Irrigation Leader

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JUNE 2024

NEW ZEALAND EDITION

Weather and Water Schemes: Mayor Gary Kircher Talks About Irrigated Farming in the Waitaki District

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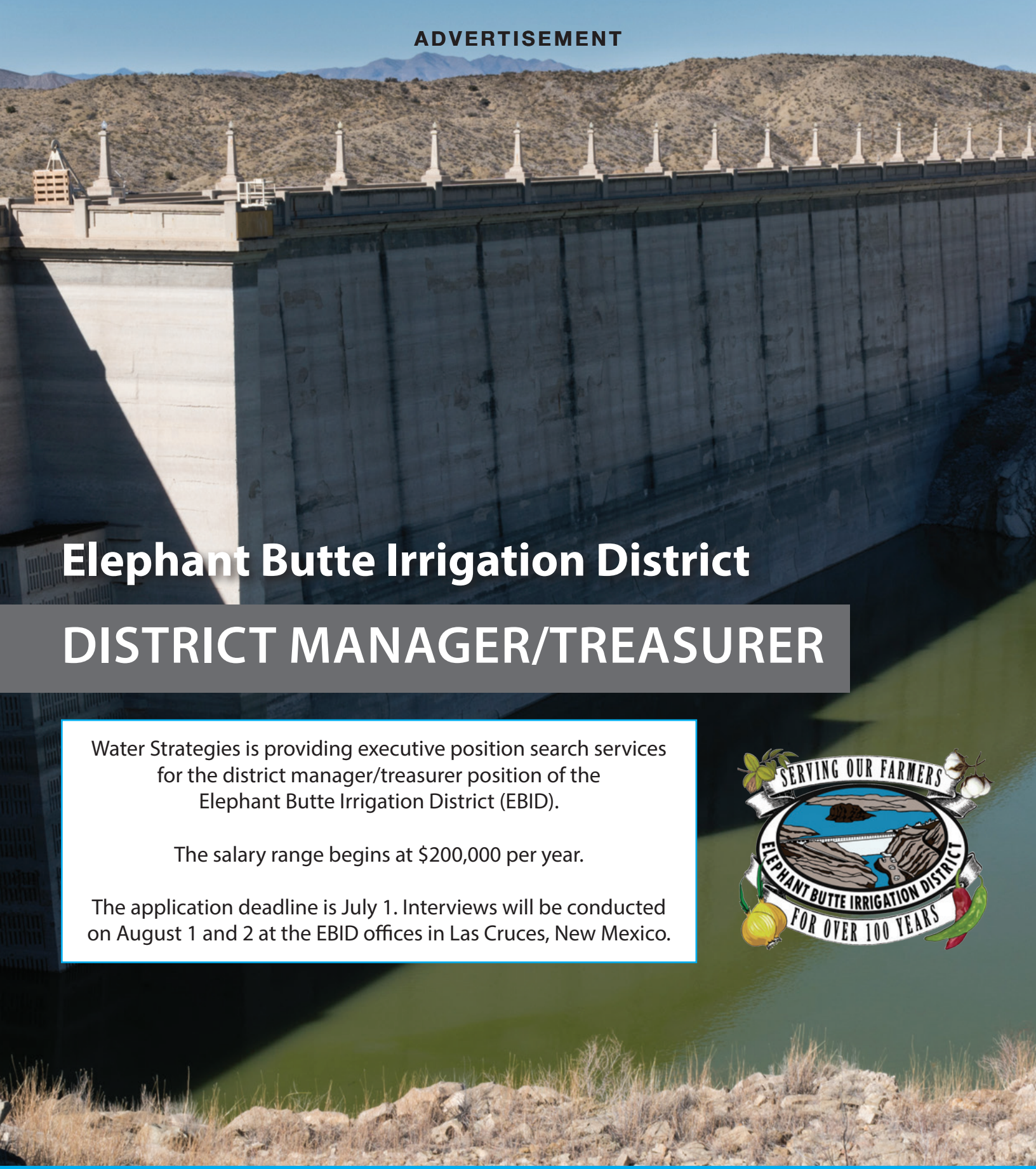

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Do you have a story idea for an upcoming issue? Contact our editor-in-chief, Kris Polly, at kris.polly@waterstrategies.com.

Irrigation Leader

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COVER PHOTO:
Gary Kircher, Mayor, Waitaki District.
Photo courtesy of Gary Kircher.

PHOTO COURTESY OF GARY KIRCHER.

Working for the Long Term in Waitaki

By Kris Polly

In this month's cover story, we interview Gary Kircher, the mayor of the Waitaki District. With several terms on the council and several terms as mayor under his belt, he has a long-standing familiarity with the details of local irrigation schemes and the needs of irrigation farmers. In our interview, we talk about funding needs, the prospects for more water storage, regulation, and more.

Then, we turn again to a top international water issue: Mexico's underdelivery of water to Texas under the terms of the 1944 Treaty on the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande. This month, our cover interview is with United States Senator Ted Cruz, who highlights the "devastating" effect the shortfall in deliveries is having on South Texas farmers and pledges to keep pressing for a solution. Then, we speak with Tom McLemore, the general manager of Harlingen Irrigation District Cameron County No. 1, to get an on-the-ground view of how the situation is affecting irrigated agriculture.

Next, we turn to several novel technologies that are helping save water in irrigation applications worldwide.

Transpira is an award-winning new product line from the Toro Company that uses a sensor installed directly in the trunk of a tree to measure water use. Senior Product Manager Adam Setzler tells us more about its practicalities and benefits.

Then, we speak with Jan Gould, the CEO of Responsive Drip Irrigation, LLC, which has created a microporous dripline that releases water directly in response to plant root signals. Because it never overwaters, it can save 30–50 percent of the water used by conventional drip systems. Plus, there are no emitters to unplug!

Meanwhile, Juniper Systems is providing mapping tools to improve irrigation asset management, including rugged tablets, high-precision global positioning systems receivers, and easy-to-use software. Trevor Brown, the Uinta software product manager, tells us more.

Finally, we look at innovation in the crop itself. Emily Meccage, the senior manager of R&D at Forage Genetics International, informs us about the HarvXtra strain of alfalfa the company has developed. This reduced-lignin strain allows growers to adjust or lengthen their harvest schedule without affecting quality, meaning that they can get more or equal amounts of water.

As we work to address water scarcity around the world, everyone has a role to play. Our political leaders can help by passing farsighted laws or by pushing water users to abide by the agreements they have signed. Our industry leaders can help by pushing forward the technologies that will help us use water efficiently, manage our systems more effectively, and grow more with less. IL

Kris Polly is the editor-in-chief of Irrigation Leader *magazine and the president 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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Melanie Brooks, CEO, MHV Water, New Zealand

Weather and Water Schemes: Mayor Gary Kircher Talks About Irrigated Farming in the Waitaki District

Pivot-irrigated pasture in Waitaki District.

Many small rural communities in the Waitaki District of New Zealand's South Island rely on agriculture to boost the economy. In this interview, District Mayor Gary Kircher talks with Irrigation Leader *about how investments in water schemes have made irrigated farming more productive and resilient in the face of drought. He also talks about some trends downstream, from adding water storage to tightening environmental protection.*

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

Gary Kircher: I followed a winding path to get to where I am today. I wasn't born in the Waitaki District, but I have spent most of my life here. After high school, I worked for a couple of companies, and in those jobs, I learned photography. When I was 22, I started my own professional and retail photography business. In the 2000s, I started a business growing lettuce and other crops hydroponically. I did that for several years while I was looking for something else to do. In 2001, I was elected as a councilor to the Waitaki District council. After serving three 3-year terms, I had a term away from the council and was then elected as mayor in 2013. They haven't gotten rid of me yet.

Irrigation Leader: Please introduce the Waitaki District.

Gary Kircher: New Zealand is fairly mountainous, and the Southern Alps run right down the South Island. The northern border of the Waitaki District runs along the Waitaki River from the east coast to the middle of the Southern Alps. The Waitaki District is quite large, at 7,000 square kilometers (2,700 square miles), but has just 24,000 people. Oamaru is the main population center, with about 14,000 people. We have many small rural communities, and we're reliant on agriculture, which is the key contributor to our economy. We also have a large-scale mining operation that generates 30 percent of our district's gross domestic product.

We get a lot of our water from the rivers that start in the mountains. The largest of them, the Waitaki River, is the third-largest river in New Zealand. The North Otago part of our district is traditionally quite dry and has been prone to severe droughts every 7, 8, or 10 years. That has made farming difficult. Irrigation in the district started in the 1960s and 1970s close to the Kakanui, Shag, and Waitaki Rivers. A couple of the main schemes started as government initiatives, and then communities bought them for $1 to help cushion them from the worst droughts.

In 2001, when I first got on the council, a couple of potential water schemes were being touted for the hinterland of Oamaru. One option was a gravity-fed scheme; the other would be driven by pumps. After a lot of infighting about which was the right option, the mayor at the time, Alan McLay, worked with the Waitaki Development Board to form Irrigation North Otago to come to an objective decision about which scheme would work best. The pumped scheme was determined to be most

PHOTO COURTESY OF GARY KIRCHER.

likely to succeed. Many meetings were held with farmers to determine how the scheme should develop, and along the way, our council agreed to be one of the investors. That council investment enabled the new North Otago Irrigation Company not just to build the scheme for the people who put their hands up at the time but to make sure that the new scheme was going to be there for the broader farming community in the future. Generally, that has worked. That was nominally 20,000 acres of extra irrigation.

The council is also a shareholder in the Lower Waitaki Irrigation Company, one of the $1 schemes. It provides water for household water supplies in Oamaru and some of the rural areas around Oamaru and down the east coast. The council has also helped Benmore Irrigation Company expand its irrigation scheme by acting as a guarantor to it. The council has also supported requirements to improve water conservation and to expand irrigation to more farms. Following regional council requirements to use water more efficiently, we provided a loan to the Kurow-Duntroon Irrigation Company, which was mostly a canal and border dike irrigation scheme, so that it could pipe its water and switch to spray irrigation.

Irrigation Leader: Has there been a shift from sheep and beef to irrigated dairy in your district?

Gary Kircher: Yes; that change has accompanied the expansion of irrigation. Sheep and beef farming is still relatively significant, with some sheep and beef farms adopting irrigation. There is also a reasonable amount of cropping that uses irrigation, at least on parts of the farms. We're challenged by droughts, which irrigation not only mitigates but amid which it helps produce record yields. Some of the early schemes were cheap enough that those options were still open to farmers, but the cost of water in some areas has become prohibitive for most traditional types of farming, and farmers have had to change to dairy. It was the best economic option at the time, and it still is. Dairy is far more prominent now. There are two dairy factories in the Waimate District, next to us. One of them is owned by Fonterra, the co-op that oversees much of the processing and export of dairy in New Zealand and is New Zealand's biggest company.

Some farmers got the opportunity to buy shares to irrigate parts of their farms, which provided a buffer against drought. Before that, when droughts got bad, they had to sell off their breeding stock and start virtually from zero. Now, they don't have to do that. More farmers are able to farm through dry spells, although the droughts in the last 20 years haven't been as severe as in the past. When we have a hot, dry year, farmers with irrigation on their crops have record yields.

Irrigation Leader: Would you tell us about hydropower in the district?

Gary Kircher: The first dam on the Waitaki River, the Waitaki Dam, was built in 1934. It was largely built by manual labor as a work program during the Great Depression. That dam created created Lake Waitaki. There's been an ongoing development of dams on the lower reaches of the Waitaki River and further up into the higher country. Hydro generation provides a significant part of New Zealand's electricity. It has helped with irrigation by providing much-needed electricity for pumping water up and down the valley, to neighboring valleys, and around farms. Beyond access to that generation, those dams have provided better river management; reduced catastrophic flooding; and made river levels more consistent, which in turn makes irrigation more reliable. We still get floods, but large rain events are much easier to manage. The more accurate the forecast is, the more the power companies can start lowering the lakes to absorb the increased rainfall.

Waitaki Dam.

The Waitaki River, which is the main source for the bigger irrigation schemes, has an allocation agreement among the hydro generators, irrigators, Māori communities, and the regional councils that oversee it. The use of allocations and the requirements of resource consents, which can require water users to reduce or cease their water takes when the level of the river goes below certain volumes, help make the system work better. This setup has given some schemes 90–98 percent security of water supply, whereas in some places, it might be 70 percent. Hydro generation has contributed in all those ways to make schemes better and more resilient.

Irrigation Leader: Across the dairying regions of the South Island, there have been various ecological concerns about nitrates in groundwater. What are the main environmental quality concerns in your district, and how they are being addressed?

Gary Kircher: A lot of work has been done to ensure good farm management to reduce the leaching of nitrates into

our water system. It hasn't been stopped, but it is slowly improving. Some of our small streams are polluted, and there is ongoing work to address that. Farms that supply products to Fonterra have to follow requirements related to things such as fencing, keeping livestock out of waterways, guaranteeing sufficient flows, effluent management, and riparian planting to mitigate those issues. Dairy farming has a bad reputation because there are bad operators responsible for *dirty dairying*, a term that's now in the public vernacular. An increasing number of catchment groups, many of them farmer led, are working to increase biodiversity and water quality in partnership with the regional councils that are responsible for those matters. It hasn't been easy, and there's a long way to go. Pollution is exacerbated in some areas by overallocation, which reduces the ability of streams to absorb whatever is going into them.

Irrigation Leader: What other trends do you see?

Gary Kircher: The trends are generally related to environmental protection. There are requirements for farm management and the efficient use of water. We're facing increasing restrictions on water takes to ensure that there is sufficient water left in streams and tributaries to maintain a healthy ecosystem. Farmers will also have to start limiting their emissions. A lot of research is being conducted into things such as how grasslands can reduce carbon dioxide and methane emissions. New Zealand is trying to minimize those emissions and be seen internationally as a responsible food producer. We're efficient in much of our food production. We're trying to make sure that we keep going in the right direction.

More areas want irrigation, but most of the affordable schemes have already been built, so now water is getting expensive. If you add to that the resource consent requirements, irrigation from even the cheapest scheme will cost more. The Lower Waitaki Irrigation Company is still running all its water through water races and canals; those structures will likely have to be piped. That is going to be a major investment not only for irrigators but for us, since we get town supply from the company. Water in New Zealand is generally abundant, but it's getting expensive because of all these factors.

The council supplies drinking water and deals with wastewater. Resource consent requirements around discharging wastewater and making sure it's fully treated are increasing. The required quality for domestic drinking water is increasing. We've got some major money to spend across New Zealand on that. We had 24 water schemes in the Waitaki District, many of which supplied water to rural areas. The council took over a lot of those rural water schemes that were created by farmers and connected multiple schemes to centralize treatment, resulting in a reduction of the number of schemes to 15. We have seven of our smaller schemes left. One is the Ohau Alpine Village, and the rest are large, rural schemes where most of the water goes to stock rather than people. We have roughly $20–$25 million to spend on those seven schemes, but the low number of people there means that the relatively high cost needs to be borne by few rate payers. That is especially true in the case of farms that use six or seven times the amount of water used by a household.

Irrigation Leader: What is your message to the national government?

Gary Kircher: Since the new government started last November, it has focused on investment in storage and has made some regional funding available. Water storage will be critical in many areas of the country, but it will be particularly so in the Waitaki District. In our area, water storage is a good solution to many of our problems. We're a mountainous area, so we tend to get large dumps of rain that head to the ocean relatively quickly. We need ongoing investment in river management to make sure that increased river flows don't cause too much damage, and harvesting water is one of the ways to reduce that risk. Agriculture is still the predominant player in the economy, and we need government support to keep improving its productivity.

I'm not going to rail against environmental regulations, because they are needed. More needs to be done to clean up our waterways. Farmers can be a little slow to play their part, although it's not just farming that's creating pollution. Polluters need to be treated equally. I'd rather see people encouraged to spend money to deal with problems instead of paying fines. There are other areas where water schemes will be beneficial. There's enough water to spread around. The government could play a part in enabling that.

Irrigation Leader: What is your vision for the future?

Gary Kircher: As a council, we've been happy with the investment we've made in irrigation. It has given confidence and financial support to the farming sector. It's been good for the environment—for instance, helping Kurow-Duntroon Irrigation Company do its conservation upgrades has taken some pressure off of some of the small tributaries and kept more water in minor catchments. The goal is to improve productivity in a sustainable way. We want to celebrate the farmers who are already doing their best to leave the land as good or better than it was when they found it. That's been the tradition for over 100 years. IL

Gary Kircher is the mayor of Waitaki. He can be contacted at gkircher@waitaki.govt.nz.

PHOTO COURTESY OF GARY KIRCHER.

Senator Ted Cruz: Working to Secure the Water Texas Farmers Deserve

Senator Cruz speaks to agriculture community leaders with Senator John Boozman, ranking member of the Senate Agriculture Committee, at a roundtable in Corpus Christi, Texas.

Under the terms of the 1944 Treaty on the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, the United States receives one-third of the water reaching the Rio Grande from six named tributaries located in Mexico, as long as that amount is not less than an average of 350,000 acre-feet a year over the course of a 5-year cycle. However, Mexico is behind on its deliveries, and the accumulating shortfall of water is having devastating effects on farmers in South Texas and on the industries and communities that rely on them. In this interview, United States Senator Ted Cruz of Texas tells us about the significance of the issue and how he is using every lever at his disposal to resolve it and provide South Texas farmers with the water they need.

Irrigation Leader: Please tell us about your background and how you came to serve in Congress.

Senator Cruz: I am a United States senator from the state of Texas. I have represented Texas for 12 years, and it is an extraordinary privilege to fight for 30 million Texans every day—to fight for jobs, to fight for security, and to fight for our constitutional rights. As the son of a Cuban immigrant who came to Texas in 1957 with nothing, who did not speak English, and washed dishes, making 50 cents an hour, for me to now have the opportunity to represent and fight for the entire state is truly the privilege of a lifetime.

Irrigation Leader: Please tell us about the importance of irrigated agriculture to the state of Texas.

Senator Cruz: Agriculture is the backbone of Texas. We are a massive ag state. Texas farmers and ranchers feed and clothe not just Texas but the entire country and the entire world. Farming and ranching don't work without water. Water is

PHOTOS COURTESY OF THE OFFICE OF SENATOR TED CRUZ.

the lifeblood of agriculture, and for much of Texas, getting water is not easy. The hard work and creativity with which water providers ensure that farmers have the water they need is vitally important to the continued strength and growth of Texas agriculture.

Irrigation Leader: Please explain the relationship between the United States and Mexico on the Rio Grande and how it has resulted in a shortfall in deliveries from Mexico.

Senator Cruz: I'll start by telling you how this issue came directly to my attention. Last summer, I conducted an ag roundtable listening tour across the state. I did roundtables in Amarillo, Corpus Christi, and Lubbock. At each of the roundtables, I sat down with farmers, ranchers, and stakeholders in the ag community to listen to their concerns. My colleague John Boozman, who is a United States senator from Arkansas and serves as the ranking member on the Senate Agriculture Committee, flew down and joined me for those roundtables. I was appreciative that John took the time to come to Texas, as he is deeply enmeshed in drafting the next Farm Bill. I work closely with the Ag Committee on the Farm Bill, but given that John, along with the chairman, is one of the principal drafters of the bill, I wanted him to hear concerns directly from Texas farmers and ranchers so we could be sure that the interests of Texans would be reflected upon. When we were at the roundtable in Corpus, the stakeholders I was meeting with brought to my attention an issue I had not previously encountered that concerned the 1944 treaty on water between Mexico and the United States. Under the terms of that treaty, Mexico is obligated to deliver 1.75 million acre-feet over the course of a 5-year cycle to South Texas, which means delivering 350,000 acre-feet of water a year. The treaty is administered by the International Boundary and Water Commission (IBWC). Unfortunately, Mexico is badly in arrears, and there has been a massive shortfall in terms of the water it has delivered. According to the U.S. section of the IBWC, Mexico currently owes the United States nearly 600,000 acre-feet of water. That was back in year 3 of the 5-year cycle, and at this point, the United States has received only about 39 percent of the water that Mexico is obligated to provide. That amount is just barely over a year's worth of Mexico's 5-year obligation, and it has now become all but physically impossible for Mexico to meet that obligation.

When I heard about this issue at the roundtable, my immediate reaction was, "This is an area where we can help. We should be able to lean in and try to get Mexico to comply with its treaty obligations." I returned to Washington, DC, in September, and I drafted legislation that would direct the U.S. Department of State to use its full diplomatic force to press Mexico to meet its obligations under the treaty. I introduced that legislation as an amendment on the floor of the Senate and forced a vote on it. The amendment ended up getting a bipartisan majority vote in favor on the floor of the Senate. Unfortunately, the amendment did not pass into law, because Chuck Schumer and the Democrats filibustered the amendment. They demanded 60 votes, and although it got a bipartisan majority, it did not get 60 votes. Nonetheless, it was valuable to have a bipartisan majority of the Senate on record agreeing this issue was important. I then picked up the phone and had an extended call with Maria-Elena Giner, the commissioner of the U.S. section of the IBWC, urging her to lean in vigorously to get Mexico to meet its treaty obligations. I underscored that with the Senate vote, she had a significant majority of the Senate from both parties clearly stating that this was a priority for the United States. She committed to me that she would press to do so. She has been negotiating to get a minute adopted regarding Mexico's obligations.

Senator Cruz visits the Rio Grande.

Irrigation Leader: How is the shortfall in deliveries affecting growers, irrigation districts, and other businesses in the Rio Grande Valley?

Senator Cruz: It's having a devastating effect. For example, in February of this year, we learned that the Rio Grande Valley Sugar Growers' sugarcane mill was closing because of the acute water shortages that have been directly caused by Mexico's failure to uphold its end of the treaty. All farmers in South Texas, whether they are growing citrus, cotton, sugar, or other crops, are struggling in the face of drought and desperately need the water Mexico owes us. There's a serious shortfall.

Irrigation Leader: Do you have any sense of when the new minute order dealing with the shortfall may be signed? What is the State Department doing to push the signing along?

Senator Cruz: I don't know for sure. My understanding is that Andrés Manuel López Obrador, the president

Senator Cruz meeting with constituents.

Senator Cruz meeting with a constituent from the Future Farmers of America.

of Mexico, required the two northern Mexico states to approve the minute order and that Tamaulipas is apparently objecting. In other words, the minute is running into a roadblock on the Mexican side. I am urging our State Department to keep pressing Mexico. It has a treaty obligation and needs to honor it. Even without the minute order, Mexico should honor the treaty and provide the water.

In recent weeks, I met with a number of business leaders in Mexico City who want to enhance economic cooperation with Texas. I had a very productive meeting with them, but I made clear that the issue of Mexico's breach of the water treaty was a serious impediment to Texas expanding its economic commerce with Mexico. If business leaders want a deeper relationship with Texas, they need to press their own government to meet the treaty obligations. They committed to me that they would be pressing in Mexico City for the Mexican government to do the right thing. Between that pressure in Mexico and the pressure that I continue to put on the State Department, I am hopeful we will see progress. We have not yet solved the problem, but I can tell you that I'm going to keep pressing and pressing and pressing until Mexico meets its obligations and the farmers in Texas get the water they are owed, deserve, and need.

Irrigation Leader: If the water delivery cannot be resolved soon, is there any financial relief planned for Rio Grande Valley growers and irrigation districts?

Senator Cruz: There may well be. We continue to have ongoing discussions with the State of Texas, local leaders, and the federal government about what resources are available. My team constantly meets with groups of farmers and citrus growers in South Texas about emergency measures that could be undertaken, including trying to find ways to truck water into South Texas to meet the immediate need. We will continue working cooperatively and creatively with state and local leaders to work to meet the growers' needs.

Irrigation Leader: Rio Grande Valley growers and irrigators have been in touch with their county commissioners, seeking a declaration of disaster for the counties along the Rio Grande that are affected by this issue. Is your office able to do anything to assist in the disaster declaration?

Senator Cruz: We will certainly work with the affected communities at both the local and the state levels to assist with this disaster declaration and with any and all relief that can be provided.

Irrigation Leader: What do you see as the way forward in this situation? Is there a lasting solution that can be worked out that is positive for both countries and the farmers?

Senator Cruz: A lasting solution is probably a longer-term conversation. Right now, my focus is on the urgency of getting water now. In the face of the drought, what matters is getting the water as soon as humanly possible. More broadly, it is always beneficial to work to address underlying tensions and find solutions that work better for all affected parties. That is a longer-term discussion that should not distract from the urgency of providing immediate relief.

Irrigation Leader: What is your message to irrigated farmers in the Rio Grande Valley?

Senator Cruz: I appreciate your strength and resilience. Stick with it. We are with you. We are fighting for you. My office and I will continue pressing, using every lever we have both with the State Department and with the government of Mexico to do everything humanly possible to get Mexico to honor its treaty obligations and provide the water that it owes to each of you, the farmers of Texas. IL

Ted Cruz is a United States senator from Texas. He can be contacted at cruz.senate.gov and at (202) 224-5922.

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Tom McLemore of Harlingen Irrigation District: Current Challenges and Future Prospects for Irrigated Agriculture in the Rio Grande Valley

Agricultural land in the HID service area. All of HID's water is sourced from the Rio Grande.

Automated gates in the HID system.

Harlingen Irrigation District Cameron County No. 1, also known as Harlingen Irrigation District (HID), is one of the numerous South Texas irrigation districts harmed by Mexico's underdelivery of water under the terms of the 1944 Treaty on the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande. In this interview, we speak with HID's general manager, Tom McLemore, about the challenges caused by this long-lasting shortage and how it is affecting district operations. We also delve into aging infrastructure issues and the future of agriculture in the Rio Grande Valley.

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

Tom McLemore: After finishing my enlistment in the navy in 1987, my wife, Martha, and I came home to farm with her family. That was my first exposure to irrigated agriculture. Then, in 2005 the general manager of HID, Wayne Halbert, who farmed in the same area as us, asked me to consider coming to the district as a project manager for the Agricultural Water Conservation Demonstration Initiative. This was a 10-year grant awarded to HID to demonstrate water conservation in surface irrigation and explore other alternatives for irrigation in the Rio Grande Valley. This grant was, in part, a response to the drought and low reservoir levels we experienced in the late 1990s and early 2000s, caused by the same issue we are dealing with today: Mexico's underdelivery under the 1944 treaty. That project was completed in 2015, and at the same time, Wayne was planning to retire. He asked me to stay on and move into his position.

Irrigation Leader: Please introduce HID.

Tom McLemore: The Harlingen Land and Water Company (HL&WC) was the forerunner to the district. The HL&WC was put together by Lon C. Hill, and construction on the canal system began in 1905. This was one of the first of many land and water companies up and down the Rio Grande Valley that were established by developers to populate and develop the farming industry of the region. By 1910, most of these land and water companies were either bankrupt or on the verge of bankruptcy. The new landowners needed a way to provide for the diversion and delivery of water to the farms that they had recently put into cultivation. The Texas Legislature passed legislation that allowed for the establishment of irrigation districts.

HID was established on May 13, 1914, by the Cameron County Commissioner's Court as the Cameron County Irrigation District No. 1, pursuant to section 13, chapter 172, of the acts of the regular session of the 33rd Legislature of the State of Texas. On May 31, 1919, the district was converted to and renamed the Cameron County Water Improvement District No. 1 under existing statutes. In 1945, it was renamed the Cameron County Water Control and Improvement District No. 1. In 1978, under the provisions of sections 51 and 58 of the Texas Water Code, the district became Harlingen Irrigation District Cameron County No. 1. In 1995, the 74th Texas Legislature established section 49 of the Texas Water Code, which now applies to the operations of the district.

PHOTOS COURTESY OF HID.

HID serves approximately 30,000 acres of irrigated cropland and has an authorized water right for 44,496.812 acres, 1,462.4 of which are subject to proration during periods of shortage. This water right yields a maximum allocation of 114,898.03 acre-feet of water per annum when storage lakes are at conservation level. HID is the diverter for approximately 22,000 acre-feet of domestic/municipal water that are designated for the municipalities it serves. The district has an additional domestic allocation of 892 acre-feet that is used to supplement the needs of these municipalities and serve the domestic needs of the rural areas within the district. The boundaries of the district enclose 88.3 square miles, including the cities of Harlingen; Palm Valley; Rangerville; and parts of Combs, Los Indios, and Primera.

HID services more than 3,000 accounts. Our customers are irrigated farmers in the Harlingen and Rangerville areas and six municipalities surrounding Harlingen. The district delivers to an average of 35,000 acres planted with various crops. The vast acreage of the district is serviced under individual water orders on an as-needed basis. The district also services annual permits on close to 1,000 accounts, which include lawn watering, golf courses, parks, school yards, and ponds.

The primary crops grown by our customers include citrus fruit, corn, cotton, grain sorghum, hay, onions, sesame, and a variety of other vegetables. Furrow irrigation accounts for 95 percent of the district's irrigation deliveries. The district supplies, at no cost to the customer, special turnout connections and encourages the use of poly pipe, gated pipe, and similar delivery systems. Approximately 90 percent of the district has converted to these practices. Flood irrigation is the general practice for orchards and pastures. Drip or micro spray-emitter systems are in place in a few orchards and commercial nurseries.

In 2010, HID fully automated its main canal system. The automated gate was developed with a grant from the Texas Water Development Board and later expanded with a grant from the Bureau of Reclamation. This was probably the biggest improvement to the district's delivery system since we underwent a Reclamation project in the 1950s and 1960s. At that time, we placed the majority of our lateral canals underground and pressurized them.

Irrigation Leader: What is the source of your water and how much do you divert per year?

Tom McLemore: The Rio Grande is our sole source of water. On average, we deliver 50,000–60,000 acre-feet to 30,000 acres of farmland. Along with that, we deliver around 22,000 acre-feet of raw municipal water.

Irrigation Leader: Would you tell us about the infrastructure you own and operate? Is aging infrastructure an issue that you deal with?

Tom McLemore: As mentioned before, our district is over 100 years old. The last major infrastructure upgrade was done in the 1950s and 1960s. The pipelines and relift pumps that were installed at that time are aging out and have become major maintenance issues. Our lift pumps at the river were installed in the 1920s and 1930s, and while they have been maintained quite well over the years, they are still old and becoming harder to repair. Aging infrastructure is our biggest maintenance issue.

Irrigation Leader: How have you been affected by Mexico's shortfall in deliveries under the 1944 treaty? What have been the effects on the district and on your customers? How are you responding?

Tom McLemore: HID has been very negatively affected by the shortfall in deliveries. Mexico's reluctance to deliver water under the 1944 treaty has become a major issue for all the districts in the Rio Grande Valley. Our district went on water restrictions in May 2021. This is the first and longest time since 2000 that HID has had to restrict the use of irrigation water. After 3 years of restrictions, our farmers are really feeling the effects. We have some multigenerational farms that will most likely close down their operations because of the lack of a reliable water source. Our sugar industry has already closed down. Our response is to do our best to deliver the water that we have as efficiently as we can and to stop all ancillary deliveries, such as those that serve lawn and park irrigation. Because of the 4-day travel time from the reservoir to our lift pumps, in the past, we would try to keep water in our canals in anticipation of an irrigation. Now, we no longer divert unless we have a water order in hand. It has required us to more closely monitor and police our deliveries, and it has required our customers to better plan their requests for water.

Irrigation Leader: How does the shortage of water affect irrigation districts' revenue streams, and what are the effects of this?

Tom McLemore: HID receives approximately 30 percent of its revenue from the delivery of irrigation water. With many of our canals dry because of the lack of water, one would think it would be the perfect time for maintenance and upgrades. However, those activities are expensive, and with the lack of revenues, we have had to make the decision to do only what we can afford at any given time. We have put off applying for Reclamation grants because they require a 50 percent cost-share, and given our uncertainty about the availability of water, we are holding back the cash reserves we have to operate on.

Irrigation Leader: What other sources of funding are available for infrastructure modernization? Is more needed?

Tom McLemore: Our primary source of funding for infrastructure improvements is Reclamation's WaterSMART grant program. The State of Texas has some loan opportunities, but our board has always been reluctant to borrow money for infrastructure improvements. It prefers to use the sale of assets, such as rights of way and water rights, to fund improvement projects. However, those funds have been needed to operate the district during this water crisis.

Irrigation Leader: Has your district explored other sources of water, such as desalination, groundwater, or brackish water, to mitigate the current situation of water deliveries?

Tom McLemore: In the 1950s, quite a few deep wells were dug for irrigation. Many of those wells provided water of questionable quality, and a lot of farmland was hurt by the application of poor-quality water. For the most part, our groundwater is too saline for irrigation and contains a lot of boron, which is detrimental to the land. Desalination is too expensive for irrigation. It has been explored for municipal water in other districts, but we have not explored it in our district.

Irrigation Leader: What is the current status of the disaster declarations in the various Rio Grande Valley counties? How do such declarations help?

Tom McLemore: Our county did declare a disaster. We have not discovered exactly how that declaration is going to help irrigation districts.

Irrigation Leader: What has been your experience working with local, state, and federal governments and elected officials? What is your message to them?

Tom McLemore: They seem to be attentive to our situation and have listened to our concerns, but the message we keep getting is that their hands are tied when it comes to getting Mexico to deliver water. That is the job of the U.S. Department of State, and it has a lot on its plate right now. Some have been trying to find ways to help with funding during this time, but we have not seen anything yet. As I mentioned before, now is the time to improve our delivery system. A fast track to funding for district improvements would be very helpful so that when we recover from this drought, we will have the ability to stretch our water.

Irrigation Leader: What are your thoughts on how the issue of Mexico's shortfall in deliveries might be resolved in a positive manner over the longer term?

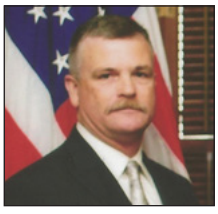
Tom McLemore: Over the long term, I think both countries are going to have to agree that the treaty is important and that there is an obligation for Mexico to deliver the water as described in the treaty. The major problem is that there is no way to enforce the delivery requirements of the treaty. Other than that, I don't believe there is a manmade solution to the problem. The only thing that will improve the situation in the valley is rainfall in areas of the watershed where the water cannot be captured by Mexico. The parts of the Rio Grande watershed in Mexico have been overdeveloped, and Mexico has no mechanism in place to control the use of the water. Sadly, I don't see that changing in the near or distant future. Districts are going to have to find ways to mitigate the losses in their delivery systems so that the water we do get in the reservoirs lasts longer. Unfortunately, that mitigation is expensive.

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

Tom McLemore: The Rio Grande Valley is changing. Agriculture, while still important to the valley, is not the economic power that it used to be. Much of our production has moved south. Many of our elected officials have no idea of the effect of agriculture on the valley or how our irrigation systems work. Most of the population can't tell you where their water comes from. They are not aware that 95 percent of the municipalities receive their raw water via an irrigation district. Those districts, because of their age, suffer great losses in the conveyance of that water, but there are very few funding mechanisms to improve their conveyance systems. There is funding for municipalities and for on-farm improvements, but the opportunities for districts are limited. I would like to see that change. This is a complicated subject, and solving the problems will require districts, municipalities, and irrigators to work together. If one thing comes out of this drought, I hope that it is the awareness of how fragile our systems are and the need for all users to invest in them if we plan for any type of growth in the valley.

Irrigation Leader: What is your vision for the future?

Tom McLemore: My vision for the future is to find a young, enthusiastic individual to take my place and find new ways to approach the age-old problem of water use in the valley. Along with our infrastructure, the individuals who have been fighting the water battle in the valley are aging as well. Over the next few years, we will lose a lot of historical knowledge about water in the Rio Grande system. Our districts are going to require new, younger leaders who will continue to advocate for the water right holders in the Rio Grande Valley. I believe that is a must if districts are going to remain viable in the future. IL



Tom McLemore is the general manager of the Harlingen Irrigation District Cameron County No. 1. For more on HID, visit hidcc1.org/.

PHOTO COURTESY OF HID.

Toro Transpira: Delivering Water Use Data Directly From the Tree

Transpira uses a sensor installed directly in a tree to measure the transpiration process, providing insights into how much water the crop is using.

If you're trying to figure out how much water an orchard crop is using, why go anywhere other than directly to the tree? That's the idea behind Transpira, a technology from the Toro Ag division of the Toro Company. With a sensor that is easily installed directly in a trunk, Transpira pulls data on water movement inside the tree and delivers them in formats that are easy for growers to interpret and act on. In this interview, Senior Product Manager Adam Setzler tells us more about this technology and its potential benefits.

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

Adam Setzler: I've been in agricultural irrigation and water management for 15 years, joining Toro Ag about 3 years ago. Much of my prior work was in field monitoring: working with soil moisture probes and weather stations for irrigation, disease, and pest management.

I joined Toro Ag for the opportunity to work on innovative and effective products. When the company decided to invest in automation and monitoring systems, it was a natural fit for me. I found myself launching back into the world of field monitoring.

That experience helped me understand the unique opportunity that we have with our new product, Transpira. Standard technologies, such as soil moisture monitoring and evapotranspiration (ET) weather stations, are great tools and can provide a lot of useful information to growers, but they are missing a key element—information directly from the plant about how much water it is using. That is what Transpira provides.

Irrigation Leader: Please tell us about the Toro Company.

Adam Setzler: The Toro Company has been around since 1914, starting out as a manufacturer of tractor engines and implements. A lot of people are familiar with Toro lawnmowers and landscaping tools, but our company includes a much broader collection of equipment and water management businesses.

We have a long legacy in irrigation and agriculture. Over the last 50 years, the Toro Company has developed a wide portfolio of irrigation products that serve the golf, residential, commercial, and agricultural markets.

Within agricultural irrigation, our focus has been on drip and micro irrigation. We are proud to be at the leading edge of water use efficiency and sustainable irrigation practices, with a long history of innovation through our industry-leading drip tape products. In recent years, we have extended our product range to provide a more complete system portfolio, including irrigation automation and monitoring product lines.

Our Toro Ag division, the group I work in, sits in a sweet spot in terms of company size and resources. We know all our customers and dealers well, so we give personalized service while also having the resources and backing of a large corporation. It's been an effective combination.

Irrigation Leader: Would you tell us about the new product award you received from the Irrigation Association in 2023?

Adam Setzler: Last year, we partnered with a technology startup, Treetoscope, to commercially launch the Toro Transpira product line. The product uses a sensor installed

PHOTOS COURTESY OF THE TORO COMPANY.

directly in a tree to measure the transpiration process, providing insights into how much water the crop is using.

We felt that we had found something fresh in a technology space that is filled with products that are mostly small variations on a standard set of concepts, with gaps in our understanding of what the plant is actually doing. We want to help fill those gaps.

We were excited to accept the Irrigation Association's new product award in November 2023 and to have an opportunity to present Toro Transpira and share why we felt this product was unique.

Toro Ag has won a number of these new product awards over the years, including recently for our Tempus AG automation system in 2021. It's been nice to follow that award with something from the monitoring side of the business.

Irrigation Leader: What is the basic idea behind Transpira?

Adam Setzler: Transpira provides information directly from the plant on how much water the crop is using. It gives a specific measurement of water use for that particular crop, rather than a general status or index. We provide those data in a digestible way so that growers can schedule their irrigations based on measured or forecasted consumption without having to extensively interpret or adjust the data.

Irrigation Leader: How does this direct plant sensing work, and how does it make water application more efficient?

Adam Setzler: The plant sensing process is very simple. The monitoring device uses a small temperature sensor with a heating element. During measurements, the sensor applies a very small amount of heat inside the tree. It monitors the response of the tree to the heat that is applied.

When water is flowing faster inside the tree, it carries away the heat that's being applied, and it takes more energy to maintain the same temperature difference. When water is moving more slowly, the heat builds up around the sensor, and less energy is required. It's a basic measurement that tells us how quickly water is moving through the structure of the tree. That's the science behind this—it's very basic. An extremely specialized instrument is not required to do this.

To make the information usable for irrigation scheduling, our partners have developed crop-specific algorithms to translate the raw data from a rate of flow into a measure of exactly how much water that tree is using. If we scale those measurements to the field level based on planting density, we can know how much water the whole field is using.

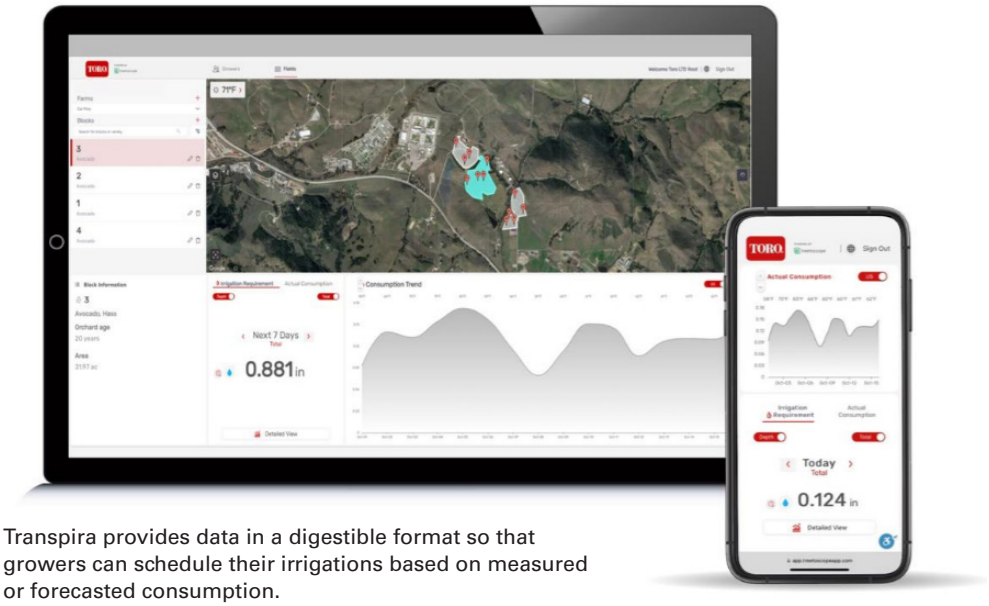
Installation is very easy. You drill a 4-millimeter pilot hole into the tree, insert the sensor, and enter some basic parameters about the tree into the installation app. It takes less than 10 minutes per site and can be performed by growers, technicians, or members of our dealer network. We typically have three sensors installed in a given block. You're in and out in less than 30 minutes and need only basic tools.

We don't require the instruments to be calibrated in field. There is a several-week normalization process for the sensors at the beginning of the growing season to ensure that the values we're getting accurately reflect the expected water consumption.

Access to the information is very user-friendly. The data are made available on the cloud from a web or mobile interface. We provide field-level data on water usage measured in inches of water (similar to the measure of calculated ET) or in total gallons used in that irrigation block. The system also combines the measured water consumption with future weather forecasts to project an irrigation requirement for the next 1–7 days.

Installing Transpira involves drilling a 4-millimeter pilot hole into the tree, inserting a sensor, and entering basic parameters about the tree into the installation app. It takes less than 10 minutes per site.

With the initial release, Toro Ag is offering Transpira for a selection of permanent crops, including almonds, apples, avocados, citrus, grapes, pecans, and pistachios.



Transpira provides data in a digestible format so that growers can schedule their irrigations based on measured or forecasted consumption.

If the grower provides the flow rates of their irrigation system, we can also provide them with a system runtime that matches their measured or forecasted water usage. We can tell a grower how long they need to run their equipment to irrigate an amount equivalent to what the sensor says the field is using or is projected to use. That's a feature a lot of growers connect with. It makes the modeled situation real in terms of using it to plan irrigations. It puts the information into units they're used to dealing with, namely how many minutes or hours they need to run their irrigation controller for a particular valve.

Irrigation Leader: What are the main crops that this technology is applicable to? How can a grower get started with Transpira?

Adam Setzler: With the initial release, we are offering Transpira for a selection of permanent crops, including almonds, apples, avocados, citrus, grapes, pecans, and pistachios. We have another three crops in beta testing this year and an extensive roadmap to expand the types of crops that we work with.

To start the process, growers can contact their Toro Ag dealer or our Toro Transpira team to let us know what crop and variety they're working with. Within our system, we create field boundaries using a simple mapping tool to identify which blocks the grower wants to monitor.

We do a remote site survey with data from soil maps, normalized difference vegetation index maps, and terrain maps to determine the best locations to install Transpira sensors in that specific field. Using the locations provided by the site survey, the installer picks the individual trees when they're out in the field.

We've tried to make it as simple and quick as possible for growers to get started. We have a dedicated team in North America focused on this product that supports our growers. Toro Ag has a very robust dealer network, many members of which have received training and are able to sell the Toro Transpira system directly.

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

Adam Setzler: Our goal is to provide something simple, specific, and actionable. There are many field monitoring systems for irrigation management out there. I think it can be very challenging for growers to sift through all the noise. They don't have a ton of time to dedicate to learning how to use a new system, how to interpret the information, and what they should do when it comes time to decide how much to irrigate. Transpira is focused on how to provide—as simply and accessibly as possible—something that directly addresses how much a grower should irrigate. That's what sets Toro Transpira apart and makes this a unique product platform.

Irrigation Leader: What is your vision for the future?

Adam Setzler: We want to lower the barriers between insights gained and actions taken. We want to make it easier to take practical steps toward irrigation automation.

The growers will always be steering, but we want to provide them with ways to reduce the time, effort, and interpretation needed for irrigation decisions. On the execution side, we want to provide an easier pathway from field insights to precise control of irrigation through automation.

There's a labor-saving aspect to this. It takes a lot of time and effort to analyze and decide how to irrigate, whether your goal is to reduce water or to optimize yield. If we can reduce that workload for the grower, that's going to be a big part of any success story.

There are connections to water conservation, too, especially as regulations put more pressure on how much water growers can use. This technology gives them the opportunity to make sure they're applying the right amount of water at the right time. IL

Adam Setzler is a senior product manager for The Toro Company. He can be reached at adam.setzler@toro.com.

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Jan Gould of Responsive Drip Irrigation: Dripline That Irrigates in Response to Root Signals

Sweet corn growing in Abu Dhabi. A pilot RDI system was installed to evaluate whether vegetable crops could be grown in an open field with sand and higher-salinity water. The RDI system was able to germinate sweet corn seeds and produced high yields.

Cabbage being grown with an RDI system in Abu Dhabi.

Responsive Drip Irrigation, LLC (RDI), has developed a new type of subterranean dripline that CEO Jan Gould says is not just innovative but stands to disrupt the entire industry. Using a patented microporous tube that interacts with signals from plant roots on an organic cellular level, RDI's dripline releases water and nutrients only when plants need them, allowing it to save 30–50 percent of the water and fertilizer used by conventional drip irrigation. In this interview, we learn more about the use and benefits of this exciting technology.

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

Jan Gould: I originally worked in the medical profession for more than 35 years. The medical/financial company that I created was acquired, which provided me the opportunity to focus on my concerns regarding the environment and what the future might hold for people and the planet. In 2010, I began searching for solutions that might help to change the destructive course that seemed to lie ahead. For the past 15 years, I have dedicated my time and passion to irrigation, becoming a strong advocate for water conservation, improved water management, food security, sustainability, and environmental preservation. My mission has been to increase food production and save water for our children today and for our children's children and grandchildren. My main focus has been developing a solution to these challenges. I created, developed, and am now distributing a disruptive irrigation technology through my company, RDI. RDI is a U.S.-based company that has its main office in Bradenton, Florida, and is currently working on projects in water-stressed states in the western United States.

After winning the Best Innovation for a Start-Up award at the Global Forum for Innovation in Agriculture (GFIA) in Abu Dhabi in 2019, RDI established a manufacturing and distribution facility in the United Arab Emirates (UAE) in 2020 and implemented small pilot projects there. The system showed dramatic results, producing increased crop yields using half the water and fertilizer of traditional drip irrigation. As a result, large open-field farms and commercial greenhouses adopted the system, and the technology has spread to more than 30 countries around the world.

In 2022, RDI's Nature & Water Conservancy Center for Global Sustainability opened in Abu Dhabi. The center is focused on R&D into innovative solutions and collaboration with universities and companies, introducing new technology for water management, soil regeneration, and carbon sequestering; best practices in agriculture; methods for preserving landscapes and green spaces in urban areas; and sustainable practices that will positively affect the environment. The center offers education on innovative products and methods and serves as a resource and educational center. It aims to lead the way for an agricultural transformation that will use the latest ag-tech products and regenerative practices to preserve the planet for future generations.

Irrigation Leader: Please tell us more about RDI as a company.

PHOTOS COURTESY OF RDI.

Jan Gould: When the company was established in 2013, it had only a handful of employees. We focused on researching materials, studying water savings, developing the technology and patents, implementing trial projects, and then creating a production process to commercialize the technology. RDI's technology was released into the market in 2019, when it captured attention at the GFIA conference in Abu Dhabi. I began working with the Abu Dhabi Investment Office after RDI was selected as one of the first four companies to participate in its AgTech program in 2020.

Of course, COVID-19 affected our development and release into the market. Trade shows and conferences, where new innovations could be showcased, were canceled or held virtually, making it difficult to show the system in operation and demonstrate its results through photos. Although I was working with the Abu Dhabi Investment Office, travel back and forth at that time was extremely difficult, involving repeated testing, verification, vaccines, and masks on 18- to 24-hour airline trips. It was a monumental task to get operations, staff, and machinery set up in Abu Dhabi.

As of 2024, we have expanded our manufacturing capacity in the United States and the UAE. Our staff has grown dramatically, not only in numbers but in experience. The staff at RDI were the first people to work with a nanotechnology that provided irrigation regulated through organic chemistry rather than mechanical controls. Entirely new installations, procedures, and mathematical calculations were required to design the system to meet water capacity needs. This dedicated staff, with diverse educational backgrounds, nationalities, ages, genders, religions, and cultures, worked collaboratively and committed their time and efforts not just to a job, but to a shared vision for making a difference. They have become experts in the RDI technology. Engineers and professors from other countries visit RDI's projects and attend educational training programs presented by RDI staff. RDI's engineers also travel to other countries to help companies install the system and teach people how to use and maintain it. We are making a difference. This technology contributes to all 17 of the United Nations' Sustainable Development Goals. It can save 50 percent of the water used in agriculture while producing twice as much food.

RDI is a small startup company with a disruptive technology. We are not known or recognized in the industry, like the big corporations that have been the leaders in this sector for more than 50 years. When people hear about our technology, they don't believe that its results are possible. It is deemed too good to be true. As a result, although we have proved it in the desert of the UAE and on farms in many other countries, they want to see for themselves whether it will work in their area. Until RDI has sufficient projects in the marketplace for customers to see the results for themselves, there will be apprehension about adopting the technology.

Artichokes being grown in Monterey, California, with an RDI system.

Irrigation Leader: Who are your customers and where are they primarily located?

Jan Gould: We have distributors in Africa, Australia, Europe, India and Pakistan, and the Middle East. They have installed or are implementing demo plots to showcase the technology and develop the market. We are collaborating with universities and research institutes in Germany, Iraq, the Netherlands, Pakistan, Portugal, Serbia, Spain, the UAE, and the United States. We have just finished the 3-year AgTech program with the Abu Dhabi Investment Office, in which RDI achieved and surpassed the key performance indicators laid out in our agreement. RDI is also involved in a program with Action Against Hunger in Iraq to provide our system to smallholder farmers in Iraq and educate them.

After successful demonstrations of the technology's performance and its results for agriculture, water conservation, soil health, environment, and climate change, we are now turning our attention back to the United States. We can address water scarcity in the western United States; assist and help promote regenerative agriculture and biodiversity across the United States; and increase green spaces in urban areas to reduce the urban heat island effect.

Irrigation Leader: What issues with conventional drip irrigation were you addressing with your innovation?

Jan Gould: Drip irrigation is complex and expensive to install. Standard drip irrigation requires specific crop, soil, watering, fertilizer, and agronomic expertise. The efficiency of the system and the resulting crop health depend on the level of expertise of the farmer, who needs to establish an irrigation schedule that delivers the amount of water needed by the crop. Determining that amount requires calculations based on soil percolation, crop requirements, the stage of

Tomatoes being grown in a greenhouse in Abu Dhabi using an RDI system.

Winter pumpkins being grown in a greenhouse in Abu Dhabi using an RDI system.

growth, evapotranspiration, and the system's flow rates. Further, the watering schedule is set by controls that must be adjusted for the weather, the soil, and the stage of the crop. A lack of understanding of these requirements and a lack of data lead to overwatering, poor crop health, crop loss, evaporation, or runoff.

With RDI's nanotechnology, the plant controls its watering cycle. When plants need water, they release exudates from their roots. RDI's nanotechnology responds by releasing water from its micropores. The system provides a slow-release water flow that matches the roots' absorption capacity, never overwatering or underwatering. Plant stress is minimized, producing higher crop yields using less chemicals and saving half the water and fertilizer.

Brackish water and water with high mineral content can crystallize and block standard drip tubes or clog the emitters, requiring expensive filtration systems, acid washes of the system, and tube replacement. There are no emitters to clog in RDI's product. The entire surface is microporous, releasing water whenever the plant needs it, so there are no emitters to clog and no root intrusion.

Standard drip irrigation requires a high level of system pressure, so electricity or fuel oil is required to operate pumps. Row lengths are limited due to pressure loss. By contrast, the RDI system operates at very low pressure. It doesn't require electricity or pumps and can irrigate with a gravity-fed rain barrel. There is no pressure loss from the low-flow, low-pressure RDI tubing, so rows can be extended to four times the length of standard drip-irrigated rows with equal crop growth at the end of the row.

Fertilizer runoff from surface drip irrigation contaminates water sources, increasing algae blooms and acidity and thus harming marine life. The use of fertilizers and herbicides increases soil salinity and degrades the soil. The RDI system uses half the fertilizer of other drip systems and can be used with soil activators and bioorganics, which would further reduce the use of fertilizers.

Most drip irrigation tubes are manufactured from a petroleum base, and because emitters clog from agrichemicals and root intrusion, the tubes must be replaced every 2–3 years or even annually. When it is replaced, the old drip tubing usually ends up in landfills or is burned (though some areas now require recycling). RDI stays under the surface season after season, year after year. It doesn't need to be replaced every few years and will continue to respond to plant signals for more than a decade.

Irrigation Leader: Please tell us about how your technology works to respond to root signals from the plant to release water.

Jan Gould: All plants emit root signals to uptake moisture and nutrients from the surrounding soil. The RDI technology uses a patented microporous tube that interacts with signals from plant roots on an organic cellular level. Using a patented combination of hydrophilic and hydrophobic materials, RDI's nanotubing has billions of micropores that interact and respond to these root signals, releasing water and nutrients as the plant calls for it. The tubes release water at a very low pressure and slow variable flow rate that match the plant's absorption capacity. When the plant is satisfied, it stops emitting these root signals, and the micropores of the RDI tube stop releasing water.

Irrigation Leader: What is the effect of this in terms of plant health and water use?

Jan Gould: The plants receive water when they need it based on their individual requirements. They are never overwatered or underwatered, eliminating plant stress. Plants on the RDI system develop 7–10 days faster and will continue fruiting for harvest for weeks longer than those on other systems, producing higher yields.

With traditional irrigation, a set volume of water is applied at timed watering cycles, based on the estimated

PHOTOS COURTESY OF RDI.

crop water requirements in that region and calculations of plant evapotranspiration and soil percolation. A large volume of water is released at higher pressure over a short period of time. The plant roots are not able to take up that amount of water at one time, so the excess saturates the soil; runs off between rows (causing weeds to grow); evaporates; or is lost to percolation, going too deep for the roots to access. The RDI system uses 30–50 percent less water than standard drip irrigation systems, depending on how well they are controlled and adjusted to field and crop requirements. The RDI system can save 80–90 percent of the water used by center-pivot systems, sprayers, water cannons, or flood irrigation.

Irrigation Leader: Is this technology applicable to any crop, or is it best for specific crops in specific regions?

Jan Gould: It works on all types of crops in all climates and in soil of all types. It also works for turf, ornamental plants and shrubs, trees, rooftop gardens, and vertical walls, meaning that it can expand greenspaces in urban areas. It also works with reclaimed treated water so that freshwater supplies do not need to be used for landscape irrigation.

Irrigation Leader: Does the installation of your system require company personnel, or can it be done by the customer?

Jan Gould: It is simple to install for smallholder farmers. We have installation guides that we have tried to make as simple as possible. We are beginning to create instructional videos, pictographs, and instructions that will be translated into different languages. For larger, commercial-scale projects that require more infrastructure, including main water lines and pumps, RDI has a technical team that can design the project and work with the farm's or city's personnel to install the system. Alternatively, RDI can provide a turnkey option.

Irrigation Leader: What results might a user see from using your system?

Jan Gould: The RDI system will reduce expenditure on water; agrichemicals (fertilizers, herbicides, and so on); energy; equipment maintenance and replacement; and labor. It will increase revenue because of higher crop yields and higher-grade crops that are grown using less chemicals or organically.

Irrigation Leader: Do you currently have installations in the United States?

Jan Gould: We are only just starting out in the United States, since our focus since 2020 has been R&D in the UAE. Interest and projects have developed in other countries as people have seen the results of the projects in Abu Dhabi and as the technology has received awards.

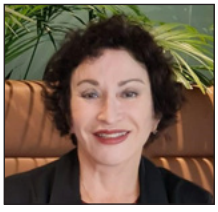
Irrigation Leader: Are there any projects on the horizon for RDI that you would like to touch on?

Jan Gould: We are working on many exciting projects that I'm hopeful will gain more visibility for RDI's technology and increase its adoption in many regions. Among them are

- testing drought-tolerant cotton seeds in the desert
- installing for almonds and pistachios in Australia
- reducing the greenhouse gas emissions of flower and vegetable production in the Netherlands
- developing new substrates for greenhouse crop production from sustainable materials
- collaborating with companies producing bioorganics and soil activators to restore soil
- working on resort projects with a landscape architect in Croatia
- installing turf in Algarve, Portugal, to preserve green areas while limiting water use
- producing greenhouse vegetables for a large grower in Mexico and the United States
- irrigating the corners of fields in Romania where center-pivot coverage is not possible, leading to the replacement of center pivots
- using reclaimed wastewater to irrigate desert fields for fodder crops
- working on projects in Arizona with date palms and open-field vegetable crops to decrease water consumption

Irrigation Leader: What is your vision for the future?

Jan Gould: Since I started this journey, the driving force has been to make a positive change that can help to reverse some of the damage that has been done to the planet and to preserve the resources and magnificent beauty of the earth for future generations: not just sustainability but restoration. My hope is to work with our current business partners and build more relationships to spread this technology all over the world. After I am gone, it is my hope that my footprints will be washed away with the tide in the sand, but the oceans, fish, sand, soil, plants, trees, animals, and humans will still be there, just as they were at my birth or maybe even a little better, but certainly not worse. IL



Jan Gould is the CEO of Responsive Drip Irrigation, LLC. For more on RDI, visit responsivedrip.com.

Trevor Brown of Juniper Systems: High-Precision GPS Mapping for Irrigation Asset Management

Juniper Systems tablets and the Geode GNSS receiver.

Juniper Systems has developed ultra-rugged tablets to pair with its high-precision global positioning system (GPS) receivers and flexible software to help various types of irrigators track assets and save time and money. Whether it is hot, cold, humid, or dusty, this technology maintains coordination between the office and field in a user-friendly way to maintain as-built irrigation systems and manage system improvements. In this interview, Irrigation Leader *learns from Trevor Brown, Juniper Systems' Uinta software product manager, about how this technology has made advancements for high-precision mapping easy and reliable for the industry.*

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

Trevor Brown: My undergraduate degree is in business, specifically supply chains and marketing. After college, I started my early career at Intel as a factory planner and transitioned to multiple roles there. At Intel, I gained a lot of experience in factory operations and a solid foundation in data management. I've always been interested in the outdoors, and I left Intel to pursue a graduate degree from Indiana University in natural resource management. After some volunteer work at the Charles Darwin Foundation in the Galapagos Islands, Ecuador, I found a job at Juniper Systems as the natural resources market manager. Juniper Systems has a long history of working with many types of natural resource customers. In fact, many of the company's first customers were in forestry, fisheries, and other environmental-type applications. It was exciting for me to combine my interests in technology and natural resources. Later, I transitioned to different roles within our sales and marketing team, including product management, which allowed me to learn about our many other customers and their field data collection and geospatial mapping needs. Helping customers and learning about their interesting jobs is definitely one of the best parts of my job.

In my roles at Juniper Systems, I became familiar with many third-party software applications that customers used with our ultra-rugged tablets and GPS services. Some of our customers had poor experiences with or were underserved by available software options. We really wanted to create a better overall experience for our customers with both hardware and software. We conceived a product that was user friendly, easy to train, and easy to support, but also flexible enough to be used across many different customer applications. With that, I became the product manager for our Uinta software. We launched our new Uinta software the same week in 2020 during which things here in Utah began shutting down because of the pandemic. However, the pandemic spurred a lot of growth in certain industries that were well suited for the Uinta software, including irrigation mapping and other water-related applications, such as water utility mapping. We've come a long way since then and have added a lot of customers. Customers can typically get set up and trained to be experts in the high-accuracy mapping of irrigation as-builts in about 30 minutes through a training with our Uinta customer success team or a training run by a premier partner or simply by watching a video.

Irrigation Leader: Please tell us about Juniper Systems.

Trevor Brown: Juniper Systems started in 1993, but its history goes back to the 1980s. Our founder, Ron Campbell, was one of five brothers who founded our parent company, Campbell Scientific. The five brothers had an agricultural

IMAGES COURTESY OF JUNIPER SYSTEMS.

upbringing and a deep interest in technology. These brothers got together and started Campbell Scientific, which is a leader in environmental measurement systems, including stationary data loggers for all kinds of data collection and monitoring.

After some years, Ron started a separate company, eventually called Harvest Master, that was focused on seed research products. The seed research products collected agricultural plot research data and were mounted on the outside of combine harvesters with a data logger inside the cab. This early data logger mounted inside the combine eventually offered the option of entering data directly into the logger. This device had a small display and a keyboard for data notation. It was an early handheld computer. It was not long before people realized the value of logging data in a mobile environment.

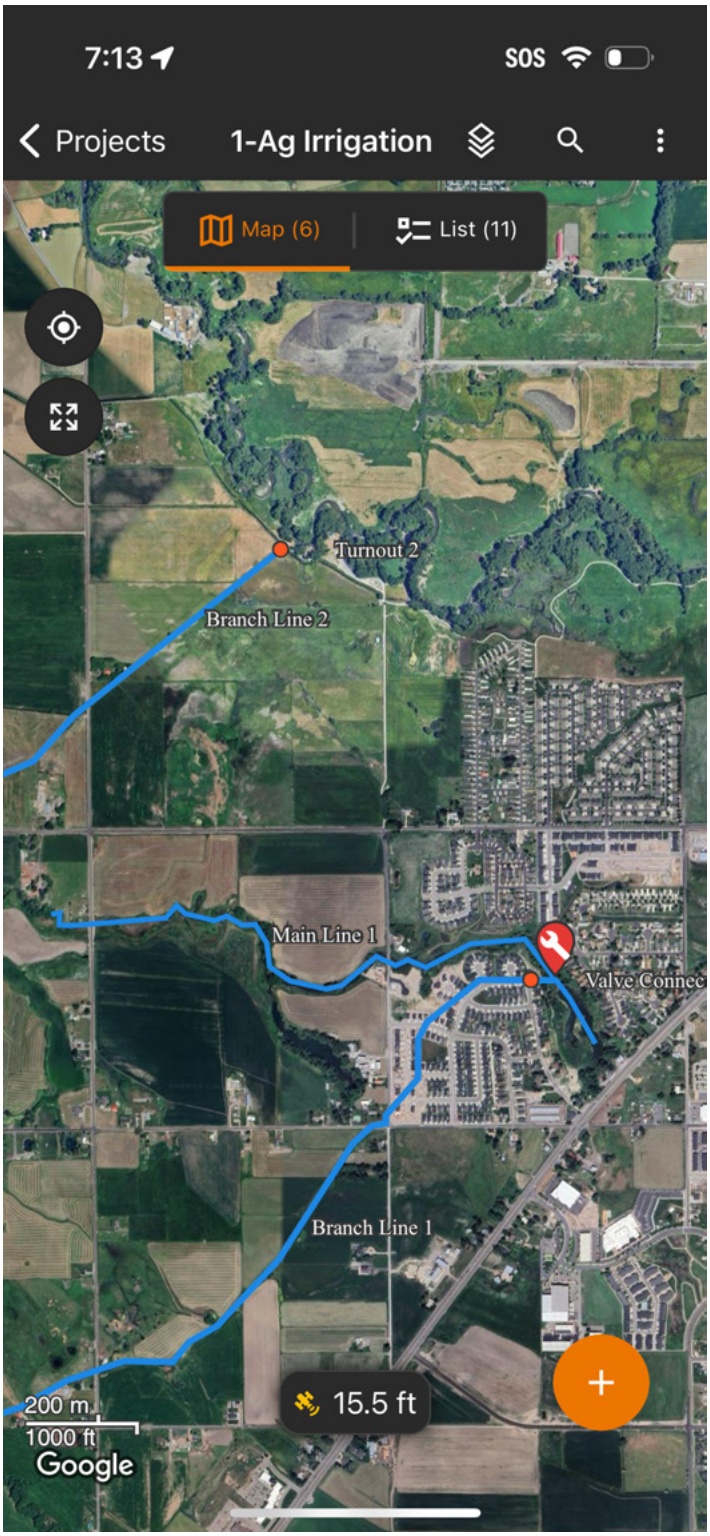
Early customers used our data collectors for forestry and other outdoor data collection activities. Eventually, the name was changed to Juniper Systems to better acknowledge our nonagricultural customers. Now, Juniper Systems supports customers involved in land surveying, utility mapping, manufacturing, industrial applications, and more. Of course, agriculture still plays a big role in our company, but now our products support many more data collection needs.

Today, we are experts at field data collection, particularly in outdoor or harsh environments. We make ultra-rugged Windows and Android field tablets and high-precision GPS receivers, all designed to be dependable in extreme environments. Our customers often work in hot, cold, and harsh conditions, and our gear is designed to keep working and to protect their valuable data. We design, develop, and support all our products at our factory in Logan, Utah, and have customers all around the world. We also depend a lot on the expertise of our premier dealers to help our customers be successful.

Irrigation Leader: Can you elaborate on your innovative technology, including your tablets, handhelds, and software for the irrigation industry?

Trevor Brown: Our irrigation customers typically use one of our rugged Windows or Android data collectors, such as our Archer 4 Android, or their own Android or Apple iOS phone with our Uinta software to quickly and accurately map irrigation as-builts. However, phone or consumer GPS is typically only accurate to about 15 feet (5 meters). That accuracy is okay for some situations, but not great if you are working in irrigation, trying to do things such as determining the total lengths of installed PVC pipe at a job or navigating back to broken sprinkler heads that you have previously mapped. Our high-accuracy Geode global navigation satellite system (GNSS) receiver pairs via Bluetooth with a mobile device and becomes the GPS location provider for it, providing accuracies of about 1–2 feet (30–60 centimeters). Other Geode receiver models use real-time kinematic positioning and are even more accurate. The Geode GNSS receiver is one of my favorite products that Juniper Systems has ever built. It just works.

Users map irrigation as-builts with an irrigation template that allows them to record information about all the irrigation assets and take photos. The irrigation template can easily be customized to match a user's data collection preferences. Uinta projects synchronize automatically to the cloud so that others can see the map on their Windows office computers. Users can even map offline when they lack an internet connection and synchronize to the cloud later.



An agricultural canal system mapped in Uinta.

A pivot irrigation system mapped in Uinta.

Completed as-built maps can be exported to common file formats and shared with others via geographic information system or computer-assisted design (CAD) systems. People usually share maps via Google Earth, Esri shapefiles, or Microsoft Excel or export to a nice-looking PDF map report with photos and as-built information. The exports include all the information about irrigation assets and their location. That's helpful to our customers who want to do something such as presenting a professional-looking bid proposal that includes the total number of part repairs or replacements required of specific irrigation equipment. Once a bid proposal like that is accepted, install technicians know what is required and where to go to get the job done.

Irrigation Leader: How can this technology help manage an irrigation operation?

Trevor Brown: Uinta software is used as a field data management and reporting software. First, it makes it easy to map an irrigation as-built at a job site. Next, it makes it easy to share the project data between the field and the office. This is especially helpful if there are multiple crews and many jobs. Lastly, irrigation as-builts can be used to support reports or shared directly with customers.

Irrigation Leader: What kind of total solutions can you provide for an irrigator, and how do you continue support after installation?

Trevor Brown: We provide both the hardware and software from our factory headquarters. A common total solution includes one of our rugged handhelds, such as the Archer 4 Android; Uinta software with free irrigation templates; and one of our high-accuracy Geode GNSS receivers. We provide a solid warranty, and customers can even call the factory directly and talk to a real person.

Irrigation Leader: Would you explain how you encourage irrigators or producers who may be unfamiliar with this technology to integrate it into their operations?

Trevor Brown: At Juniper Systems, we recognize that our customers are not always tech experts, so we design our products to be easy to use. We need to make our products hassle free so that customers can save time and money. Converting from paper forms and maps to digital records may seem challenging, especially when integrating high-accuracy GPS. However, in most cases, our customers can be trained to map their as-built irrigation systems in minutes. Office users benefit by getting project information quickly for report purposes.

Irrigation Leader: What's next for Juniper Systems?

Trevor Brown: Our engineering and product teams are always coming out with new products and features. We always prioritize our development based on the feedback we receive from customers. On the Uinta software side, I expect we will continue to support additional file import and export formats, including additional options to integrate with CAD systems. We will also continue to update our irrigation templates for both commercial and agricultural applications based on customer feedback.

Irrigation Leader: What is your vision for the future?

Trevor Brown: Managing irrigation data between the office and field crews can be a big hassle. I envision irrigation and other water managers using Juniper Systems' products to better understand what is installed in any of their irrigation projects and where it is. If our customers can be more efficient at sharing as-builts with their customers, returning to sites for maintenance, and reporting, then they can save time and money. IL

Trevor Brown is the Uinta software product manager at Juniper Systems. For more on Juniper Systems, visit www.junipersys.com.

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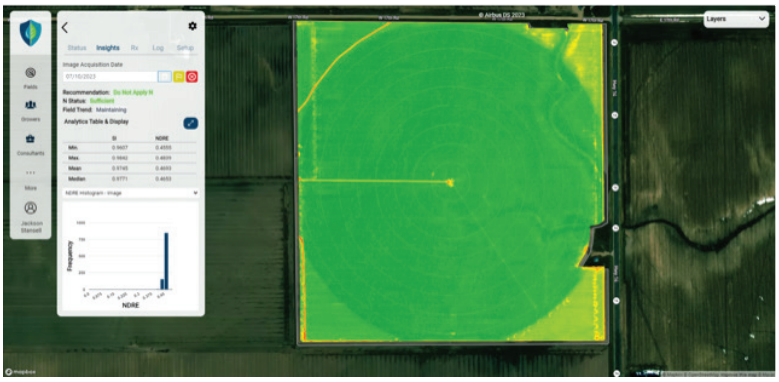

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Emily Meccage of Forage Genetics International: Alfalfa Gets a New Pair of Genes

FGI's pivot-irrigated plots in Garden City, Kansas, which include HarvXtra, Roundup Ready, and conventional alfalfa.

For 30 years, Forage Genetics International (FGI) has brought a host of biotech innovations to the forage industry. Two of its latest products, Roundup Ready alfalfa and HarvXtra alfalfa, are genetically modified crops designed respectively to withstand glyphosate application and produce less lignin, which makes forage more digestible for livestock. In this interview, Emily Meccage, FGI's senior manager of R&D, talks about the benefits of HarvXtra alfalfa and how FGI is helping growers adapt to a changing world.

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

Emily Meccage: I am the senior manager of R&D here at FGI. I have been here for about 4½ years in various roles, from lead agronomist to product and development manager. Before coming to FGI, I was the extension forage specialist at Montana State University for 5 years.

Irrigation Leader: Please introduce FGI.

Emily Meccage: FGI is the world's largest alfalfa genetics supplier. We are also an alfalfa marketing company, the only company in the world that produces traited alfalfa. Roundup Ready alfalfa and HarvXtra alfalfa are among our products. We sell them to retailers, distributors, and dealers through our internal brands and license them to other alfalfa marketing companies.

Irrigation Leader: How did you develop these types of alfalfa?

Emily Meccage: Our traited alfalfa, Roundup Ready and HarvXtra, are both biotech products that resulted from external collaborations with groups such as the Noble Research Center and Monsanto. We inserted a gene into these alfalfa varieties to get the trait that we were looking for—the ability to withstand glyphosate application in the case of Roundup Ready or a reduction in lignin production in the case of HarvXtra. We also have a conventional alfalfa breeding program.

Irrigation Leader: Would you tell us about the cultivation of alfalfa, especially in the United States?

Emily Meccage: Alfalfa has historically been an important crop for the agricultural industry. Traditionally, it has been the third-most-valuable crop in the United States. Last year, it was overtaken by wheat, so now the biggest crops in order of economic importance are corn, beans, wheat, and then alfalfa.

I am passionate about all the benefits that alfalfa has to offer. It is a high-quality forage for livestock. It is one of the

PHOTOS COURTESY OF FGI.

most efficient in terms of the amount of protein produced per acre. Its symbiosis with rhizobium in the soil allows it to fix nitrogen. It can take nitrogen from the atmosphere, and those rhizobia convert it into a form of nitrogen that plants can use. Once we rotate out of alfalfa, it provides what we call a *nitrogen credit*. That means that if we follow alfalfa with corn, we do not need to apply any synthetic nitrogen fertilizer for the first year. Research has found that even in the second year, that alfalfa crop can provide up to 50 percent of corn's nitrogen needs. Alfalfa also helps prevent soil erosion, especially on sloped surfaces. Because of its long taproot, it can access soil nutrients and soil moisture deep in the soil profile. On average, a healthy alfalfa plant in good soil can grow about 5 feet of roots per year—taproots have been found that extend as deep as 35 feet. Alfalfa is also an excellent nutrient scavenger. It is currently being used to help clean up watersheds in Minnesota and Wisconsin, where the water sources have high levels of nitrates and phosphates.

Alfalfa gets a bad rap when we talk about water use; people perceive it to be a water guzzler. The issue that I have with that characterization is that the facts are frequently taken out of context. In California, for example, alfalfa is demonized as the crop that takes all the water that is used for agriculture. But the reality is that alfalfa growers get multiple harvests per year, whereas crops such as corn or almonds produce only one, or in some cases two, harvests per year. So yes, we are applying a lot of water to those acres, but we are also getting a lot of product. By that measure, the water efficiency of alfalfa is comparable to that of many other crops.

Irrigation Leader: What benefits does HarvXtra alfalfa offer?

Emily Meccage: HarvXtra alfalfa is a biotech, reduced-lignin alfalfa. Lignin is an important component of the cell wall that helps confer rigidity to the plant, and plants accumulate lignin as they mature. But lignin is highly indigestible by livestock. We were able to create a more digestible plant by reducing the amount of lignin by around 15 percent. HarvXtra alfalfa also maintains higher quality as it matures. HarvXtra alfalfa that was harvested on a 33-day schedule has fiber digestibility and fiber components similar to that of conventional alfalfa harvested after 28 days, so it maintains its quality while producing a higher yield per acre. And because we grow alfalfa to feed livestock, higher-quality forage will potentially equate to a larger amount of animal products, such as milk or meat, per acre of forage.

These characteristics also give our growers more flexibility. For example, if they see a rainstorm coming when they would like to be harvesting, they can hold off and know that the quality will not decline significantly.

Irrigation Leader: How can that flexibility help farmers?

Emily Meccage: There are three ways you can use HarvXtra. The first is to maintain the same harvest schedule that you normally use, which would produce similar yields but deliver a higher quality. The second is to extend your harvest interval and move from 28 days to 33 days. That way, you improve your yield and maintain the quality that you would get from a conventional crop that was harvested a little earlier. The third option is to take advantage of the product's flexibility by varying the harvest schedule. Maybe you want to take that first harvest at the normal time but extend harvest 2, 3, or 4. Our customers have been very successful with that approach. Conversely, we have seen some growers eliminate an entire cutting. Our long-term research shows that reducing the number of cuttings increases the health of the plant. We can increase the overall yield over the lifespan of a stand by, in some cases, up to 30 percent.

FGI's Davis, California, testing location.

Irrigation Leader: What upshot does that have for water use?

Emily Meccage: I like to think about it in terms of efficiency. If we can increase the amount of digestible fiber per acre without applying more water, then obviously that is a win for us. The other thing to remember is that alfalfa can go dormant if water is scarce. In many areas in the West, people are applying a deficit irrigation strategy. They know that they do not have the full amount of water required for that entire season, so they water fully upfront for that first harvest. Then, they may shut off the water so that they are only applying 50 percent of that crop's water needs. Alfalfa will just go dormant until water is applied again, or the production will be significantly reduced. That is not something that can be done with most other crops. I recently joined a group in the Colorado River basin that is looking at using alfalfa to increase reservoir levels through that deficit irrigation strategy while layering the HarvXtra technology specifically to maximize overall production.

Irrigation Leader: Is HarvXtra something that anybody can use, or is it targeted to specific regions or users?

Emily Meccage: We see the biggest benefits of HarvXtra in the Midwest and the Northeast, where growers are generally looking for high-quality forage. In the West, growers use the flexibility of HarvXtra to allow the crop to stay in the field a little longer. Our HarvXtra products are stacked with our Roundup Ready trait, which confers another level of flexibility, especially for people in the West who need to manage fields across really large geographical areas.

Irrigation Leader: What expectations should growers have about the return on investment (ROI) they might see from HarvXtra?

Emily Meccage: HarvXtra Alfalfa can boost growers' ROI in three ways: improved quality, higher yield potential, or more flexibility. Growers can choose the best option for their situation by considering the market, their resources, their management practices, and the needs of their operation. The ROI varies depending on how the customer uses HarvXtra alfalfa on their operation. To calculate their own ROI opportunity with HarvXtra alfalfa, growers can use a tool on our website that allows them to customize based on their operation.

I like to remind people that alfalfa is a perennial crop. If you're in the Midwest, you are looking at profiting from that investment for 4–5 years. It's not just an annual investment, like corn or beans. So when you are thinking about that ROI and penciling things out, remember to include the fact that you will have it for multiple years; you do not have to till your fields every year.

Irrigation Leader: What other research is FGI working on?

Emily Meccage: We are researching, internally and with others, how we can mix alfalfa with other forage species and grow it in different cropping rotations and investigating how that works in a water scarce environment. We are actively reaching out to universities and government agencies to figure out how we can better use the scarce water resources in the West and how alfalfa can help. There is currently a lot of interest in those questions and a lot of resources going into answering them.

In the last couple of years, we have successfully improved the overall disease resistance of our product, which is paying off in areas where we are seeing a higher disease and soil pathogen load. Another issue we see with alfalfa is that it's being pushed onto ground that has very low or high pH, a lot of salts, and poor-quality irrigation water. Our R&D department has been focused on producing varieties that are going to work well in these areas.

We are also looking at the sustainability question by asking how alfalfa fits into these other cropping systems and how can we measure and quantify its benefits. We are working with one of our sister companies, TruTerra, to try to figure out how we can use alfalfa in conjunction with some of these other cropping technologies to maximize the overall on-farm efficiency and maximize the quality of the feedstuff that we are feeding to our livestock.

Irrigation Leader: What is your vision for the future?

Emily Meccage: Since coming to FGI, I have been focused on how to help our growers. How do we help farmers stay profitable and relevant? We know that things are going to look a lot different in 10 years. We know that water restrictions and other policy changes are coming. Alfalfa is being pushed into land where it has never been grown before, not necessarily in ideal situations. We are trying to engage with other parts of our industry to make sure that our growers are equipped to handle the changing climate and changing regulations. How do we make sure that we are equipping our growers with the tools that will enable them to survive in that changing environment? We are also engaging more with other groups and working with our congressional representatives to advocate for agriculture. We need to not only stay relevant but make sure that the general population understands what growers are up against and what we are trying to accomplish. IL

Emily Meccage is the senior manager of R&D at Forage Genetics International. For more on FGI, visit foragegenetics.com.

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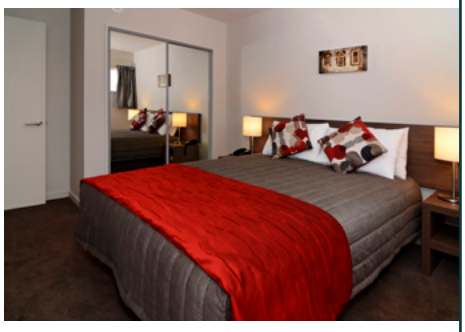

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Irrigation Leader

Upcoming Events

June 25–26 Tristate Tour and Meeting (Idaho, Oregon, Washington), Burley, ID

July 10–11 North Dakota Water Resource Districts Association and North Dakota Water Education Foundation, Joint Summer Water Meeting, Minot, ND

July 12–15 National Association of Counties, Annual Conference and Exposition, Tampa, FL

July 17–19 American Water Resources Association, Universities Council on Water Resources, and the National Institutes for Water Resources, Joint Water Resources Conference, St. Louis, MO

July 17–19 Groundwater Management District Association, Summer Conference, Omaha, NE

July 23–25 National Water Resources Association, Western Water Seminar, Kennewick, WA

July 25 Water Day at the North Dakota State Fair, Minot, ND

August 5–7 National Conference of State Legislatures, Legislative Summit, Louisville, KY

August 19–22 Colorado Water Congress, Summer Conference, Colorado Springs, CO

September 9–11 National Rural Water Association, WaterPro Conference, Savannah, GA

September 10–12 Husker Harvest Days, Grand Island, NE

September 11–12 Nevada Water Resources Association, Fall Symposium, Reno, NV

September 17–18 P3 Electrified Summit, San Diego, CA

September 20 Agribusiness and Water Council of Arizona, Annual Meeting and Water Conference, Phoenix, AZ

September 24–26 American Water Works Association, Watersmart Innovations, Las Vegas, NV

September 24–26 National Drilling Association Convention, Cleveland, OH

September 26–27 International Conference on Drip Irrigation and Agricultural Development, Vancouver, Canada

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

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