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The 2014 National Hydraulic Engineering Conference Exceeds Expectations!

By Cynthia Nurmi

After months of planning, the 2014 National Hydraulic Engineering Conference (NHEC) became reality on the third week of August. The conference, hosted by the Iowa DOT and supported by the AASHTO Technical Committee on Hydrology and Hydraulics, the TRB Subcommittee on Hydrology, Hydraulics, and Water Quality, FHWA, and the USCOE, exceeded expectations with more than 200 attendees and 70 speakers from state DOTs, consultants, academia, and other government agencies.

State and National Practices Shared

Larry Weber of the IIHR opened the 2014 NHEC as the keynote speaker. Mr. Weber highlighted the hydrologic and hydraulic research conducted at the University of Iowa IIHR, as well as the Iowa Flood Center. Then, Iowa DOT and several other states gave their perspectives on issues and the state of the practice of transportation hydrology and hydraulics. FHWA, AASHTO, and TRB provided a national perspective. The audience responded to and posed questions to the panel furthering the discussion of issues and practices. The conference attendees then continued the session discussions in smaller groups during the evening get-together atop the conference hotel, where attendees enjoyed Iowa-themed refreshments. Over the following days, conference attendees partook in presentations on 2D modeling, fish passage, water quality, scour, hydraulic software, climate change, etc.

Keynote Speaker Larry Weber addresses conference attendees.

Corn dogs and bacon anyone?!

(Continued on page 13)

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Upcoming Hydraulic Events

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JANUARY 2015:

- NHI Course 135027—Shorewood, MN - January 6-8, 2015
- NHI Course 135041—Sparks, MD - January 6-9, 2015
- NHI Course 135065—Lacrosse, WI - January 6-8, 2015
- TRB Conference—Washington, D.C. - January 11-15, 2015
- NHI Course 135056—Madison, WI - January 13-15, 2015
- NHI Course 135080—Baton Rouge, LA - January 20-22, 2015
- NHI Course 135027—Madison, WI - January 27-29, 2015

FEBRUARY 2015:

- NHI Course 135056—Milwaukee, WI - February 3-5, 2015
- NHI Course 135065—Kearney, NE - February 11-13, 2015
- NHI Course 135027—Green Bay, WI - February 24-26, 2015
- NHI Course 135048—Lansing, MI - February 24-26, 2015

MARCH 2015:

- NHI Course 135047—San Juan, PR - March 6, 2015
- NHI Course 135041—Helena, MT - March 9-12, 2015
- NHI Course 135041—San Juan, PR - March 10-13, 2015
- NHI Course 135090—San Juan, PR - March 16-18, 2015

For more information on NHI course, please visit: https://www.nhi.fhwa.dot.gov/
For more information on the TRB Conference, please visit: http://www.trb.org/

FHWA Staffing Updates!

Dan Ghere Becomes New Manager!

Dan Ghere, Manager
FHWA Resource Center
Hydraulic TST Manager

FHWA has selected Dan Ghere as the new Resource Center Hydraulic Technical Services Team (TST) Manager to replace Larry Arneson. Dan joined the Resource Center in 2001 after serving 34 years as the Chief Hydraulic Engineer for the Illinois Department of Transportation. While he provides technical assistance in all areas of highway hydraulics, he serves as the Resource Center's technical lead on issues related to urban drainage and pump station design. Another area of specialty interest is design and installation of countermeasures for scour critical bridges. His work activities include conducting drainage reviews of State DOTs, instructing NHI classes, maintaining and updating FHWA technical reference manuals, testing and evaluation of hydraulic software, and providing technical assistance to division offices and State DOTs on all matters related to bridge and culvert hydraulics and to highway drainage. Dan is a Registered Professional Engineer in the State of Illinois and he holds a BS Degree in Civil Engineering from the University of Illinois.

Bart Bergendahl Joins Resource Center

Bart Bergendahl joined the FHWA Resource Center Hydraulics TST in October as a Senior Hydraulic Engineer. Bart will serve the mid-western states with respect to hydraulic and hydrologic technical issues. Bart has more than 35 years of experience in the fields of hydrology, hydraulics, sediment-transport and scour analysis, river mechanics and stream stability, fluvial geomorphology, and urban drainage system analysis/design in both the public and private sectors. He began his hydraulic engineering career with the Federal Highway Administration in 1977 in what was then called the Eastern Direct Federal Division Office in Arlington, VA. He worked 7+ years in the private sector during the 1990's and most recently served as Hydraulic Discipline Lead for Federal Lands. He has a Master's of Science degree in Hydraulic Engineering from Colorado State University, and is a registered professional engineer in Arizona and Illinois. To contact Bart, please call (720) 963-3754 or email at bart.bergendahl@dot.gov.

In the Lab with Kornel

Hydraulic Performance of Shallow Foundations for Support of Bridge Abutments

Lab and CFD Modeling Used to Investigate Riprap Protection of Shallow Foundations

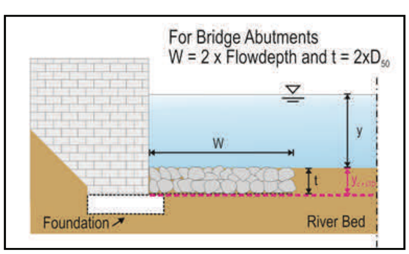
Physical Modeling results showing observed edge failure of the countermeasure.

Researchers at the J. Sterling Jones Hydraulics Laboratory (HRL) are conducting Physical and Computational Fluid Dynamics (CFD) modeling using a scaled model of a Geosynthetic Reinforced Soil (GRS) vertical-wall bridge abutment to investigate the performance of HEC-23 recommended riprap installations for the cases of narrow bridge openings. Preliminary results show how the contracted flow in the bridge opening adjusts in response to variations of bed roughness due to riprap placement. This adjustment increases the magnitude of bed shear stresses on the unprotected channel bed leading to underestimated contraction scour depths. Consequently, the increase in erosion of the unprotected bed may undermine the riprap mattress creating instability, and ultimately causing edge failure of the countermeasure in the bridge opening. Preliminary results of this research study are summarized below:

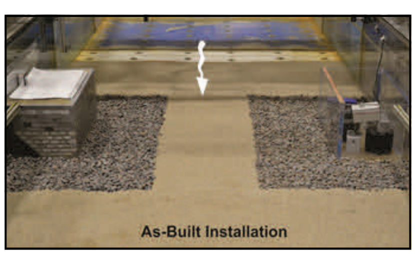
Experimental Case 1: Countermeasure Installation As Recommended for Bridge Abutments

Edge Failure of Countermeasure Observed.

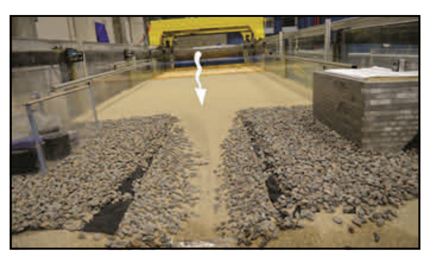
The countermeasure causes increased contraction scour depths undermining countermeasure installation. The countermeasure drops into the main channel where no filter material is placed. The countermeasure extends far enough into the opening to protect the footing.



HEC-23 D.G. 14



Before Test

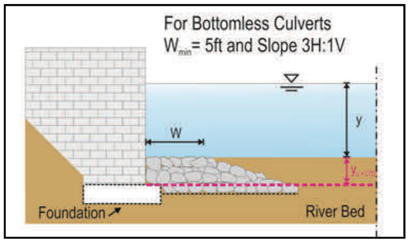


After Test

Experimental Case 2: Countermeasure Installation As Recommended for Bottomless Culverts

Edge Failure of Countermeasure Observed.

Same failure mode as Case 1. Undermining destabilizes sloped countermeasure installation. Extent of countermeasure could potentially be too short. Large countermeasure failure area.



HEC-23 D.G. 18

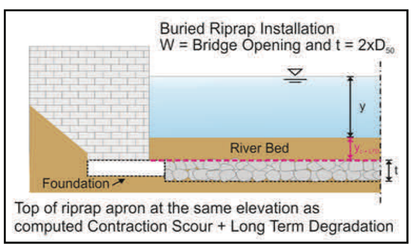
Before Test

After Test

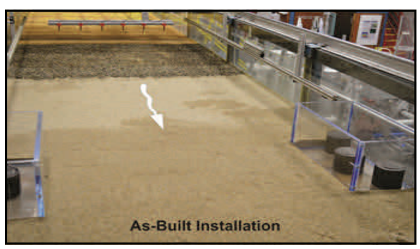
Experimental Case 3: Buried Full-Width Protection

No Failure of Countermeasure Observed.

AOP bed channel forms naturally in the center of the opening. Research will potentially recommend this countermeasure installation.



Proposed D.G. Buried
Full Width Protection



Before Test

After Test

Fish Passage in Large Culverts with Low Flow

The HRL has completed research on the variation of velocity in a culvert cross-section. The researchers corroborated physical modeling with computational fluid dynamics numerical modeling. The published report of the research will be of interest to hydraulic engineers and environmental scientists involved in the design of new or retrofit of existing CMPs for fish passage. You may download a copy of the report at:

http://www.fhwa.dot.gov/publications/research/infrastructure/structures/bridge/14064/

In the Lab with Kornel

Three Dimensional CFD Used in Design of Pier Scour Countermeasures at Santa Ana River Bridge

Scour Prediction

The BNSF Railroad Bridge over the Santa Ana River downstream of Prado Dam in Riverside County, CA is classified as scour critical. The upstream dam, built in 1941, hinders sediment supply, which contributes to a predicted 15 to 18 feet of long term degradation scour. The channel has degraded between 4 and 8 feet since 1978. The pier scour at the 23-foot wide rectangular piers is estimated at 32 feet for a 100 year or greater flood event using HEC 18 with a discharge of 30,000 cfs from the dam and an additional 3,500 cfs of local runoff. The combined 47 to 50 feet of scour at the piers would undermine the pile caps, an event the bridge could not withstand.

BSNF Railroad Bridge

Aerial View of BSNF Railroad Bridge

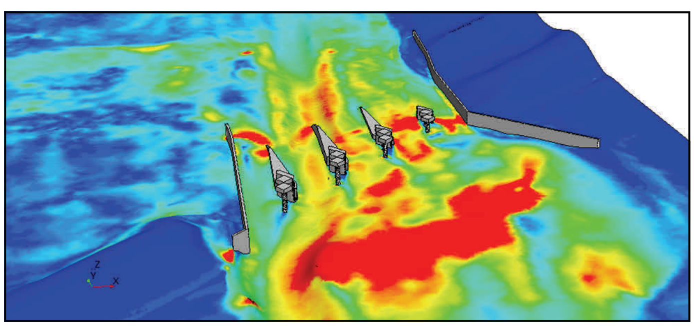
New Countermeasure Concept

The U.S. Army Corps of Engineers, L.A. District, has developed a new countermeasure concept to protect the bridge and satisfy environmental constraints required to preserve the habitat of the endangered Santa Ana Sucker fish. The rectangular piers each have two 6-foot cylindrical piers in the downstream supporting additional railroad tracks constructed in 1995. The proposed countermeasure will encase the four central sets of piers with driven sheet pile and construct triangular concrete pier extensions from 100 to 200 feet into the upstream from each pier group tapering from a 26-foot width at the piers to 2-foot at the pier extension nose. The goal is to shift the potential for local pier scour away from the bridge support piers into the upstream and reduce the local scour at the extension nose by using a narrow upward sloping nose that reduces local eddy size in flood flow and directs the flow upward.

Optimizing Design Via CFD

Through an interagency agreement, Argonne National Laboratory's Transportation Research and Analysis Computing Center (TRACC) used computational fluid dynamics (CFD) to optimize the design of the pier extensions and guide walls that will protect a set of outer piers and abutments on each side of the channel. The CFD model used the full-scale detailed topology 1900 feet upstream, 1500 feet downstream, and 1500 feet across the channel including the flood plain to the west. The design will be tested using a 1/30 scale model at the U.S. Army Engineer Research and Development Center (ERDC) in Vicksburg, MS.

The CFD modelling consists of a set of cases under flood flow conditions including existing topology with and without the pier extensions and several long term degradation scour alternatives with extreme case scenarios where the river migrates into the floodplain at the upstream west bank. The curvature of the west bank guide wall, the length of the pier extensions, and the angle of the extensions are the primary design variables. The pier extensions need to be aligned to the extent possible with the direction of the flow, especially when the flow angle of attack changes more than a few degrees. In that case, the flow distribution between piers changes and creates conditions for a larger local scour hole at the point where flow separates off the nose of the pier extension. The 3D CFD analyzes vertical flow patterns and the consequential impact bed shear stress near the piers and pier extensions. The design goals are to keep the velocity as uniform as possible between piers, to minimize overall bed shear at the bridge and extensions, and, in particular, to verify that the pier extensions shift local high shear zones near the nose of existing piers upstream to the position of the nose of the pier extensions.



Bed Shear stress at piers with the extensions angled at 10 degrees west (left) for existing 2014 topology.

Learn More ...

For more information about this project, please contact Steven Lottes, SLottes@anl.gov, or Cezary Bojanowski, CBojanowski@anl.gov, at Argonne TRACC. For more information about CFD modeling in Highway Hydraulics, please contact Kornel Kerenyi, kornel.kerenyi@got.gov at FHWA Hydraulics Research.

Computing with Scott

SRH-2D Model Update

SRH-2D Improvements

Since initially modifying the SRH-2D model and developing a custom user interface in SMS, the FHWA and USBR have continued to develop the model and improve the user interface. New features are in beta testing and will be available with SMS 12.0 that is anticipated to be released in January 2015. Among the new features are culverts, weirs, gates, bridge pressure flow, and depth varied roughness values. The sediment transport features in SRH-2D are also being integrated into the SMS user interface and should be available in mid-2015.

SRH-2D Training

Many State DOTs have expressed interest in taking training in SRH-2D. To meet this interest, Scott Hogan of FHWA provided a half-day workshop at the 2014 National Hydraulic Engineering Conference in Iowa. Also, FHWA is revising its existing NHI Course No. 135071 "Surface Water Modeling System with Flo2DH and SMS". The revised course with the same course number will have a new title, "Two-dimensional Hydraulic Modeling of Rivers at Highway Encroachments". The course may be scheduled beginning in Spring 2015. If you are interested in hosting or attending the revised course, check the NHI web site: (http://www.nhi.fhwa.dot.gov/). Sign up for session alerts, which will notify you automatically when a course session is scheduled. In addition to the NHI training course, technical assistance and support for state DOTs is available from FHWA Resource Center Hydraulic Engineers.

Where to Download SRH-2D

Links to the current version of SMS/SRH-2D and instructions for installing and registering SMS can be found on FHWA's Hydraulic Webpage under the software section (http://www.fhwa.dot.gov/engineering/hydraulics/software/). The SRH-2D program is automatically included with the current version of SMS 11.2. The SRH-2D program is public domain software and FHWA provides licenses for the SMS interface to all FHWA and DOT employees.

SRH-2D User's Group

Do you want to discuss specific 2D issues with other DOT modelers? Then join the Two-Dimensional Modeling User's Group that will meet via web conference for an hour each month to discuss various 2D model topics, updates, and questions raised by the participants. Sample topics include 2D mesh development techniques, determining model limits, boundary condition options, modeling bridges and culverts, tools for evaluating results, modeling 'tips and tricks' and several more. To sign up and receive meeting notifications, send an email with your contact information and stated interest to Scott Hogan at scott.hogan@dot.gov.

Hydraulic Guidance from Dan

Highway Drainage in Depressed Sections

HEC 22 Depressed Drainage Criteria:

“The relative elevation of the highway and surrounding terrain is an additional consideration where water can be drained only through a storm drainage system, as in underpasses and depressed sections. The potential for ponding to hazardous depths should be considered in selecting the frequency and spread criteria and in checking the design against storm runoff events of lesser frequency than the design event.

Recommended design frequency for depressed sections and underpasses where ponded water can be removed only through the storm drainage system is a 50-year frequency event. The use of a lesser frequency event, such as a 100-year storm, to assess hazards at critical locations where water can be ponded to appreciable depths is commonly referred to as a check storm or check event.”

What forms the basis of this criteria?

The overall consideration of the criteria in HEC 22 is to protect the traveling public. Typically, when a standard curb exists in a sag section of roadway, water can overtop the curb to allow water to “escape”. In many cases, resulting depths are not hazardous (however, the water may still exceed spread limits). “Depressed sections” are sag sections in which stormwater can only escape via a storm drainage system. Underpasses typically fall into this category where the roadway profile restrains ponding water longitudinally while a barrier wall retains water laterally. “Depressed sections” are especially prone to excessive spread and flooding. If the drainage system is not functioning (clogged) or is non-existent or rainfall intensity is excessive, then water can pond to hazardous depths. Hazardous depths include those that are capable of stalling vehicles leaving occupants stranded in the ponded water. The designer must consider factors such as local terrain and site conditions in determining whether the section results in such hazardous depths.

Hazardous roadway ponding in other sections?

The designer should also consider and evaluate roadways with concrete safety barriers or other obstructions along at-grade locations (with or without sags or depressed sections). These barriers or obstructions may prevent water from escaping and create potential occurrences of hazardous depths of ponded water. The evaluation should consider the greatest length of pavement section available for storage of ponded water in minor sags and if there is opportunity for water to escape down grade.

Brian's Updates on Climate Change

Highways in a Coastal Environment: Assessing Extreme Events

Vulnerability of Assets

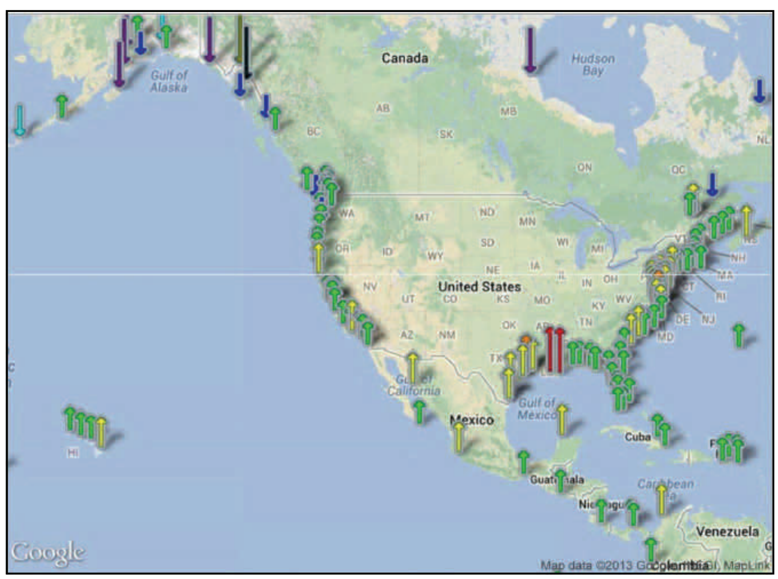
The United States has more than 60,000 miles of road and 36,000 bridges in a coastal environment. To assist states with the design of these roads and bridges, FHWA developed Hydraulic Engineering Circular (HEC): "Highways in the Coastal Environment," HEC-25 (2nd ed., FHWA 2008). However, many states and local communities are beginning to look beyond design to assessing the vulnerability of assets due to changing sea levels and extreme events. To assist states and communities with this assessment, the FHWA has developed a supplement to HEC 25—HEC 25, Volume 2, "Highways in the Coastal Environment: Assessing Extreme Events" (HEC-25 v2). The supplement focuses on quantifying exposure to sea level change and storm surge and waves that may intensify due to climate change.

Identification of Relevant Coastal Processes

One of the first steps in assessing the vulnerability of assets is to determine which coastal processes are relevant to the asset and could change with time. Chapter 2 of the supplement focuses on two of these processes: coastal water levels and waves. Coastal water levels change daily via tides, periodically due to storm events (storm surge and wave setup), or long term due to climate change (sea level rise). Wave height, in turn, is dependent on the water depth and so as depth increases so will the wave heights.

Regional Differences in Water Levels

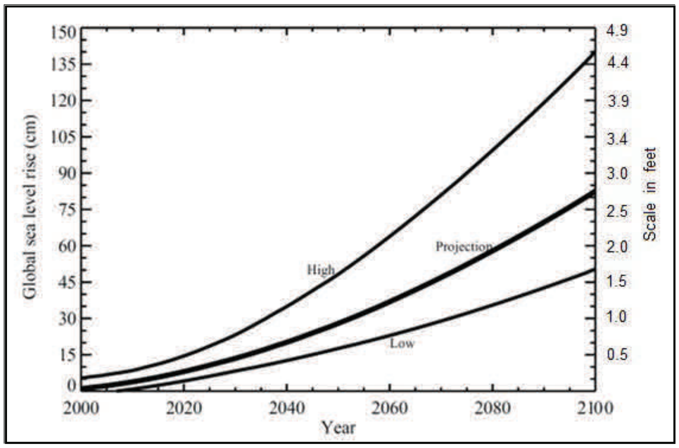
The components of coastal water level (tides, storm surge, wave set up, sea level rise, etc.) vary geographically. Therefore, HEC-25 v2 has grouped the discussion of the components into four general regions: Gulf of Mexico and South Atlantic Coast, Mid-Atlantic and New England Coast, Great Lakes Coast, and Pacific Coast.



Variation in Sea Level Rise

Future Sea Levels

In addition to geographic variations in the coastal water level, one should consider temporal changes due to climate change. Specifically, one should predict the sea level changes throughout the design life of an asset. To predict the future sea level, one begins with the current sea level for the local area (see http://tidesandcurrents.noaa.gov/) and then adds the projected future sea level change based on the life of the asset, the importance of the asset to the transportation network, and the potential consequences to life and property if the asset were to fail or be significantly damaged. Chapter 2 of HEC-25 v2 illustrates this process for determining future sea levels.



Example of Future Sea Level Curves

Risk to Assets

Another aspect of the vulnerability assessment is to determine the tolerable risk for the asset. Risk is the combination of the probability of an event occurring and the consequences of failure. Chapter 3 of HEC-25 v2 discusses several existing methods for determining the probability of the event and describes some of the types of failures (damage) that can occur.

Adaptation to Overcome Risks

Once vulnerability is assessed, one should plan how best to overcome potential risks or how to make the asset more resilient to sea level change and extreme events. Chapter 3 discusses several strategies for adaptation, including manage and maintain, increase redundancy, protect, accommodate, and relocate.

Level of Effort

Depending on the asset and the purpose of the assessment, the level of effort of the vulnerability assessment will vary. For example a very quick, low level effort may be to look at a FEMA map and then add any potential sea level change to determine the potential surge and wave levels the asset will encounter. When the asset is very costly to replace, then a more in depth level of effort may be merited, such as determining future sea levels and then running coastal numerical models to determine the surge and waves on top of the future sea levels. Chapter 4 of HEC-25 v2 discusses three levels of effort. Chapter 5 walks through various scenarios using the three levels of effort to exemplify the assessment process.

Brian's Updates on Climate Change

Gulf Coast Phase 2 Climate Study

Study Overview

The U.S. Department of Transportation (U.S. DOT) conducted a comprehensive, multi-phase study of the Central Gulf Coast region to better understand climate change impacts on transportation infrastructure and identify potential adaptation strategies. For Phase 2 of the study, U.S. DOT sought to develop methods for evaluating vulnerability and adaptation measures that could be used by other transportation agencies and pilot tested them on the transportation system in Mobile, Alabama. The project team evaluated the impacts on six transportation modes (highways, ports, airports, rail, transit, and pipelines) from projected changes in temperature and precipitation, sea level rise, and the storm surges and winds associated with more intense storms. The project resulted in a detailed assessment of the Mobile transportation system's vulnerability as well as approaches for using climate data in transportation vulnerability assessments; methods for evaluating vulnerability and adaptation options; and tools and resources that will assist other transportation agencies in conducting similar work.

Rollout in January

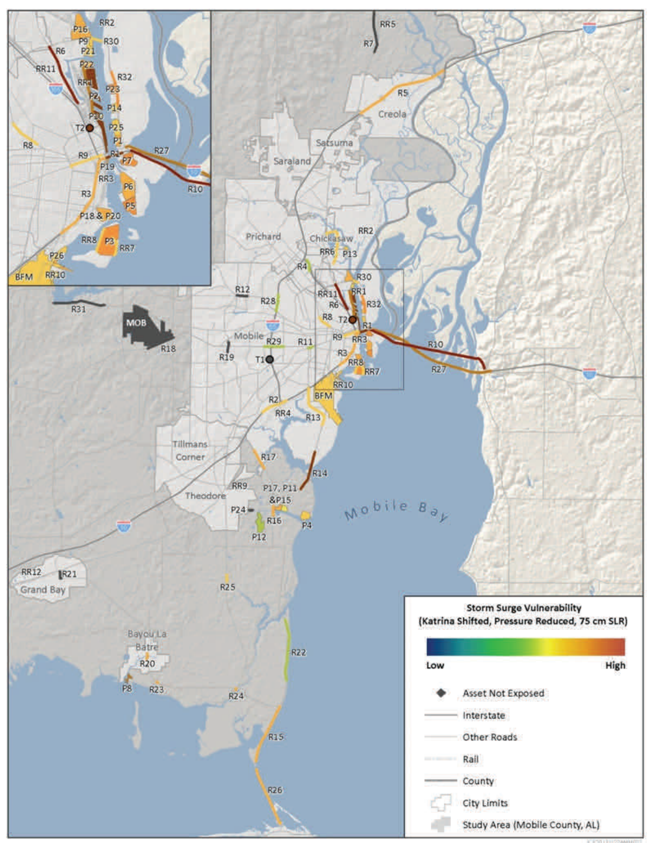
Results from the study as well as an overview of the free, downloadable, climate data and vulnerability assessment tools will be presented in a webcast event to be held on January 22, 2-3:30pm (Eastern Time) from DOT headquarters in Washington, D.C.

Additional Information

Stay tuned for further announcements via GovDelivery and on the FHWA Climate Adaptation website under upcoming events: http://www.fhwa.dot.gov/environment/climate_change/.

Further information on the Gulf Coast Phase 2 study can be found at: http://www.fhwa.dot.gov/environment/climate_change/adaptation/case_studies/gulf_coast_study/gcsph2.pdf

or contact Brian Beucler at (202) 366-4598 or email at brian.beucler@dot.gov.



Overview of Project

2014 NHEC, cont.

New in 2014

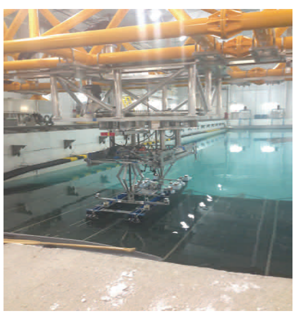
New to the conference this year were two pre-conference workshops. Greg Grenato of the USGS taught a workshop on the SELDM water quality software. Scott Hogan of the FHWA taught a workshop on the updated SRH-2D software. Both sessions were well attended.

The Flumes Return

The NHI flumes returned to the conference this year. During breaks, attendees learned much about hydraulic properties of culverts from demonstrations and mini-lectures by Dr. Eric Brown of FHWA. Attendees also learned about coastal hydraulics from demonstrations in the coastal wave flume run by Dr. Brett Webb of University of South Alabama.

Attendees watch flume

Amazing Field Trip



Wave Flume at IIHR

The field trip for the 2014 NHEC included visiting the renown University of Iowa Hydraulics Research Labs (IIHR), where attendees observed research in traditional flumes and a coastal wave flume and then talked with researchers on the projects. Next, attendees visited a flood protection site to learn about the design and construction of mitigation measures to protect the town of Coralville from future Iowa River flooding.

Mark Miles Award

To honor our colleague and friend, Mark Miles, State Hydraulic Engineer of Alaska, who died suddenly in 2006, the NHEC presents the Mark Miles Award. The Award honors and recognizes the contribution of its recipient to the transportation hydraulic engineering community. Dr. Larry Arneson was selected as the recipient of this year's Mark Miles Award. Congratulations Larry on an award that recognizes your distinguished career and tremendous contribution to the hydraulic engineering community.

Dr. Larry Arneson

Presentation Recordings

PowerPoints and videos of the 2014 NHEC presentations have been uploaded to the University of Iowa Library. To view the presentations and videos go to http://ir.uiowa.edu/nhec2014/.

Acknowledgements

We would like to thank the following for their contributions to the articles in the newsletter:

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Kornel Kerenyi
Oscar Suaznabar

Argonne National Lab
Steven Lottes

FHWA Hydraulic Contacts

The FHWA Hydraulic Staff are available to assist you with FHWA Hydraulic related issues. A list of Hydraulic Staff may be found at:
http://www.fhwa.dot.gov/engineering/hydraulics/staff.cfm

NHEC 2014
National Hydraulic Engineering Conference
Designing Sustainable Infrastructure in a Changing Environment

2014 NHEC
Videos/Presentations
Available Now!

http://ir.uiowa.edu/nhec2014/

U.S. Department of Transportation
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HYDROLOGY AND HYDRAULICS NEWS

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