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VOLUME 5 ISSUE 9

OCTOBER 2024

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Dave Culligan of HDR's Hydropower Practice: A One-Stop Shop for the Industry

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Do you have a story idea for an upcoming issue? Contact our editor-in-chief, Kris Polly, at kris.polly@waterstrategies.com.

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COVER PHOTO:
Dave Culligan, Vice President and National Hydropower Practice Leader, HDR. Photo courtesy of HDR.

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Pushing the Industry Forward

By Kris Polly

In our cover story this month, we interview Dave Culligan, who is a vice president of HDR and leads its national hydropower practice. HDR, Mr. Culligan tells us, is a one-stop shop for the hydro industry, providing services than span licensing, permitting, engineering, dam safety, construction management and more. In our wide-ranging conversation, we talk about how HDR is pushing the industry forward through participation in initiatives including the U.S. Department of Energy's Hydropower Vision program.

Then, we highlight another industry champion: the National Hydropower Association (NHA). Marla Barnes, NHA's vice president of member and industry engagements, and Chris Hayes, its senior advisor of technical programs and training, tell us about the new Hydropower System Principles Course. A 1-day version of the course will be co-located with NHA's Clean Currents conference, which will take place October 7–10 in Portland, Oregon.

The Upper Waitaki Power Development, which was constructed in the mid-20th century in New Zealand's South Island, involves numerous hydropower dams and canals. Among its additional benefits, however, are irrigation water supply and excellent facilities for salmon farming. We learn more from Rick Ramsay, who recently retired after 32 years with Mount Cook Alpine Salmon.

Multidisciplinary consulting firm GZA provides a wide array of services for the hydropower industry. This month, we speak with Principal and Senior Vice President Matthew Taylor about one of its new offerings: comprehensive assessments required by the Federal Energy Regulatory Commission's new part 12 engineering regulations.

Next, we speak with Eddie Swanepoel of Vesconite Bearings about the company's wide range of advanced parts for hydropower facilities.

Our final story highlights the versatility, longevity, and possibilities of hydro. Breitenbush Hot Springs in Oregon was a popular resort from the 1920s to the 1960s and was resurrected in the 1970s as an off-grid wellness center. During its 1970s renewal, the new owners found and repaired an old Leffel turbine of a type designed in 1895. Today, that is still the resort's off-grid source of electricity.

As regulations evolve, industry service providers are evolving, too, with new services, new educational courses, and new technologies. I hope you enjoy reading this month about all the ways in which our hydro leaders are pushing the industry forward.

Kris Polly is the editor-in-chief of Hydro Leader *magazine and the president and CEO of Water Strategies LLC, a government relations firm he began in February 2009 for the purpose of representing and guiding water, power, and agricultural entities in their dealings with Congress, the Bureau of Reclamation, and other federal government agencies. He may be contacted at kris.polly@waterstrategies.com.*

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Dave Culligan of HDR's Hydropower Practice: A One-Stop Shop for the Industry

A dam safety inspection being performed by HDR at Seattle City Light's Diablo Dam.

HDR is a global professional services firm with a significant hydropower practice that handles all facets of engineering, environmental, and regulatory services for the industry. In this interview with HDR Vice President Dave Culligan, who leads HDR's national hydropower practice, we discuss the Federal Energy Regulatory Commission's (FERC) new part 12 relicensing process, the expansion in the development of new pumped storage projects, and more.

Hydro Leader: Please tell us about your background and how you came to be in your current position.

Dave Culligan: Throughout my career, I've been fortunate to learn from some of the best professionals on both the owner and the consultant sides. I'm grateful I've had the chance to be involved in a wide range of work, such as the FERC relicensing of over 55 hydropower facilities, to lead new conventional and pumped storage hydro development, and to serve in my current role as HDR's national hydropower practice leader.

I grew up in Bloomfield, Connecticut, and my hydropower career started in 1988 in Portland, Maine, as an entry-level engineer-in-training consultant after graduating from the University of New Hampshire with a degree in civil engineering. At the time, I was writing code for hydro operations models and doing hydraulic design, but I was also extremely fortunate to be part of a field monitor team witnessing the construction of a new 19.4-megawatt hydropower facility on the Androscoggin River in Maine. As a young engineer, it was an amazing and formative experience to be on the front lines of new hydro construction from first shovel through startup and commissioning. I'd say it's through this experience that I came to recognize hydro as not only a clean, renewable energy resource, but a career path.

I moved to Syracuse, New York, in 1990 to work with Niagara Mohawk Power Corporation, where I became involved in dam safety, FERC compliance, and the so-called *class of 1993* wave of FERC relicensings. In 1995, I started the Syracuse office for Northrop, Devine and Tarbell/Devine Tarbell & Associates, which was acquired by HDR in 2008. Between 2003 and 2008, I worked for Brookfield Renewable Partners, advancing new hydro development and expansion work.

I joined HDR in 2009 and currently serve as a vice president and as the leader of our national hydropower practice, based in Syracuse, New York.

PHOTOS COURTESY OF HDR.

Hydro Leader: Please introduce HDR and its services for the hydropower market.

Dave Culligan: HDR is a 100 percent employee-owned professional services firm. Founded over a century ago to bring electricity to a changing world, we are now a global company specializing in architecture, engineering, environmental, and construction services. Our success in built and natural environments continues as we collaborate to solve our clients' and communities' most complex challenges. Founded in 1917, HDR is headquartered in Omaha, Nebraska, and today we're over 13,000 employees strong with more than 200 offices around the globe.

Our hydropower practice comprises more than 200 professionals who provide a full suite of expertise in all facets of engineering, environmental, and regulatory services to the hydropower industry.

Hydro Leader: What types of projects does the hydropower practice handle?

Dave Culligan: I like to say we're a one-stop shop for the industry—it's tough to think of a hydropower project, issue, or situation we haven't encountered. Our experience is wide, our bench is deep, and we listen first to really understand the problem or issue at hand. All of this allows us to be flexible and scalable and to support a wide portfolio ranging from small projects to megaprojects.

Some of the typical core lines of service we provide for conventional and pumped storage hydro and marine energy include

- FERC licensing/relicensing
- permitting
- environmental/field services
- dam safety
- all forms of engineering
- fleet modernization
- asset and program management
- owner's engineer services
- new hydro and pumped storage development
- construction management

It's important to recognize that there are many fantastic professionals in the industry, and we're proud of all the great work and long-standing relationships we have with our team partners. This is an integral part of doing things right and making great things possible for our clients.

Hydro Leader: Is there any particular project success story you were a part of that you would like to highlight?

Dave Culligan: That's a tough one! I've been involved in the FERC relicensing of more than 55 hydro facilities. Many of these have entailed comprehensive settlement agreements, and several have involved adding new generation.

I'm most proud of our success in using operations models to demonstrate and preserve the value of hydropower in

In addition to supporting dam safety and engineering work, HDR is the lead consultant for the relicensing of Brookfield Renewable's Bear Swamp Pumped Storage Project.

The Lowell Hydroelectric Project, owned by Boott Hydropower LLC, is located in a historic district and is currently pursuing a new FERC license with HDR as its lead consultant.

relicensings. Our models are instrumental in developing balanced and beneficial relicensing outcomes that can satisfy both power and nonpower interests.

Every time a new FERC license is issued, it's gratifying to have played a role in helping a hydro facility continue to do what it does best—provide society with clean, renewable energy while also providing important nonpower benefits, such as recreation, environmental enhancements, or flood control—for another 30–50 years.

Hydro Leader: How have you championed new hydro development throughout your career?

Dave Culligan: A lot of this has come through my day-to-day work as an owner or consultant, during which I've worked to add new generation at existing facilities, get projects licensed or relicensed, pursue the powering of nonpowered dams, and study the feasibility and further the development of new pumped storage hydro.

I've been fortunate and proud to have supported the development of the U.S. Department of Energy's (DOE) *Hydropower Vision* report and the associated quantitative modeling, documenting that a viable pathway exists to add up to 50 gigawatts (GW) of new hydro by 2050.

I'm equally fortunate to have served on the board of directors of the National Hydropower Association (NHA) from 2015 through 2022, including 3 years as treasurer on the executive committee, helping the industry shape and influence regulatory and legislative advances in order to benefit hydropower development. NHA's work has been amazing, leading to wins such as securing key hydro provisions in the 2022 Inflation Reduction Act to expand investment tax credits and production tax credits and in the 2021 Infrastructure Investment and Jobs Act, leading to $753 million of funding for DOE's 242, 243, and 247 grant programs, which respectively support adding hydro at existing nonpowered dams; implementing efficiency upgrades at existing hydropower facilities; and funding grid resilience, dam safety upgrades, and environmental enhancements at existing hydropower facilities.

Hydro Leader: Please tell us about your involvement in DOE's Hydropower Vision program.

Dave Culligan: In 2014, DOE initiated its landmark national Hydropower Vision program, which established the analytical basis for an ambitious roadmap intended to usher in a new era of growth in sustainable domestic hydropower. NHA recognized the need to participate in this first-of-its-kind effort, and I was honored to serve as NHA's representative on DOE's Vision Core Team as the liaison between NHA and DOE.

I provided technical guidance and infused NHA and industry interests and perspectives into the program. The resulting 2016 *Hydropower Vision* report was based on optimizing the nation's existing hydropower fleet and pursuing new hydropower growth and doing both in a responsible and sustainable manner. It's an amazing compendium of the U.S. hydropower industry and documents a viable pathway to add up to 50 GW of new hydro by 2050.

The associated Hydropower Vision Roadmap defines a range of actions to realize this growth and the economic and social benefits of increased hydropower. As *Hydropower Vision* approaches its 10-year anniversary, it remains a living document. To this day, DOE continues to work with the hydropower community to improve and advance the

PHOTOS COURTESY OF HDR.

roadmap. Taking part in the Hydropower Vision program is one of the most rewarding things I've done in my career.

Hydro Leader: What trends have you seen regarding conventional and pumped storage projects?

Dave Culligan: I think we've all seen a resurgence over the past several years in the development of new hydro, pumped storage in particular. This is only increasing as society seeks to incorporate additional energy storage on the grid. We know that conventional hydropower and pumped storage are proven enablers of other renewables and that pumped storage can provide massive energy storage and grid services, and we've seen the proof that hydropower energy and capacity are vital to grid stability nationwide, particularly in the West. We're deeply involved in pumped storage relicensings, upgrade and expansion studies, and many new pumped storage projects at varying stages of development. With all this, it feels like the industry is on the cusp of seeing some pumped storage projects move into more advanced development stages, which makes for exciting times indeed!

Hydro Leader: Would you describe FERC's new dam safety regulations for those who may not be familiar with them?

Dave Culligan: FERC's regulation and oversight of nonfederal hydroelectric projects includes dam safety under part 12 of title 18 of the Code of Federal Regulations, titled "Safety of Waterpower Projects and Project Works." FERC part 12 regulations have evolved with time, but the 2017 Oroville incident, along with FERC's review of other incidents, served as a catalyst for substantial updates defined in FERC Order 880, which was issued in December 2021 and went into effect in April 2022.

Order 880 implements many new provisions, most notably a two-tier dam safety inspection approach comprising a comprehensive assessment (CA) and a periodic inspection, each performed at alternating 10-year intervals to retain a 5-year inspection interval. The CA is designed to be a comprehensive deep dive. A CA team comprises an independent consultant, subject-matter experts whose expertise aligns with the nature and technical complexities of the project at hand, and facilitators and risk analysts who handle the risk assessment component of the CA. The CA team is subject to FERC approval and needs to meet applicable FERC requirements related to experience, training, and other matters. FERC's implementation of CAs began in earnest in 2022 with a goal of achieving 75 CAs per year over the next several years. That has made the implementation of these new regulations a large undertaking for both FERC and the industry.

Hydro Leader: How do you help your clients work through these regulatory requirements?

Dave Culligan: Between our hydropower practice and our dams and levees practice, HDR has all the personnel needed to form complete CA teams. We have a deep bench of independent consultants, subject-matter experts, facilitators, and risk analysts. Each project and CA is different, and one size doesn't necessarily fit all. We work closely with our clients to develop a team and an approach that are cost effective, yet scalable to and consistent with FERC's expectations and requirements. We led two of the first CAs ever performed, and the number of CAs we're performing continues to steadily rise in response to industry needs as FERC ramps up its CA program.

Hydro Leader: Is there anything you would like to add?

Dave Culligan: I think we all need to be ambassadors for the industry and continue to bring the next generation of our workforce into the field. I've been fortunate to be part of the hydropower community in some form or fashion for my entire career. The size of our industry truly fosters a family atmosphere. One of the most rewarding aspects of this career is the chance to give back to industry, whether through DOE involvement, service on the NHA board, or industry conferences and events. Everyone's journey is different, but I'd encourage those who may be new to the industry to reach out and become as involved as you can. I'm confident you'll find it very rewarding, as I have.

Hydro Leader: What is your vision for the future?

Dave Culligan: The realist in me recognizes it will take time to get where we want on things such as regulatory reform; a level playing field on incentives; or the appropriate valuation of hydropower energy, capacity, and ancillary services. But the optimist in me believes we will get there. When we do, I see a future in which the value of hydropower is fully recognized, nonpowered dams are being responsibly powered, new pumped storage is being constructed, and the number of hydropower jobs continues to rise.

My biggest vision and hope for the future is that the issue of workforce development is solved in an equitable manner and there is a new generation of young hydropower enthusiasts ready to deploy the technology of today and tomorrow to carry the industry forward. I think we've seen more than a glimpse of that in recent collegiate hydropower contests, and I'm confident the future is bright for hydropower! H

Dave Culligan is a vice president at HDR and the leader of HDR's national hydropower practice. He can be contacted at david.culligan@hdrinc.com.

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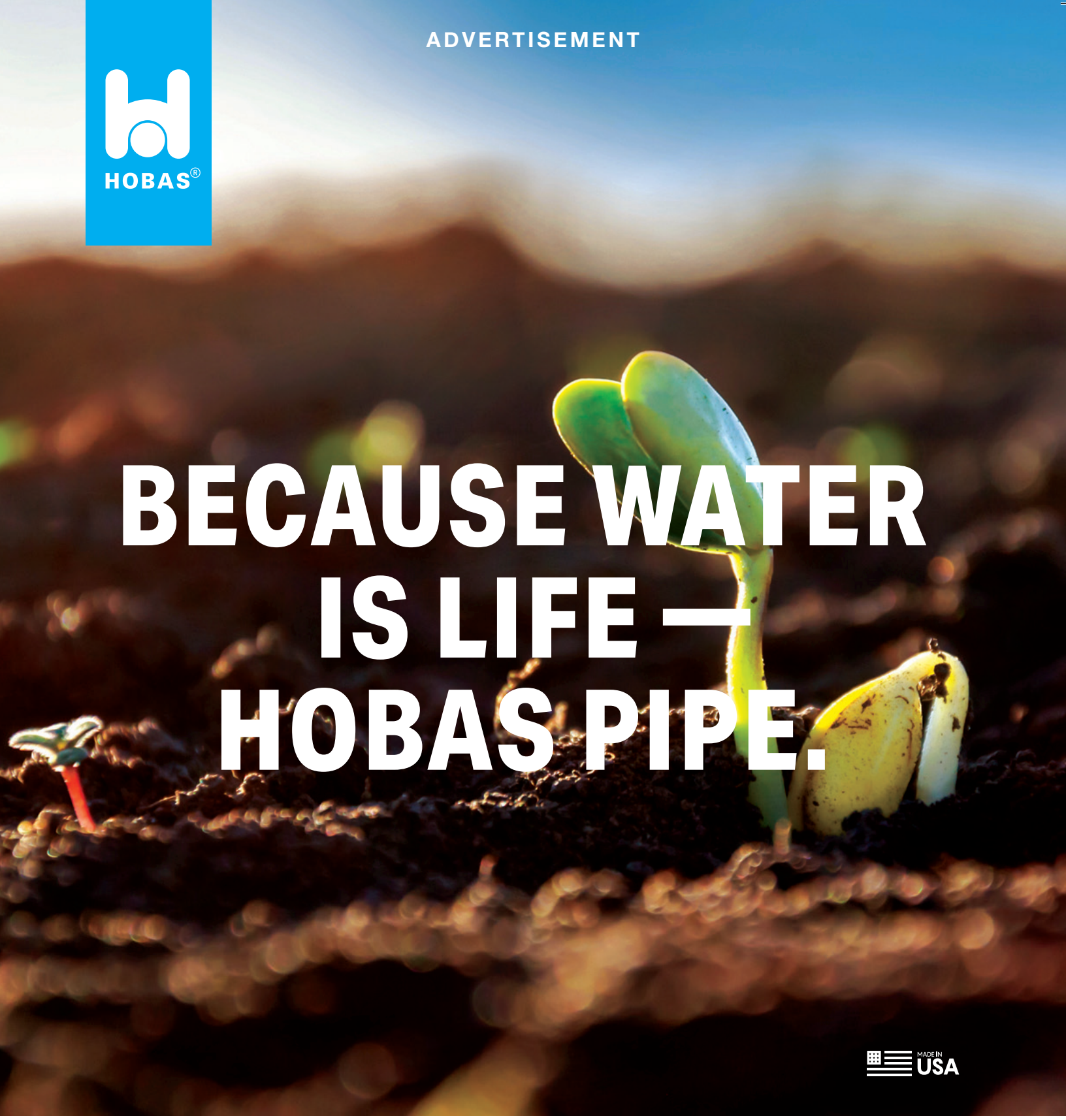

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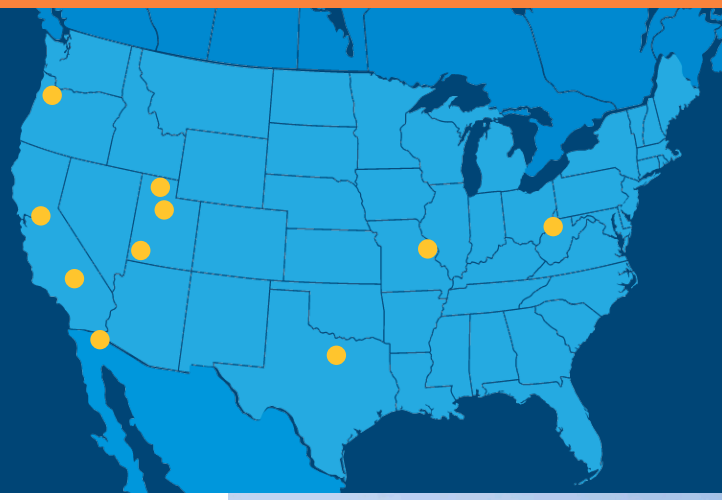

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How the National Hydropower Association Is Powering Up the Industry: Clean Currents and the Launch of the New Hydropower System Principles Course

A presentation at the Innovation Power House at Clean Currents 2023.

Hydro workers and employers have long expressed a need for more technical and operational training. New and transitioning workers need to get up to speed quickly, and hydro operators need to capture and pass on priceless institutional knowledge. The National Hydropower Association (NHA) is working to meet these needs. The association will offer a variety of educational programming at its upcoming Clean Currents conference and exhibition in October. Co-located with Clean Currents is a new 1-Day Hydropower System Principles Course, being offered by the NHA Hydro Academy. In this interview, Marla Barnes, NHA's vice president of member and industry engagements, and Chris Hayes, its senior advisor of technical programs and training, share with Hydro Leader *readers what's in store.*

Hydro Leader: Ms. Barnes, please tell us about NHA's educational programming and why you hired Mr. Hayes to help expand those offerings.

Marla Barnes: For a long time, NHA has been a leader in advocating for the industry with regulators, policymakers, and the public. But we recognized that we needed to provide more services and programming on the technical and operational side of the industry. We were fortunate to bring Chris Hayes on board as a senior advisor to NHA. Chris has worked in hydropower for more than 20 years and has a background in engineering, knowledge transfer, and business development. Before joining NHA, he directed the development and growth of CEATI International's

PHOTOS COURTSY OF NHA.

hydropower program and was also the vice president of utility account management, in which position he managed member utility accounts covering programs related to power generation, distributed energy resources, transmission, distribution, asset management, and security. Chris has been with us since February 2023 and has worked with our team to further develop the technical and training offerings that we provide to the industry and our member organizations.

Hydro Leader: Mr. Hayes, why is this such a critical time for continuing education and professional development on the technical and operational sides of the industry?

Chris Hayes: The industry is facing a wide range of challenges, including aging infrastructure, a wave of retirements some call the *silver tsunami*, and the integration of new and emerging technologies. It's never been more important to capture the lessons of the past for the benefit of people working in the industry today and tomorrow. It will also be critical to make this transition seamless and to accelerate the process wherever possible. The ability to secure institutional knowledge is highly valuable to the future success of an organization. Therefore, a good part of our programming is dedicated to the sharing of best practices; problem solving; and state-of-the-art updates on emerging trends, regulations, technologies, and issues.

Marla Barnes: One of the things that I hear a lot is that employers want their staff to come on board and be ready to do the work on day 1. But often, people don't have that background; the learning curve when they start is nearly vertical. When NHA looked around, we didn't see big opportunities out there for people to quickly gather the knowledge they needed to do their jobs.

Hydro Leader: How is NHA meeting that need?

Chris Hayes: We are meeting the need through a number of different offerings, including programming at the upcoming Clean Currents conference, which is scheduled for the week of October 7 in Portland, Oregon; a brand-new Hydropower System Principles Course in either a 40-hour or a 1-day format; and articles posted on NHA's POWERHOUSE media platform, which can be found at www.hydro.org/powerhouse.

At Clean Currents, we'll focus on a variety of topics and challenges that people are managing on a day-to-day basis and thinking about relative to short-, medium-, and long-term planning. Innovation and new technologies will also form a large part of the event. For example, the event features an area called the Innovation Power House, where attendees can see four special 30-minute innovation demonstrations. Each demonstration will showcase how cutting-edge technology can be applied in the waterpower industry to solve problems, ensure worker safety, and get answers to operational challenges more quickly and cost effectively.

A panel-style discussion at Clean Currents 2023.

A keynote address at Clean Currents 2023.

For Clean Currents programming, we've put a lot of thought into how people learn and absorb knowledge. You'll see a variety of formats on the conference program, including classroom presentations, roundtable dialogues, panel sessions, poster sessions, and deep-dive workshops.

Marla Barnes: As Chris said, everyone learns differently. At Clean Currents, we're creating a learning environment in which attendees can do whatever they want throughout the week to shape their learning experience. For example, if you're a participatory learner, there are sessions such as roundtable dialogues, which are informal discussions that include everybody in the audience. If you're more of a passive learner,

The 40-hour version of the Hydropower System Principles Course will be offered virtually starting in January 2025.

you can attend classroom presentations or panel discussions to listen to experts. If you like to learn on your own, you can wander through the Waterpower Learning Center, which includes visual displays and opportunities to talk one on one with experts on various subjects.

Chris Hayes: The second way we are meeting the industry's needs is through our brand-new Hydropower System Principles Course, which we are proud to be launching this year. The Hydropower System Principles Course is offered both as a 40-hour program and as a 1-day overview. The course covers eight areas: water to wires; production planning and water management; dam safety; equipment, engineering, and technology; asset management; markets; environment; and licensing and compliance. We worked with a large cross section of the industry on the content of this initiative. More than 50 subject-matter experts and faculty were involved in the development and peer review of the course. Also included on our team of contractors are an instructional designer and a learning management system provider. It is quite a large undertaking. The 1-day introductory course will be offered in person at the same location as Clean Currents this October and again virtually in early December. The 40-hour course is really at the heart of this effort and will be offered virtually starting in January 2025. We are currently seeking accreditation so that participants can earn professional development hours and continuing education credits.

Marla Barnes: We're listening to our member organizations and the industry and trying to deliver what they need. The Hydropower System Principles Course is designed for people who are new to the industry and for longtime employees who are moving to a different department or into a management position. It is also useful for subject-matter experts—biologists, regulatory specialists, or electrical engineers, for example—who want to broaden their scope and understand more about the hydropower system as a whole.

Another way in which NHA is aiding the industry with continuing education and professional development on technical and operational topics is by publishing original written articles on our POWERHOUSE media platform. Every week, we publish new articles on the site that impart insights and knowledge on a wide variety of topics, including electricity markets, innovation and technology, project operations, project development, regulatory issues, policy, and marine energy. The articles are written by NHA staff, industry thought leaders, and subject-matter experts. To get you curious about the types of articles we publish, here are some recent titles: "Maximize Your Capital Expenditure and Optimize Hydro Asset Performance," "How an Oregon Hydro Project's Fish Passage Data Helps Inform the Industry," and "How Existing Hydropower Could Benefit from the Inflation Reduction Act." We are always looking for people to contribute articles to POWERHOUSE; if you're interested, please let me know!

Hydro Leader: Is there anything you'd like to add?

Marla Barnes: NHA is a nonprofit association dedicated to preserving and expanding clean, reliable, affordable hydropower and marine energy. The association's vision is that waterpower, in all its forms, is valued as an essential renewable energy resource that can help achieve a sustainable, clean, and secure electricity system in North America. Part of achieving that vision is having an industry workforce that is well informed, knowledgeable, and educated—and ready to apply what it knows to achieving excellence in its everyday work. As such, we are committed to providing a variety of learning and professional development tools for the industry.

Marla Barnes is the National Hydropower Association's vice president of member and industry engagements. She can be contacted at marla@hydro.org or (816) 588-4639.

Chris Hayes is the National Hydropower Association's senior advisor of technical programs and training. He can be contacted at chris@hydro.org or (514) 795-8413.

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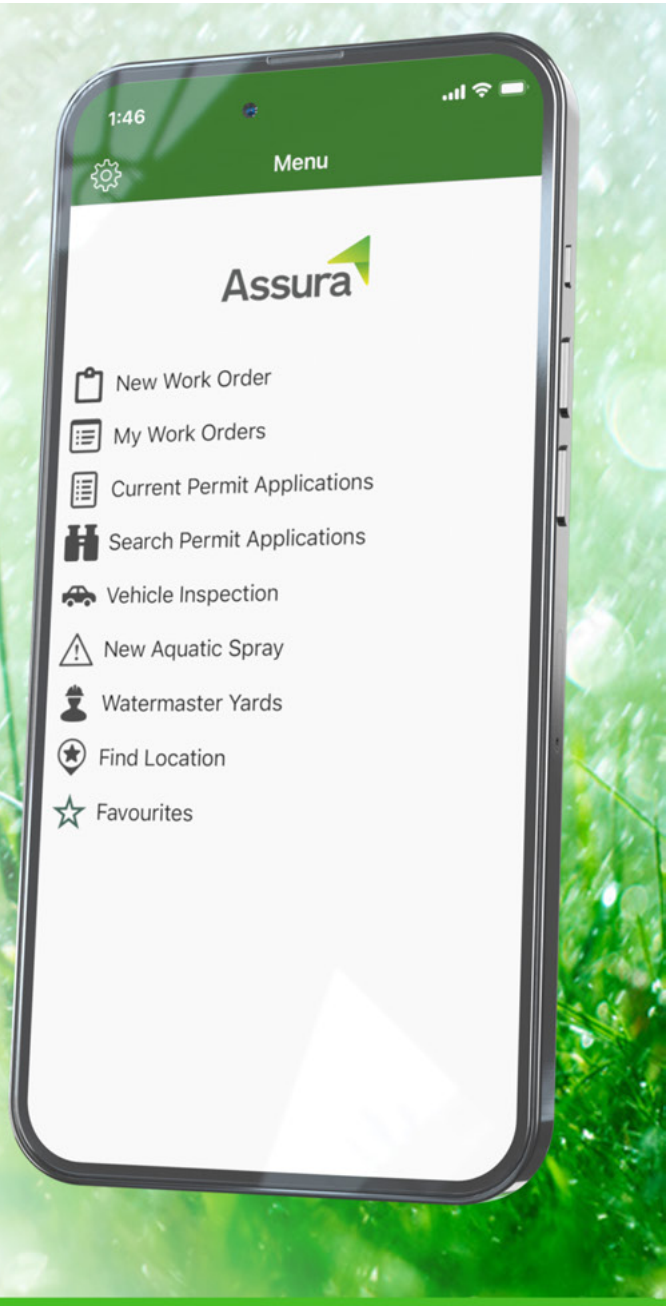

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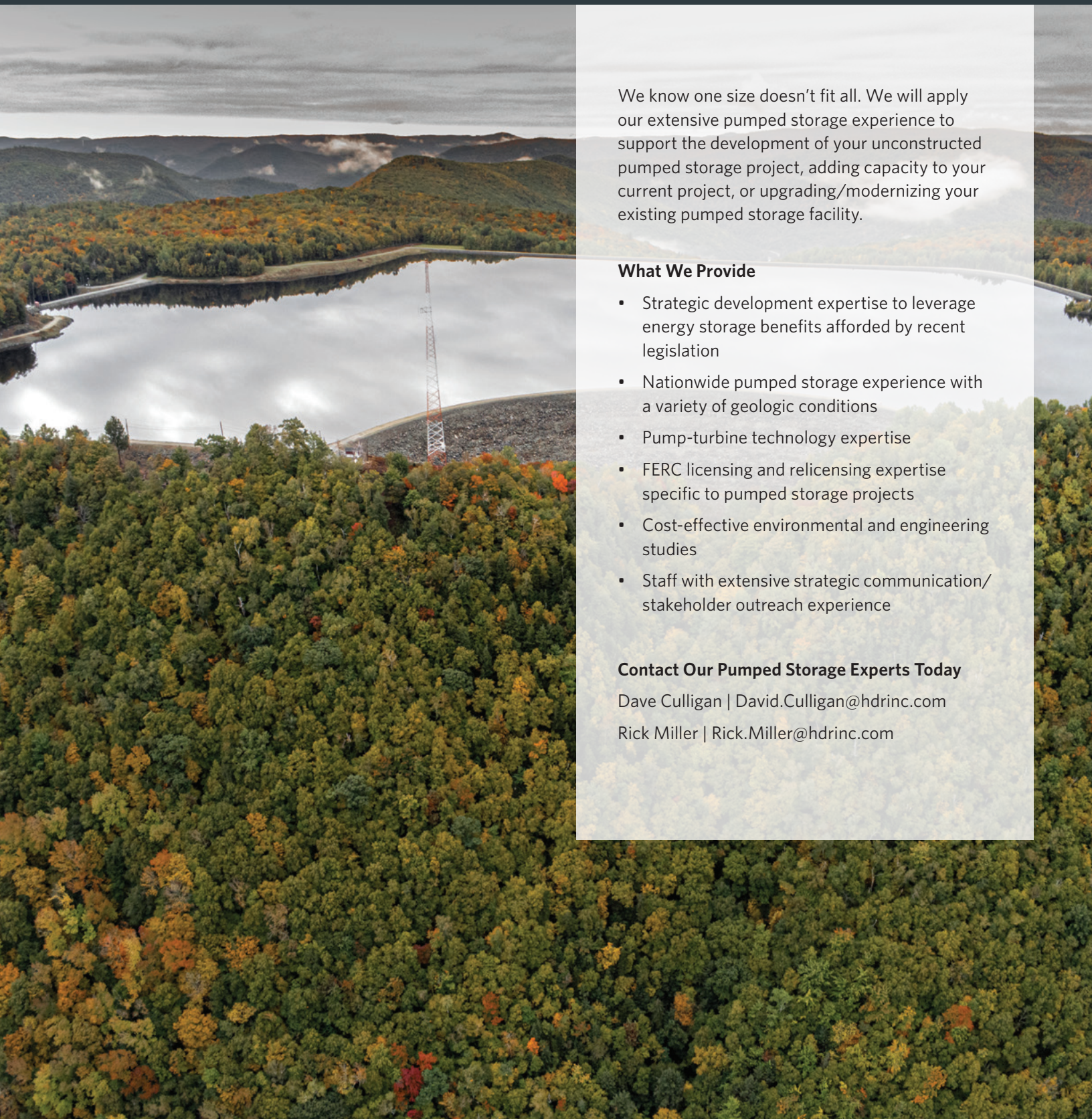

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How New Zealand's Upper Waitaki Power Development Enabled Hydropower, Irrigation, and Premium Salmon Farming in Hydro Canals

The Mount Cook Alpine Salmon farm at the end of the Tekapo Canal, which links Lake Tekapo with Lake Pukaki, seen in the background. This area is referred to as the stilling basin. There is a major irrigation outlet from the stilling basin that serves a gravity pressure system supplying the Pukaki Flats.

A major hydropower development in the Mackenzie basin of New Zealand's South Island paved the way for irrigation; dairy farming; and, that's right, salmon farming in hydro canals. In this interview, Rick Ramsay, who worked for more than 30 years at Mount Cook Alpine Salmon, talks about the basin's big hydro development, its ecological and agricultural challenges—and a fishy business that thrives on glacial waters from the Southern Alps.

Hydro Leader: Please tell us about your background and how you came to be in your current position.

Rick Ramsay: I started my career as a journalist in 1974 for a major daily newspaper. I was based in Oamaru, which is on the coast. In 1977, I applied for the position of information officer for the Upper Waitaki Power Development in the Mackenzie Basin, living here in Twizel. I was only 22 when I applied for that job, and for some reason, they gave it to me. I handled the project tours, news releases, films, and television and audiovisual programming for the power project and managed the information center.

I recently retired after 32 years as environmental manager with Mount Cook Alpine Salmon, having started with the company as a laborer when salmon farming in the hydro canals first started in 1992; serving as the general manager from 1995 to 2010; and then, as the company grew, moving into roles of asset and environmental management.

During my time in aquaculture, I was engaged in local politics from 1983 to 2001, serving as the deputy mayor of the Mackenzie District Council and as the chairman of planning from 1992 to 2001. I have the distinction of losing my seat on the council by one vote, but that defeat opened other doors, and I became a director for a number of companies associated with the electricity and salmon industries—virtually two careers at once!

Hydro Leader: Please tell us about the history of the Upper Waitaki Power Development.

Rick Ramsay: In 1904, the New Zealand Public Works Department assigned a young engineer who had been born in England but educated at Otago University to assess the

PHOTOS COURTESY OF MOUNT COOK ALPINE SALMON LTD.

hydroelectric potential of the country. He traveled through vast and wild areas throughout New Zealand, including the headwaters of the Waitaki River, and he identified a range of places suitable for hydroelectric generation. The Waitaki River is fed by three large glacial lakes: Lakes Tekapo, Pukaki, and Ohau. The first hydro project that was built was Waitaki Dam, a concrete dam completed in 1934 that is now the most downstream dam in the project. This was followed by a small station fed by Lake Tekapo and a control structure on the outlet to Lake Pukaki. Then, they moved to Benmore Dam, which was the biggest earthen dam in the Southern Hemisphere when it was completed in 1965. When it was complete, the Public Works Department built Aviemore Dam between Benmore and Waitaki Dams.

As that was progressing, the government agreed to pursue the Upper Waitaki Power Development, which would involve four new power stations, a series of linking canals, and a high dam at Lake Pukaki. It sent investigation teams to look at the geology of the Mackenzie basin, which is the area that we're in, and to plan the canals and powerhouse sites. In 1968, the Public Works Department started building the town of Twizel and moved staff and machinery from Otematata to start working on the project. Today, all those power stations are connected both to the South Island grid and to the North Island grid via the High-Voltage Direct Current Inter-Island Link. It is quite a flexible system. The original budget for the Upper Waitaki Power Development was NZ$500 million. That's about NZ$4.5 billion (US$2.76 billion) in today's terms, and it required a workforce of more than 1,200 people and a new town and industrial base. The project was completed in 1984.

Hydro Leader: How did the Upper Waitaki scheme affect farmers?

Rick Ramsay: The Upper Waitaki Power Development cut through a number of high-country sheep stations. The runholders (farmers) were entitled to compensation for the loss of land under the Public Works Act. Some of those farmers decided to be compensated through irrigation. Some of them would graze their sheep in the high country, or mountains, during the summer and then bring them down to the lower country in the winter. In some cases, they used supplementary feed, and the idea for irrigation was to produce additional supplementary feed. Other farmers received financial compensation for their land, and in some cases, they argued that the amount was insufficient given the land lost or the disruption of their farm practices. As the first canal was built between Lakes Tekapo and Pukaki, several of the farmers in that area put in siphons and took water out of the canal. Beyond that, very little irrigation was developed

When the government designed and authorized the scheme in the mid-1960s, it made an allowance for 10 cubic meters per second (353 cubic feet per second) of water to be taken out of the scheme for irrigation. Later, the government changed the ownership structure of the hydroelectric asset entities, making them partially private companies. As part of that process, the new state entity Electricorp decided to renew all water rights for the operation of the Upper Waitaki scheme. It was a public process, and there was a lot of input from the community. Only one entity, the Benmore Irrigation Company, asked for water for irrigation. In effect, the power companies that were formed, Meridian Energy and Genesis Energy, got to use whatever was not allocated for irrigation for power generation.

A Mount Cook Alpine Salmon farm in the Ōhau C Canal, located alongside some of the early border-dike irrigation carried out by Glencairn Station with water supplied by siphon from the canal. Visible along the right side of the photo is a headrace against the foothills that is supplied from the Ōhau B Power Station intake.

In the late 1990s, the government decided that it did not want to continue being the owner of some of the land, so it created a process whereby landowners could acquire private title to some of the land by returning some of the high-country land to the Department of Conservation. The farmers wanted to develop the land they privately owned and intensify farming. Irrigation was key to that goal, because the Mackenzie basin is dry, with an average rainfall of 22 inches a year, cold winters, and hot summers. The farmers formed the Mackenzie Irrigation Company and obtained an allocation of water that had been identified in the original order in council that had authorized the power scheme.

Hydro Leader: Please tell us about how that contributed to the growth of intensive farming in the basin and the environmental backlash to that growth.

Rick Ramsay: In the late 1990s, dairy farmers saw the potential for dairying in the Mackenzie basin. Other people opposed any dairying in the basin. But these farmers spent the money, installed irrigation systems, and succeeded in establishing large dairy farms supported by irrigation. The main effects have been an increase in the levels of nitrate in the water and changes to the landscape. The regional government, Environment Canterbury, established limits on

Rick Ramsay at Mount Cook Alpine Salmon's Ruataniwha Farm on the Ōhau B Canal.

the nitrate inputs to the various lakes and water bodies from agriculture, aquaculture, and other discharges.

In recent years, there has been a public uproar about farm intensification in the Mackenzie basin. The local councils and farmers ended up in a fight over planning rules. In the early 1990s, the whole basin was recognized as an outstanding natural landscape under the Resource Management Act. That and other rulings of the Environment Court of New Zealand appear to have limited the further intensification of farming. Owing to these recent constraints, I don't believe the farmers' water allocations can be fully used now.

Hydro Leader: Please tell us about the ecological challenges in the Mackenzie basin.

Rick Ramsay: Many years ago, the high country was covered in a tall grass called tussock. People still see the basin as a place of golden waving tussocks, which, of course, is not actually what it is, because some of it is just ryegrass, and there are few good remnants of tussock grassland left. The Golden Mackenzie, as the basin is called, has faced three major threats: rabbits, a weed called hieracium, and invasive trees. The principal sheep type here was the Merino, which came from Spain and is used to grazing on hard country. The farmers frequently burned the tussocks to create new shoots for the sheep to eat. Unfortunately, that practice destroyed the vigor of the tussocks and was followed by an invasion of *Hieracium pilosella* (hawkweed), which they spent a lot of money trying to find ways to reduce. On top of that, the rabbit population exploded. The rabbits ate the tussocks and everything else. Another problem in the Mackenzie is the spread of the *Pinus contorta* (lodgepole pine), which was introduced around 1880 from northwestern North America. In recent times, it has spread over vast areas of the basin. It takes a lot of effort and money to control. Eliminating it has become an almost impossible task, but intensive farming helps control it, because it involves things such as plowing and intensive stocking grazing. However, given the massive fight over intensification, intensive farming cannot be relied on to control its spread.

Hydro Leader: How has intensification affected the lakes in the basin?

Rick Ramsay: The water quality in the lakes is judged based on the trophic level index. Water quality parameters have been set for the various lakes and water bodies. I think the last large irrigation scheme was done on the Pukaki Flats, which has an intake off the Tekapo Canal, for a huge dairy farm. There was a massive fight involving environmental groups over the size of the dairy farm and its potential impacts. That farm did not get consent for as many cows as it wanted, but it is still large, with some 5,000 cows over 3 units.

Hydro Leader: Please tell us about Mount Cook Alpine Salmon and its fish farming operation.

Rick Ramsay: When the Upper Waitaki Power Development project was finished in 1984, I stayed in the area and started a local newspaper. In 1992, three keen fishermen had a vision to create a freshwater salmon farm in the hydro canals. They didn't know much about the canals though, whereas I knew how they operated thanks to my involvement with the power scheme. I had also been on the local district council and had been the chairman of planning and deputy mayor. I joined them and started salmon farming in the canals, which was a world first. I started out doing everything and ended up as the environmental manager.

Today, Mount Cook is a global and domestic supplier of freshwater Chinook salmon. We're the biggest employer in the basin. Compared with farming on land, aquaculture in the canals has a high output on a tiny footprint. We occupy four canals and have a turnover of around NZ$43 million (US$26.4 million). Our water quality is the best you could ask for, because the water is coming from melting snow, glacial melt, and heavy rainfall from the mountains, and there is no intensive farming around the lakes.

I've tried to collaborate with farmers, and recently, a catchment group has been formed. The secretary and the chair are salmon farm staff, and farmers make up the rest of the committee. The farmers recognize that those people are here to help protect and improve the environment; we're not fighting over water.

Hydro Leader: Would you tell us a little bit more about the Mount Cook Alpine Salmon's market?

Rick Ramsay: Our output is minuscule compared with ocean salmon farms, which are enormous. At full production, we produce around about 2,500 tonnes. We farm Chinook or king salmon, which are difficult to farm. Internationally,

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Atlantic salmon are the main type farmed, because that species has the characteristics of sheep. Chinook, on the other hand, are like deer. They're flighty; they stress; they die easily. In New Zealand, we don't have Atlantic salmon—only introduced Chinook and sockeye salmon. There are some sea farms in New Zealand that are much bigger than us that produce Chinook as well. We have a niche product in the international market, and the quality of the fish that we grow has been recognized as the best in the world by chefs and in blind taste tests. Our fish command a premium, which is fortunate, because they're not the easiest thing to grow. We have nearly a 50/50 split between international and domestic sales. Our main export market is the United States, and Wegmans is one of our biggest customers. Our fish can be frozen with no effect on the taste or texture. You can process them, freeze them, and ship them to the United States, where they are used for sashimi. We used to sell our salmon frozen, head off, and gutted, and they were thawed, filleted, and made into sushi for the Emperor of Japan. That's how good it is. We don't have that market any longer, but it was a great sales story at the time! We also sell smoked salmon products domestically and have a retail shop on the Pukaki High Dam, where we sell a wide range of our products.

Hydro Leader: Are there plans to increase production in the canals?

Rick Ramsay: We don't plan to increase the production of Chinook, but we plan to diversify into sockeye salmon. When we started fish farming, we started with sockeye. We were the only place in the world outside Canada that had a population of sockeye salmon. When they were brought to New Zealand in the early 1900s, there was no disease in the area from which they were sourced. Since then, diseases have begun to affect them, so it is hard to farm them outside New Zealand. When we started farming them, the sockeye were small and matured early. We didn't know a lot about farming in the canals then, either, and had no one to call on for advice. Later, we switched to Chinook because the hatchery that was producing the sockeye closed down. I've always wanted to farm sockeye again. In the last 3 years, we got permission from the government to source them from the wild, to start spawning them, and to start a breeding program. This year may be the last year that we have to collect them in the wild. A breeding program typically takes 8–9 years, but there's a lot of technology now, such as genetic sampling, that we didn't have back in the 1990s. Sockeye salmon are a resilient fish—the opposite of Chinook. You can farm them at higher densities, and they don't stress out, catch diseases, or lose their scales. Once the company gets the hang of how to breed them and figures out what sizes and stocking densities work best, it will start marketing them. So I've finished my career where I started, with sockeye salmon.

Hydro Leader: Is there anything else about the power scheme that you would like to add?

Rick Ramsay: If you tried to develop that power scheme now, it likely wouldn't happen. You look back and think, how did anyone think we were capable of digging those canals and building those dams, power stations, and new towns? If you tried to promote that in today's environmental and planning regulatory regime, I don't think you'd ever succeed. I don't know where the government got the money to build this scheme. Following the Upper Waitaki Power Development, New Zealand engaged in an infrastructure development program called Think Big, which was promoted by one political party. It built another hydroelectric dam, Clyde Dam; a petrochemical plant; a refinery; and more. Today, people point to Think Big and say, "What a waste of time that was, and look at the overseas debt it incurred." They have forgotten that because Clyde Dam was built, we now have one of the world's highest levels of renewable energy. Because of all these hydro schemes, about 81 percent of our electricity comes from renewable sources. In terms of the environmental impact, we lost the Ohau, Pukaki, and Tekapo Rivers, but the hydro lakes form one of the most beautiful recreational areas in the country. We have an international rowing course on Lake Ruataniwha that was designed as part of the Upper Waitaki scheme. Irrigation, hydroelectric generation, and aquaculture are three things that have occurred as a result of the hydro scheme. I think that's not a bad payback.

Hydro Leader: What is vision for the future?

Rick Ramsay: My vision for the future is that today's technology and knowledge of various plant types means that nutrient leaching from intensive farming can be reduced enormously. The danger of degrading major water bodies can be reduced, which would mean that further intensification using modern irrigation and farming methods would be possible. We know that today's technology and sensors make that possible. Unfortunately, we're judged by what happened in the past. I believe that progressive farmers, working with university researchers and other environmental specialists, will show that we can farm with a lower environmental impact. It's the same with salmon farming: We will learn to produce more with the same amount of feed and cause less environmental impact. That's where I see New Zealand's farming future. H

Rick Ramsay recently retired after 32 years with Mount Cook Alpine Salmon. He can be contacted at rick.mtcooksalmon@xtra.co.nz.

Matthew Taylor of GZA: A Bright Future for Dams and Hydropower

A GZA technician performs a rope-access inspection of the spillway tainter gates at the Remmel Development in Arkansas.

For 60 years, consulting firm GZA has been involved in site inspections, investigations, design, construction, removal, and seismic evaluations for more than 1,000 dams throughout the United States. Since the Federal Energy Regulatory Commission (FERC) released its new part 12 engineering regulations in 2021, the firm has expanded its dam and hydropower services to include comprehensive assessments (CAs) that accord with FERC's new rules. In this interview, Matthew Taylor, GZA's dams, levees, and hydropower practice leader, talks about assembling a "dream team" of qualified independent consultants (ICs) and subject-matter experts to conduct FERC's new part 12 CAs for its clients.

Hydro Leader: Please tell us about your background and how you came to be in your current position.

Matthew Taylor: I spent the first 8 years of my career working as a traditional geotechnical engineer at a 30-person geotechnical and environmental firm outside Boston. I started as a field engineer working on large earthwork projects and deep foundation installations and performing subsurface explorations before becoming a project manager. During that time, I also joined the Boston Society of Civil Engineers Section (BSCES) Geo-Institute committee, which allowed me to interact with all the top geotechnical firms in the Boston area.

When I realized that I was ready for a new challenge, I was able to leverage my BSCES Geo-Institute committee relationships to identify and ultimately join a large architectural and engineering firm in the Boston area. I spent the next 4 years working on large infrastructure projects; that included my first exposure to dam engineering. I quickly realized that dam work was what I wanted to focus the rest of my career on.

Once again, I looked at the firms represented within the BSCES Geo-Institute committee and identified GZA as

PHOTOS COURTESY OF GZA.

the place where I saw the best opportunity to pursue my passion for working on dams. In 2007, I joined GZA as a senior project manager in the dams and water resources group. I was promoted to the Metro Boston dam and levee group leader in 2016 and was then named GZA's dams, levees, and hydropower practice leader in 2023.

Hydro Leader: Please tell us about your expertise in dams, levees, and hydropower.

Matthew Taylor: I am a registered professional engineer in six states, a FERC-approved IC, and a FERC-approved potential failure mode analysis (PFMA) and level 2 risk analysis (L2RA) facilitator. My expertise includes site inspections, including state-regulated dam safety inspections; U.S. Army Corps of Engineers periodic inspections of levee systems; and FERC part 12 dam safety inspections. I've developed and executed numerous subsurface exploration and instrumentation installation programs, including ones that required FERC and Army Corps drilling program plans. I've been responsible for seepage and slope stability analyses of embankment dams and gravity stability analyses and 2-D and 3-D finite element analyses for concrete and masonry dams. I've been the engineer of record on numerous dam rehabilitation projects involving stability improvements and spillway capacity modifications. I've also been the engineer of record for the tallest dam removal/stream restoration project in Massachusetts. Lastly, I am currently leading GZA's first FERC hydropower relicensing assignment.

Hydro Leader: Please introduce GZA.

Matthew Taylor: GZA was founded in 1964 by Donald Goldberg and William Zoino as a geotechnical consulting partnership in Newton, Massachusetts. It has since grown into a multidisciplinary consulting firm with over 750 staff in 32 offices across the United States. We're 100 percent employee owned, which allows us to control the direction of our company. Our core services are geotechnical, environmental, ecological, water, and construction management. These core services have allowed us to expand our practice areas to strategically respond to our clients' needs and other market forces. Those expanded practice areas include geostructural and structural engineering; environmental site assessment and remediation; natural resources and ecological services; water resources; waterfront and coastal engineering; contractor services and construction management; and dams, levees, and hydropower.

GZA has a long history in the dams and hydropower space. William Zoino began his career as a dam engineer at EBASCO Services Inc. before he cofounded GZA. GZA's early dam work included a key role in the execution of the National Dam Safety Program in the late 1970s and early 1980s. In the subsequent decades, one of GZA's principal engineers, Bill Hover, continued to grow

A photo taken during a daily inspection of the Osage Hydroelectric Project in Missouri, conducted by GZA and the site operator in support of the external owner's dam safety program.

GZA field staff initializes and installs vibrating wire piezometers and an automated data acquisition system at the North Fork spillway and embankment improvements project in Black Mountain, North Carolina.

GZA's dam practice by working on the key water supply reservoir dams for the cities of Boston, Hartford, and New York. Today, GZA continues to provide dam and levee engineering services for many municipalities and state-owned water suppliers as well as the Army Corps and its flood-control systems. In the early 2000s, GZA began performing hydropower feasibility studies at nonpowered dams. We oversaw the installation of small hydro units at two previously unpowered dams. Since 2010, GZA has performed over 50 part 12 inspections for FERC-regulated hydropower projects under the jurisdictions of FERC's

A photo taken during a daily inspection of Taum Sauk Pumped Storage Project in Missouri, conducted by GZA and the site operator in support of the external owner's dam safety program.

GZA performed the investigations, alternatives analyses, preliminary and final design, environmental permitting, and construction phase engineering services for the removal of the Upper Roberts Meadow Reservoir Dam in Northampton, Massachusetts.

Atlanta, Chicago, and New York regional offices. Since FERC's new engineering guidelines were rolled out in 2021, GZA has performed or is in the process of performing 15 periodic inspections and 2 CAs.

GZA is well positioned to support our dam and hydro clients across the country. The hubs of our dam practices are our Metro Boston and northern New Jersey offices, with additional dam practitioners in Boulder, Colorado; Clarksville, Tennessee; and Livonia, Michigan. We have seven FERC-approved ICs—individuals with extensive dam safety experience who can perform part 12 inspections—three of whom have received the necessary training to be FERC-approved PFMA and L2RA facilitators. Our dam, levee, and hydropower practice services include site inspections, detailed field investigations, engineering studies, design and services, construction, administration, and resident engineering. Our clients have also engaged us to prepare and update inflow design flood studies and emergency action plans, to perform owners' dam safety program audits, and to assist them in developing operations and maintenance plans. Our levee and hydropower practice serves state-regulated water supply and recreational water body dams, federally constructed flood control projects, and FERC-regulated hydropower dams ranging from 1 to 900 megawatts.

Hydro Leader: Please tell us how you help your clients manage FERC compliance and licensing.

Matthew Taylor: We're currently assisting a municipality in upstate New York to relicense its 700-kilowatt hydropower project, which is due in 2025. We've leveraged our hydro experience knowledge with our strong ecological and natural resource practice and engaged a few strategic subcontractors to allow us to take on this new service offering. We're now looking to expand our relicensing service to our other hydro clients. For instance, we're currently working through the early stages of assisting one of our Midwest hydropower clients with the development of a strategic relicensing plan for its three hydro projects, which are located on the same river.

Hydro Leader: Are there any hydropower project success stories you'd like to highlight?

Matthew Taylor: In the spring, GZA began work on our first FERC CA for a hydropower project in the southeastern United States. I served as the PFMA and L2RA facilitator. GZA's IC team was on site for a week, with 1 day dedicated to the site inspection and 4 days allotted to the PFMA session. We spent a lot of time preparing for the site inspection; the PFMA workshop; and the L2RA workshop, which was scheduled to happen a month later.

Our plan for the first workshop week was to perform the PFMA session in accordance with the new chapter 17 guidelines, using the in-person time to fully develop each PFMA before beginning the risk estimating, which was going to be performed during the second workshop week, a month later. However, during the potential failure mode (PFM) brainstorming session, FERC expressed some concerns that we were not fully screening the candidate PFMs to support the L2RA process. We decided to push forward with our plan of completing the initial brainstorming and continuing to focus on the PFMA portion of the assignment.

However, when we moved into fully developing the candidate PFMs, FERC made it clear to us that we were headed down the wrong path and that we needed to develop each PFM and move directly into the risk-estimating side of the process before we developed the next PFM. Fortunately,

PHOTOS COURTESY OF GZA.

we had already completed the L2RA preparation work, including developing the hydrologic hazard and seismic hazard curves in our risk estimating and data tracking tool. Our IC team was able to work with the licensee to pivot and add the risk estimating process for each of the PFMs under consideration during that first workshop week. If you're a football fan, we'd describe it as calling a major audible at the line and running a very different play from what we'd called in the huddle.

The in-person workshop week ended up being successful and productive. FERC appreciated our ability to refocus the in-person workshop and complimented our team dynamics, facilitation skills, and in-house developed risk analysis and documentation tools. We concluded the in-person week with a hotwash session in which FERC let us know that our IC team had performed well and that the workshop was one of the better ones it had been a part of under the new regulations.

Hydro Leader: What upcoming conferences or events will GZA be attending?

Matthew Taylor: GZA is a sustaining member of both the Association of State Dam Safety Officials (ASDSO) and the U.S. Society on Dams (USSD). We've been regular participants at their regional and national conferences for 25 years. In 2019, GZA joined the National Hydropower Association (NHA) to improve our exposure and visibility in the hydro market.

GZA was a gold sponsor for ASDSO's national conference in September in Denver, Colorado, where we delivered two presentations: Kevin Finn and I presented a talk titled "A Portfolio Dam Risk Assessment of Seven High-Hazard, Non-FERC-Regulated Dams in Vermont," and John Delano and Mengxuan Zhao presented a talk titled "Seepage Modeling Under Pressure: Using Historical and Real-Time Data to Evaluate and Install Relief Wells."

In March 2024, I attended CEATI International's Hydropower Conference in Palm Springs, California. It was the first time that GZA had attended this event. This conference is CEATI's only event open to consultants and vendors, and we will definitely be attending again in 2025. In April 2025, GZA will also be at the USSD Annual Meeting in Kansas City, Missouri.

Hydro Leader: Is there anything else that you'd like to highlight?

Matthew Taylor: There are two things. First, I am really appreciative of the fact that I was able to begin my career by working full time in the field. The experiences I gained there have been a tremendous benefit to me as a designer, project manager, and principal in charge. I have a well-informed perspective on how projects are built, I can anticipate construction issues that need to be considered during design, and I'm confident in my ability to respond to questions from the field when things change. Those early experiences in the field definitely set me up for success during the middle and later stages of my career.

Second, when I was preparing for our first CA this past spring, I was talking to my son about putting together the IC team of subject-matter experts. He said that it sounded like we were creating a dream team. I hadn't looked at it that way before, but he's right—that's what these IC teams are. It is not typical for our most experienced folks—our subject-matter experts—to be able to work on the same project at the same time, but that is specifically what FERC requires for a CA. Fortunately, at GZA, we are able to assemble our IC teams with mostly in-house staff, which creates a unique opportunity for our best people to work closely together and learn from one another in real time. Our IC teams are excited about the opportunity to work on our next CA, which will happen this fall, and on the two additional CAs that we have lined up for 2025.

Hydro Leader: What is your vision for the future?

Matthew Taylor: I think that the future for dams and hydropower is bright. The desire for reliable renewable energy will continue to highlight the importance of our country's hydro fleet. The deteriorating condition of these aging facilities, the increased frequency of storms, and the increase in comprehensive dam safety regulations will increase the demand for qualified dam, levee, and hydro professionals. Dam owners are going to need to establish long-term relationships with their consultants so that they can be trusted advisors who help them navigate these new requirements. It's incumbent on us to develop the next generation of engineers and scientists to do that work.

I also think that early contractor involvement (ECI) is an approach that is well suited to dam rehabilitation projects. These projects routinely involve multiple levels of risk that are either retained by the owner or passed on to the contractor. The ECI approach allows those risks to be discussed early in the design process and thus allows those risks to be assigned to the appropriate party in a fair and equitable manner. GZA is currently participating in a dam rehab project in Connecticut that uses the ECI approach, and I've seen those benefits firsthand. I fully expect that this contracting approach will continue to gain popularity in the dam industry over time. H

Matthew Taylor is a principal and senior vice president at GZA. He can be contacted at matthew.taylor@gza.com.

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Hydro Leader: Please tell us about your background and how you came to be in your current position.

Eddie Swanepoel: I have been employed by Vesconite Bearings since 2010. My initial focus was on the sugar sector, particularly mill applications, ranging from sugar production to packaging. I have been especially successful in developing U.S. sugar mill applications, including for cane and beet sugar. Another area of interest during my tenure at Vesconite Bearings has been marine renewables, notably marine renewables in Ireland and the UK. Since relocating to New Zealand, I have promoted Vesconite materials among end users and resellers. Hydroelectricity, among many other industry sectors, has become an important focus of Vesconite New Zealand.

Hydro Leader: Please introduce Vesconite and its product lines.

Eddie Swanepoel: Vesconite Bearings is a world-leading manufacturer of low-friction, wear-resistant bearing materials for various industries, including the pump, agriculture, rail, mining, heavy transport, hydro, wind and wave energy, earthmoving, marine, and construction industries.

Vesconite Bearings' story goes back to 1958. The company was originally focused on engine reconditioning and hard-chroming, but in 1968, founder and chemical engineer Alain Leger began researching the potential for bearing materials in the ultradeep gold mines of South Africa, a notoriously harsh environment characterized by abrasive dust and moisture.

Since our establishment, our company has grown to some 140 employees. About 100 are based at our manufacturing facility in Virginia, South Africa. Our Johannesburg sales and administration division employs the balance of staff members, and recently, our international sales have expanded to Australia, Dubai, Namibia, the Netherlands, New Zealand, Singapore, the UK, and the United States.

Vesconite Hilube wicket gate bushings are operating successfully at various hydropower plants.

Vesconite Bearings also uses international sales consultants, stocking distributors, and resellers. Their presence in their respective countries is essential to Vesconite Bearings' business.

Hydro Leader: Where are your products manufactured?

Eddie Swanepoel: Our factory in Virginia, South Africa, spans an area of 15,000 square meters (161,459 square feet). This is one of the largest engineering polymer facilities in the world, producing Vesconite, Vesconite Hilube, Vesconite Superlube, Hitemp 150, Hitemp 160, Hitemp 230, Vescoflex, Hilube 10, Hilube 20, Ultrablack, Vescolene, and Polycap bearing and wear materials.

The company has 100 computer numeric control machines, including five-axis milling centers, that can make highly complex parts. We are particularly proud of our large-volume production facility, which produces runs of 10,000–100,000 per part a year, and our extra-large bearing production unit, which can quickly produce 2-meter-long (6.56-foot-long) bearings with outside diameters of up to 1.6 meters (5.25 feet).

Our products are shipped directly from the factory to all corners of the globe. Our average dispatch time is

PHOTOS COURTESY OF VESCONITE BEARINGS.

in most cases 2–5 days from the time of order. This is an achievement we are proud of.

Hydro Leader: What are some of Vesconite's key hydro industry applications?

Eddie Swanepoel: I will mention seven. Our Vesconite Hilube bushings can enhance the operation of wicket gate bushes by providing wear resistance and low friction. Our high-performance wear pads improve the lifespan and reliability of regulating rings. Vesconite's stable and durable materials ensure smooth and efficient movement in control arms. Our dimensionally stable and wear-resistant labyrinth seals achieve superior sealing performance, which allows for much closer clearances. Using our corrosion-resistant guides enhances the reliability and performance of pressure relief valves. Vesconite's durable bushings ensure the efficient and reliable operation of stop logs. Lastly, our low-friction, wear-resistant roller bushings improve the efficiency and lifespan of intake screen rollers.

Hydro Leader: What makes your Vesconite Hilube bushings distinctive, and how do they prolong the life of hydro components?

Eddie Swanepoel: First, Vesconite Hilube eliminates lubrication. It is internally lubricated with advanced solid polymers. This avoids environmental risk and other problems associated with greasing and lubrication systems. Some bearings, including trunnion bearings, will not seize even if they are stationary for long periods.

Second, it can run dry. The internal lubricants of Vesconite Hilube allow bushings to run dry in many oscillating applications. Vesconite Hilube can run dry in high-speed rotational applications with limited, low loads, including on pump line-shaft bearings.

There is no water swell. Vesconite Hilube is dimensionally stable and does not swell in water. Bushings can be designed and manufactured with close clearances without the fear of seizure. Vesconite will not delaminate.

Low wear allows for the long life of the hydro component. Vesconite Hilube demonstrates low wear both on the bushing and on the expensive metal counter surface.

Low friction stops chatter and vibration caused by stick-slip.

This technology allows high load-supporting ability, wet or dry, up to 4,250 pounds per square inch.

There is low creep. This assists with trunnion bearings on tainter gates, since gates can remain open or closed for long periods.

Hydro Leader: Please tell us about your pump refurbishment services.

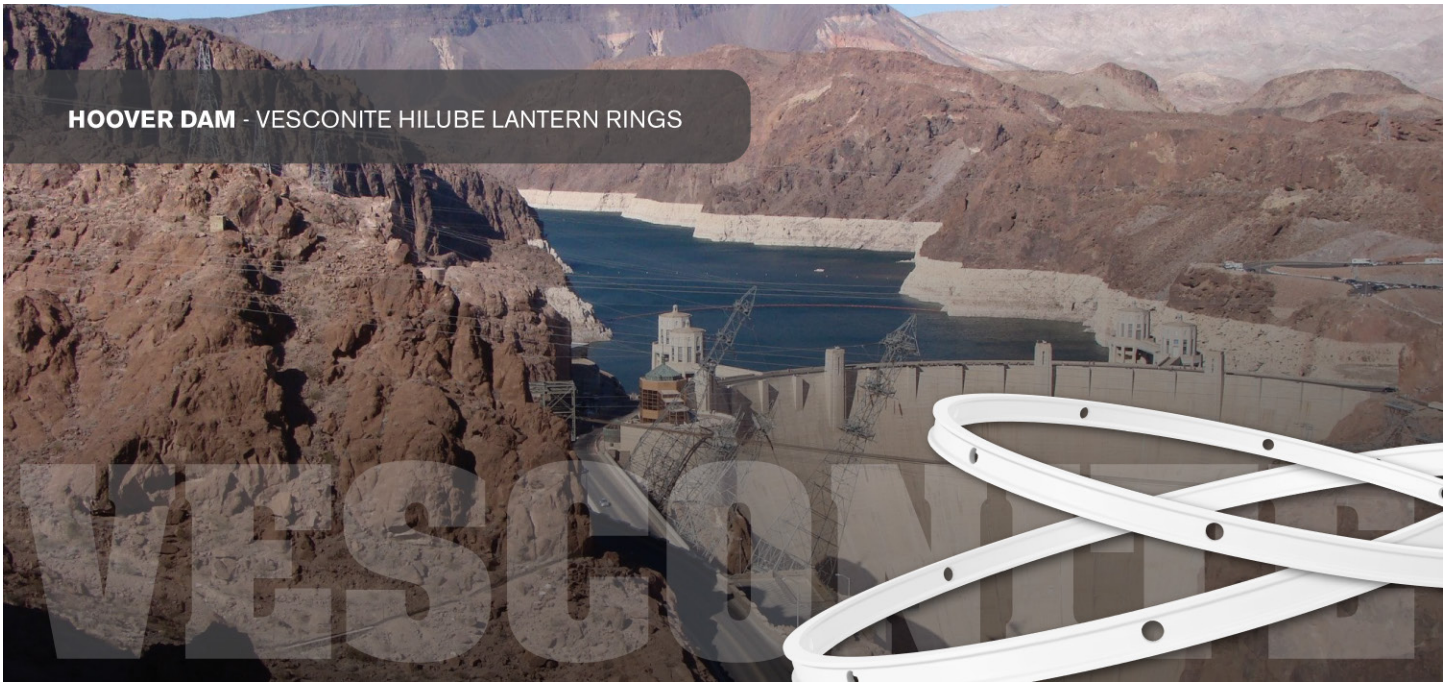
Eddie Swanepoel: Vesconite Bearings has had considerable success in the pump industry, particularly on vertical pumps. We supply wear components, such as bushings and wear rings, to pump original equipment manufacturers and pump repair shops.

Vesconite Hilube wear rings and wicket gate bushings are some of the important components that Vesconite Bearings supplies to hydroelectricity projects globally.

Applications include line-shaft bearings, bowl bearings, suction inlet bearings, stuffing box bearings, and wear rings. Vesconite's no-swell characteristics allow you to run the bearings with small clearances between the bearing and shaft, resulting in better efficiency; less shaft runout; less vibration; and the extension of the life of other pump bearings, seals, and motor components.

Hydro Leader: Where in the United States has your technology been used?

Eddie Swanepoel: Many companies use Vesconite Bearings' technologies. Pacific Gas & Electric has used Vesconite Hilube at various facilities for change ring wear pads, wicket gate bushings, segmented shaft seals, and the main bearing for a vertical Pelton. Southern California Edison has installed Vesconite Hilube wicket gate bushings and shaft seals at Big Creek Powerhouse 3. Dominion Energy has installed Vesconite Hilube link arm bushings and the main shaft bearing at various facilities. Andritz Hydro has installed Vesconite Hilube servomotor cylinder banks, pressure relief valve guide plates, change ring vertical guides, change ring wear pads, and main shaft bearings at various facilities. Canyon Hydro has installed Vesconite Hilube change ring wear pads and wicket gate bushings at various facilities. Southern California Edison has installed wicket gate bushings at its Mammoth Pool Powerhouse. Brookfield Renewable Power has employed Vesconite Hilube for the wicket gate bushings, control arm, and the main turbine bearing at its Erie Boulevard Projects.



Vesconite Hilube lantern rings were recently supplied to the Hoover Dam Hydro Plant.

Hydro Leader: What solution did you provide to the Hoover Dam Hydroelectric Plant?

Eddie Swanepoel: We started supplying our Vesconite Hilube material to that facility through a company called Precision Powered Products, which was subsequently bought by Andritz Hydro. Our current applications include pressure-relief guide plates and change-ring vertical guides. We recently supplied Vesconite Hilube for the labyrinth seal between the packings, replacing the bronze seal.

Hydro Leader: Are you looking for more U.S. hydro clients? Why should U.S. hydropower owners and operators choose Vesconite?

Eddie Swanepoel: We are definitely looking for more U.S. hydro clients. Powertech Laboratories tested our materials and found them to be nonswelling and safe to use in wet and dry applications. Vesconite Bearings has 20 years of involvement in the hydropower industry and considerable experience at U.S. hydropower facilities, as I mentioned previously.

Vesconite is a specialized thermoplastic material renowned for its superior properties. It is the ideal choice for various hydro industry applications, whether they are related to hydropower generation, pump systems, or water management. Vesconite can significantly enhance the performance and longevity of your equipment. Our unmatched advantages include exceptional wear resistance to abrasion and impact, which extends service life. This is crucial for components constantly exposed to water and abrasive particles. Vesconite's self-lubricating properties reduce friction, resulting in improved efficiency, lower energy consumption, and quieter operation. With dimensional stability and minimal water absorption, our technology maintains its shape and mechanical properties even when submerged, ensuring reliable performance in wet environments. Unlike metal components, our products do not corrode. This resistance offers superior longevity and requires less maintenance. While excelling in hydro applications, Vesconite is highly versatile and is suitable for geothermal and numerous other sectors, showcasing its broad utility.

Hydro Leader: Do you have any notable hydropower success stories to highlight?

Eddie Swanepoel: Two years ago, we supplied the Yacyretá Hydro Power facility in Paraguay and Argentina with the full refurbishment of four turbines, including top, intermediate, and lower wicket gate bearings; link arm bushings and washers; operating ring wear pads and vertical guides; and crevice pin bushings.

Hydro Leader: What is your vision for the future?

Eddie Swanepoel: The company continuously improves our processes and responds to client needs for improved delivery times, bearing materials that meet new requirements, and engineering for new applications for an ever-changing global business environment. H

Eddie Swanepoel is the director of Vesconite Bearings New Zealand. He can be contacted at eddie@vesconite.com.

PHOTOS COURTESY OF VESCONITE BEARINGS.

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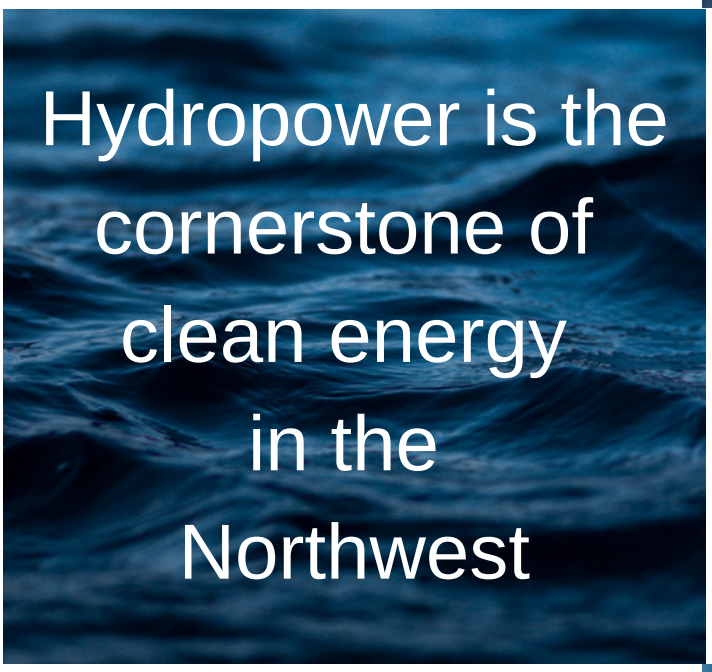

A REGIONAL VOICE IN THE HYDROPOWER INDUSTRY

WHO WE ARE

NWHA was founded in 1981 to support small hydro developers and has since grown into a 130-member strong collective of hydropower developers, utilities, manufacturers, consultants, and researchers.

WHAT WE STAND FOR

Being timely and relevant
to our members.
Clean Energy & Affordable Power.
Protecting the environment that characterizes the Northwest.
Efficient Regulatory Processes.
Ensuring hydropower treated equally with Production Tax Credits and Investment Tax Credits.

Peter Moore of Breitenbush Hot Springs: An Off-Grid Resort Powered by Refurbished Small Hydro

The lodge at Breitenbush Hot Springs.

Breitenbush Hot Springs, located in Marion County, Oregon, was developed as a resort in the 1920s and became a sought-after destination for decades. In the 1970s, the then-abandoned site was majorly renovated, and over several years of work, the original hydro turbine was refurbished, using an instruction booklet from 1895. Today, it produces 40 kilowatts (kW) of hydroelectricity to power the entire resort and support thousands of guests and staff year-round.

Hydro Leader: Please tell us about your background and how you came to be in your current position.

Peter Moore: I have been with Breitenbush Hot Springs since spring 1978. Before that, I spent 4 years getting a degree in anthropology at San Francisco State University and working on sustainability and education issues in the Bay Area. When I discovered Breitenbush, the property and its 100 buildings had just been purchased for $250,000 by a person with a vision: to bring the old ghost town of a resort back to life as a healing retreat and conference center managed by a democratically governed worker/owner co-op dedicated to self-reliance and service.

Making that mission a reality required quite a bit of work. We had to recondition the old Leffel turbine found on the property, a type of turbine invented in 1895, to produce electricity from the Breitenbush River. We drilled geothermal wells, installed downhole heat exchangers, and delivered hot water through supply/return piping to all buildings on both sides of the river. We had to divert surface water from the river, filter it through media and bag filters, chlorinate it, pump it to a reservoir on top of a hill on the property, and then gravity-feed it back down through distribution pipes to all the structures. We had to clear-cut 4 acres of trees; pull the stumps; level the land; dig over 1 mile of trenches; and, with transit and rod, install the largest leach field in Marion County. It was a lot of work,

PHOTO BY WONDERLANE. PUBLIC DOMAIN.

and it took the founding group of us years to get it all done. Ultimately, we wanted to invite guests to the property; have them enjoy the many outdoor hot springs and pools and the river; serve organic, vegetarian meals; and live our lives independently and off the grid while creating our own economic engine.

Hydro Leader: Please tell us about Breitenbush Hot Springs' history.

Peter Moore: Breitenbush Hot Springs has a rich history. One hundred sixty acres at Breitenbush, located on the side of Mt. Jefferson in the wilderness, were first homesteaded in 1904, then became a rather famous resort as they were developed. The site was known as the Lourdes of Oregon because of the many testimonials about spontaneous healing at the hot springs. Developed in the late 1920s, there were well over 100 buildings here, including a large multistory hotel lodge, restaurants, an Olympic-sized swimming pool filled with 150,000 gallons of hot springs water, and many other amenities. From the late 1920s until the early 1960s, Breitenbush produced direct-current electricity from the river and was open to the public from May through September. In 1972, the business was closed. A group of us purchased the abandoned resort—a ghost town, really—in the late 1970s and began a massive repair of the site. We now serve thousands of guests each year from all over the United States and the world.

Hydro Leader: Tell us more about your hydroelectric generation.

Peter Moore: In the river, we found the old Leffel turbine, which is cast iron and turns on a lignum vitae bearing. We reconditioned the turbine, bought some ironwood from Panama, turned it to the exact spec from the 1895 instruction booklet, and put it back into use at the bottom of the old penstock. We installed an alternating-current generator and a flywheel on the main shaft to enable us to handle large motor loads to solve the power dip that occurred when we started our 5-horsepower water pumps. We produce 40 kW of hydroelectricity using that turbine. This results in 3-phase 208-volt power, which steps up to 480 volts for transmission in an underground conduit. We send it underground through conduits around the property to various transformer stations, where we transform it to household electricity. From there, we send the power to our various buildings. We are very conscious of electrical usage because of the limited supply. In addition to household uses, the power is used to run water pumps, septic pumps, and all the other electrical devices needed to keep things going.

Hydro Leader: Please tell us about the fish diversion and flume for the hydro plant.

Peter Moore: We constructed our first flume above ground with marine-grade plywood and two-by-fours from deconstructed picnic tables that were left over from the

PHOTO BY PAIGE HAMM, LICENSED UNDER CC BY-ND 2.0.

A diversion dam on the Breitenbush River.

1960s. Initially, we had to construct a small diversion dam to divert a bit of the river through headgates and into the flume, which carried it 900 feet downstream to the powerhouse, where it dropped into the penstock, through the old turbine, and finally out the tailrace and back into the river. The fish diversion was a later requirement of the state, and we completed that project in 2004. In about 2009, we tore out the wooden flume and installed a 42-inch-diameter penstock tube that went from the diversion dam to the powerhouse.

A visitor enjoys the eponymous hot springs of Breitenbush.

Hydro Leader: What other technology does your small hydro facility use?

Peter Moore: We have added automation and are now looking into the inevitable future use of AI. The State of Oregon required us to install an air load-bank system to waste any residual electricity in the form of heat into the atmosphere.

Hydro Leader: How do you use geothermal energy at Breitenbush?

Peter Moore: During the resort's heyday, from the 1920s to 1964, Breitenbush was only open from May through September, but we wanted to live at Breitenbush and be open to the public year round. To do that, we wanted to heat our cabins and all other structures geothermally by drilling geothermal wells and installing downhole heat exchangers. This presented a big challenge, as none of us knew how to drill wells. Moreover, we learned that geothermal wells are the most dangerous kind of well to drill, because even low-temperature geothermal water is hotter than boiling water. We bought an old cable-rig well driller from 1943, refurbished it, and began to drill. It took us about 4 years to drill several wells, which ranged from 500 to 700 feet deep; install the downhole heat exchangers; dig miles of trench; install and insulate the supply and return lines in these trenches; tee off distribution piping into over 100 structures; find hundreds of old cast-iron radiators in junkyards and metal recycling locations; install everything; and make it work.

We introduce clean surface water from the river into this system through a one-way check valve. The water inside the 2-inch steel pipe travels 500 feet down the well, makes a tight U, and travels back to the surface. At this point, it is almost boiling, because the water inside the well is above the boiling point, which heats the pipe and, in turn, the water inside the pipe. This sets up a natural thermosiphon engine that then sends the hot water coursing through the supply-side pipe till it passes through a radiator, returns to the well, and repeats the cycle.

Hydro Leader: Have you had to do any upscaling with growth or refurbishment projects since its start?

Peter Moore: Yes, we have had to continuously and iteratively maintain and upscale the system. We have designed and installed a programmable logic controller and a human-machine interface to help us manage the multiple data sets and alarm functions necessary.

Hydro Leader: What is your vision for the future of Breitenbush?

Peter Moore: We will continue to cocreate a beacon of social sanity by demonstrating our commitment to being self-reliant people living off the grid; serving guests from all over the world; and offering workshops, retreats, and conferences year round. In 2019, we hosted some 37,000 guests and had a year-round staff of up to 100 workers. COVID-19 closed us down in March 2020, and in September 2020, a massive forest fire burned down 73 of our structures and thousands of our trees. Our volunteer fire department, the Breitenbush Fire Department, fought that fire, and we saved 75 of our buildings, including the historic multistory lodge and the powerhouse. This year we are back in the black after several years of barely surviving economically after the fire. H

Peter Moore is the business director of the Breitenbush Cooperative. For more on Breitenbush Hot Springs, visit breitenbush.com.

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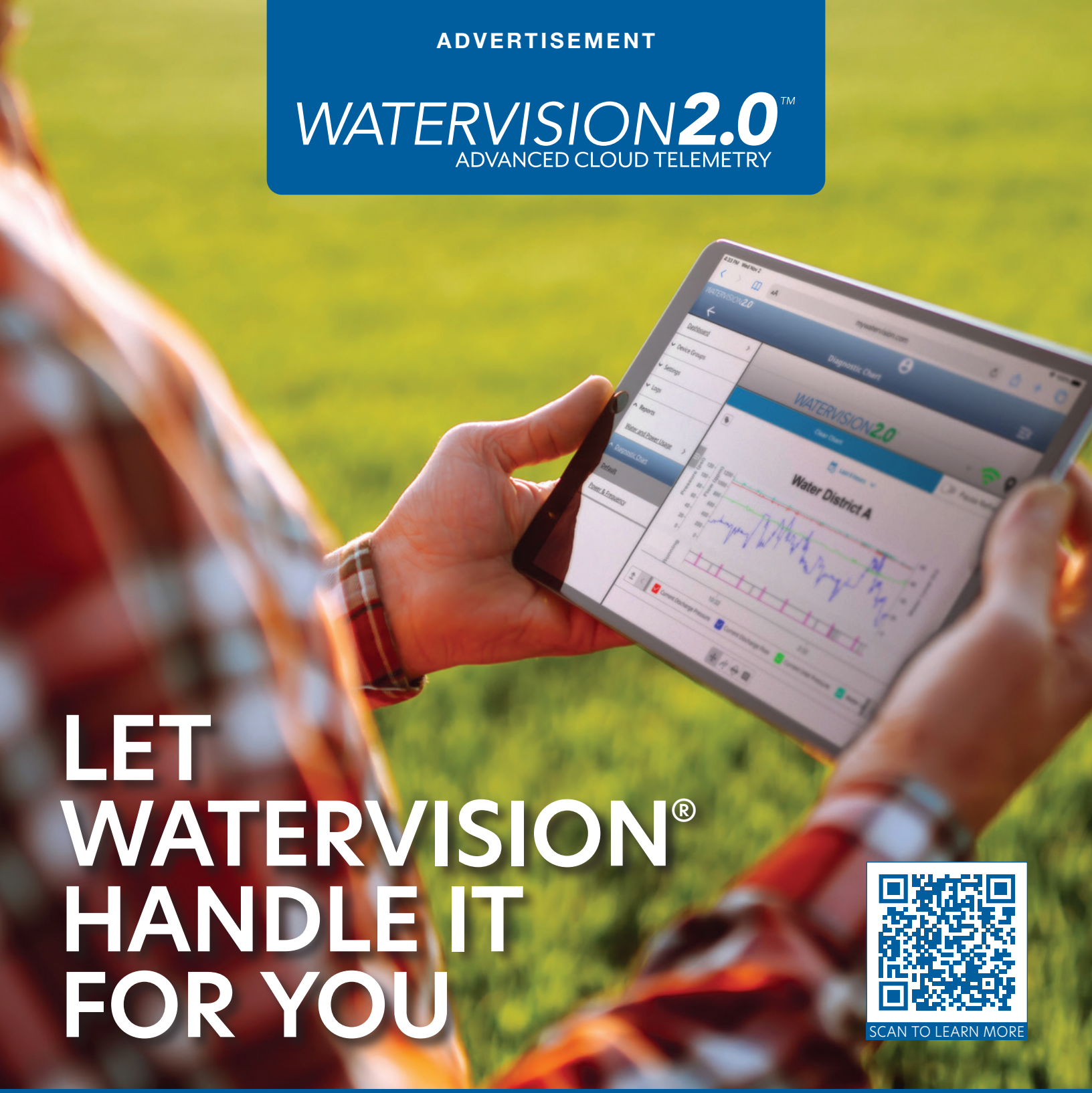

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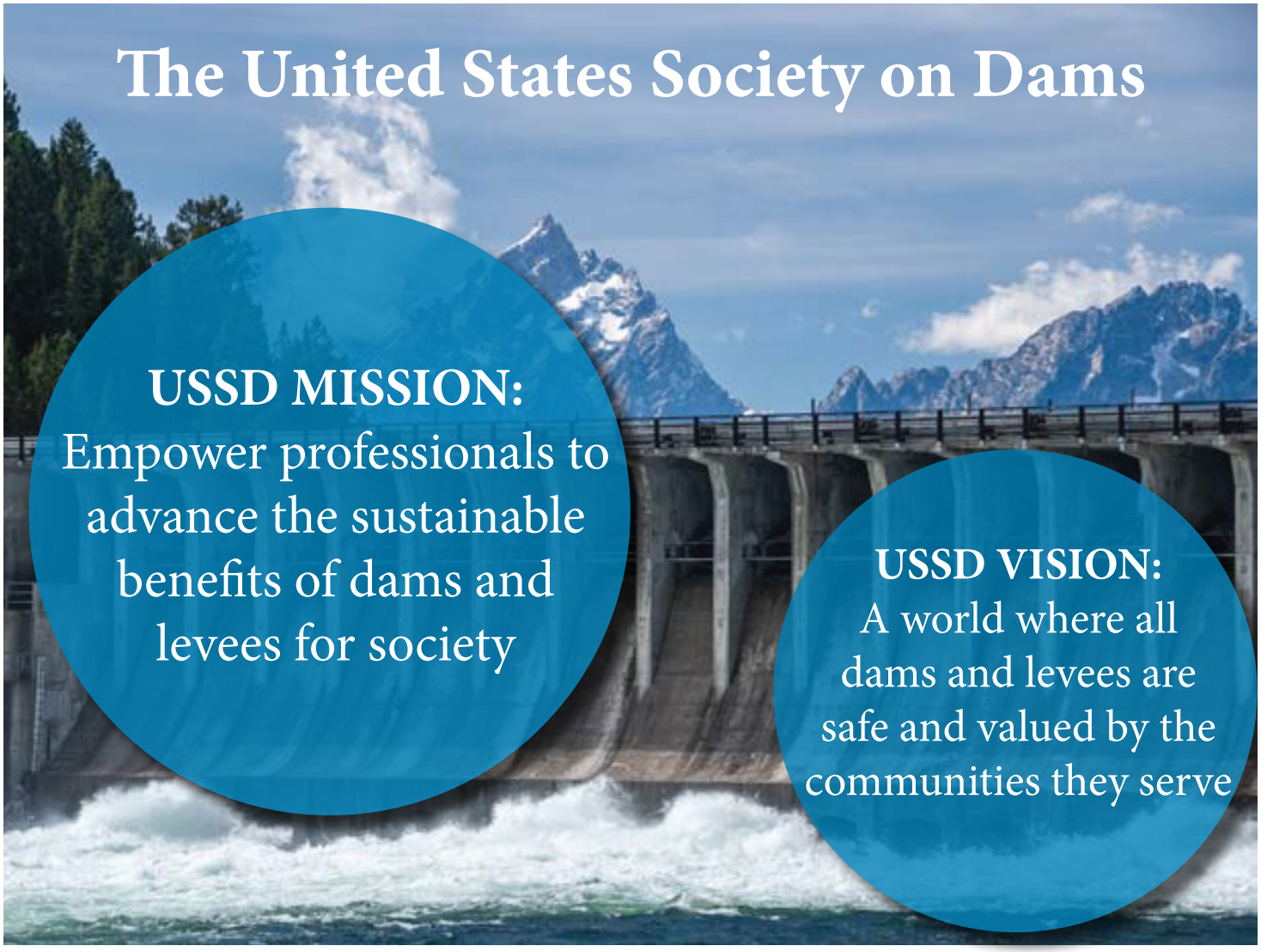
The United States Society on Dams



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Hydro Leader

Upcoming Events

October 1–3 Coalition of Rio Grande Water Users, Conference, Santa Fe, NM

October 2–3 Oregon Water Resources Congress, Elmer G. McDaniels Memorial Golf Tournament and Technical Seminar, Sisters, OR

October 7–10 National Hydropower Association, Clean Currents, Portland, OR

October 15 Utah Water Users Association, Annual Utah Water Summit, Layton, UT

October 15–17 Upper Missouri Water Association Conference, Fairmont Hot Springs, MT

October 20–23 American Public Power Association, Legal and Regulatory Conference, Nashville, TN

October 22–23 Interstate Council on Water Policy, Annual Meeting, Lawrence, KS

October 23–25 Texas Water Conservation Association, Fall Conference, San Antonio, TX

October 25 Agribusiness and Water Council of Arizona, H2Open Golf Tournament, Casa Grande, AZ

October 29–30 National Conference of State Legislatures, Base Camp, TBD

November 5–6 Rural Water Technology Alliance, Annual Training and Water Technologies Conference, Orem, UT

November 5–7 National Water Resources Association, Annual Conference and Leadership Forum, Albuquerque, NM

November 10–12 Edison Electric Institute, Financial Conference, Hollywood, FL

November 13–14 Kansas Water Office, Governor's Conference on the Future of Water in Kansas, Manhattan, KS

November 19–20 CEATI International, Transmission and Distribution Conference, Palm Springs, CA

November 25–26 Nebraska Water Resources Association, Annual Meeting and Convention, Kearney, NE

December 2–4 Oregon Water Resources Congress, Annual Conference, Hood River, OR

December 3–5 Association of California Water Agencies, Fall Conference and Expo, Palm Desert, CA

December 4–6 Colorado River Water Users Association Conference, Las Vegas, NV

December 4–6 Washington State Water Resources Association, Annual Conference, Spokane, WA

December 10–11 National Hydropower Association, California Regional Meeting, Redding, CA

December 10–13 North Dakota Water Users Association, Joint North Dakota Water Convention and Irrigation Workshop, Bismarck, ND

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