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THE EFFECTS OF DROUGHT ON THE FOLSOM LAKE

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WEST Consultant is a water resources engineering firm specializing in hydrology, multi-dimensional hydraulics and sediment transport modeling.

(www.westconsultants.com)

California's weather is doing what it does best; swing wildly from one extreme to the other. There's really no normal weather in the Golden State, just an average of extremes.

Lately, it's been extremely dry. Calendar year 2013 was epic. Records for low rainfall were not just broken in many locations-they were shattered.

On average about 50% of California's precipitation comes in just three months: December, January and February. About 75% occurs from November through March. The northern Sierra Nevada Mountains are the major source of California's water supply. This is a region which averages 50 inches of precipitation annually, much in the form of winter snow.

From January 2013 through January 2014, only two months of precipitation in northern California were above average as indicated by the Northern Sierra 8 Station Precipitation Index shown in Figure 1. The "above average" precipitation in June and September 2013 did little more than momentarily take the edge off the fire danger but offered no improvement to water supplies.

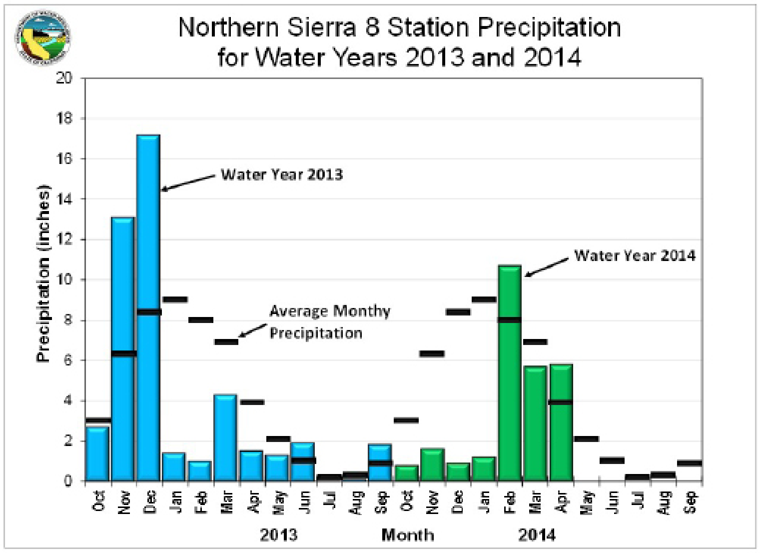

Figure 1

California's Central Valley was especially dry. Sacramento saw 52 consecutive days with no rain during the heart of what is normally its rainy season. A small storm on January 28 finally broke the streak. This dry spell exceeded previous records of 46 days in 1884 and a 44 days in 1976. On average, Sacramento would receive about one-third of its annual total during this 52 day period.

Figure 2

"Fulsom Lake at just 17% of its capacity on January 31, 2014"

By the end of January 2014, storage in the state's key water supply reservoirs was critically low. Portions of lake beds not seen in decades were exposed. One of the state's major water supply facilities, Folsom Lake, stood at just 17% of its capacity on January 31. (See Figure 2)

Responding to the dwindling reservoir storage, a meager mountain snowpack, and a bleak forecast, Governor Jerry Brown made the official drought declaration in late January. He called on Californians to reduce water consumption by 20% to help conserve remaining supplies.

Water managers throughout the state closely monitor water supply forecasts issued by the National Weather Service's California Nevada River Forecast Center. (CNRFC) The CNRFC forecasters combine observed precipitation and temperature, estimated snowmelt, and the latest weather

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EDITOR'S CORNER

As you may or may not be aware, EWRI conducted a member services survey in Fall of 2012 with the goal of finding out what members believe EWRI is doing well (or not well) and where better service and value can be provided. Out of the results of this survey, EWRI's Governing Board developed a set of five strategic goals, which were discussed and refined by EWRI Council Leadership in 2013. Among these goals is for EWRI to be a "Trusted professional association with a dynamic digital portal for delivering cutting edge technical information".

EWRI is now in the implementation process to provide to its members a new dynamic digital portal which will provide improved connectivity to each other and to our collective experience and expertise through an open forum for discussions on current topics and to share knowledge. This portal will also provide improved access to current information on events such as the EWRI Congress and other conferences and meetings. Access to past issues of Currents and other EWRI publications will also be made available. The portal, which will be known as "EWRI Collaborate" will be available to EWRI membership in Summer 2014. This portal will be connected to and is intended to supplement the existing EWRI website. More information will be coming to EWRI membership on this portal in the near future.

Please also be aware of the upcoming EWRI World Environmental and Water Resources Congress in Portland, OR from June 1-5, 2014. Registration is open and can be accessed at http://content.asce.org/conferences/ewri2014/registration.html. I hope to see you there.

Please contact me at jlweiland2003@yahoo.com as well as Veronique Nguyen of ASCE at VNguyen@asce.org with your articles, announcements, and other content you would like to share in Currents. We look forward to hearing from you!

John Weiland
Communications Council Chair

PRESIDENT'S COLUMN

From Mad Men to President Obama

The Evolving and Diverse Environmental and Water Resources Work Force -Stories from the Trenches

Having attended engineering school when the world of Don Draper and Mad Men was still recent history, some aspects in the working world and profession have changed significantly. Others aspects are still slowly evolving, as we attempt to understand and work collectively with people from different backgrounds and use our diversity to achieve better solutions for the benefit of mankind.

I have spent most of my engineering career trying to ignore some of the differences between people, especially considering that we are more alike than we are different . Like some engineers, sometimes I miss the subtleties of certain social interactions. However, a recent incident has forced me to think about communication patterns and the distance we may have yet to travel within the profession to ensure we use everyone's talents to our benefit. My story follows.

A few months ago at a professional society leadership training workshop, one of the participants woefully described the lack of diversity on their board. During a break he explained they had a woman on their board, but she wanted to quit when her term was up. His astute compatriot noted that while the female board member had a lot of ideas, almost everything she proposed the board turned down, her opinions were not accepted. A few minutes later when the break ended, the facilitator asked a question about a new topic. I raised my hand. The facilitator acknowledged me. But before I could speak, my friend with the board diversity problem started answering; ignoring the fact it was my turn to speak.

Spontaneously every female in the room started laughing. The irony and apparent cluelessness of my friend's action was too much for the women to contain themselves. Clearly every one of the women had experienced this situation. However, almost every male in the room (except for an African-American male) couldn't figure out why part of the room was laughing. Even the facilitator later admitted he did not understand what had happened.

A great teaching moment was lost...

Since then I have been paying more attention to this issue.

At a recent ASCE sustainability workshop, I noticed that the young women and the young non-white male in attendance had self selected the same discussion group. Did they do this because they felt they would be better able to express themselves and be heard? It seemed unlikely that in a room with six tables, with a majority of white males, such a demographic grouping could have occurred totally by chance.

Please don't think our society has not made progress. I certainly believe that we've made significant progress. All I have to do is think back and contrast today with my first few years out of school. When one thinks back to the culture of the time, the genesis of the many diversity programs make more sense. Some of my initial experiences and those of my peers seem comically unbelievable in hindsight.

For example, I have been emotionally scarred for life in regards to golf outings. This is due to the annual highway engineers outing that used to have strategically placed bikini draped models working the golf course holes for tips. Fortunately the culture of the golf outing changed shortly after I was hired, but for me, the damage had been done.

At the time, I felt like I was still a foreign exchange student trying to understand and make my way in a different culture, being as respectful as possible. In some cases, I was the first professional female some men had ever encountered. For example, most men today realize that you don't take women for business lunches to restaurants that specialize in noon lingerie shows. I don't think my host was trying to be disrespectful. He actually was taking me out to ask a favor, but seemed kind of clueless as to how to entertain me. He was treating me like he treated everyone else he took out for lunch.

In some cases I found differences in working styles and relationship expectations, based on generational differences. While I was used to hanging in out in guys dorm rooms to work on school projects, I had to realize when I was young that many of the older engineers had never worked with females in school on projects. I quickly learned that at some conferences you never accompany the person who tells you "…I need to pick up a manual/book/schedule in my hotel room…" unless you know them well. It saves a lot of misunderstandings. Sometimes older folks need to understand that a young person's interest and wide-eyed adoration of older person's professional accomplishments may be just hero worshipping or the search for a mentor and should not be assumed to be the entree to an intimate and personal relationship.

Even American born males in the environmental and water resources profession have on occasion taken some heat from less enlightened co-workers about their diverse professional relationships. One of my favorite stories is about a friend who was getting complaints from his boss about too many personal calls. He had at least four female engineers (including me) calling him on a weekly basis about various water resources projects we were all working on. His boss, a highway engineer (those darn highway guys, again), just assumed they were all women he was dating or trying to date. It went so far that when he tried to invite a female engineering client to an ASCE dinner, his boss told him he couldn't use the company funds for his personal socializing. Kind of wonder what kind of guy would consider an ASCE dinner a winning date night…

Much has changed over the course of my career, including the excitement of having a bi-racial President of the United States. We need to hear and acknowledge the different voices from the diverse members of our community.

Very soon ASCE-EWRI we will be offering a trial engagement platform for your use. You'll receive announcements of this engagement platform soon. Let's take advantage of this inclusive tool to collaborate to improve our professional practice.

I am proud to be a member of this organization; an organization in which I feel my voice is appreciated and valued. I hope you feel your voice is as valued and appreciated in return.

President,
Karen Kabbes, P.E., D.WRE,
ENV SP, M.ASCE

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forecast information to produce probabilistic forecasts that extend out to one year. Probabilistic forecasts provide a range of values, with each value assigned a confidence level (e.g. a monthly inflow forecast of 220,000 acre-feet might have less than a 10% chance of being equaled or exceeded while a lower forecast of 90,000 acre-feet might have a 50% chance of being equaled or exceeded). Probabilistic forecasts of reservoir inflows and seasonal runoff volumes provide important insights to decision-makers managing critical water resources.

Figure 3 shows the probabilistic forecasts made on February 1 for monthly inflows to Folsom Lake. At that time it was still possible to get significant precipitation in February and March and build the Sierra snowpack. However, there was high confidence that even an extraordinarily wet late winter/spring wouldn't bring the seasonal runoff volumes back to average.

As it turned out, February and March 2014 saw precipitation patterns return to more normal conditions. Figure 4 shows the water year to date accumulations of the Northern Sierra 8 Station Precipitation Index compared to extreme wet, extreme dry, and average years. The 2013-14 precipitation accumulations closely tracked the driest years on record. Fortunately, the February and March storms raised precipitation totals off "rock bottom" but they are still well below average.

The latest forecasts for seasonal runoff into Folsom Lake stand at just 37% of average. Typically, there's little chance of significant precipitation after mid-April. The CNRFC forecasts shown in Figure 5 show just that. With a minimal mountain snowpack remaining, peak runoff is now expected in April rather than in late May or June as is typical.

As of April 15, Folsom Lake has recovered somewhat from its abysmal levels in late January. (Figure 6) However, there's little chance for further improvement this season. Scarce supplies mean contracted water deliveries may be cut to zero in some cases. Thousands of acres of the nation's most productive farmland will lay fallow. The impacts of California's drought will be felt nationwide with rising food prices.

The current dry spell is the third year of below average precipitation in California. That's about the limit of what the state's current water infrastructure can manage. A fourth dry year could be disastrous.

There may be hope on the horizon. The National Oceanic and Atmospheric Administration is indicating that there's an El Nino brewing in the Pacific Ocean. Some forecasters suggest it could be a strong one.

A strong El Nino could be the drought buster the state desperately needs. On the other hand, a strong El Nino can bring too much precipitation too soon, yielding flash floods and landslides. It can break

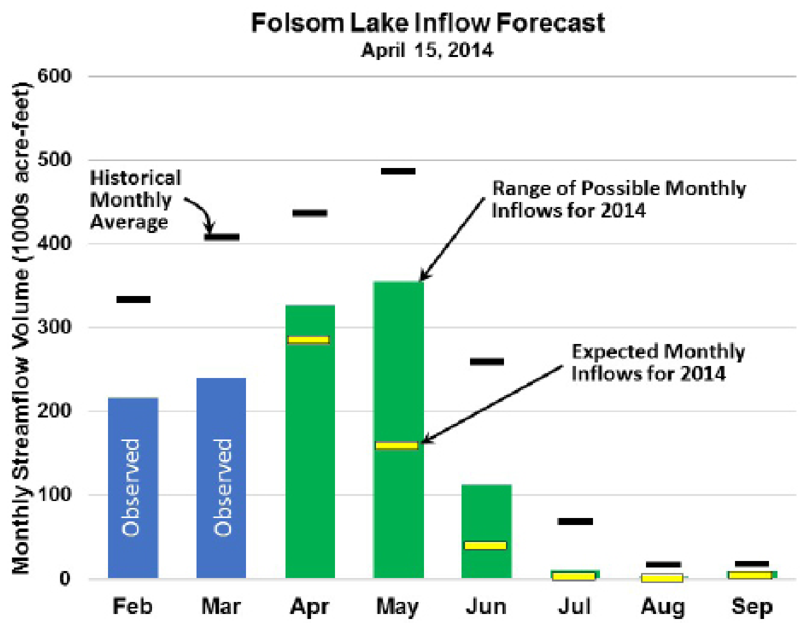

Figure 5

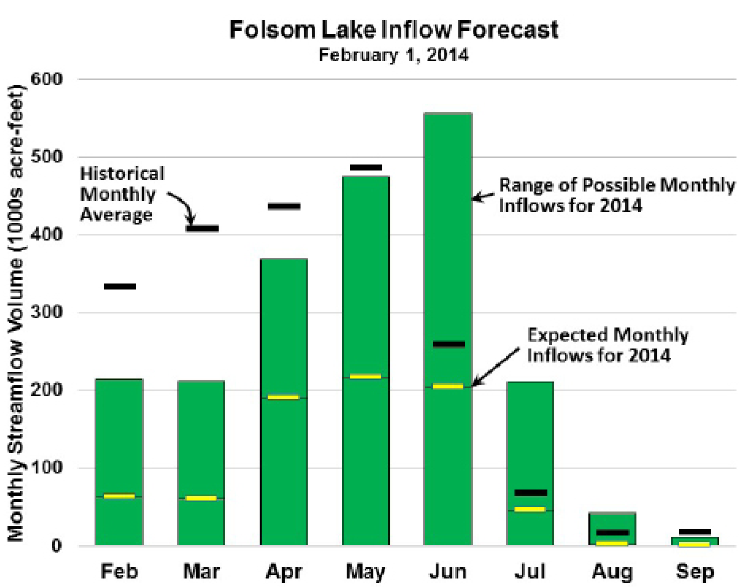

Figure 3

Figure 6

the drought but move the needle to the opposite end of the spectrum of weather disasters. If that happens, it's just more evidence that there's no such thing as normal weather in California. It's just the average of two extremes.

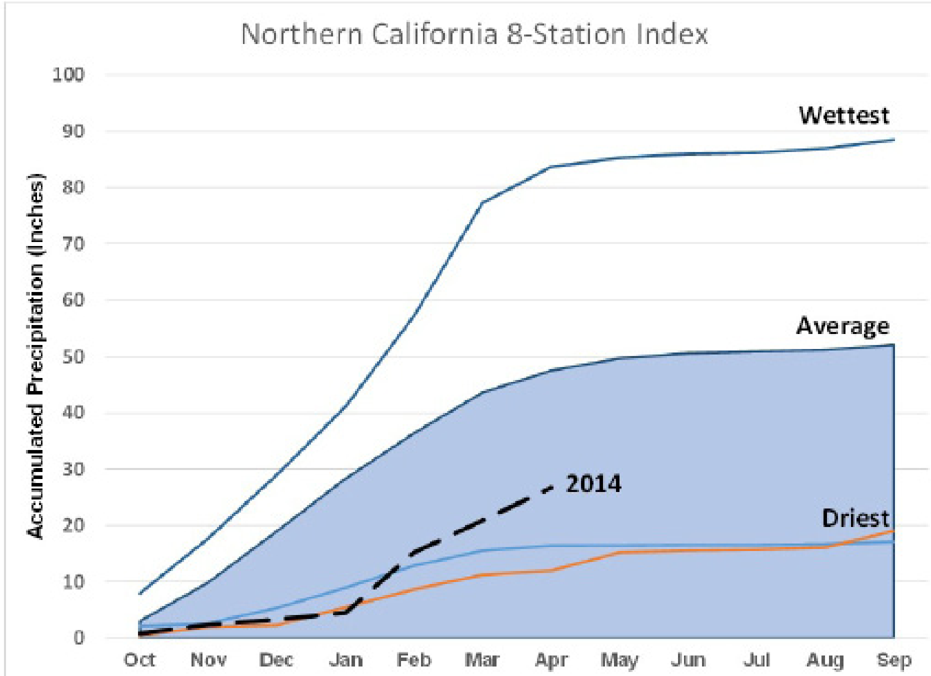

Figure 4

Graphics courtesy of David Curtis using data from California's Department of Water Resources

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National Weather Service
California Nevada River Forecast Center Sacramento California (Personal Conversation)

Maury Roos
California Dept. of Water Resources, Sacramento, CA (Personal Conversation)

FROM CALIFORNIA'S DEPARTMENT OF WATER RESOURCES NEWS RELEASE 4-18-2014

Rain and snow from February and March storms have allowed the California Department of Water Resources (DWR) to increase water contract allocations for State Water Project (SWP) deliveries from zero to five percent. Precipitation from these recent storms also eliminates the current need for rock barriers to be constructed in the Sacramento-San Joaquin River Delta to prevent saltwater intrusion from San Francisco Bay.

"During February and March, state and federal water agencies worked together to capture storm runoff and increase our water supplies. As a result, the late spring storms have translated into much needed water supplies for communities, farmers and environmental habitat," said DWR Director Mark Cowin. "As this drought continues, we need all Californians to remain vigilant and use every drop of water wisely."

As the current drought persisted into its third year, on January 31, DWR announced its first zero water allocation (water delivery estimate) ever for all State Water Project contractors. The SWP supplies water to 29 public agencies serving more than 25 million Californians and irrigates nearly a million acres of irrigated farmland.
Collectively, the 29 SWP "contractors" requested just over 4 million acre-feet of water to be delivered this calendar year. The increase to a five percent allocation will make a little more than 200,000 acre- feet available. An acre-foot is enough water to supply a family of four for approximately a year.

THE DALLES DAM – AN ASCE NATIONAL HISTORIC CIVIL ENGINEERING LANDMARK

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ASCE recently recognized The Dalles Lock and Dam, in The Dalles, Oregon as an ASCE National Historic Civil Engineering Landmark. The award will be presented at the 2014 EWRI World Environmental & Water Resources Congress to be held in June in Portland, Oregon.

Construction of The Dalles Lock and Dam (Figure 1) just downstream from a series of treacherous rapids near the city of The Dalles, OR was initiated by the U.S. Army Corps of Engineers (Corps) in 1952 under authorization from the River and Harbor and Flood Control Act of 1950. It is a run-of-river dam approximately 192 miles upstream of the mouth of the Columbia River. It was built primarily to provide hydropower and navigation to the Pacific Northwest, a region which had seen unprecedented growth and demand for electricity and commerce in the two decades prior to its authorization.

The navigation lock, on the north shore of the Columbia River, was built to replace the outmoded Dalles-Celilo Canal, providing safe passage for barge traffic past the new dam and the natural river obstructions. Construction of the navigation lock commenced in September 1954 and the first lockage took place in March 1957, one week after the dam was completed and the pool began to rise. By the end of fiscal year 1959, 3.4 billion kw-hrs were produced for the Bonneville Power Administration (U.S. Army Engineer District , 1970).

In October 1959, The Dalles Lock and Dam was officially dedicated by Vice President Richard M. Nixon with a number of dignitaries in attendance, including the U.S. Army Corps of Engineers Chief Engineer Lieutenant General Emerson C. Itschner. The Dalles Lock and Dam, when completed was not only the longest dam on the Columbia River at over 1.5 miles long (Ogden Standard Examiner, 1959), but according to Lt. Gen Itschner, it was the "largest multi-purpose dam the Corps of Engineers has ever built" (Oregonian, 1959). It was the fourth Corps Dam built on the Columbia River after Bonneville, Chief Joseph, and McNary Dams. By the end of 1960, once all of the first phase turbine units had come on-line, The Dalles Dam was second only to Grand Coulee dam in power production on The Columbia River (Ogden Standard Examiner, 1959). Today it is the sixth largest hydropower project in the United States (United States Society on Dams).

Figure 1_The Dalles Dam (Courtesy USGS)

By 1970, The Dalles Dam and the rest of the Columbia River Power System combined to make North Central Oregon the "power center of the world" (U.S. Army Engineer District, 1970). The region had been connected to Los Angeles and Arizona via the $660 million Pacific Northwest-Pacific Southwest Intertie. The Intertie was a brilliant scheme that took advantage of the differing temporal demands for energy between the two regions. The Northwest needed energy for heating in the winter and the Southwest needed energy for air conditioning and irrigation in the summer. The Intertie served these needs by facilitating a method for sending cheap Columbia River hydropower to Los Angeles and Arizona in the summer and in turn thermal steam plants in the southwest could send power up to the Northwest in the winter. The Intertie (now called the Pacific DC Intertie) is high voltage direct current (HVDC) transmission line running from Celilo near The Dalles Dam to Sylmar, California-a distance of 846 miles with a rated capacity of

3,100 MW (Litzenberger, 2006). The power supply provided by the energy infrastructure at The Dalles Dam and the Pacific DC Intertie made the city of The Dalles an attractive place for Google to recently locate its first owned and operated data center-a $1.2 billion facility (Google).

Long before electricity was a forethought of Pacific Northwest development, navigation improvements on the Columbia River were a topic of much discussion within the Corps of Engineers and the Northwest community as a whole. The Columbia River upstream of Portland contained many hazardous rapids and falls such as the Cascade Rapids, The Dalles' 3-mile and 5-mile rapids, Celilo Falls, John Day Rapids, Umatilla Rapids and the Homely Rapids. Bonneville, The Dalles, John Day, and McNary Dams were built for multiple purposes, but transportation was amongst the most important at the time. Together, these dams created a series of navigable lakes, by which barge traffic could move so efficiently that today more than 50 million tons of cargo valued at more than $23 billion annually pass through the Columbia and Snake River System accounting for over 100,000 Northwest jobs (Northwest River Partners, 2012). The Columbia and Snake River System accounts for 37 percent of all U.S. wheat exports, 70 percent of all U.S. barley exports, and 10 percent of all U.S. corn exports (Meira). Construction of The Dalles Dam Navigation Lock at a modern and efficient size has made this possible.

Inundating Celilo Falls was arguably the most controversial aspect of construction of The Dalles Dam. The area was not only a geologically unique and striking feature on the river, but it was an ancient fishing area for Native Americans. For more than 16,000 years, indigenous tribes had inhabited the region (Eugene Register Guard, 1959), and it had long been a crossroads for inter-tribal trade. Native Americans would net or spear upstream migratory salmon from cantilevered wooden platforms as the fish attempted to leap the "roaring falls". A settlement of $23.5 million was reached between the federal government and the Yakima, Umatilla, Warm Springs, and the Nez Perce tribes, which amounted to approximately $4,000 per tribal member (Willingham, 1992). Today, the Corps works closely with the Columbia River Inter-Tribal Fish Commission to continually improve fish passage on the Columbia River.

The most unique features of The Dalles Dam are its length, more than 1.5 miles in total, and its shape, easily recognizable from the air by the flights that pass overhead daily to and from Portland International Airport. The project is "L-shaped", with its powerhouse extending laterally upstream from the spillway. This prominent feature of The Dalles Dam layout provides for a distinct rectangular-shaped reservoir pool. Power production was a primary purpose, but to make The Dalles Dam feasible and economically self-sufficient, a large enough powerhouse was required. The Dalles Dam has 22 turbine units in a powerhouse that is a half-mile long. Along with the quarter-mile long spillway that was required to pass the project design flood of 2.29 million cfs, the overall length of the project exceeded the available half-mile width of the river at this location. Thus, the L-shape concept was born.

The geologic conditions in the river at the dam site, complex topography with numerous chutes and rapids, led to perhaps the most brilliant design component of The Dalles Dam. The epic Missoula Floods of the last ice age shaped the terrain of much of the Pacific Northwest, and the Columbia River Gorge was no exception. The striking geologic features of the Gorge draw visitors from all over the world. The Columbia River at The Dalles possesses a bed carved into basalt by the Missoula Floods with a labyrinth of angular chutes and drops – one of the reasons for the original Dalles-Celilo canal and ultimately The Dalles Dam Navigation Lock. The dam site featured exposed bedrock just downstream of a large natural pool called "Big Eddy", which forced the river through a narrow chute, making three severe 90 degree turns (Figure 2).

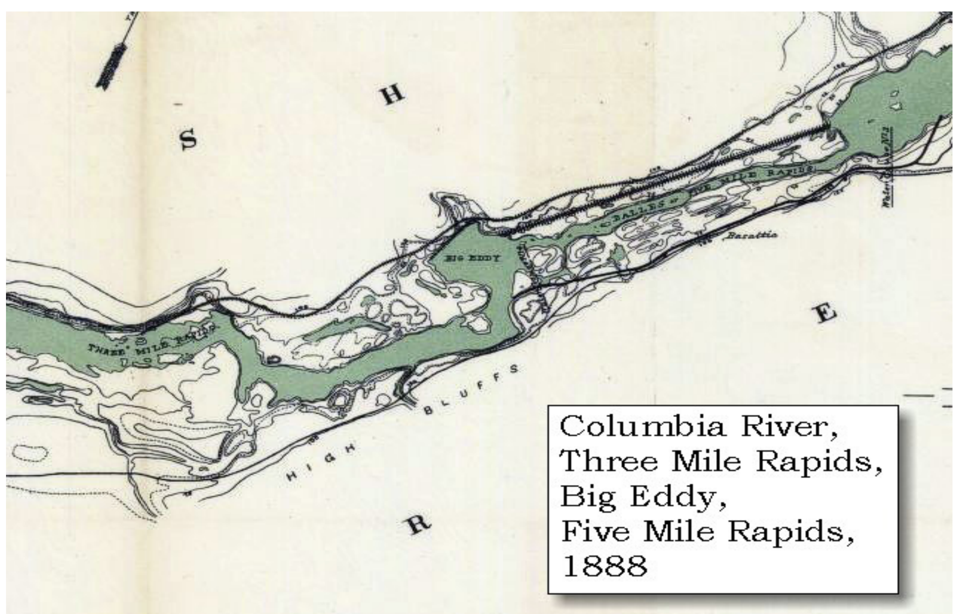
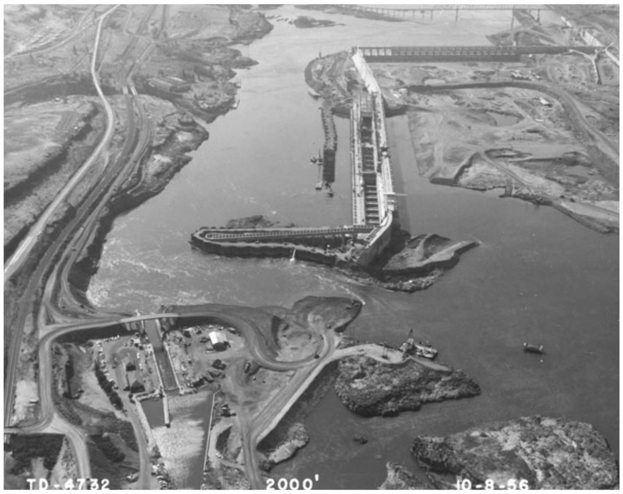


***Figure 2**_Site of the Future The Dalles Dam (Courtesy University of Washington Library Archives)*

Figure 3_The Dalles Dam Days Before Closure (Courtesy U.S. Army Corp of Engineers)



The spillway was sited to accommodate a direct flow path in the downstream direction, maximizing its efficiency for passing large floods. The Corps opted to locate it at the downstream end of the exposed bedrock just above the shelf that abruptly dropped into the natural river. The stilling basin itself was built on the edge of the shelf, which made excavation feasible. More importantly, siting on the shelf allowed the Corps to construct the spillway entirely in the dry, without having to divert the river. In fact, most of the dam, including the powerhouse was constructed on the exposed bedrock shelf, minimizing the need for cofferdams and in-water work. Constructing the stilling basin on the shelf and the unique "L-shape" of the dam provided some unexpected benefits to downstream migratory fish passage, which would only be discovered decades later. Specifically, the shallow stilling basin minimizes gas entrainment of flows plunging over the spillway, which helps to prevent nitrogen supersaturation in fish, a historic problem at most of the other Lower Columbia and Snake River dams. Furthermore, with the powerhouse parallel to the flow and upstream of the spillway, The Dalles Dam passes downstream migratory fish at an unusually high fish passage per unit discharge at the spillway. For example, when 40 percent of the flow is passing the spillway, about 80 percent of the fish pass the spillway (versus other less preferred and more dangerous means, namely the powerhouse) (Outdoor Idaho).

Although the dam was primarily constructed in the dry on the exposed bedrock shelf, final closure of the dam required blocking the original river, which flowed through a narrow channel just upstream of the powerhouse. This highlights the most interesting phase of the construction of The Dalles Dam. Prior to construction of most dams, the river is diverted around the worksite. The process can contribute an enormous price to the overall cost of building a dam. Some sites, in relatively narrow canyons, require tunnel diversions (Hoover Dam for example), others require an elaborate coffering scheme, involving tremendous efforts with earth moving and/or pile driving. The Dalles Dam avoided these costs by building on the rock shelf and allowing the river to maintain its original course until final closure of the dam.

In 1956, with the majority of the lock and dam constructed, the Corps began the process of closing the original river with a rockfill embankment dam. The design and construction of The Dalles Closure Dam has become a model case study for cofferdam and closure dam design around the world (Packshaw, 1963). The Closure Dam is located just upstream of the powerhouse, connecting the powerhouse to the south abutment. It's a 285 ft high rock fill layered on the upstream side with a gravel filter and sand blanket. The Closure Dam today is about 2000 ft long, however most of that length was constructed in the dry, east of the original channel, adjacent to the Dalles-Celilo Canal. The remaining opening was closed by end-dumping large rock into the actively flowing Columbia River, with velocities as high as 12 ft per second. The river here was about 500 ft wide about 180 ft deep. The photograph in Figure 3 shows The Dalles Dam just days before closure was initiated and about five months prior to the completion of the Closure Dam.

Final closure was undoubtedly one of the most stressful and exciting stages of construction of The Dalles Dam. The uncertainty of success was considerable, given the depth and velocity of the Columbia River through this section. Final closure (Figures 4 and 5) of the original river was accomplished on October 17, 1956 by "concentrating all

***Figure 4 (above, right)** The Dalles Dam Just Before Closure (Courtesy U.S. Army Corp of Engineers)*

***Figure 5 (below, right)** Final Closure (Courtesy U.S. Army Corp of Engineers)* available equipment" and end-dumping over a span of 1.5 hours. The short duration of the final closure operation was necessary so that there wasn't enough time for appreciable head to build up as more water arrived at the dam site (Packshaw, 1963).

However, a considerable amount was still flowing through the closure section opening. Rock as large as 500 pounds was dumped into the raging river as quickly as possible. Vernon Robert Bradley, The Dalles Dam Project Superintendent for the Guy F. Atkinson Construction Company, noted during the initial process, that as quickly as rock was dumped into the river, it was washing away (Bradley, 2013). Fortunately the rocks eventually began to take hold and the dumping process succeeded in closing the river. Over the next five months, construction of the remainder of the Closure Dam proceeded, which included a low-permeable upstream face, composed of smaller rock, gravel, and a sand blanket. The final section of The Dalles Closure Dam is presented in Figure 6. On March 9, 1957 the Closure Dam was completed.

The Dalles Dam is a one-of-a-kind civil engineering achievement. It highlights the benefits that a multi-purpose dam of this scope can have on the regional and national economies. At the time of construction, no other dam in the United States possessed such multi-purpose functionality. The design and construction of The Dalles Dam, taking advantage of the local geology, and with consideration of the multi-purpose needs, served as a model for dam construction for decades to come.

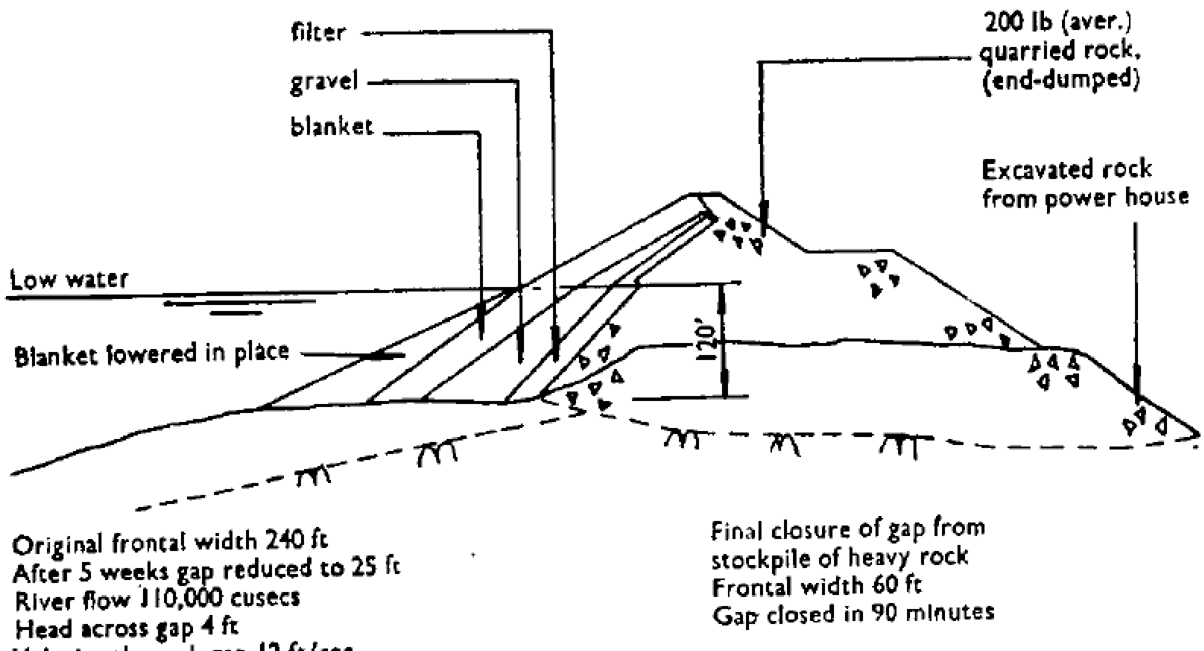


***Figure 6**_The Dalles Closure Dam Section (Packshaw, 1963)*

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CHEMICAL AND BIOLOGICAL SCREENING OF CHEMICAL MIXTURES IN WATER

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All water is prone to chemical contamination through natural and anthropogenic activities, yet water safety is generally judged based on numerical thresholds for only a minute portion of known contaminants. Considering that modern analytical instruments are readily capable of detecting ultra-trace levels of a wide array of chemicals in water, the public and agencies responsible for protection of public health struggle to prioritize and potentially regulate chemicals detected in water. This challenge becomes especially critical in potable water reuse applications where wastewater is used to augment drinking water supplies (Grant, Saphores et al. 2012). Indeed, the primary means for extending freshwater supplies within a given region are desalination and reuse (Shannon, Bohn et al. 2008). However, both alternative supply options lead to unique water quality challenges related to chemical contaminant occurrence and transformation. Traditional prioritization and regulatory schemes based largely on animal testing are slow, expensive, and often not representative of human health. Considering the rapidly evolving landscape of water portfolio augmentation, population growth and urbanization, and potential for additive or synergistic toxicity, new tools are desperately needed to rapidly and efficiently screen water for mixtures of chemical contaminants.

The latest generation of analytical and bioanalytical tools offers great advantages towards more comprehensively screening water. Recently, both gas chromatography and liquid chromatography coupled with high-resolution quadrupole time-of-flight mass spectrometry (GC- and LC-QTOF) can provide rapid and highly sensitive screening for volatile and semi/non-volatile chemical contaminants. Most importantly, these analytical techniques create large data sets that can be mined to identify those contaminants that are unique to a given source water or treatment condition within a particular water quality range. Through a partnership with Agilent Technologies, the University of Arizona is exploring these technologies for application in potable water reuse. Figure 1 provides an example of the application of LC-QTOF analyses for screening the organic chemical profile of a wastewater before and after four different doses (columns) of the powerful oxidant ozone. In this figure, each horizontal line represents a unique chemical structure with color shading representing the intensity (or concentration) of each component within the particular sample. This particular example demonstrates that thousands of chemicals can be detected in a single LC-QTOF analysis, which would be infeasible to process manually. However, using statistically based software (Agilent Technologies Mass Profiler Professional) the overall chemical occurrence trends can rapidly be elucidated. Furthermore, because of the high-mass resolution and tandem mass spectrometry (MS/MS) capabilities of the QTOF instruments, these molecular features can be further examined to identify the most likely molecular formula and structure for each chemical detected. Lastly, since full mass spectrum data are collected

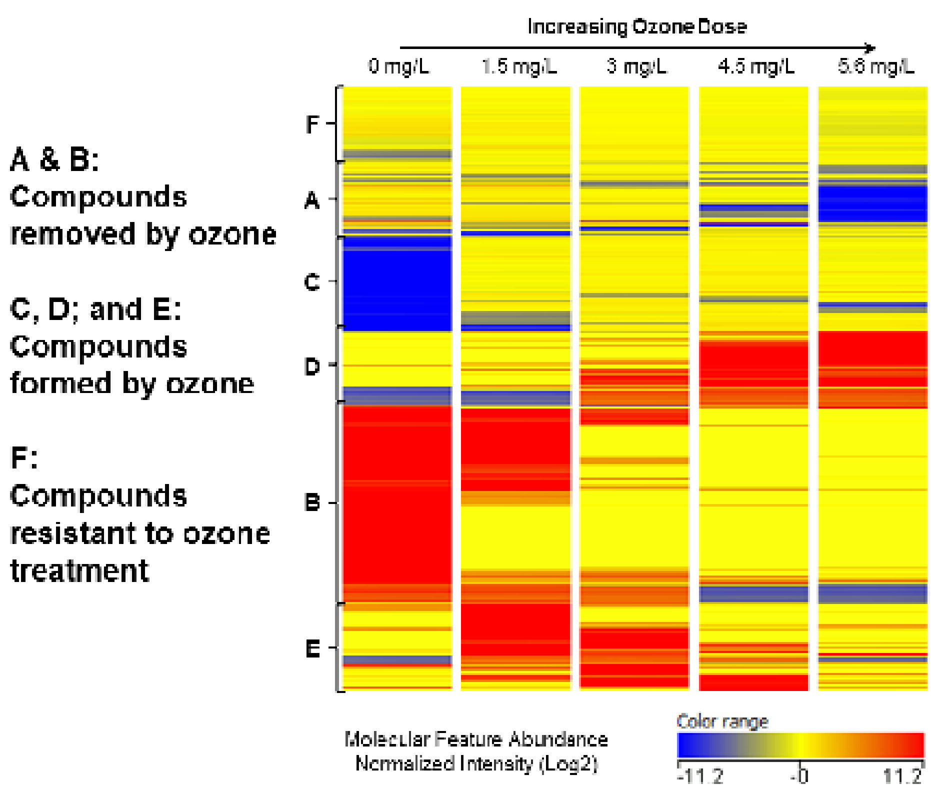

Figure 1. *Hierarchical Clustering Analysis (HCA) of Chemicals Occurring in Wastewater and Transformed by Ozonation*

for each sample, should a new contaminant of interest become later identified, the existing data files can be examined to determine if the particular chemical was, or was not, present at the time of analysis.

While mass spectrometry has advanced to the point that nearly any chemical present in water can be identified and quantified, analytical instruments alone cannot provide a definitive measure of water safety. Biological information is required in order to better understand if a particular mixture of chemicals present in water is able to elicit toxicologically-relevant responses. Historical paradigm would involve dosing rats and/or mice with one chemical using a limited number of doses. Today, advanced biological screening tools are commercially available to screen for cumulative mixture bioactivity rapidly, sensitively, and relatively inexpensively (Escher, Allinson et al. 2014). By combining the comprehensive screening capabilities of bioassays along with the structural elucidation power of mass spectrometry, toxicity identification and evaluation (TIE) strategies can now be applied to not only determine if a chemical mixture in water contains bioactive substances, but also to identify and quantify those chemicals responsible. As biological and analytical screening tools become more efficient, the field of metabolomics has been born wherein a mass spectrometer can now be used to directly measure the biochemical activity with cells or intact animals after exposure to chemicals (Tomita and Kami 2012).

As alternative water sources continue to be explored as sustainable resources, increasing public and regulatory scrutiny are certain. The identification of bioactive chemicals using biological and analytical screening techniques also will help to prioritize those chemicals that should be considered for more thorough toxicological testing and potential regulation. These tools provide an evaluation of both chemical mixtures occurring in source water and the mixture of transformation products resulting from water treatment processes. High-throughput, comprehensive analytical and biological screening tools coupled with on-line sensor technologies will help increase confidence in the reliability and safety of water reuse.

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SYMPOSIUM HIGHLIGHTS IDEAS AND PERSPECTIVES TO TACKLE THE MOST VEXING ISSUES FACING HYDRO-METEOROLOGY TODAY

Doug Scott

Source: ASCE News (orginally published April 24, 2014)

As a civil engineer, have you ever gone into a home or structure following a flood event to determine the origin and extent of damage and prepare the scope of repairs required to restore the structure to its original condition?

Attending the symposium were approximately 160 experts, including hydrologists, meteorologists, academics, water resource engineers and managers, emergency management professionals, government policymakers, natural resource scientists, environmental engineers, researchers, and consultants from the U.S. and around the world. Photo Credit:Veronique Nguyen

"The emotional and personal memory [of that experience] is a stark reminder of why your work [as engineers and scientists] is essential to building sustainable and resilient communities and to keeping folks out of harm's way," Karen C. Kabbes, P.E., D.WRE, ENV SP, M.ASCE, and president of the ASCE/ Environmental & Water Resources Institute (EWRI), told attendees of the 2014 International Symposium on Weather Radar and Hydrology.

"And keeping people out of harm's way is one of the concerns of ASCE, the oldest engineering society in the U.S."

According to the Federal Emergency Management Agency (FEMA), each year approximately 90% of all disaster-related property damage results from flooding. Since 2003, the average flood claim in the U.S. has been more than $46,000 with yearly totals averaging $3.5 billion. Flooding causes damage not only to the interior contents and finish materials but to mechanical and electrical equipment as well.

"Infrastructure [spending] in the U.S. totals about $1 trillion dollars a year [and] almost every nickel of our constructed infrastructure is in some way related to rainfall," added David C. Curtis, Ph.D., Aff.M.ASCE, vice president of West Consultants Inc., and a member of the symposium's Organizing and Steering Committee. "Rainfall is integrated into the design of all infrastructure we build, whether it is conversion to runoff, the sizing of big bridge openings, [or] loading for buildings for structural integrity, irrigation, infiltration; the list goes on and on.

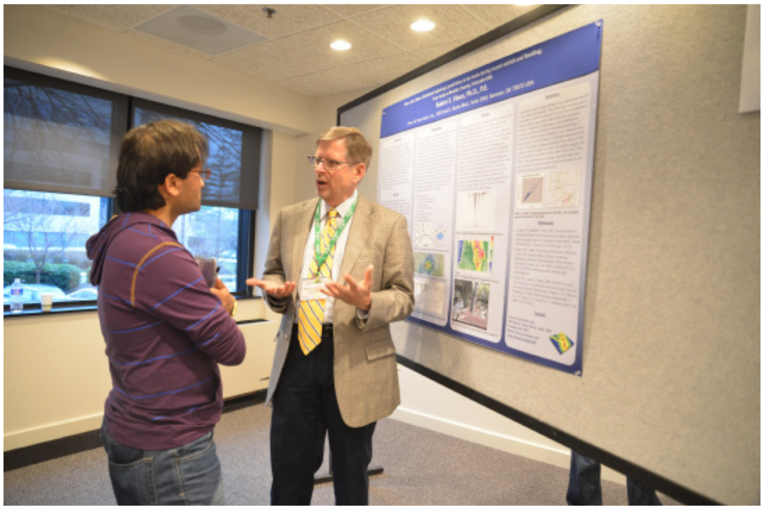
"But what we are finding in many cases is that the design standards that have been historically developed from rain gauge networks have been too coarse; in other words the gauges are not dense enough to actually capture the variability that we see in rainfall every day. So what this symposium is all about is figuring out better ways to understand the total volume of water that is falling on our watershed so we [as engineers and scientists] can actually do a better job both in designing the structure and in managing flood events in real time."

Held April 7-10 at ASCE headquarters in Reston, Virginia, the 2014 International Symposium on Weather Radar and Hydrology was the 9th in a series since 1989. This year, it was sponsored by ASCE/EWRI. Approximately 165 experts from universities and organizations from 21 nations, who specialize in collecting and analyzing data from weather radar and transferring that into hydrology information, attended the symposium.

Exchanging Information about the Science and Engineering of Radar and Hydrology

Chandra S. Pathak, Ph.D., P.E., D.WRE, Hydrology, Hydraulics and Coastal Community of Practice engineer for the U.S. Army Corps of Engineers, and chair of the symposium, says that the pinnacle element of this symposium, entitled "Bridging Research and Applications," is that with the continued advancement of computers and radar, it has increased the ability of engineers and scientists to collect and translate rainfall information. As opposed to the old standard rainfall gauges, much of this information can now be obtained by using radar methods – such as Doppler Radar, commonly used by television meteorologists in on-air weather reporting – and can be modeled and used to describe and translate the kind of real-time rainfall information that meteorologists are seeing on the ground in an effort to anticipate and/or predict near-term flooding events.

"What we are talking about," explained Pathak, "is this technology known as Doppler Radar where the rainfall



A total of 65 oral presentations and 81 poster presentations were presented on topics ranging from hydrologic modeling and weather radar applications in urban areas to radar analysis for use in hydrological design and precipitation variability and extremes. Photo Credit: Veronique Nguyen

is measured indirectly as opposed to the old rain gauge, which many of us have in our backyard and is just a small cylinder that you put in the ground and [which] lets us know how much rain fell.

“Now imagine doing that for a living as a meteorologist, using an instrument of that same kind, which is very expensive to maintain because it contains a sophisticated computerized clock to measure rainfall by minutes, and needs constant maintenance. We are now beginning to use this new Doppler Radar technology, which allows you to more accurately track and collect rainfall data from location to location, and develops methods of estimating rainfall, which are useful to engineers in so many different ways.”

“If anybody takes anything away from symposium, it’s a renewed sense of energy to redouble your efforts to make advances in this science,”
said David C. Curtis, Ph.D., Aff.M.ASCE, vice president of West Consultants Inc. and the keynote speaker at the banquet dinner held at the National Press Club. Photo Credit: Veronique Nguyen

“If anybody takes anything away from this symposium,” notes Curtis, the keynote speaker at the banquet dinner held at the National Press Club, “it’s a renewed sense of energy to redouble your efforts to make advances in this science.”

Building Understanding Between Civil Engineers and Meteorologists

The symposium’s 4-day program consisted of 13 technical sessions and 4 poster sessions in one single track. A total of 65 oral presentations and 81 poster presentations were presented on topics ranging from hydrologic modeling, weather radar applications in urban areas, hydrologic flood forecasting, precipitation estimation, radar analysis for use in hydrological design, ensemble and probabilistic approaches in hydrologic applications, and precipitation variability and extremes.

“There are a number of things that we hope attendees came away with and number one, through the various session and poster presentations, they discovered new methods of information gathering and better data analysis,” says Pathak. “The second is taking advantage of the unique situation at this symposium whereby civil engineers can sit together with meteorologists and understand each other’s needs and requirements.

“Normally when civil engineers get together they are all of one discipline. Here, they are interacting with meteorologists and understanding how data is collected, what their limitations [are], and the data analysis side of it. And the meteorologists, in turn, understand what civil engineers do and how they come up with design standards. We end up with an understanding of both professions. So people are exchanging phone numbers, talking to each other, and developing personal relationships and understanding there are other people working on these issues.”

Pathak says the next International Symposium on Weather Radar and Hydrology will take place in Seoul, Korea, in 2017.

FLOOD RISK MANAGEMENT – THE NEED FOR SOUND POLICIES AND PRACTICES

Now in the April 2014 Issue of "Civil Engineering" – The Magazine of the American Society of Civil Engineering.

Following the tragedy of Hurricane Katrina, and at the request of the US Army Corps of Engineers, ASCE created and supported a panel of experts to provide a real-time objective review of the findings of the Interagency Performance Evaluation Task Force (IPET) investigating the failure of the New Orleans Hurricane Protection System during Hurricane Katrina in 2005. Following the review, the External Review Panel (ERP) prepared a report, The New Orleans Hurricane Protection System: What Went Wrong and Why? The ERP report concluded with ten "Calls-to-Action."

After six years had passed, ASCE was interested in the progress that had been made in implementing the calls-to-action and in determining if the American public is safer from the dangers of flooding. The mission of the Task Committee on Flood Safety Policies and Practices was to investigate whether the lessons learned from levee failures during Hurricane Katrina have been incorporated in the planning, design, construction and management of engineering water resource projects and to provide a basis for influencing any needed change in public policy and engineering practice related to flood safety.

Flood Risk Management Breakout Workshop
Carol Haddock, P.E., M.ASCE, (left)
P. Kay Whitlock, P.E., D.WRE, F.ASCE (right)

Over the last two years, the committee interviewed national, state, and local experts involved with flood risk management from many flood prone areas. The purpose of the interviews was to determine any progress and in what direction we needed to go. During the course of this work, it was found that while much progress has been achieved, much needs to be done. This was brought home by Sandy and other extreme events since Katrina. Four fundamental questions were developed that reflect the reccurring themes of the interviews.

Flood Risk Management:

- What are the overarching goals?
- What are the Roles and Responsibilities?
- What Resources are needed?
- What Approaches Needed for Managing Flood Risk?

A Summit was held in April 2013 that brought together flood risk experts from the US and abroad. The purpose of the Summit was to develop a broad consensus addressing these areas of Flood Risk Management. As a result of the committee's extensive interviews and the Summit discussions, Civil Engineering Magazine published an article on the findings of the committee.

Read the report-out from the April 2013 Summit; FLOOD RISK MANAGEMENT – THE NEED FOR SOUND POLICIES AND PRACTICES in the April 2014 Issue of "Civil Engineering" – The Magazine of the American Society of Civil Engineering. Read ahead, as we've included a few quotes from the article to provide a sense of the issues addressed.

"A clear message gleaned from the summit was the need for a common understanding of flood risk management—its major elements and objectives. The TCFSPP believes that flood risk management seeks to reduce flood risk to communities and individuals through identification and analysis of the flood hazard, the vulnerability of communities to these hazards, and the potential resulting consequences."

"The roles and responsibilities of some government entities and of private property, historic preservation, and environmental interests can be seen as in conflict and in competition with each other, which can impede effective flood risk management."

"Far too often we as a society have chosen to alter natural processes and systems to assist in meeting a perceived need. A common example is developing floodplains for residential or industrial/commercial purposes."

"Effective flood risk management requires continuous and adequate funding of both structural and nonstructural approaches to reduce the growing flood risk to the nation."

Several AAWRE Diplomates and active ASCE-EWRI Members participated both in the summit and the Task Committee. Robert Traver, Ph.D., P.E., DWRE, F.EWRI, F.ASCE, Chair, Christine Andersen, P.E., M.ASCE, Billy Edge, Ph.D., P.E., D.CE, Dist.M.ASCE, David Fowler, P.E., M.EWRI, Gerald Galloway, Jr., Ph.D, P.E., Hon.D.WRE, Dist.M.ASCE, Robert B. Gilbert, Ph.D., P.E., D.GE, M.ASCE, Carol Haddock, P.E., M.ASCE, Lewis E. Link, Ph.D., HG, M.ASCE, John Moyle, P.E., M.ASCE, Lawrence Roth, P.E., G.E., D.GE, F.ASCE, and P. Kay Whitlock, P.E., D.WRE, F.ASCE

ASCE-EWRI Standards Notices and Publications
www.ascelibrary.org/standards

ASCE/EWRI 60-12 | Guideline for Development of Effective Water Sharing Agreements

ANSI/ASCE/EWRI 56-10 and 57-10 | Guidelines for the Physical Security of Water Utilities and Guidelines for the Physical Security of Wastewater/Stormwater Utilities

ASCE/EWRI 54-10 | Standard Guideline for the Geostatistical Estimation and Block-Average of Homogeneous and Isotropic Saturated Hydraulic Conductivity

ASCE/EWRI 50-08 and 51-08 | Standard Guideline for Fitting Saturated Hydraulic Conductivity Using Probability Density Function and Standard Guideline for Calculating the Effective Saturated Hydraulic Conductivity

ASCE/EWRI 45-05, 46-05, and 47-05 | Standard Guidelines for the Design of Urban Stormwater Systems, Standard Guidelines for Installation of Urban Stormwater Systems, and Standard Guidelines for the Operation and Maintenance of Urban Stormwater Systems

ANSI/ASCE/EWRI 44-13 | Standard Practice for the Design and Operation of Supercooled Fog Dispersal Projects

ASCE/EWRI 42-04 | Standard Practice for the Design and Operation of Precipitation Enhancement Projects

ASCE/EWRI 40-03 | Regulated Riparian Model Water Code

EWRI/ASCE 39-03 | Standard Practice for the Design and Operation of Hail Suppression Projects

EWRI/ASCE 35-01 | Guidelines for Quality Assurance of Installed Fine-Pore Aeration Equipment

EWRI/ASCE 34-01 | Standard Guidelines for Artificial Recharge of Ground Water

ASCE/EWRI 33-09 | Comprehensive Transboundary Water Quality Management Agreement

ASCE 18-96 | Standard Guidelines for In-Process Oxygen Transfer Testing

ANSI/ASCE/EWRI 12-13, 13-13, and 14-13 | Standard Guidelines for the Design, Installation, and Operation and Maintenance of Urban Subsurface Drainage

ASCE/EWRI 2-06 | Measurement of Oxygen Transfer in Clean Water

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Meetings to Watch For…

World Environmental & Water Resources Congress 2014
June 1-5, 2014 Portland, Oregon

2015 International Low Impact Development (LID) Conference
January 17-21, 2015 Houston, Texas

World Environmental & Water Resources Congress 2015
May 17-21, 2015 Houston, Texas

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