HYDROLINK

A Hydrology and Hydraulics Newsletter

August 2009 Issue: 3

AASHTO Technical Committee on Hydrology and Hydraulics

Message from the Technical Committee on Hydrology & Hydraulics Chair

Mike Fazio, UTDOT

Lately, sustainability has become a buzz word in transportation circles. We are encouraged to use renewable sources of energy, to have energy efficient transportation, buildings, and so on. The importance of becoming sustainable is self evident: we ought to use our limited resources sparingly, using what energy we can produce from clean and renewable sources, if we want sufficient economical and eco-friendly energy available for the future.

In a recent trip to Europe, I visited with a friend who lives in a home built in the 13th century. His home provided shelter for many generations; the energy used to build this home has lasted several centuries, because it was built using proven techniques and prime building materials. Many buildings and roads around the world are functional after centuries because they were designed to last. A sustainable highway is one that lasts.

Florida DOT is investing to discover, design and install drainage facilities that last. Florida DOT requires culverts installed in their system to have a minimum 100-year design service life.

Sustainable and economical drainage infrastructure such as this may need to be replaced or repaired only once in one hundred years instead of two or three times, as currently may be necessary for many pipe installations. We are spending millions of dollars to repair and replace aging culverts, costs that might have been avoided had we invested in longer service life designs.

Only appropriate design, materials, and construction methods can ensure that highways will last longer. To ensure we are building a more sustainable infrastructure, drainage systems should be engineered for the location and conditions where that drainage system is located and each installation evaluated and inspected to verify the required engineering conditions that are essential to achieve a long service life. We all need to become more aware, better equipped, and increasingly vigilant to reach the goal of a truly sustainable infrastructure.

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Technical Committee on Hydrology and Hydraulics at the 2009 Spring Meeting
Lakewood, CO

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BridgeWatch – An Overview of the Software Application

Lotwick Reese, Idaho DOT

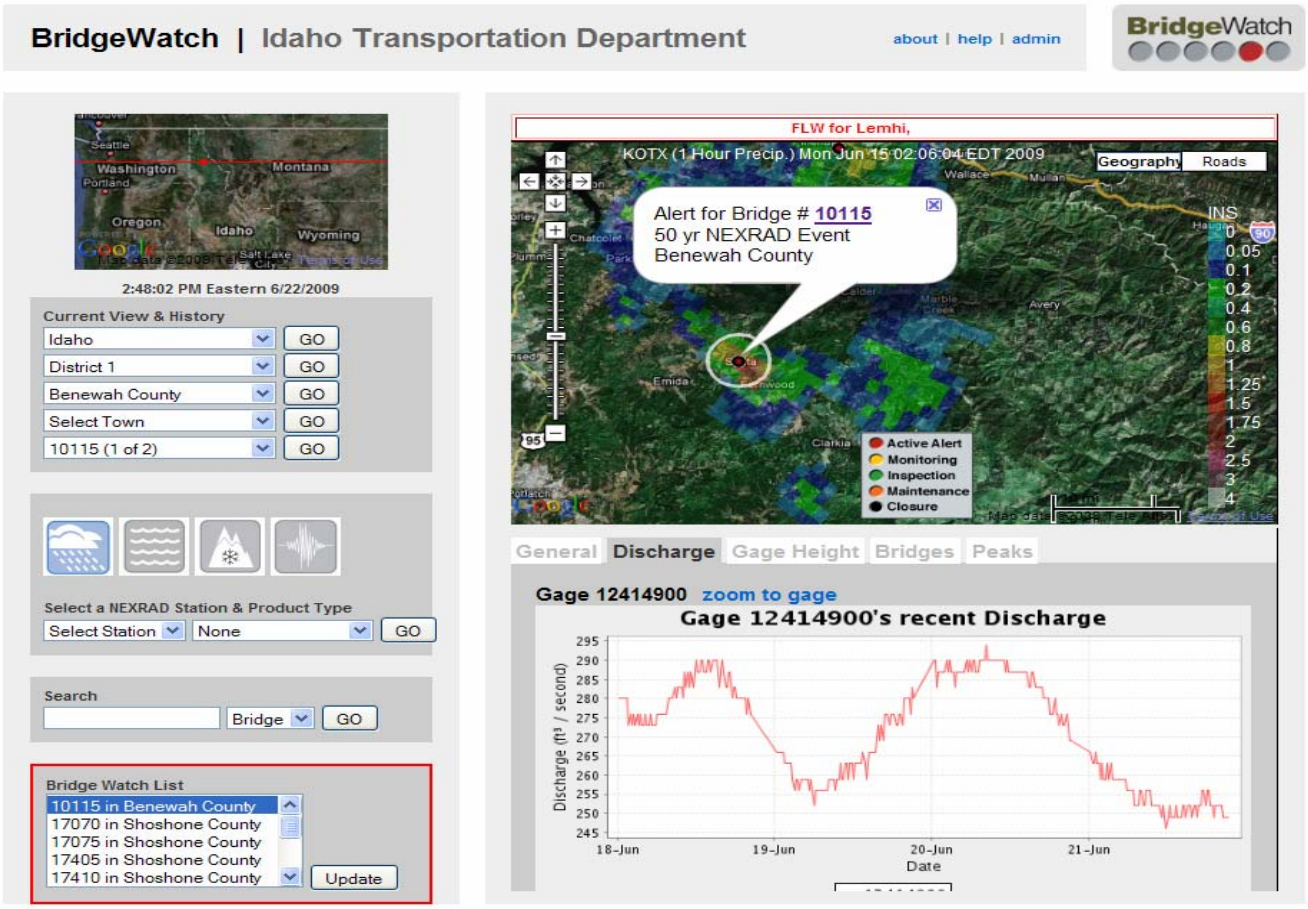
During a flood, bridges are more susceptible to failure from scour caused by flowing water eroding supporting materials from streambeds, piers, and abutments. Many factors can affect bridge scour, such as channel and bridge geometry, floodplain and flow characteristics, streambed materials, channel protection and stability, riprap placement, ice formation, and debris. Mitigating this hazard to public safety has been, and continues to be, a daunting challenge for transportation professionals.

To better protect the Idaho traveling public from sour-critical bridge failure, Idaho's Transportation Department (ITD), has implemented scour-critical bridges into a web-based monitoring software application known as BridgeWatch®.

BridgeWatch was developed by USEngineering Solutions Corp. (USES), a U.S. based software company that provides real-time monitoring technologies for public officials and field-personnel to focus their efforts on specific at risk sites, rather than entire counties or large watersheds.

BridgeWatch compiles, monitors, and overlays multiple streams of official real-time information from the National Weather Service (NWS), U.S. Geological Survey (USGS), and the National Resources Conservation Service (NRCS) into a geo-spatial environment.

The most common cause of flooding is from significant precipitation, and by using NWS radars throughout the region, accumulated rainfall amounts can be displayed and monitored over bridge specific basins throughout the State, and can trigger alerts if measurements exceed assigned critical thresholds. (See ITD BrdigeWatch screen capture below.)



ITD BridgeWatch Alert for 50-yr NEXRAD Event - USES Copyright 2009

However, Idaho's mountains and their snow-pack also pose a threat to scour-critical bridges. During warm periods, significant snowmelt can occur causing severe flooding. NRCS SNOTEL sites provide insight regarding snow-pack and snowmelt that is constantly monitored by BridgeWatch. The application also incorporates USGS stream-gages, constantly watching water height and discharge.

The BridgeWatch application was customized for ITD's needs and specifications. Each site within the program contains critical thresholds set by ITD officials. When a threshold is exceeded, notifications are immediately distributed via email, fax, and text messages to targeted ITD maintenance and engineering staff and local officials. Officials can then remotely access BridgeWatch and not only view site alerts, but also review general bridge specifications, view pictures, plans, inspection reports, and individual bridge plans of action (POA), or simply get directions to the at-risk site.

ITD's BridgeWatch provides multiple tools and critical information in an easily accessible location, that saves time and effort, which is critical during emergencies. Tools like the ticket management system enable ITD staff to digitally document their responses and coordinate the effectuation of scour-critical bridge POAs. USEngineering is constantly working to implement the best data into its programs to provide users with the most accurate view of real-time risks. To learn more about the Idaho BridgeWatch system please contact Mr. Lotwick I. Reese, PE/LS State Hydraulic Engineer, Idaho Transportation Department, Boise, Idaho at (208) 334-8491, lotwick.reese@itd.idaho.gov or visit the USES website at www.usengineeringsolutions.com

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HEC 22, Urban Drainage Design – New Edition

Dan Ghere, FHWA

The FHWA's hydraulics discipline is continually reviewing and updating the technical material on its publications in the Hydraulic Design Series, HDS, and the Hydraulic Engineering Circulars, HEC. The goal is to ensure that these publications present the most up-to-date technology, guidance and research available to the highway industry. Currently, the Second Edition of HEC 22, Urban Drainage Design, dated August 2001 is being updated to reflect a new methodology in storm drain design.

A critical component of storm drain design is the plotting of the hydraulic gradeline of the complete storm drain system to ensure that the design has properly accounted for all energy losses in the system and surcharging of access holes and inlets will not occur. The current methodology for calculating energy losses in access holes presented in the Second Edition of HEC 22 has limitations in some surcharged conditions or when super critical flow is experienced in the storm drain.

A new methodology, developed by Roger Kilgore, of Kilgore Consulting and Management, was presented to FHWA in a paper titled "A Proposed Energy Loss Methodology For Access Holes." The new methodology treats the hydraulic conditions in an access hole similar to inlet and outlet control in a culvert. The procedure for calculating the energy losses associated with an access hole is divided into two basic parts. The first step is a determination of an initial energy level representing the flow conditions dictated by either the inlet or outlet flow controls of the outlet pipe. This initial energy level component is then adjusted for additional losses associated with the flow characteristics of incoming flow in the access hole. The adjustment factors are related to only three inflow conditions: the angle formed between the inflow and outflow pipe, the effects of plunging inflow, and the effects of benching within the access hole.

Laboratory experiments were conducted at the FHWA's J. Sterling Jones hydraulics laboratory in McLean, Virginia under the guidance of Dr. Kornel Kerenyi and Mr. Joe Krolak, of FHWA, to evaluate and verify the proposed new methodology. The theories studied in the research were (1) initial access hole energy level, (2) adjustments for benching, angled inflow, and plunging inflow, and (3) inflow pipe exit losses. The research results confirmed the loss coefficients and procedures presented in the proposed new methodology and were published as "Junction Loss Experiments: Laboratory Report," Publication No. FHWA-RDT-07-036, dated March 2007.

The Third Edition of HEC 22 will provide a detailed and robust step by step procedure that recognizes the many possible flow profiles that occur within a storm drain. This methodology is very conducive to the development of software for storm drain analysis and design. A new project to develop an FHWA sponsored software package has been initiated and is underway. The new methodology has been incorporated into the class room material for NHI course 135027, Urban Drainage Design, and the draft Chapter 7 of the Third Edition of HEC 22, which presents the new methodology, has been printed and is distributed with the class material.

The work associated with the Third Edition of HEC 22 with the incorporation of the new energy loss methodology is being performed by Ayres Associates and is scheduled for publication in December 2009. Please direct all questions and inquiries on the Third Edition of HEC 22 to Dan Ghere, FHWA Resource Center, 4749 Lincoln Mall Drive, Suite 600, Matteson, IL 60443, (708) 283-3557 or by e-mail at dan.ghere@dot.gov. index

HEC 23 Bridge Scour and Stream Instability Countermeasures–New Edition

Jorge Pagan-Ortiz, FHWA

The recent completion of NCHRP projects dealing with scour countermeasure design and specifications and the focus on the development and implementation of Plans of Action (POAs) for bridges identified as scour critical led the Federal Highway Administration (FHWA) to the update of its primary publication on stream stability and scour countermeasures, Hydraulic Engineering Circular (HEC) 23 titled "Bridge Scour and Stream Instability Countermeasures, Third Edition."

The Third Edition of HEC 23, which is being developed in partnership with Ayres Associates, will consist of two volumes: Volume 1, which presents an updated chapter on POA guidance and introduces a standard template and an updated countermeasure matrix to assist the designer on the selection of stream instability and scour countermeasures. Also, Volume 1 presents a new chapter on riprap design, specifications, and quality control; an expanded chapter on biotechnical countermeasures; and an updated chapter on scour monitoring and instrumentation with an installation case study. Volume 2 presents detailed design guidelines on stream stability and scour. Seven new design guidelines have been added to the Third Edition of HEC 23, which now presents a total of 19 guidelines grouped into six categories: stream instability, streambank and roadway embankment protection, bridge pier protection, abutment protection, filter design and special applications.

The Third Edition of HEC 23 will be the primary reference of the National Highway Institute (NHI) training course number 135048, which is currently being updated in another partnership effort between the FHWA and Ayres Associates. FHWA is expecting to complete both, the Third Edition of HEC 23 and its companion NHI training course 135048 in October 2009. Please direct any questions on the Third Edition of HEC 23 and the NHI Course 135048 to Jorge E. Pagán-Ortiz, FHWA, Office of Bridge Technology, 1200 New Jersey Avenue, SE, Washington, D.C. 20590, (202) 366-4604, or by e-mail at jorge.pagan@dot.gov.

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HY-8 Status and Activities

Joe Krolak, FHWA

HY-8 is a computerized implementation of FHWA culvert hydraulic approaches and protocols. The HY-8 program is available at no charge to the hydraulic and transportation communities. The FHWA has been producing computerized culvert hydraulic software since the early 1960's (with the HY-1 program). The FHWA released the initial version of the HY-8 program in the early 1980's. In 2005, the FHWA contracted with the Brigham Young University to develop a 32-bit (and 64-bit) Windows compatible version of HY-8. This version provided graphical user interface (GUI) for the same hydraulic calculations performed in DOS versions of HY-8. FHWA intended to plan and fund this development effort using a series of planned phases.

The first phase resulted in an initial release (version 7.0) that performed basic culvert hydraulics. The second phase (version 7.1) incorporated energy dissipater module; performed hydraulic analyses of embedded culverts; allowed use of modified outlet loss coefficients; incorporates dynamic culvert shape database with

new materials; and implemented various improvements, technical updates, and bug corrections.

Coming Soon

In summer of 2009, FHWA will release version 7.2 of the HY-8 software. HY-8 7.2 represents a "maintenance phase "of the upgrade plan. Version 7.2 incorporates numerous minor enhancements, bug fixes, and other changes. Version 7.2 will serve as the official release until the next development phase is implemented. ATCHH members and State Hydraulic Units should look forward to receiving an e-mail from FHWA describing how to obtain this version 7.2 maintenance release very shortly.

The Third Phase

The next development phase ("third phase") uses a pooled fund effort[1] to fund and support incremental upgrades and additions of features, based on available time, budget, and adoption of new hydraulic practices and techniques.
The project will consist of several tasks, some of which are described below. These tasks are listed in no particular order – where possible, the tasks may be developed concurrently. Some tasks will require technical review and approval by PFP members before any programming efforts. This ensures these correspond to FHWA (or AASHTO) guidance and practices.

- **Hydrograph Routing:** Implement hydrograph routing into the HY-8 program. The routing approach will be consistent with FHWA methods and practices. The data for determining the inflow hydrograph and stage-storage curves would be supplied by the user. The task will also consider additional approaches to enter this information.
- **Hydraulic Jump Code Implementation**: The phase two HY-8 development efforts developed a theoretical framework and "pseudo-code" for computing hydraulic jumps. The FHWA reviewed the resulting product to ascertain whether they corresponded to FHWA guidance and practices. This task will implement algorithms for analyzing hydraulic jumps in available HY-8 shapes. The task will borrow logic from the BCAP program for hydraulic jumps to facilitate the necessary calculations, but will enhance the approach by computing a backwater curve upstream from the culvert outlet.
- **Broken Back Culvert Code Implementation:** Implement algorithms for analyzing broken-back culverts for all currently available HY-8 shapes. Incorporating a broken-back shape into HY-8 represents a major change in coding structure and logic because the hydraulic control for headwater calculations may occur at the culvert inlet, break in slope, or outlet.
- **Allow Modification of the Individual Analysis Discharge Values:** In the past, users have only been allowed to enter a minimum, design, and maximum

[1] For details or to participate in the pooled fund effort (State DOTs or governmental entities), please go to http://www.pooledfund.org/projectdetails.asp?id=428&status=4.

value for discharge. HY-8 computes 11 discharge values based on these three values, and there is no way to edit the individual values that HY-8 computes. The task would then implement a means to allow users to modify the flow values that HY-8 uses to compute the performance table in the Culvert/Crossing input dialog.

- **Horizontal Culvert Barrels:** Implement the ability to analyze horizontally-sloped culvert barrels.
- **Adversely Sloped Barrels:** Implement the ability to analyze adversely-sloped culvert barrels.
- **Review and incorporate NCHRP 15-24 results:** NCHRP 15-24 was intended to refine existing hydraulic loss coefficients and to develop new hydraulic loss coefficients for analysis and design of culverts for conventional and nontraditional, environmentally sensitive installations. FHWA hopes to incorporate the results of this study into the HY-8 program and HDS-5 document.
- **South Dakota's Prefabricated Reinforced Concrete Box Culverts:** The FHWA completed an exhaustive set of tests on the "South Dakota prefabricated reinforced concrete box culvert." This task would incorporate separate inlet control polynomial equations and inlet loss coefficients developed for different combinations of barrel dimensions, fillets, and inlets.
- **Flared End Sections:** Inlet loss coefficients (outlet control) and headwater/depth curves (inlet control) have been developed for concrete and metal flared end sections by Dr. Bruce McEnroe at the University of Kansas. The results were published in TRR 1483.
- **Concrete Open-bottom Arches:** Concrete open-bottom arch culverts have been tested by Professor Donald Chase at the University of Dayton and reported in 1999. Dr. Chase used small scale models on the order of the same size as those used in the original NBS work upon which HDS-5 is based.
- **Maintenance Activities:** on-going maintenance phases.

To date, the States of AL, IA, MN, OH, and SD have agreed to participate in this pooled fund study. (Thank You!).
Their support is enough to begin developing a formal scope of work and move forward to a contract, but not sufficient to fully fund the effort. Therefore, FHWA encourages other State DOTs to also consider making a contribution to this important project.

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HIGHLIGHTS: Concerns of the States

Issue: Are other states being required to consider volume control, not just peak flow in their transportation projects? If yes, what are you doing to meet these new requirements?

Responses:

Maryland requires volume control. For drainage basins less than 2 cfs, it is waived or not required. For areas above that threshold, extended detention is the only approved methodology for volume control.

Another concern of the State for us is turbidity control during construction. I would like to learn what others are doing.

Maryland SHA

Delaware is in the middle of rewriting our E&S control regulations but we do have a few existing watersheds that have volumetric limits. The limits were achieved mostly through extended detention and LID practices.

The proposed approach is to require infiltration of the 1 year event, where at all possible, and better downstream management through watershed timing. The goal of the new approach is to avoid extended peaks by dividing the watersheds up into 3 sections of increasing detention requirements as we move upstream. Given Delaware's smaller watersheds and tidal outfalls, the latter may not be practical in other states.

Our state DEP(DNREC) is in the process of trying to model every watershed so until then, we are falling back on the 10% rule for downstream analysis and safe conveyance. Which is about the point things start to get a bit muddy. I had made a recommendation that we come up with a proportional capacity formula for contributing area based on soils and land use for each section but it did not gain any traction. So for now it is first come, first serve.

In addition, the settlement of a water quality law suite has resulted in the immediate implementation of TMDL reduction requirements on a watershed basis. The end result is that all designs/approaches will have to be consistent with the established watershed plan.

In order to expedite the process and reduce some of the analysis, DNREC has laid out a flow chart that may allow the elimination of pre vs. post analysis if all the criteria can be met. In addition, they have mapped out all the prime recharge and infiltration areas for public use or importation as shape files. We are still working on the nuts and bolts for quantifying acceptable practices.

In a related matter, DelDOT is attempting to limit or eliminate off site conveyance through state r/w and drainage systems, particularly runoff that was not previously conveyed. With the new TMDL regs and enforcement, we can no longer afford to be the conveyor of last resort.

Delaware DOT

In Minnesota there is a lot of discussion about requiring infiltration for construction projects. So far only a few Watershed Districts have adopted rules requiring infiltration but is sounds like future NPDES permits may incorporate volume control requirements. So far most volume control is done using infiltration trenches or infiltration areas. There is some research being done on pervious pavements and amended soils (that reduce runoff). We

do have issues complying in some locations due to high water tables, clay soils, and proximity to water supply wells.

Minnesota DOT

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AASHTO Update – Overivew on EPA Rulings for Effluent Limitations and New Source Guidelines for Construction and Development

Kelley Rehm P.E.

On November 28, 2008 the U.S. Environmental Protection Agency (EPA) EPA published in the Federal Register a proposed regulation to establish technology-based effluent limitation guidelines and new source performance standards for the construction and development industry. More information on this proposal can be found at: http://www.epa.gov/waterscience/guide/construction/ . Since these regulations greatly affect the transportation community, AASHTO quickly became involved in preparing comments to the proposed regulation. A small working group was formed made up of AASHTO members from several states and including members of the AASHTO Standing Committee on the Environment, and the AASHTO Highway Subcommittees on Construction, Bridges and Design. Several conference calls were held to develop comments to the proposed rule and a response was developed. These comments can be seen in the docket folder at:
http://www.regulations.gov/search/Regs/home.html#documentDetail?R=09000064808e001e

On April 1, 2009 the EPA provided a status report concerning its actions through March 2009 with respect to effluent limitations guidelines and new source performance standards for the construction and development industry. During this reporting period, EPA met with several stakeholders to discuss the proposed regulation. Some of the stakeholders consider the proposed regulation to be too costly, infeasible and would like the Agency to consider less stringent requirements. AASHTO agrees with this group and hopes to see exceptions made to the ruling for linear type of construction such as highways. Other stakeholders consider the proposed regulation to not do enough to control stormwater discharges from construction sites.

EPA has met with the United States Department of Transportation to discuss implications of the proposed regulation on road and highway construction projects and has continued to gather data to add to the rulemaking record, including, but not limited to:

a. Data that represents the concentration of pollutants, such as sediment and turbidity, from construction projects that are implementing erosion and sediment controls and pollution prevention measures;

b. Performance and cost data from advanced treatment systems;

c. Data to update and enhance the profile of the construction sector; this data will be used in EPA's evaluation of costs and economic impacts for the final rule.

The comment period closed on February 26, 2009. EPA received several hundred comments from a wide range of industry representatives, federal agencies, state and local governments, non-governmental organizations and individuals. EPA is currently reviewing the comments received and is deciding in a process to determine whether the proposed regulation should be modified. Another progress report is expected from the EPA on August 1, 2009.

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Announcements

Meeting News

The fall 2009 meeting of AASHTO Technical Committee on Hydrology & Hydraulics (TCHH) will be in Indianapolis, IN. The host Mr. Merril Dougherty, P.E., Hydraulic Supervisor of IN DOT, has scheduled this meeting in cooperation with the AASHTO Technical Committee on Environmental Design (TCED) for the week of September 14-18, 2009. The meeting will be for members of these technical committees and invited guests only.

A number of 30 rooms at the Embassy Suites at downtown Indianapolis will be reserved for this meeting, from September 14 to September 19, 2009. This hotel is located across the street from Circle Center Mall, with several restaurants within walking distance. The Hotel rate is $94.00/night with a tax of 16%. The rate can be extended through the weekend. The reservation cut-off date is August 14, 2009. Contact Information is below:

110 West Washington Street, Indianapolis, Indiana, United States 46204
Tel: 1-317-236-1800 Fax: 1-317-236-1816
http://embassysuites1.hilton.com/en_US/es/hotel/INDWWES-Embassy-Suites-Indianapolis-Downtown-Indiana/index.do

The Hotel does provide parking for participants' cars at the cost of $20.00 US dollars /day with in/out privileges. The Hotel does not provide free transport from the Indianapolis airport, but there are private airport shuttle companies (Carey or Unique limo) for shared rides at the cost of $14.00 US dollars/one way. The meeting will take place in the Indiana Government Center, which is located about two blocks from the hotel. This Center is equipped with Web broadcasting technology so that members can participate in the meeting through Video and Audio links. For more information about the Fall 2009 meeting of the AASHTO TCHH, please contact:

Mr. Merril E. Dougherty
Phone : (317)232-6776
Email : mdougherty@indot.in.gov

New Chairman of the TRB Technical Committee AFB60 - "Hydraulics, Hydrology and Water Quality"

Mr. Jon Zirkle, P.E. of the Tennessee DOT (TDOT) has been selected to replace Mr. Brian Roberts, P.E. as new chairman of the TRB AFB60 "Hydraulics, Hydrology and Water Quality" Technical Committee for a three-year term (2009-2012). His chairmanship began in April

2009 and he is busy working for the up-coming 2009 Mid-Year meeting of the committee in conjunction with Stormcom in Anaheim, California from August 17 to August 20, 2009.

Mr. Zirkle is a registered Professional Engineer with the State of Tennessee since 2001. He received his Bachelor Degree in Civil Engineering from the University of Tennessee in Knoxville in 1995 and started working for TDOT that same year. He then got his Masters Degree in Civil Engineering in 2004 also from the University of Tennessee. Since February 2002, Mr. Zirkle has been the Civil Engineer Manager 1 in the Hydraulics Section of TDOT. Mr. Zirkle is also a member of the NSPE-TSPE, ASHE, AWRA and was a panel member of NCHRP project 24-26 "Effects of Debris on Bridge Pier Scour".

Congratulations, Jon. We offer you our best wishes for your new duty and sincerely hope that the cooperation between our committees will continue in the future.

Photos Needed!

The Federal Highway Administration's Hydraulic Team is looking for photos of hydraulics structures with interesting features. The first major category of photos we would like you to send is for bridges. The photos could show flooding, overtopping, scour at piers and abutments, the impacts of channel aggradation or degradation, channel migration, unusual configurations, unusual design elements, bridge deck drainage, and failures. Although it is not imperative, it would be great to have a brief description of the photo that includes: the subject of the photo, where the photo was taken, the date the photo was taken, and who took the photo.

Please send photos to Larry A. Arneson, at larry.arneson@dot.gov. If there are too many photos or if they are too large to send through E-mail, alternate arrangements can be made for sending them. Thank you in advance for your help.

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Membership News

Welcome to new AASHTO Technical Committee on Hydrology and Hydraulics (TCHH) members who joined in 2009, Mr. David Moses of the Kentucky Transportation Cabinet. Mr. Moses is the Chief Drainage Engineer for Kentucky Transportation Cabinet. He graduated from the University of Kentucky with a Bachelor of Science in Civil Engineering in 1993. Since that time he has worked for the Department of Transportation in the Divisions of Construction, Operations and Design, and as a design engineer for GRW Engineering in Lexington, Kentucky. In April 2001 he obtained his Masters of Science in Civil Engineering, with an emphasis in hydraulics, at the University of Kentucky. He is a registered professional engineer and land surveyor in the state of Kentucky. He and his wife Laura, have a 5 year old son Andrew, and 2 year old son John reside in Lexington, Ky.

TCHH is sorry to hear of the passing of Raja Veeramachaneni (FHWA, Director - Office of Project Development and Environmental Review) Saturday July 25, 2009. Raja was a member of TCHH since 1997 and was Chair for two meetings (Fall 2003 at Cody , WY and Spring 2004, Little Rock, AK). Raja resigned from the TCHH after the Spring 2004 meeting. He will be missed.

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Calendar of Events

AASHTO TCHH Fall Meeting
September 14-18, 2009
Indianapolis, IN
Embassy Suites Downtown
(Invitation Only)

33rd International Association of Hydraulic Engineering and Research Congress
August 10 – 14, 2009
Vancouver, British Columbia
http://content.asce.org/conferences/iahr09

45th Annual Water Resources Conference — 2009 American Water Resources Association
November 9 – 12 , 2009
Seattle, WA
http://www.awra.org/index.html

Transportation Research Board
January 10 – 14, 2009
Washington, D.C.
http://www.trb.org/AnnualMeeting/default.asp

This newsletter is published biannually by the AASHTO Technical Committee on Hydrology and Hydraulics. Please send suggestions for articles and comments to: Andrea.Hendrickson@dot.state.mn.us***, or call*** **651-366-4466.**

To be added to the mailing list please send your email to Kelley Rehm at: ***krehm@aashto.org***

For more information on the Technical Committee on Hydrology and Hydraulics see: **http://design.transportation.org/?siteid=59&pageid=1661**

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