publication in FY 08.
- StreamStats data preparation and possible implementation of StreamStats for MN in FY 08 or FY 09.
- Provide hydraulic investigation support as requested, including bridge scour.
- Continued writing an investigative report that summarizes baseline water-quality conditions for a multi-year cooperative investigation of the effects of a proposed four-lane divided highway on the water quality and hydrology of relatively pristine streams and wetlands that drain to a large lake important for fisheries and tourism. The highway expansion has been delayed due to funding cuts, so an interpretive report will summarize only pre-construction conditions.
- The Basin Characteristics project/Minnesota Department of Natural Resources Lakeshed Project prepares (http://www.dnr.state.mn.us/watersheds/lakeshed_project.html) hydrologically enhanced 1:24,000 Digital Elevation Model (DEM) data for use with automated basin characteristic and flood frequency ArchHydro extension. The Basin Characteristics project is updating basin characteristics for over 10,000 level 4-7 HUs in Minnesota and surrounding States.
- Stream-Slope Research: Testing automated methods of generating stream-slopes with DEMs and lidar, against the manual, semi-manual, and traditional survey methods.
- All basin characteristics data is available on-line at the Minnesota Watershed Information Project <http://gisdmspl.cr.usgs.gov/watershed/index.htm>. This web page allows users to get basin characteristics and watershed areas for over 10,000 level 4-7 watersheds in and around Minnesota.

Mississippi

- Continue to provide streamflow records, hydrologic analyses of basins, and hydraulic analyses of the flooding potential at selected stream crossings, known as bridge-site studies. Scour analyses are also conducted at selected sites.
- Continue to operate and maintain 96 crest-stage gages.
- Scour monitoring instrumentation was installed at a coastal bridge in 2007. Streambed soundings will be obtained at this and other selected bridges to document scour.
- Continue to prepare an updated version of the 1991 flood-frequency reports to include the use of GIS determined basin characteristics for development of regional flood-frequency equations and the implementation of StreamStats. In 2007, completed development of 1:24,000-scale watershed boundary dataset for the State attributed with watershed and subwatershed boundaries, codes, names, and areas. Draft open-file report has been written, and 1:500,000-scale atlas is being prepared for review.

Missouri

- Operated a network of 38 crest-stage gages to be used with future flood frequency study.
- Operation and maintenance of 7 stream-gaging stations as part of the state-wide stream-gaging network.
- Hydraulic analysis at selected bridge sites. Proposal in process to use a two-dimensional hydraulic model at a complex site.
- Published results of a bridge scour analysis using a two-dimensional hydraulic model at one bridge on the Mississippi River in southeastern Missouri. Hurizinga, R;J., 2007, Two-dimensional simulation of flow and evaluation of bridge scour at structure A-1700 on Interstate 155 over the Mississippi River near Caruthersville, Missouri: U.S. Geological Survey Scientific Investigations Report 2007-5230, 33 p. (<http://pubs.usgs.gov/sir/2007/5230/>)
- Installed a near-real-time fathometric scour sensor at a gaged site on Chariton River near Prairie Hill, Missouri. MoDOT is interested in using similar technology at other scour-critical sites.

Montana

- Bridge-scour data collection and analysis program ongoing since 1991. As part of this program, near real-time scour monitoring is being conducted at four sites.
- Small-stream peak-discharge data collection program ongoing since 1955. Currently operating 96 crest-stage gages and 2 flood-hydrograph continuous-record streamflow gages.
- Ongoing cooperative project to investigate the hydrology of selected wetland areas affected by proposed highway projects.

Nebraska

- No highway related projects at this time.

Nevada

- Maintain a Statewide network of 24 crest-stage gages.
- USGS and Nevada Department of Transportation entered into an agreement in FY06 to compute sediment loads in the Clear Creek Drainage. This study will assess the impact of runoff from a U.S. Highway. The study is event driven where the sample collection intensifies during snowmelt and summer thunderstorms. The data collection of the study is complete and the report is being drafted.
- A web based flood chronology of the Carson River Basin in cooperation with the State of Nevada and FEMA is available at <http://nevada.usgs.gov/crflid/index.htm>. The web site shows frequency plots, lists of flood discharge with Return Periods or Recurrence Intervals, and digital photographs of floods in the Carson River Basin.

New Hampshire

- A 2-year study began in FY07 in cooperation with New Hampshire DOT to update flood-flow frequency regression equations and to implement StreamStats for the state of New Hampshire.
- New Hampshire Department of Transportation (NHDOT) funds approximately one-third of New Hampshire's stream-gaging network.

New Jersey

- Operate and maintain the New Jersey Tide Telemetry System, which includes 25 real-time tide gages, 31 tidal crest-stage gages, and 5 computer base stations. These gages are located on various back bays and tidal estuaries of coastal rivers. The purpose of the System is to provide real-time data for road closures and evacuations, and also to develop a long-term tide database for design purposes.
- Operate and maintain 42 crest-stage gages on small drainage basins of less than 2 square mile, and 15 older crest-stage gages under 9 square miles in drainage area. After 10-years of record have been recorded, a study to compare the gaged results with the various flood magnitude and frequency estimation methods will be initiated.

New Mexico

- The New Mexico crest-stage gage network of 100 gages will be expanded to 120 gages the next 2 years. Currently, 48 crest-stage gages with automated transducers are in operation in ephemeral streams around New Mexico. A USGS Fact Sheet FS 2005-3136, titled "Automated crest-stage gage application in ephemeral streams in New Mexico," by Scott Waltemeyer has been published. (<http://pubs.usgs.gov/fs/2005/3136/>)
- Flood-flow frequency estimates were updated for New Mexico in FY2007. This also included determining new and updating basin/climatic characteristics using the USGS National Elevation Dataset (NED) and other raster data layers. New variable average basin slope and average basin elevation were found to be statistically significant in several regional regression equations as is the revised drainage area. A report has been published documenting the study. Waltemeyer, S.D., 2006, Analysis of the magnitude and frequency of peak discharges for the Navajo Nation in Arizona, Utah, Colorado, and New Mexico: U.S. Geological Survey Scientific Investigations Report 2006-5306, 42 p. (<http://pubs.usgs.gov/sir/2006/5306/>)

- **StreamStats**—A U.S. Geological Survey (USGS) Web application for stream information for New Mexico has been funded by the USGS in cooperation with the New Mexico Department of Transportation for FY 2006-09. Information about the StreamStats can be found at <http://water.usgs.gov/osw/streamstats/>.

New York

- Documentation of notable floods through collection of flood information such as peak stages and discharges at discontinued gages, flood profiles along flooded streams, and indirect flood discharge measurements at miscellaneous flooded sites.
- Heavy rain during June 2006 resulted in record flooding in the Delaware, Susquehanna and Mohawk River basins. This event resulted in 100- to greater than 500-year recurrence intervals in the Delaware, Susquehanna and Mohawk River basins. Several indirect measurements were made and a flood report to document this flooding is in progress.
- Characteristics for more than 500 gaged basins throughout New York have been derived using GIS techniques and coverages. These characteristics include several land use categories, meteorological parameters, and numerous morphometric variables (based on the physical shape, drainage structure, and relief of each basin and main channel) have been used in an update of flood-frequency relations for New York (Lumia, 2006). GIS datasets and software are included on a DVD in the report to allow automated calculation of flood frequency discharges.
- Maintain a statewide network of 48 crest-stage gages.
- A continued effort to use GIS techniques and coverages to automate the computation of flood discharges at any unregulated site on streams in New York using STREAMSTATS is in progress.
- An effort to update a report showing the maximum known stages and discharges at nearly 1500 gaging stations in New York is in progress. Recurrence intervals will be assigned to each peak discharge, where feasible. The scope of this report was revised to include peaks from the 2006 water year due to significant flooding in 2006.
- USGS is assisting the NYSDOT in the developing an RFP to use natural brine for use in highway de-icing in the Syracuse, NY area. The USGS NY WSC is a member of the Technical Advisory Group for this project and also helped NYSDOT site and drill the well, and provided the spec's for the brine pump.
- USGS NY WSC is working with the State Emergency Management Office, NYSDOT, NYSGS, and others to propose development of a statewide landslide susceptibility mapping project. While there is no formal agreement yet, an example area (Schenectady County) was mapped to be included in the State hazard mitigation plan being submitted to FEMA.
- A multi-year effort to develop regional models (curves) of bankfull discharge and hydraulic geometry for streams of New York State. Relations have been developed by hydro-physiographic region and by Rosgen stream type to develop models of bankfull characteristics at gaged streams which are necessary to confirm bankfull features at ungaged reference reaches and to design natural-channel-design restoration projects. The study is collaboration between the USGS, New York City Department of Environmental Protection, Cornell, and New York State Departments of Transportation, State, and Environmental Conservation. Selected streams in all regions of the State have been surveyed at this time.
- **Recent Publications**
 - Lumia, R., Freehafer, D.A., and Smith, M.J., 2006 Magnitude and Frequency of floods in New York: U.S. Geological Survey Scientific Investigation Report 2006-5112, 152p. (<http://pubs.usgs.gov/sir/2006/5112/>)
 - Mulvihill, C.I., Filipowicz, A., Coleman, A. and B.P. Baldigo, 2007, Regionalized Equations for Bankfull Discharge and Channel Characteristics of Streams in New York State—Hydrologic Regions 1 and 2 in the Adirondack Region of Northern New York: U.S. Geological Survey Scientific Investigations Report 2007-5189, 18 p., online only. (<http://pubs.usgs.gov/sir/2007/5189/pdf/SIR2007-5189.pdf>)
 - Mulvihill, C.I., Ernst, A.G., and Baldigo, B.P., 2005, Regionalized Equations for Bankfull Discharge and Channel Characteristics of Streams in New York State: Hydrologic Region 6 in the Southern

- Tier of New York: U.S. Geological Survey Scientific Investigations Report 2005-5100, 14 p., online only. (<http://ny.water.usgs.gov/pubs/wri/sir055100/sir2005-5100.pdf>)
- Mulvihill, C.I., Ernst, A.G., and Baldigo, B.P., 2006, Regionalized Equations for Bankfull-Discharge and Channel Characteristics of Streams in New York State: Hydrologic Region 7 in Western New York: U.S. Geological Survey Scientific Investigations Report 2006-5075, 14 p., online only. (<http://ny.water.usgs.gov/pubs/wri/sir065075/sir2006-5075.pdf>)
- Suro, T.P. and Firda, G.D., 2006, Flood of April 2-3, 2005 in the Neversink River Basin, New York: U.S. Geological Survey Open-File Report 2006-1319, 90 p. (<http://pubs.usgs.gov/of/2006/1319/>)
- Suro, T.P. and Firda, G.D., 2007, Flood of April 2-3, 2005 in the Esopus River Basin, New York: U.S. Geological Survey Open-File Report 2007-1036, 90 p. (<http://pubs.usgs.gov/of/2007/1036/>)
- Westergard, B.E., Mulvihill, C.I., Ernst, A.G., and Baldigo, B.P., 2005, Regionalized Equations for Bankfull-Discharge and Channel Characteristics of Streams in New York State – Hydrologic Region 5 in Central New York: U.S. Geological Survey Scientific Investigations Report 2004-5247, 16 p., online only. (<http://ny.water.usgs.gov/pubs/wri/sir045247/sir2004-5247.pdf>)

North Carolina

- The project to **Update Rural Flood Frequency Equations for North Carolina** in conjunction with South Carolina and Georgia for which the regionalization will be based on watershed boundaries rather than political boundaries is ongoing and planned to be completed in FY2008. Contact Curtis Weaver (jcweaver@usgs.gov) concerning this project.
- Phase I of the project to evaluate **Two-Dimensional and One-Dimensional Numerical Models for Bridges in North Carolina** was completed in FY 2007. The SIR is currently in the process of receiving Director's approval. Contact Chad Wagner (cwagner@usgs.gov) concerning this project.
- Continued to operate a continuous water-quality streamflow gaging station on Goose Creek at Fairview, NC (02124692) just outside of Charlotte in cooperation with the NCDOT. The gaging station has been in operation since 1999 to monitor the water-quality effects of an interstate bypass that runs through the Goose Creek watershed where the presence of the Federally Endangered Carolina Healsplitter mussel has been documented. The site is also being used to develop a continuous rating of sediment load by directly measuring a sediment surrogate (specific conductance).
- Near the end of FY 2007, the NC WSC entered into an cooperative pilot project with NCDOT to **Develop and Implement StreamStats and NHDPlus Applications using Local Resolution Data in the Upper French Broad River Basin, North Carolina**. Currently (2007) StreamStats and NHDPlus applications exclusively use 10- and 30-meter Digital Elevation Models (DEMs) and 1:24,000 and 1:100,000 scale National Hydrography Dataset (NHD). Although these datasets are adequate for some applications, availability of higher resolution elevation data, predominately from Light Detection and Ranging (LIDAR), is promoting demand to incorporate these more accurate data into scientific applications and decision making. As an example, a local resolution NHD product was completed in 2007 for 19 counties in western North Carolina. The best available combination of digital orthophotography, digital terrain models derived from LIDAR and existing hydrography was used to create the local resolution NHD.
- The USGS in cooperation with the North Carolina Department of Transportation (NCDOT) is conducting a pilot project to develop and implement NHDPlus and StreamStats applications for the Upper French Broad River basin in western North Carolina. The pilot project utilizes the local resolution NHD product, 20-foot DEMs (derived from LIDAR data), and the most current regional streamflow regression equations, and datasets of landscape characteristics. Basin characteristics developed for the streamflow regression application, including National Oceanic and Atmospheric Association (NOAA) rainfall intensity data, topographic variables (for example slope and drainage area) and best available land cover classifications, will be incorporated into StreamStats and NHDPlus tables. Issues and recommendations on dataset development and application implementation for future similar use of high resolution datasets will be documented.
- The NC WSC has also been very involved in providing technical modeling support to the PA WSC on a habitat assessment study with the PennDOT, however this project will be detailed in the PA WSC summary of FHWA activities.

- **Publications:** Wagner, C.R. and others, 2006, Scour at Contracted Bridges, National Cooperative Highway Research Program (Project 24-14), Transportation Research Board, 299 pp. (http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w83.pdf)

North Dakota

- A network of 28 crest stage gages was operated in cooperation with the North Dakota Department of Transportation. The purpose of the network is to provide annual discharge peaks on small basins with less than 100 square miles. These data can then be used to improve our knowledge about flood frequencies on small basins and refine predictive regression equations.
- Operated one lake stage gage and one continuous-record discharge gage.
- **Two-dimensional unsteady flow model**
In cooperation with the North Dakota Department of Transportation and the North Dakota State Water Commission, the USGS is conducting an investigation to develop a two-dimensional unsteady flow model of Devils Lake, North Dakota. The objectives are to develop and apply a circulation model of Devils Lake. The model is being developed using data collected in 2006. The model will provide information on water movement patterns, lake level variations, and transport of dissolved materials throughout the lake under variety of weather, inflow, and lake-level conditions.
- **Flood elevation frequencies for Devils Lake**
Unlike a riverine flood, the one-percent chance flood elevation for Devils Lake changes from year-to-year as the initial lake level changes. In cooperation with FEMA, Region VIII, the USGS is conducting a study to provide the most up-to-date and scientifically defensible estimates of the regulatory flood elevations for Devils Lake that correspond with the same cumulative risk as a "100-year" riverine flood.

Ohio

- A network of 18 crest-stage gages was operated in cooperation with the Ohio DOT and the Ohio Department of Natural Resources. The crest-stage gage data will be used to augment existing flood-frequency information available for Ohio.
- A StreamStats application has been developed for Ohio. A report describing the application for Ohio has been published. Koltun, G.F., Kula, S.P., and Puskas, B.M., 2006, A streamflow statistics (StreamStats) Web application for Ohio: U.S. Geological Survey Investigations Report 2006-5312, 62 p. (<http://pubs.usgs.gov/sir/2006/5312>)

Oklahoma

- StreamStats is being developing for Oklahoma to:
 - Automatically measure basin and climatic characteristics for ungaged sites using GIS;
 - Provide published streamflow statistics, basin and climatic characteristics, and other information for data-collection stations contained in published streamflow statistics reports.
 - Provide estimates of flood-frequency statistics, basin and climatic characteristics, and other information for user-selected points on ungaged streams; and
 - Link to USGS NWIS on line data.
 - This work began in July 2005 and will be completed June 2009.

Oregon

- Completed data analysis for estimating streamflow characteristics using regression equations, including flow duration and low-flow at ungaged sites for the entire state of Oregon. These coverages and equations will be implemented into Oregon StreamStats in 2008. A report describing this work is to be published in 2008. Risley, John, Stonewall, Adam, and Haluska, Tana, *in review*, Estimating flow-duration and low-flow frequency statistics for unregulated streams in Oregon: U.S. Geological Survey Scientific Investigations Report 2008-XXXX.
- The investigation of existing bio-engineered sites at four gaging stations in Oregon to document how bio-engineered bank protection performs over a range of hydraulic conditions was completed in 2007. The stage, discharge, and velocity information, combined with the covering, design and

construction of the bio-engineered bank protection installations was evaluated for improving current design procedures. A USGS Memo describing the USGS role in the project has been released. This memo will be included in an ODOT report later this year.

Pennsylvania

- StreamStats: The current application of StreamStats for Pennsylvania (<http://water.usgs.gov/osw/streamstats/pennsylvania.html>) can be used to estimate low-flow statistics, including the 7-day, 10-year; 7-day, 2-year; 30-day, 10-year; 30-day, 2-year; and the 90-day, 10-year low flow, base-flow statistics, including the 10-year, 25-year, and 50-year base flows, and mean flows, including the harmonic mean and mean annual flow as well as selected basin characteristics at ungaged sites throughout the state.
- Flood-flow frequency streamflow statistics, 2-, 5-, 10-, 50-, 100-, and 500-year, are being developed for ungaged areas using regional regression techniques. A report will be made available and equations will be implemented in StreamStats.
- Continuous radar is being used to collect water velocities at the surface at the Susquehanna River at Bloomsburg (01538700) gaging station. This instrument is ideal especially during unsteady flow events such as those created by debris and ice jams and will help to provide real-time streamflow estimates throughout the year without the need for a series of flow measurements. Additional velocity data will be collected at other sites that are a high-priority for the National Weather Service. The additional data will be corroborated with recently acquired acoustic velocity meters and an enhanced radar antenna.
- Investigation and modeling of velocity and streambed configuration in relation to mussel habitat and bridge-pier design in the Allegheny River at Foxburg, Pa. A journal article describing the results of the study is near completion.
- Biological investigations, Allegheny River (BRD projects)—
 - Distribution, density, and viability of native freshwater mussel populations in the free-flowing Allegheny River.
 - Effect of relocation and disturbance from bridge construction on survival and recolonization of freshwater mussels at West Hickory, Pa.
 - Relocation of native freshwater bivalves: evaluation of survival, movement, and recruitment at Kennerdell, Pa.
- Valley Creek Highway Encroachment— Monitoring of a constructed wetland, stabilized stream reach in Valley Forge National Historical Park, and a planted riparian buffer began in 2000 and concluded in 2006. A USGS report is now being prepared to describe and interpret the monitoring results.

Puerto Rico

- No highway related projects at this time.

Rhode Island

- No highway related projects at this time.

South Carolina

- Operates 6 continuous-record gaging stations and 49 partial-record crest-stage stations. (Number of gaging stations fluctuates slightly from year to year.)
- **Live-bed pier and contraction scour envelope curves**

In October 2005, the U.S. Geological Survey (USGS) and South Carolina Department of Transportation (SCDOT) began a cooperative program to investigate live-bed pier and contraction scour in the Piedmont and Coastal Plain of South Carolina. The purpose and objectives of this project include (1) the documentation of historic occurrences of live-bed pier scour and contraction scour at approximately 80 bridges in the Piedmont and Coastal Plain of South Carolina using ground penetrating radar; focus will be given to old bridges and bridges that have had large floods; (2) a comparison of observed scour with predicted scour in order to assess the scour prediction methods of HEC-18; (3) the investigation of various physical relations that may help explain live-bed scour processes in South Carolina; and (4) if possible, the development of envelope curves for evaluating the potential for live-bed pier and contraction scour in South Carolina. Data have been collected at

78 bridges, and hydraulic models and scour analysis are being made at these sites. Analysis of the field data will continue in 2008 with final report publication in 2009.

- **Calibration of clear-water abutment scour equations using field data**

Research conducted by the USGS in cooperation with the Federal Highway Administration and the Maryland State Highway Administration has identified the critical velocity variable as a potential source of error for selected clear-water abutment scour equations. Preliminary results indicate that performance of these equations could improve if a better method for estimating this variable was used. A literature review indicated that current practice for estimating critical velocity is poorly defined, has limited field verification, and is unlikely to see improvement in the near future. Therefore, a direct way to develop a method for estimating critical velocity that will lead to improved scour prediction equations is not readily available. However, it is possible to indirectly evaluate critical velocity and in turn improve the scour prediction equations by calibrating the equations with field data. To accomplish the calibration, the clear-water abutment scour equations are used to back-calculate the critical velocity required to force the equation to match measured scour. These back-calculated critical velocities can then be used to develop an improved method for estimating critical velocity. Field data from South Carolina and the USGS National Bridge Scour Database, including 224 measurements of abutment scour, will be used in the calibration and validation analysis. Preliminary results indicate that the calibration will improve the performance of the clear-water abutment-scour equations. Additionally, the results suggest that better performance for other bridge-scour equations can be achieved by using a similar procedure.

- **Rural flood frequency investigation**

The USGS in cooperation with the SCDOT began a rural flood frequency investigation in 2006. The objectives of this investigation are to update the magnitude and frequencies of peak streamflows of unregulated and regulated streams in South Carolina, when adequate data are available. The South Carolina Water Science Center will coordinate with the Georgia and North Carolina Water Science Centers to establish consistent physiographic regions at the state boundaries and also will seek to establish consistent explanatory variables and (or) regional equations at the state boundaries. The project will result in updated regional rural-flood-frequency equations for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence intervals.

- **Performance of four best management practices for highway runoff**

In June 2004, the USGS and the SCDOT began a cooperative investigation to collect water-quality data to be used to assess the performance of four Best Management Practices (BMPs) for highway runoff in Beaufort and Colleton Counties, South Carolina. This investigation has four objectives: (1) determine event-mean concentrations; (2) calculate loads entering and leaving the BMPs; (3) estimate the removal efficiency of the commercially available BMPs for selected constituents such as suspended sediment, metals, oil and grease, and fecal indicator bacteria in roadway runoff; and (4) evaluate the relation between water-quality constituent concentrations and loads to average daily traffic data by correlation analysis. To reduce uncertainty in the removal efficiency estimation and average daily traffic correlation evaluation, a data set of 12 to 15 sampling events will be used. Field work is completed and the final report should be available in 2008.

- **Recent Publications**

Benedict, S.T., and Caldwell, A.W., 2006, Development and evaluation of clear-water pier and contraction scour envelope curves in the Coastal Plain and Piedmont Provinces of South Carolina: U.S. Geological Survey Scientific Investigations Report 2005-5289. (<http://pubs.usgs.gov/sir/2005/5289/>)

Benedict, S.T., Deshpande, N., Aziz, N.M., and Conrads, P.A., 2006, Trends of abutment-scour prediction equations applied to 144 field sites in South Carolina: U.S. Geological Survey, Open-File Report 03-295. (<http://pubs.usgs.gov/of/2003/ofr03-295/>)

South Dakota

- Operate a network of about 50 crest-stage gages for the purpose of peak-flow analysis.

- Work is nearly complete on a statewide update of peak-flow frequency estimates for gaged streams in the state. A draft report has been completed and colleague reviews of the draft also have been completed. Publication of the report will be forthcoming, following finalization of the review and revision process.
- Work is nearly complete on a multi-year study initiated in 2003 to evaluate scour potential at bridges on primary highways using a combination of Level 1.5 and Level 2 analyses. Level 1.5 analyses have been completed for all of the applicable primary bridges in the state and Level 2 analyses were performed for a subset of 18 of these bridges. A final report is planned for completion by the end of Federal fiscal year 2008 and will focus on a comparison of results between the Level 1.5 and Level 2 analyses.
- Implementation of StreamStats in South Dakota was initiated in 2005 and will continue through 2008. An important initial activity has been formation of a statewide steering committee that will help guide decisions regarding utilization of existing geospatial information, and possible procurement of additional, relevant geospatial information. A separate project (with different cooperators) to complete a 6th level Hydrologic Unit Map for South Dakota is nearly complete, and will serve as a cornerstone for StreamStats digital base layers.
- A reconnaissance-level study to evaluate the potential of using paleoflood hydrology techniques to improve flood-frequency estimates for the Black Hills area through extension and extrapolation of existing peak-flow records was recently completed. The initial phase demonstrated that applicable approaches for estimating magnitudes and ages of historical peak-flow events could be very successful. Discussions currently are underway with SDDOT and other potential cooperators regarding possible implementation of subsequent study phases.

Tennessee

- Providing hydraulic interpretative support and miscellaneous flood-measurement support to Tennessee Department of Transportation (TDOT) as needed.
- Operating an ongoing network of 40+ crest-stage gages at or near highway crossings and operating another 15 stage-discharge gages across the state for the purpose of flood-frequency analysis and general resource evaluation.
- Routinely updating basin characteristics files and statewide flood-frequency equations for ungaged streams in Tennessee. Our most recent update was based on the region-of-influence statistical model and was completed in FY 2003.
- Continuously monitoring turbidity and relating turbidity to sediment concentrations on a stream in West Tennessee. This was initiated in FY2004.
- Large-scale study of the effects of highway construction on stream ecology throughout Tennessee—looking specifically at sediment export from disturbed areas, the efficiency of sediment control structures (EPSCs) at construction sites, sediment transport processes, the effects of sediment on downstream habitat and biotic communities, and improved methods for monitoring sediment-related effects. This work began in FY2004 and should continue through FY2012.
- Refining GIS coverages and enhancing tools and analytical protocols for the Tennessee Streamstats page (<http://water.usgs.gov/osw/streamstats/tennessee.html>). This page was completed and released in 2007. We are currently working to improve high-flow and low-flow equations by incorporating GIS-based basin characterization and adapting Streamstats to handle a Region of Influence (ROI) computational approach. This work should be completed in FY2008. Additional modifications planned for FY2008-09 include improved characterization of shallow closed depressions in karst terrains.

Texas

- **Bed Mobility in Edwards Plateau, Central Texas (FY05-08): ON-GOING**

The SW research group with the Texas Water Science Center is engaged in a peer-to-peer research consortium with Texas Tech University, Lamar University, and University of Houston in a project funded by the Texas Department of Transportation to investigate gravel transport phenomena within the Plateau. Gravel transport within high gradient streams is contributing to recurring infrastructure damage in the study area. The Department hopes that the research will contribute to enhanced design guidance on bridges and low-water crossings. The primary USGS focus will be on spatial documentation of gravel transport through imagery and field investigations. The four-year project terminates in August 2008. Contact Frank T. Heitmuller (ftheitmu@usgs.gov) for further information.

- **Rational Method Assessment (FY08--10): ON-GOING**

- The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Lamar University and University of Houston in a project funded by the Texas Department of Transportation to investigate the rational method for small to moderately sized rural and urban watersheds in Texas.

- **Refinement of Flood-Frequency Relations (FY07--09): ON-GOING**

The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Texas Tech University in a project funded by the Texas Department of Transportation to develop statewide regional regression equations to estimate peak-streamflow frequency for ungaged locations (focused on undeveloped watersheds) in Texas using L-moment-based analysis of at-site annual peak streamflow values. The scope of the project includes 1,030 streamflow-gaging stations and various methods (technologies) for estimation of watershed characteristics. This project is intended to produce one or more additional equation ensembles from those developed in the mid 1990s.

- **Assessment of Watershed Subdivision on Hydrologic Modeling (FY08--10): ON-GOING**

The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Texas Tech University, Lamar University, and University of Houston in a project funded by the Texas Department of Transportation to investigate the effects of watershed subdivision on hydrologic models and to provide guidance (if possible) as to how or why subdivision should be done.

- **Unit Hydrographs for Texas (FY01-07): COMPLETED**

The SW research group with the Texas Water Science Center has been engaged in a peer-to-peer research consortium with Texas Tech University, Lamar University, and University of Houston in a project from about 2001--2007 funded by the Texas Department of Transportation to investigate the timing characteristics for unit hydrographs on small to moderately sized rural and urban watersheds in Texas. Unit hydrographs for 93 watersheds in Texas have been estimated through a myriad of techniques including linear programming, instantaneous unit hydrograph, and gamma distribution fitting to peak and time to peak values. The project has been on going for many years and several publications are completed or in progress. The last two years years of the project involved assessment of loss models for engineering design applications.

- **Small Watershed Gaging Program: (FY06-10, and three more 5-year increments)**

The Texas Department of Transportation and the USGS have returned in earnest to small watershed data collection. About 50 crest-stage gages on small watershed in western Texas were deployed to record flood peaks. About ten of these gages will have autonomous stage recording and rainfall for production of rainfall and runoff data sets to drive the TxDOT research program in future decades. Three of the gages will be operated as continuous real-time (conventional gages).

- **Recent Publications**

Asquith, W.H., and Roussel, M.C., 2007, An initial-abstraction, constant-loss model for unit hydrograph modeling for applicable watersheds in Texas: U.S. Geological Survey Scientific Investigations Report 2007-5243, 82 p. [in press]

Asquith, W.H., Cleveland, T.G., Xing, Fang, Thompson, D.B., 2006, Unit hydrograph estimation for applicable Texas watersheds: Texas Department of Transportation Research Report 0--4193--4, Center for Multidisciplinary Research in Transportation, Texas Tech University, [approved by TxDOT and through USGS colleague review].

Asquith, W.H., Thompson, D.B., Cleveland, T.G., and Fang, Xing, 2004, Synthesis of rainfall and runoff data used for Texas Department of Transportation Research Projects 0--4193 and 0--4194: U.S. Geological Survey Open-File Report 2004--1035, 1,050 p. (<http://pubs.usgs.gov/of/2004/1035/>)

Asquith, W.H., and Roussel, M.C., 2003, Atlas of interoccurrence intervals for selected thresholds of daily precipitation in Texas: U.S. Geological Survey Water-Resources Investigations 03--4281, 204 p. (<http://pubs.usgs.gov/wri/wri03-4281/>)

Cleveland, T.G., He, Xin, Asquith, W.H., Fang, Xing, and Thompson, D.B., 2006, Instantaneous unit hydrograph selection for rainfall-runoff modeling of small watersheds in North and South Central Texas: ASCE Journal of Irrigation and Drainage, Sept.--Oct. 2006, p. 479--485.

Utah

- Recently completed an update of the peak-flow regression equations for the state of Utah, a cooperative investigation with the Utah Department of Transportation. The USGS StreamStats program is undergoing implementation for Utah and will include the new peak-flow equations.

- **Recent Publications**

Kenney, T.A., Wilkowske, C.D., and Wright, S.J., 2007, Methods for estimating magnitude and frequency of peak flows for natural streams in Utah: U.S. Geological Survey Scientific Investigations Report 2007-5158. (<http://pubs.usgs.gov/sir/2007/5158/>)

Vermont

- Vermont Agency of Transportation (VTrans) is currently funding a network of 29 crest-stage gages located in small headwater watersheds throughout the state.
- VTrans is funding two streamgaging stations (Potash Brook in South Burlington, VT and Allen Brook in Williston, VT) for continuing research of storm water management on small urban streams.
- A cooperative investigation between VTrans and the USGS began in FY05 to investigate the effects of road salting on stream quality. In FY06 and 07, stream water-quality monitoring (continuous conductance and discrete samples for chloride, sodium and calcium) and flow were performed at 3 streams at locations upstream and downstream of state highways. In FY08, stream data are being analyzed and a USGS interpretative report will be prepared summarizing the results of the study.

Virginia

- Continuation of Annual Flood Peaks of Streams in Virginia—The objectives of the study are to update annual flood-peak data in preparation for a flood frequency analysis study.
- Maintain and operate a network of 45 crest-stage gages to determine annual peak flows, document extreme flow events, and improve flood frequency estimates.
- Collection of stream geomorphic data in the Piedmont physiographic province at USGS streamflow-gaging stations to be used in the development of regional channel geometry curves.

- **Recent Publications**

Krstolic, J.L., and Chaplin, J.J., 2007, Bankfull regional curves for streams in the non-urban, non-tidal Coastal Plain Physiographic Province, Virginia and Maryland: U.S. Geological Survey Scientific Investigations Report 2007--5162, 48 p. (<http://pubs.usgs.gov/sir/2007/5162/>)

Hayes, D.C., and Wiegand, Ute, 2006, Drainage areas of selected streams in Virginia: U.S. Geological Survey Open-File Report 2006--1308, 51 p. (<http://pubs.usgs.gov/of/2006/1308/>)

Washington

No highway related projects at his time.

West Virginia

- Operates and maintains 14 crest stage gages.
- Provides some funding for operation and maintenance of streamflow-gaging stations.
- Collection of stream geomorphic data in the Appalachian Plateaus physiographic province at USGS streamflow-gaging stations and some ungaged locations.

- Analysis of flood-frequency skew coefficients following WRC guidelines.
- Provide some funding for computation of GIS-based basin characteristics.
- Flood-frequency study following WRC guidelines with 10 years of additional streamflow data and results of skew analysis.

Wisconsin

- **Flood Frequency**
 - A network of 89 crest-stage gages will continue to be operated in cooperation with WisDOT to provide on-going peak-flow data for flood-frequency information and analysis.
 - Completed GIS determination of basin characteristics.
 - Currently working on updating the regression equations using GIS-based basin characteristics. Revised report will be printed in FY2008.
 - Starting to compile GIS info necessary to implement the StreamStats application, which allows for automated determination of basin characteristics and flood frequency analysis for ungaged sites. Expect implementation of StreamStats some time in FY2009.

- **Evaluation of Storm Water Treatment Technologies for Highway Runoff**

Comparing Structural BMPs at Milwaukee's Historic Third Ward River Walk and I-794 Freeway Test Site -The Wisconsin Department of Transportation (WisDOT) is required to improve the quality of runoff from roadways under their control as part of the National Pollution Discharge Elimination System (NPDES) and an agreement with the Wisconsin Department of Natural Resources (WDNR). In addition, future state and federal regulations will prescribe new performance standards for non-point runoff management and calculation requirements for total maximum daily loads (TMDLs) of contaminants discharging in watershed basins.

One way to improve the quality of roadway runoff, particularly in urban areas, is to use structural Best Management Practices (BMPs). There are several commercially available BMPs that could be used, but these new technologies lack field performance testing and validation, especially in Wisconsin type climates. So it is essential to field test these devices to determine their contaminant removal efficiency and practical application for WisDOT.

This study is funded by the National Cooperative Highway Research Program and is being conducted by the WisDOT in cooperation with the U.S. Geological Survey. The objective of this study will evaluate two structural BMPs to determine their removal efficiency.

Data collection and analysis is complete and a final report will be available in 2007

- **Pollutant Loadings to Storm Water Run-Off from Highways**

The Impact of a Highway Sweeping Program-Phase II - This study is in cooperation with the National Cooperative Highway Research Program and is being conducted by the WisDOT in cooperation with the U.S. Geological Survey. The study site is located on USH 151 near IH 90/94/39, in Madison WI. The objective of this study is a continuation of a previous highway sweeping study that will evaluate the effectiveness of a highway-sweeping program as a best management practice (BMP) for reducing pollutant levels. Phase II would address the data collection and analysis issues that occurred during the Phase I study by using new technology for monitoring and calibrating flow, eliminating freeway median area, improved sample processing and change in laboratory procedures for particle size distribution.

Phase I Report

Waschbusch, R.J. 2003, Data and Method of a 1999-2000 Street Sweeping Study on an Urban Freeway in Milwaukee County, Wisconsin, U. S. Geological Survey Open file Report 03-03, 41P.

Data collection is complete and a final report on Phase II will be available in 2008.

- **Evaluation of Storm Water Treatment Technologies for Parking-lot Runoff**

The Wisconsin Department of Transportation (WisDOT) has a Cooperative Agreement with the Wisconsin Department of Natural Resources (WDNR) (November 2002), Trans401 (December 2002), and NR 216 (September 2002), that require the Department to establish a Storm water Management program to reduce Total Suspended Solid (TSS) loading from highway surfaces. The regulations require the Department evaluate and assess best management practices (BMPs). This study is made possible by a partnership with the Madison Gas and Electric Company (MG&E), United States Geological Survey (USGS), Stormwater Management Inc., and the Wisconsin Department of Natural Resources (WDNR). The site is a parking lot located in downtown Madison, WI at the MG&E facilities plant and the BMP to be evaluated is gravity filtration.

This study would complement research just completed on a filtration BMP called the StormFilter (Evaluation of Storm Water Treatment Technologies for Highway Runoff, under the direction of Wendy Braun, WDOT). The StormFilter was evaluated using runoff from Highway 794 in Milwaukee. A 45 percent reduction in TSS loads was observed for the 30 storms used for the evaluation. Before these results are applied to other highways or DOT facilities, such as park and rides, maintenance yards and rest areas, it must be determined if the findings are unique to the characteristics of the runoff from elevated freeways.

Data collection is complete and a final report is scheduled to be available in 2008.

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Data collection is continuing and a final report is scheduled to be available in 2008.

Wyoming

- No highway related projects at this time.