I still remember those early moments during my first few years as a new member of TCHH, when other members introduced themselves as “State Hydraulics Engineers.” At the time I thought to myself, ‘Will I be able to meaningfully contribute? Am I valuable to this group?’ I still do not know the answers, but I can confidently say that I have done my best. I listened. I learned. I grew. It has been a transformative 11-year journey, and for the past three years, I had the privilege to serve as Chair. And it is time to pass the torch, and I am certain that current Vice Chair Michael Hogan will carry it well. The committee had many retirements and departures and now it is reenergized with many new appointments.

For those of you who may be thinking or debating about joining the committee or serving as a chair, I would like to offer some of my thoughts as I reflect upon some of the many questions I had myself and someone in our field may ask of themselves.

What was it like serving on TCHH? Do you have any regrets?

It has been a fantastic journey. I listened and learned. I grew personally and professionally. I started out having doubts about myself and my abilities, which gave way to feeling pretty good and finally and more importantly being humbled by my experience. I studied my predecessors and received kind mentoring. I have no regrets, just well-wishes and hopes to the future. When I first joined, TCHH had plans to publish AASHTO Drainage Guidelines and an AASHTO Drainage Manual. The vision for these documents included policies and procedures. These endeavors were accomplished with the publication of Guidelines in 2007 and Manual in 2014.

A current endeavor for TCHH is to continue to represent the hydrology and hydraulics community, update manuals as needed and to develop a publication that will provide insight into hydraulics and hydrology for practicing engineers that most seasoned engineers take for granted. This publication is also intended to include state-of-the-art guidance, research, or knowledge that is being developed by one or more state DOTs. (Each state’s unique needs may be beneficial to others.) This publication would be new for the committee. The state-of-the-art information available through this publication may eventually result in additions or changes to the content in subsequent updates to the manual or guidelines. The vision for this publication inspired me to serve on this committee. It offered the chance to learn new things and allowed me to directly participate in being an integral part of strengthening the knowledge and practice of what we do. Currently a workgroup called “The Exchange” within the committee will start development of this publication that focuses on exchange of information.

As the drainage manual and guidelines updates were completed, committee members began an intense discussion for possible updates that branched into many different directions and specifically on climate change affecting hydrology and hydraulics. As leaders for the Hydrology and Hydraulics community, the technical
committee needed to react -- and we did. “The Exchange” took a momentary back seat so that the committee could provide a quick and succinct response on climate change. After many long meetings and discussions, the group agreed and recommended that applied research was needed to translate climate science into useful information for engineers. The research needs were developed, funded, and quickly launched. As the research progressed, work for “The Exchange” regained momentum. I am excited about the participating members and leadership of this workgroup. I am very hopeful that this effort will be successful, in-part due to the ingenuity of the selfless characteristics of a non-profit organization of filled with highly skilled professionals from across the nation.

**Do I need to be a genius to be a member or chair of TCHH?**

Of course not, although it never hurts. The reality is that you do not need to know everything – and neither does anyone else. You are there to share your knowledge with others. Moreover, others are there to share their knowledge with you. It is about being an equal partner within an organization of professionals where humbleness is across the board. Listen carefully; you will learn and understand the message. The intent of the message is to make you successful. I know I have learned and grown, both personally and professionally, by being a member of this committee. I am forever grateful.

**Then why leave?**

I am a little over two-thirds into my career and I feel it is time to transition from being the student, perpetually learning and trying to be a good steward of an organization, to doing deeper, personal soul searching, which allows me to open up opportunities for very talented emerging members to steer the organization. I will continue to serve as part of the National Highway Cooperative Research Program as well as continue involvement through other means. With nothing but best wishes to this committee, in serving the mission of AASHTO, I will be departing from TCHH, at the end of the autumn 2016 meeting which is jointly held with the National Hydraulics Engineering Conference in Portland. If you have not yet registered for this conference, please do so. It has always been a very powerful conference and I am sure it will be again this year. I look forward to seeing you there.

Sincerely,

Karuna

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**11th hour NHEC 2016 Reminder!**

Matthew O’Connor, Illinois DOT

The National Hydraulic Engineering Conference will be held next month in Portland, Oregon, running August 9 through 12. Themed "Hydraulic Engineering Diversity - Bridging Coast to Desert", the conference includes over 70 presentations and three half-day workshop options. If you opt out of the workshop, field trips to nearby Bonneville Dam on the Columbia River and ODOT’s Stormwater Treatment Test Center are available. If you have not registered, registration ($375) closes July 31. Agenda, registration and lodging information can be found at the conference website shown here. Note that pre-registration is required for workshop participants and the dam trip. Please contact Beth Sandver at Beth.R.Sandver@odot.state.or.us to pre-register for a workshop or dam trip. No international attendees may visit Bonneville Dam due to security clearance requirements.

[https://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/Pages/conferences/NHEC/2016_NHEC_Conference.aspx](https://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/Pages/conferences/NHEC/2016_NHEC_Conference.aspx)

On behalf of Cynthia Nurmi, FHWA Hydraulics and the NHEC Steering Committee Chair, we hope to see you next month in Portland!
MnDOT’s New Culvert Inspection Tool – The HIVE

Better information leads to better decisions. A general rule in design, but what does this better information cost? For culverts that do not allow physical entry by a human, the answer has been upwards of $100,000 for a fiber-optic remote control video crawler along with a van to haul all the equipment and cables. The unit also requires a two-person crew to operate. But, after some research and development of a new culvert inspection unit in MnDOT District 6, the cost for this better information may be more attainable for departments tasked with managing hydraulic infrastructure. The total cost is a little under $2000, can be operated by one person, and the entire unit fits in a standard 11x17 office paper box. It is called the Hydraulic Inspection Vehicle Explorer or HIVE.

The Problem

Prior to the development of the HIVE, smaller diameter (12”-30”) culvert conditions were assessed by only the visible portion of the pipe looking from the end of the apron. Unfortunately for this inspection method, culvert condition at culvert ends can be drastically different than the culvert condition under the road. So, if the last few sections of a culvert were bad, the culvert would be replaced assuming the entire culvert was bad. No other information was available to determine otherwise. As a result, there would be times that excavation during construction revealed that the culvert under the road was in good condition. However, the road was already ripped up, so the full replacement was completed. In these instances with better inspection information under the road, the repair could have been to salvage & install a few pipe sections in the inslope, instead of a full culvert replacement. A salvage & install repair that doesn’t require removing pavement in the road is typically 5% or less of the cost of a full replacement.

Alternatively, culverts needing replacement have been missed during pre-project inspections using observations from the end of the apron. In this scenario, the culvert appeared in good condition at the ends, but the culvert under the road was in poor condition. Then, a year or so after the project was completed; a dip or hole in the road would develop due to a culvert that should have been replaced. This scenario requires additional time to coordinate an individual culvert repair, separate mobilization cost or maintenance forces cost, a patch in the newly rehabilitated pavement, and additional risk/inconvenience for the traveling public.

The Development

Rob Coughlin, MnDOT District 6 Lead HydInfra Inspector, believed he had the solution to this problem; an off the shelf remote control car that can maneuver a camera in a small diameter culvert to see the condition under the road. He shared this idea with Kristoffer Langlie, MnDOT District 6 Water Resources Engineer, who happened to have some experience with action cameras and how they connect to tablets via Wi-Fi from a few skiing trips in the Rockies.

From there, Rob came up with a parts list and rough cost. Then to get approval for funding, they both worked on documenting the benefits a tool like this would have for culvert inspection. It was at that point the project caught a big break. While double checking the record-keeping process with the Inventory Center, Rob ran into Chade Trupe, MnDOT Transportation Materials Technician and Remote Control Car Hobbyist.
Chade took the idea and brought in a few improvements from his remote control car expertise. Of particular note, Chade recommended a waterproof remote control vehicle that he knew to be very durable, and a more elegant method to control the tilt and pan of the action camera. It was at that point, the HIVE was born. At $400 for the waterproof action camera, $300 for the tablet, and $900 for the waterproof 4x4 remote control car & accessories, it is low-cost and durable video inspection crawler. The assembly requires approximately 8 hours of time by someone with basic small electrics skills (soldering).

The Results

Going into this project, it was not known what range the video feed would reach inside a culvert. It isn’t something hardware manufactures really consider or have specifications for. However, the design was given the go-ahead because even a short range of 30 feet would have been a benefit over current practices. Luckily, when the equipment came in, the range of the Wi-Fi connection for the video feed exceeded 100 feet in most culverts. And, it can vary between 50 feet and 250 feet, depending on culvert size, culvert material, and line of sight. To maximize the range, a few different tablets were tried until one was found that worked very well.

When put in use for inspections, the HIVE has provided the necessary information to make the correct decision for the problem. Specifically, the HIVE was helpful on a culvert failure on Hwy 26 that caused a hole in the paved shoulder of the road. Based on the inspection from the apron end of the 24” Corrugated Metal Pipe (CMP) culvert, the rust and holes in the pipe invert appeared to extend throughout the entire culvert length. However, the HIVE revealed that only the last 12 feet of the culvert was in poor condition. Therefore, the repair was ~$1000 for a paved invert, as opposed to ~$45,000 for a full culvert replacement.

Another example was on a project inspection for an upcoming project on Hwy 52. The HIVE identified eight Reinforced Concrete Pipe (RCP) culverts with major failures under the road that could not be seen from normal end of apron inspection on small culverts. These major failures included joint separations between 5”-8” with exposed soil visible with the HIVE. The culvert repairs are now included in the upcoming construction project.

One noteworthy refinement discovered through use: a strong recovery cable is needed, not just a string. We recommend a 1/16” stainless steel cable on a spool with color-coded markings every five feet to aid in determining repair location.

In summary, the HIVE provides better information to make better decisions, which in turn reduces the cost of managing hydraulic infrastructure. The HIVE is an innovative way to view the inside of small diameter culverts without spending large capital costs. It has been invaluable for determining the accurate repair on both construction projects and maintenance repair issues.
A 108 inch span structural plate conduit under Interstate 90 in Lorain County, Ohio was inspected by Ohio DOT culvert inspection staff in early 2012. The culvert was built in 1966 and it conveyed drainage under an on-ramp, interstate mainline, and an off ramp under approximately 34 feet of fill. The total length of the culvert is 342 feet and the material consisted of 7 gauge (0.188 inches) galvanized structural plate at the upper portion with 5 gauge (0.218 inches) galvanized structural plate at the invert. The Ohio DOT culvert inspection frequency for spans greater than 48 inches occurs every five years. However, this was the first inspection for this structure under the newly focused Culvert Management Program that became a major initiative in May of 2011.

Invert metal loss was found throughout the conduit with backfill loss and metal plate failure near the inlet side. A longitudinal crack in the pavement and a slight dip in the guardrail was present at the surface near the edge of pavement on the inlet side indicating embankment movement. The embankment showed signs of slow movement which was visually evident by the bends in the trunks of woody brush and small tree growth. The progression appeared to be accelerating as the slope on the embankment had an obvious depression. The culvert was considered to be in “Critical Condition”, which required immediate attention.

The failed portion of the culvert extended from the inlet to approximately 75 feet into the pipe. The longitudinal seams along the failed portion were cracked and yielded. Outside of the failed portion, the shape, alignment, and seams of the structure were very good with some invert pitting and minor loss. The sides of the pipe were sound tested at the 4 and 8 O’clock positions, which indicated that there was solid backfill material behind the conduit outside of the failed portion of the conduit. The streambed at the inlet contained eroded shale that was angular, sharp, and easily transported by the flow velocity and the pH of the water indicated a value of 8.2.

The 5 gauge material along the culvert invert, falls short of the required 75 year abrasive durability design outlined in the Ohio DOT durability design criteria, which would have required a 3 gauge material or a 12 gauge material with concrete invert paving. However, this culvert was designed and constructed prior to the durability design criteria was implemented in the 1980’s.

Several field visits were made to the culvert to access for movement and to develop a plan of action. Soil borings were taken above the culvert along it’s length at four locations to determine if voids were present; none were found.
The desire was to select a rehabilitation method that would not require open-cut or major disruption to traffic on Interstate 90 if feasible. One of the visits included a tunneling contractor whom was consulted to discuss the feasibility of replacement of the damaged portion of the culvert. Two rehabilitation options were considered feasible: culvert slip lining or tunnel liner replacement of the damaged portion with concrete field paving of the entire culvert. The tunnel liner option would commence at a location inside the existing culvert that was structurally sound. The diameter of the tunnel liner would be slightly smaller than the 108” existing conduit such that it would fit inside the existing structure and pieces of the host conduit would be removed as work progressed through the failed area.

Culvert slip lining would require a significant downsizing that would raise the headwater and limit future rehabilitation methods. Tunnel liner replacement of the damaged portion with concrete field paving of the entire culvert would maintain the headwater and allow for future slip lining (with headwater increases); however it had never been utilized by the Ohio DOT for partial rehabilitation.

The tunnel liner option was selected and the work commenced in May of 2012 under an emergency project. The scope of work included replacement of 76 feet of failed structural plate with 102 inch diameter 4 flanged tunnel liner plate with a thickness of 7 gauge (0.188 inches), pressure grouting of voids behind the tunnel liner plate, concrete field paving of the tunnel liner plate and existing 108 inch structural plate, and restoring the work area.
The work started on the inside of the culvert at 76 feet from the inlet and worked towards the inlet opening. Access to the work area was through the outlet end of the culvert and material was conveyed via a rail car system.

Temporary bracing was installed throughout the failed area during the tunneling operation to minimize the potential structure collapse and embankment failure. Sections of existing structural plate and hand mining of backfill was removed as required to construct the tunnel liner plate. Pressure grouting behind the installed tunnel liner plate was applied after the tunnel liner was constructed to completely fill any voids in the backfill. Concrete invert paving was applied to the new tunnel liner plate and the existing structural plate to complete the installation. The work was performed in nine weeks at the cost of $345,000 with no impact to the travelling public.

The value of the Culvert Management Program was realized by the discovery of the failed structure that could have been disastrous and more expensive coupled with impacts to the travelling public. It also highlights the value of the Culvert Management Program that could have discovered the culvert before the partial collapse had occurred, which would have allowed a more cost effective rehabilitation method such as concrete field paving. In addition, the method of replacement of a portion of a culvert with tunnel liner plate was successful and it has since became another available tool for situations that are warranted. The same method was employed on a project in Central Ohio in 2015 when an existing conduit was discovered during an active construction project.

Welcome New Members!

Jeff Syar
Ohio DOT

Jeffrey E. Syar is a graduate of Ohio University (go bobcats...not buckeyes) with a BS in Civil Engineering. He performed work as a Transportation Design Engineering Consultant for 6 years after college with an emphasis on Hydrology and Hydraulics. He has been employed at the Ohio Department of Transportation for 14 years, which consisted of 9 years of Hydraulic Engineering and 5 years in Aerial Engineering as the LiDAR/Photogrammetry Section Manager. He has been serving as the Administrator of the Office of Hydraulic Engineering (OHE) for the past 5 years.

OHE is responsible for hydraulic design standards and policy for all surface drainage systems and bridge structures owned and maintained by the Department. Further responsibility includes: conduit durability, culvert inspection and inventory program, post construction storm water best management practices, and the Department’s Municipal Separate Storm Sewer System (MS4) program.

OHE is active in research topics relating to the Office’s responsibilities. Active research projects include: Culvert Durability, Thermoplastic Conduit Re-rounding, Structural Benefits of Concrete Invert Paving, TSS in Urban Runoff, Catch Basin Filters, and participation in several Pooled Funded Studies.
Jeff is active in TRB committees ASF40-Subsurface Soil-Structure Interaction and AFF70-Culverts and Hydraulic Structures. He is also active in AASHTO NTPEP technical committees Spray Applied Liners and Corrugated Metal Pipe.

Jeff may be contacted by mail at the Ohio Department of Transportation, 1980 West Broad Street, Columbus, OH 43223, by phone at 614-275-1373, or by email at jeffrey.syar@dot.state.oh.us.

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**Stan Hopfe**  
**Texas DOT**

Stanley (Stan) Hopfe is a skilled engineer specializing in hydraulics and drainage. Since the beginning of his career in 1980, he has gained considerable experience in planning, design, and construction of major flood control and civil engineering projects. His experience has focused on hydraulic/hydrologic modeling, regional drainage studies, Flood Insurance Studies, channel design, roadway design, industrial drainage design, pumps stations, drainage structures, storm sewer systems, detention facility design, levee design, dams, scour analysis, LOMR/CLOMRs, and development of industrial and construction pollution prevention plans. Furthermore, Stan has served as a project advisor for over ten H&H research projects for TxDOT and NCHRP.

Stan has provided TxDOT statewide hydrology and hydraulic support for the past 11 years, and promoted last year to TxDOT's Chief Hydraulics Engineer. Prior to joining TxDOT, he worked eight years with the Harris County Flood Control District in Houston, Texas, and 19 years in the engineering consulting business on numerous flood control, industrial, and transportation-related projects. As an engineering consultant, he severed over 8 years as a Director of Hydrology and Hydraulics. Stan has a BS from the University of Houston. He is licensed Professional Engineer in the State of Texas and Certified Floodplain Manager.

Stan may be contacted by mail at the Texas Department of Transportation, 118 E. Riverside Drive, Austin, TX 78704, by phone at 512-416-2219, or by email at stan.hopfe@txdot.gov.

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**Julie Heilman**  
**Washington State DOT**

Julie Heilman has over 15 years of engineering experience in transportation, hydraulics, construction, and construction management; all of which she has obtained through her career with the Washington State Department of Transportation. She is currently serving as the State Hydraulics Engineer for the Washington State Department of Transportation. She received her Bachelor of Science at Washington State University and is a licensed Professional Engineer in the state of Washington. She manages programs to serve as support statewide in Stormwater, Fish Passage, Hydraulics, and Hydrology. As the State Hydraulics Engineer her duties include: Leading the Fish Passage Program within the hydraulic section, reviewing fish passage projects, hydraulic structures, and stream bank erosion control and stabilization countermeasures. Her and her staff serve as a consultant for complex and unique hydrologic, hydraulic, and river engineering issues statewide including as an emergency response team. She performs and reviews appropriate design analyses to predict scour depths at bridges and assists in determining intermediate pier locations and bridge span lengths in support of the WSDOT Bridge Office and develops and establishes statewide design criteria for roadway drainage, stormwater quality treatment, stormwater quantity control, bank stabilization, scour countermeasures, and bridge scour. She likes to get her feet wet by performing field inspections of drainage sites, bridge sites over water crossings, and erosion sites near rivers and fish passage barriers. She has extensive experience working with inter-disciplinary teams inside and outside of the department that include...
transportation designers, water resource specialists, biologists, geomorphologists, geotechnical experts, and structural specialists.

Julie can be contacted at the Washington State Department of Transportation 310 Maple Park Ave SE, PO Box 47329, Olympia, WA 98504-7329, by telephone at 509-577-1703, or by email at heilmaj@wsdot.wa.gov.

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Reese Celebrates Half a Century of Public Service, Announces Retirement

Rachel Westerfield, Mississippi DOT

In late February 2015, Lotwick Reese achieved a half-century of public service. It’s a staggering number, and not many achieve this depth and breadth of public service. As Reese chooses to walk away, he leaves with a refreshingly humble attitude and a well blazed trail behind him. He said if he ever wrote his memoirs, the title would be “Someday I Hope to Become a Great Engineer” but those lucky enough to know him understand that he is already there.

“Lotwick epitomized hard work, keen hydrologic and hydraulic knowledge and insights, and a collegial disposition!” – Joe Krolak, FHWA Team Leader and Principal Bridge Engineer, Hydraulics

When Reese started with the Idaho Highway Department (later Idaho Transportation Department), gasoline was 19 cents a gallon and he earned $1.30 per hour. His first semester's tuition in college was $160. He bought a brand new station wagon for $2,800. From typing all correspondence with an Underwood typewriter using carbon sheets for copies and using an old Monroe hand-crank calculator to run all computations to computers and cell phones, things have changed dramatically over the years.

Reese has worked on many hydraulics challenges at ITD over the years, some of the milestones are:

- One of his first assignments as state hydraulic engineer was for Reese to investigate why the inverted siphon under the Interstate 15/Malad Interchange would not carry water. He took the Malad Residency Survey Crew out and after some surveying found the siphon had been constructed upside down. In other words, the outlet elevation was higher than the inlet elevation. Reese re-designed the siphon.

- As chairman of the Interdisciplinary Scour Committee, Reese’s team prepared scour evaluations and action plans for over 400 scour-critical bridges throughout the state. Idaho got a late start, but became one of the first of the 50 states to complete the scour evaluation of all their bridges. The Federal Highway Administration requested permission to post Idaho’s “Plan of Action” office manual and field manual on their website as a model for other states to use.
In the fall of 2001, Reese coordinated the design and construction of one of the first A-Jacks installations nationwide on two bridges over the Snake River in eastern Idaho (District 5), the Ferry Butte (Tilden) Bridge near Blackfoot and the West Shelley Bridge. This experimental project evaluated the application of A-Jacks as a suitable pier and abutment scour countermeasure. The A-Jacks were selected over conventional riprap placement because of their stability.

In 2002, Reese collaborated with District 2 to solve a severe washout problem recurring on Idaho 11 known as “Greer Grade.” In conjunction with the district Design staff, he recommended and designed three massive 12-foot-high by 6-foot-diameter “stilling wells” to dissipate the energy of storm water runoff on extremely steep side slopes. This represented the first design of its magnitude of the stilling well structures nationwide, and the Federal Highway Administration requested permission to include this design as an example in one of its hydraulic design manuals.

In 2009, Reese and District 3 staff proposed contracting with Utah State University’s Water Research Laboratory to build a physical model of the I-84/Orchard Road Bridge crossing the New York Canal to investigate erosion. As the water in the canal flowed past the bridge piers, the channel geometry, flow conditions and pier spacing, combined with the natural frequency of the channel, created an alternating vortex in front of the pier columns that resulted in an oscillating energy wave in the channel. This destructive wave resulted in a major erosion of the channel banks and undermined the abutments of a bridge downstream. If left unchecked, the erosion would have compromised the integrity of the New York Canal and two bridges. USU graduate students constructed a 100-foot long, 1:9 scale model of the canal and bridge that replicated the oscillating wave. Through a number of experiments, the team designed a pre-cast “nose cone” that attached to the front of the piers, which stabilized the alternating vortices and resulting destructive oscillating wave. Idaho was the only state in the country to introduce such a preventative measure for this extremely rare phenomenon. This project saved thousands of taxpayer dollars and received the State “Engineering Excellence Award,” the “National Recognition Award” from the American Council of Engineering Companies (ACEC), and the “Excellence in Transportation Award” from the Idaho Transportation Department in 2012.

Reese stated “It has been a great blessing for me to have found a profession, a science, and a never-ending study — the field of hydraulic engineering — that I have loved and had the privilege to be part of through most of my adult life. And as I have said many times, it has been more than a job; it has been a passion for me. I set a goal and have had a dream for many years that I could become a great Engineer. And I think through the assignments and opportunities the Department have given me through the years, perhaps in some small way I have been able to achieve that goal.”

Reese has been recognized multiple times throughout his career. His top 5 memorable times at ITD are:
1. Being selected to fill the first State Hydraulic Engineer position in ITD’s history.
2. Being chosen to represent ITD, Idaho and the northwestern states on the American Association of State Highway and Transportation Officials (AASHTO) Hydrology and Hydraulics Technical Committee for the past 20+ years.
3. In 2007, Reese received the American Society of Civil Engineers “Outstanding Civil Engineering Achievement Award” for contributions that restored historic fish passages in eastern Idaho. The featured project replaced old arched pipe culverts that impeded fish passage with clear-span bridges, and new channel designs with natural meanders, pools and riffles. “This innovative design created a ‘fish-friendly’ environment for the revered Yellowstone Cutthroat Trout to migrate from Henry's Lake, up Targhee and Howard creeks, to their natural spawning habitat for the first time in 50 years,” he explained.

4. In 2011, Reese received the AASHTO Region 4 Design Award, recognizing the outstanding engineer from a group of 18 states located west of the Mississippi River.

5. At the National Hydraulic Engineering Conference in Nashville, Tenn., in August 2012, Reese won the Mark Miles National Hydraulic Engineer Award. This marked only the second time this prestigious award had been presented. The Nominations Committee representing department of transportation state hydraulic engineers from the 50 states, the Canadian provinces, Federal Highway Administration hydraulic engineers, their consultants and research engineers selected him.

Lotwick didn’t stop his service at the Idaho state lines. His contributions reached across the nation.

- Served the AASHTO Technical Committee of Hydrology and Hydraulics for 20+ years, and attended 30 plus TCHH meetings across the country.
- Contributed to writing and publishing several editions of the "Model Drainage Manual", "Highway Drainage Guidelines", and the recently published “AASHTO Drainage Manual”
- Presented on cutting edge H&H topics and concerns at a number of TCHH meetings and National Hydraulic Engineering Conferences

“Being able to associate with the "best of the best" State Hydraulic Engineers, FHWA Hydraulic Engineers, College Professors and Research Engineers, and Engineering Consultants, has been an extremely rewarding experience for me. It has been a great privilege for me to have had the opportunity to work with such dedicated, professionals from the TCHH the past 20 years,” said Reese

“I have learned so much, and have built friendships and memories that will last forever,” Reese stated.

Lotwick, we wish you the best on your next adventure and although we are sad that your service comes to an end, we are enriched and better engineers for knowing you and all that you have done in our field thanks to your wealth of knowledge and commitment to hydrology and hydraulics.

Sincerely,
Your TCHH friends and colleagues

Moving Forward with Advanced Hydraulic Modeling

For many years, FHWA’s guidance documents (i.e., HEC-18/ HEC-23 /HDS-7) have recommended use of two-dimensional (2D) hydraulic modeling to support more accurate and detailed analyses of bridge, channels, scour, and floodplains.

Recently, hydraulic engineering is advancing into the next era of technology with a flurry of activity in the world of 2D modeling products. Advancements in computer processing, numerical methods, and graphical analysis, coupled with more readily available topographic mapping data (primarily Lidar) have made advanced hydraulic modeling much more practical for use by hydraulic engineers. Gone are the days of running HEC-2 models using ASCII text files as input (or punch cards for those truly seasoned hydraulic modelers). One-dimensional (1D) modeling is not out of the picture, but
With the latest advancements in modeling and graphical user interfaces, 2D modeling is quickly becoming a standard tool for many hydraulic engineers. As a result, many are seeking to get "on board" and "up to speed" on the latest modeling programs for riverine applications.

With the availability of multiple 2D models, many are left in a quandary asking which model to use. Most of the current models have similar capabilities and cover a wide range of applications. However, users need to always remember that they also each have their own unique features that lend themselves to specific applications. They also have different data format requirements and require additional software for pre- and post-data processing. Ultimately, the choice of models comes down to how their capabilities align with your specific project conditions and objectives, personal and client preference and expertise, the availability/cost of the model, additional software needed, and technical assistance. Regardless of the model you choose, it is imperative to get the appropriate training for your situation and gain a thorough understanding of river mechanics and 2D modeling theory and principles. Otherwise, using any 2D model as another 'black box' may produce inappropriate results.

When considering whether to use advanced modeling technologies on your next hydraulic project, consider seeking answers to the following questions to help determine which model may best suit your needs:

- What are the size, objective, and specific needs of your project and which models are most favorable for this application? (e.g., floodplain inundation analysis, detailed bridge hydraulic analysis and scour evaluation, bank protection design, dam break analysis, shallow flow through urban areas, sediment transport, habitat analysis, etc.)
- What type of hydraulic characteristics (e.g., local velocities, cross section average depths and velocities, etc.) are necessary to support the basis of your analysis/design?
- Has the model been tested and verified for the situation you intend to use it for?
- What topographic/bathymetric mapping data (channel and overbank) is available and what pre-processing is necessary?
- What pre-/post-processing software is needed?
- Is it necessary for the model to be FEMA approved?
- What training and supplemental training materials are available?
- What technical support is available?
- What are your client's needs and interests?
- Who is qualified to review your modeling results?
- What detailed information/results do you need from the model?
- What type of information (graphics) do you need for presentations?

What are some of these models? In the next sections, FHWA provides an overview of several 2D modeling applications.
Sedimentation and River Hydraulics Model (SRH-2D)
For transportation related projects, FHWA currently recommends and supports the Bureau of Reclamation’s Sedimentation and River Hydraulics Model (SRH-2D). Users have been applying SRH-2D to investigate 2D hydraulic situations for more than a decade. FHWA especially believes that SRH-2D is the model of choice for detailed bridge hydraulics and scour analysis because it has comprehensive and validated bridge hydraulic modeling and sediment transport capabilities. Specific training for modeling bridge hydraulics with SRH-2D is available through NHI Course #135095 (www.fhwa.dot.gov/engineering/hydraulics/training.cfm). SRH-2D also has an available custom graphical interface within the Surface Water Modeling software (SMS). The combined SRH-2D/SMS application has several specific tools that are useful for evaluating detailed bridge hydraulics, bridge scour, project floodplain impacts, and countermeasure design (www.fhwa.dot.gov/engineering/hydraulics/software.cfm). Some of these tools include:

- HEC-RAS 1D cross section import for comparison and reference
- Computations and summaries for minimum, maximum, and average hydraulic parameters at specified cross sections for bridge scour evaluation, and comparison with alternatives or 1D model results
- A dataset calculator to compare datasets (e.g. existing vs. proposed) or compute additional parameters (e.g. unit discharge (depth * velocity))
- Observation lines to measure discharge at user specified locations
- Delineation of areas based on user specified criterion and ability to export GIS shape files (i.e. floodplain boundaries, specific habitat zones based on velocity and depth, etc.)
- 3D terrain visualizations for presenting and evaluating results

SRH-2D is available and functional without the SMS interface or license, but the custom interface in SMS provides a much more user friendly option and adds several additional features as noted above. FHWA provides licenses for the SMS SRH2D custom interface to all State DOT and FHWA engineers. Anyone in a review role can obtain a free license directly from Aquaveo (www.aquaveo.com/regulatory-review). Aquaveo has also committed to developing a community version of SMS that will provide free access to the basic components of the SRH-2D custom interface.

HEC-RAS 5.0 (RAS2D)
The Corps of Engineers recently released HEC-RAS 5.0 (RAS2D) that offers several new features and modeling capabilities, along with an improved RAS Mapper interface. The RAS2D model and interface is available to all users without requiring any licensing. However, additional software is needed to prepare topographic data for the model. The Corps’ RAS community also has a large and
experienced user base as a result of the ubiquitous application of 1D HEC-RAS predecessors. As of summer 2016, RAS2D does not currently have comprehensive bridge modeling capabilities to directly represent pier, abutment, and deck geometry. As a “work around” some RAS2D users have used terrain data to represent the pier and abutment geometry. However, to FHWA's knowledge, there has been no testing of results or establishing procedures for mesh development. As a result, at this time, though many are attempting (or being asked) to use RAS2D for hydraulic modeling bridges, FHWA is reluctant to recommend it for detailed bridge hydraulics and scour until RAS2D developers (and user community) can validate the methodology and develop specific bridge modeling guidance. Given the Corps resources and strong user community, FHWA anticipates and welcomes example applications on bridge projects with demonstrated procedures and results.

**Other Available 2D Models**

In addition to SRH-2D and RAS2D, there are several other suitable 2D hydraulic models available for various applications, such as FLO-2D, TUFLOW, RiverFlow2D, ADH, River2D, and others that have been available for years and continue to be improved with the advancing technology. In the past, folks might recall that FHWA supported FESWMS 2DH. The FESWMS model still exists, but FHWA felt the superior capabilities of SRH-2D justified our support and switch to that model.

Regardless of the advanced model, as long as it can provide technically and scientifically viable and robust solutions to the transportation hydraulic community, FHWA is anticipating and promoting an increased level of interest in advanced hydraulic modeling. In fact, beginning in late 2016, an Advanced Hydraulic Modeling Tools initiative will be promoted nationwide by FHWA as part of Phase 4 of our “Every Day Counts” (EDC-4) program to promote the use of 2D modeling and graphical analysis tools to a wider audience. Stay tuned!

### Pooled Fund Update

Ann-Marie Kirsch, Wisconsin DOT

The Transportation Pooled Fund Program (TPF) currently has several open solicitations for research with the potential to affect highway design practices as they relate to hydrology, hydraulics, and water quality. Details on all open solicitations can be found through the following link:

[http://www.pooledfund.org/browse/Open](http://www.pooledfund.org/browse/Open)

A list and brief summary of open solicitations regarding hydrology, hydraulics, and water quality are as follows:

- **1397 Stormwater Testing and Maintainability Center, Lead Agency: Oregon DOT, Closes 09/05/2016.**
  Technology vendors, users, and permittees need credible information concerning Stormwater Control Measures (SCM) performance to comply with National Pollutant Discharge Elimination System (NPDES) permit conditions in a timely and cost effective manner. The Stormwater Technology Testing Center (STTC) concept was developed to meet this need.
The STTC will verify the maintainability performance characteristics and costs of innovative commercial-ready stormwater treatment technologies that have the potential to improve protection of water quality and the environment. STTC will provide an independent and credible assessment of the SCM technology.

- **1426 Structural Design Methodology for Spray-Applied Pipe Liners in Gravity Storm Water Conveyance Conduits, Lead Agency: Ohio DOT, Closes March 1, 2017.**

  Spray-applied pipe lining is a trenchless technology that provides a method to structurally rehabilitate gravity storm water conveyance conduits with minimal impact to the traveling public. The liner consists of a cementitious or resin-based material that is applied in an existing host storm water conveyance conduit via a centrifugal remote applicator or by manual application.

  No single structural design methodology for a spray applied pipe liner currently exists. Vendors either apply design equations outlined in ASTM F1216, which are for Cured In Place Pipe (CIPP), or use their own design approaches.

  The AASHTO Subcommittee on Bridges and Structures, T-13 Culverts and the AASHTO NTPEP Technical Committee on Spray Applied Pipe Liners agree that the technology would be well accepted and utilized; provided the spray-applied pipe liner provides a fully structural solution. However, the lack of a nationally accepted structural design standard is a roadblock to implementation.

  Several DOTs have implemented structural spray applied pipe liners despite the lack of a national design standard. Other DOTs are waiting for a national design standard before implementing the technology.

  The objectives for Solicitation 1426 include developing recommendations for the design methodology for both cementitious and resin based spray applied pipe liners for structural rehabilitation of gravity storm water conveyance conduits; laboratory test methods to verify the proposed structural design for conduits that have been rehabilitated using the spray applied pipe liner technology; accelerated laboratory methodology to determine the liner material durability; and laboratory material testing for both cementitious and resin based materials.

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**Research Update**

In April, NCHRP announced the FY 2017 research projects. Included is Project 14-39 – The Effectiveness of Compost Amended Vegetated Filter Strips Using a Compost Blanket Application Method for Pollutant Removal from Highway Runoff. Additional information, including project statements, can be found at: [http://onlinelibrary.trb.org/onlinepubs/nchrp/NCHRPAnnouncement2017.pdf](http://onlinelibrary.trb.org/onlinepubs/nchrp/NCHRPAnnouncement2017.pdf).

Recent NCHRP publications include:

- Report 822 – *Evaluation and Assessment of Environmentally Sensitive Stream Bank Protection Measures*
- Report 761 – *Risk Based Methods Predict Bridge Scour*
- Report 809 – *Environmental Performance Measures for State Departments of Transportation*
- NCHRP 25-25 Task 92 – *Transferability of Post-Construction Stormwater Quality BMP Effectiveness Studies*
Additional information on these and other NCHRP publications can be found at http://www.trb.org/Publications/PubsNCHRPPublications.aspx.

News and information on hydraulics and hydrology research at TRB can be found at http://www.trb.org/HydraulicsHydrology/HydraulicsandHydrology1.aspx.

News and information on state research findings can be found at http://www.trb.org/Main/Blurbs.aspx?fields=ENewsletterType|State%20Research%20News.

News and information on university research findings can be found at http://www.trb.org/Main/Blurbs.aspx?fields=ENewsletterType|University%20Research%20News.

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### Calendar of Events

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<tr>
<td><strong>2016 TCHH Annual Meeting</strong></td>
<td>August 8-11</td>
<td>Portland, OR</td>
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<tr>
<td>National Hydraulic Engineering Conference</td>
<td>August 9-12</td>
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Additional information can be found on the TCHH page (link on the right)

For more information on the Technical Committee on Hydrology and Hydraulics, see http://design.transportation.org/Pages/HydrologyandHydraulics.aspx.

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 or removed from the mailing list, please email Patricia Bush at pbush@aashto.org.