

TRANSCRIPT**INTERVIEWEE:** Robert Mace**INTERVIEWER:** David Todd**DATE:** July 28, 2021**LOCATION:** San Marcos, Texas, by phone**TRANSCRIBER:** Trint, David Todd**SOURCE MEDIA:** MP3 audio file**REEL:** 4062**FILE:**

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David Todd [00:00:02] All right. With your approval, Dr. Mace, we are planning on, introducing for this little project, recording an interview for research and educational work on behalf of a nonprofit group called the Conservation History Association of Texas, and for a book and a website for Texas A&M University Press. And lastly, for preservation and archive at the Briscoe Center for American History, which is at the University of Texas at Austin. And that's, that's our goal for this recording. But I wanted to make it clear that you have equal rights to use the recording, whatever purpose you might like. So, I did want to make sure that that's kind of what your understanding was, and that's all right with you.

Robert Mace [00:00:59] That's my understanding. And it is all right with me.

David Todd [00:01:02] Super. All right. Well, let's get started. I'll try to lay out when and where and what we're up to and then we'll launch into some questions that may help guide this interview.

David Todd [00:01:15] It is July 28th, 2021. It's a little after 2:00 o'clock in the afternoon. And my name is David Todd. I am representing the Conservation History Association of Texas. I'm located in Austin. We are conducting a remote interview with Robert Mace. He is a hydrologist and a professional geoscientist. He works as the executive director and chief water policy officer at the Meadows Center for Water and the Environment. He's also a professor of practice in the Department of Geology at Texas State University. This is his most recent stop on a long career. Earlier, he served at the Texas Water Development Board and the Bureau of Economic Geology at the University of Texas at Austin.

David Todd [00:02:08] I think our paths crossed with him because in 2020 he helped produce a report called "Bringing Back Comanche Springs, an Analysis of the History, Geology, Policy and Economics". And we thought that his research on Comanche Springs and the Edwards-Trinity Aquifer and water use in the Leon-Belding irrigation area would really help us understand the nature of the nearby Leon Springs and the pupfish that were found there, and then later at Diamond Y Springs.

David Todd [00:02:43] So with that, a little entree we thought might begin with some questions.

David Todd [00:02:52] I was hoping that you could tell us a little bit about your childhood and if there might have been some people who were a big influence in your interest in working in hydrology and water conservation and other aspects like that.

Robert Mace [00:03:10] Sure. So I was born in Chicago, but gosh, when I was two or three, my folks moved to northwestern Illinois, rural Illinois, outside of Cordova, very close to the Mississippi River. We could see the lights from the barges, although the river was still a distance away. It wasn't, it wasn't a stroll to get there. My, my dad was Homer Simpson. He worked in the control booth at the Cordova Nuclear Power Plant. And then my mom was a homemaker and then wound up going to school and becoming a nurse while, while me and my brothers were growing up.

Robert Mace [00:03:59] I, as a kid, and it's kind of similar to me today. Some things just don't change. But I had a lot of different interests, but I was particularly interested in rocks and fossils. So, so I did, you know, rock collection, fossil collection, identifying fossils, learning about geologic epochs and things like that. I was also good at math. And then as I was entering into my senior year of high school, you know, the question popped up, you know, what do I want to be when I grow up? And to be honest, I had absolutely no idea.

Robert Mace [00:04:40] And my mom, who was always great about encouraging me to, to go on to college because, you know, she and her father were the first of either side of the family to go to college and they had gotten two-year degrees. So I was going to be the first to go pursue a four-year degree. So she, she was always looking, and she goes, "Hey, look at this: geophysics, you know, has the rocks, it has the math and holy crap, look how much these people make!" And, of course, you know, geophysicists tend to get jobs in the oil field. And I'm like, "Rocks, math, lots of money. Sounds good to me. Sign me up."

Robert Mace [00:05:20] And so that led me to applying to the top geophysics schools in the country. And I did really good in school. And so I was able to get into, with a scholarship into the New Mexico Institute of Mining and Technology, which was quite a change geologically and geographically from rural northwestern Illinois. And so, so really, in terms of a person, you could argue it was my mom that that necessarily got me in the water, but got me down the path of, of geology when I went first went to college.

David Todd [00:06:08] Well, that's, that's interesting. It's funny, how there can be these just a handful of people that can influence your choices and send you off in one direction or another.

David Todd [00:06:25] You know, oftentimes, especially for, you know, well-read people like you, a book can also be a big influence. Was that the case with you, or maybe a series of books?

Robert Mace [00:06:41] Well, I guess I guess what really got me into water was, you know, getting out on my own and, and starting to think for myself, you know, that, that kind of age-old rite of passage when you, you know, leave from beneath the wings of your parents. And, and because my family didn't have a lot of money and I had a scholarship, I still had costs. I was always writing for, for scholarships.

Robert Mace [00:07:16] And, and so I wrote for this one kind of more general scholarship. And, and they asked, you know, you had to put down what, what degree are you pursuing? And then it asked the question that I hadn't really thought of before, which was, you know, "how is what you are going to do going to make the world a better place?"

Robert Mace [00:07:40] And, and that was that was kind of my existential moment with geophysics, because that got me thinking, OK, well I'm going to go work for an oil company. I'm going to go find oil. Nothing against people who, you know, work for oil companies or go

find oil. But, but that was a shaky moment for me because I'm like, you know, and I wrote up some pretty good stuff, but my heart wasn't in it. And that was when I started thinking that I needed to do something else: that I needed to look, look for something else rather than, you know, geophysics in the oil patch.

Robert Mace [00:08:19] The, the other thing that I had going with me was, I was a, I was a Goth in college, so I was into music, particularly electronic music and punk rock. And, and so I started a Goth band. And so I looked like Robert Smith from The Cure. So I had the, you know, the hair all over the place, the eyeliner, wore the black trench coats, in black all the time. And, and I was working in the, the cafeteria and I was telling my my co-worker who, he was a junior at the time I was a freshman, about, you know, this issue with geophysics I had and, and not wanting to like, be like him and work my whole college career in the cafeteria, because part of the reason I went to New Mexico Tech was it's a small school, about a thousand students, and the promise of kind of working with a professor or you know, working on a job that got real experience. And so we were chatting and he said, you know, there's a there's this lady over in the hydrology department that also has some really crazy hair. Her name was Olivia. And I was kind of secretly in love with her. She was a graduate student. And so my friend was like, you know, find out who her professor is and see if he has any jobs. And I'm like, "Yeah, that's really good advice."

Robert Mace [00:09:44] And so I find out who Olivia's professor is. And it was a fellow by the name of Daniel B. Stevens who in the hydrogeologic, southwestern United States subculture, you'll know who that is. He was a professor at the time at New Mexico Tech. And he was her advisor. And so I took a look and sure enough, he had a job posted to work with his graduate students. And so I applied and you know, I kind of had the thing. It's like, well, you know, I got invited in for an interview. And it's like, what do I do? You know, do I kind of tone down the Goth-ness? I'm like, No, this is me. I'm going in full Goth. And so I showed up. And, you know, Dan, as I remember it, you know, he had a little bit of a smirk on his face because that was a pretty interesting looking dude back then. And, and I got the job.

Robert Mace [00:10:32] And, and so I wound up at that point getting hands on experience with hydrology and, and, and then kind of learning that, you know, hey there are just some really cool people that, that work in this field. You know, this is, this is stuff, and a lot of it at that that time was, you know, how to clean up the environment, you know. What to do with mine tailings spills was one, one project I worked on. Another one was transports in sand dunes. And so it was at that point that I decided that hydrology was really, really for me. I didn't answer your question about the book because it kind of felt like, like I need to talk about how I got in the hydrology first.

David Todd [00:11:24] Absolutely. Yes!

Robert Mace [00:11:26] And the book comes a little later in the timeline. But, you know, it's like, I think I'm a little different than a lot of conservationists in that, you know, like conservationists will read, you know, a key, a key book. And it's just like, OK, this is it. And I've always been more on the science side of the ledger and, and perhaps taking a little time to kind of, you know, trip into, or fall into kind of my profession and what it is that I really wanted to do.

David Todd [00:12:02] Well, that's OK. And I was delighted to hear about the punk rock band.

Robert Mace [00:12:07] We were called The Echolalia, was the name of the band?

David Todd [00:12:11] All right. I'll have to look that up and rock out to it.

David Todd [00:12:19] Well, is there a book, though, that that was influential to you, maybe something unusual that, that isn't the standard fare, but still was persuasive or evocative for you?

Robert Mace [00:12:30] Yeah, there's, so when I finished, so, so on I wound up finishing my geophysics degree at New Mexico Tech and because hydrogeology is very math intensive, geophysics background worked really well. And of course, geophysics is not only used in the oil patch. You know, shallow geophysics is also used in the, in the groundwater world as well. But I hung out at New Mexico Tech and got a hydrology degree while I was there under a fellow by the name of John Wilson, who did a lot of dense non-aqueous phase liquid type research, again, contamination type work.

Robert Mace [00:13:19] And then and then from there, I got my first real job, in terms of being full-time, in Austin when I interviewed at the Bureau of Economic Geology and got a job working with Alan Dutton on the Super-Conducting Super Collider site, which at one point the United States was seeking to be the lead in particle physics by putting a particle accelerator, 54-mile circumference that, you know, hung like a halo around Waxahachie.

Robert Mace [00:13:55] And, and the Bureau is in charge of the geologic and hydrogeologic work. And so, so I was getting involved in groundwater modeling when I was up there. And one of the things you do with kind of evaluating hydrogeology, is you look for historic, you know, look for old water level measurements, you know, as old as you can get because it tells you how the aquifer has been responding to human interventions.

Robert Mace [00:14:26] And I found this great book by Robert Hill. He was working for the U.S. Geological Survey at the time called "Geography and Geology of the Black and Grand Prairies, Texas". It was published in 1901. And, and it was, it was, it was influential to me. In part, it was kind of where I got bit by the history bug, which ties into this Comanche Spring study. It was just amazing to me that, you know, wow, all these many years ago, this really, really good work was being done. It was also interesting to me that a lot of the more recent work that had been done up there had not looked as far back as I had in finding this, this old report, that had some critical information.

Robert Mace [00:15:15] And then also it was interesting in how Robert Hill was kind of in the middle of doing early hydrogeologist analysis of the Trinity Aquifer - pretty much Dallas / Fort Worth, Waco, down to Austin - and, and how he was directly relating to policy issues of the day in water supply.

Robert Mace [00:15:41] And I loved how friendly it read. It was written in an active tense rather than the passive tense that most scientists and engineers prefer. So, for example, you know, Nixon's famous comment, "mistakes were made", is passive tense. In other words, you know, you know, somebody made mistakes, but you don't know who made the mistakes. You know, versus the act tense, which is, "I made a mistake," or, or, you know, "My vice president made, made some mistakes". So I really appreciated that writing as well in that, that old Robert T. Hill. He's considered the kind of grandfather of Texas geology. In many ways, he's also one of the the first hydrogeologists in the in the country, if not the world.

David Todd [00:16:41] Well, that's a really interesting example, because it seems like it's a, it's a, both a person who was sort of at the headwaters, so to speak, of the hydrologic field, but also was giving you insight about how aquifers reacted and behaved very early on in their study and maybe before a lot of interventions were made, pumping, was done. So that's a really interesting choice. Thanks for providing that.

Robert Mace [00:17:17] I don't know that I recommend anybody read it because I think you have to be a hydrogeo-head to really enjoy it. But, but, but that, that, yeah, that, that, that's a book I often think about and, and, and go back to.

David Todd [00:17:35] Well, I don't want to skip any important chapters, but I know that after you were at the Bureau of Economic Geology, working on this Super-Conducting Supercollider project and I guess other efforts, you also worked at the Texas Water Development Board, which is, of course, a very important, influential agency in the state. And I was curious how you ended up there and what some of your responsibilities might have been.

David Todd [00:18:06] Sure. So, so I was at the Bureau for eight and a half years. I worked with Alan Dutton, and he was an awesome person to work with. He was like the right person at the right time of my career. He really taught me how to, how to be a scientist and, you know, and how to pay attention to the details. He's also an accomplished writer. He often called himself a failed editor. You know, if he wasn't himself a hydrogeologist, he would have been an editor. And so, so and then he also was involved in groundwater modeling, which was something that, that I wound up getting involved in when I first left college, my goal was to work outside. In fact, when I went into college, I'm like, "Yeah, I like being outside. I want to work outside". Well, after two Texas summers working outside, I'm like, "Yeah, I've had enough of this. I'm going to look into groundwater modeling". That was also informed when I was looking for a job. It was it was hard to find a job. And I probably interviewed for 13 jobs in Austin and every single one of them asked me if I knew how to model. And so, so I'm like, I'm like, you know, "What is this groundwater modeling thing?".

Robert Mace [00:19:26] And so while I was at the Bureau, I learned how to develop groundwater models. I had also started working on my Ph.D. and finished it while I was at the Bureau and it had a modeling component to it.

Robert Mace [00:19:39] And then, Senate Bill, Senate Bill 1 passed in 1997, which was a major water legislation, and probably the biggest water legislation that had passed since maybe '49 when the Water Development Board was created by the Legislature that introduced water planning. Senate Bill 1 kind of redesigned water planning with, inside of a top-down planning approach, a bottom-up approach.

Robert Mace [00:20:12] And the Hill Country stakeholders wanted their own regional water planning group. The state ultimately got divided into 16 water planning groups. The Hill Country wanted its own, but it got divided into three or four and they weren't happy about it. And they had some pretty good connections. And so the Water Development Board, as a consolation prize, said, "Well, what's your concern?" And their concern was groundwater - what was happening to Hill Country streams and springs. And they wanted a tool to assess that.

Robert Mace [00:20:43] So the Board said, "Well, we'll develop a groundwater model for you." And, and so I got brought on, first as a contractor from the, from the Bureau, to help the Board with this modeling project. And, and one thing that was neat about it, and different

about typical modeling projects, was there was a strong stakeholder component to it. Senate Bill 1 with this regional water planning, you know, really pushed water planning to stakeholders. And it fundamentally changed how water decisions are made in the state. And so, so it's pretty much, it's expected that stakeholders are involved in the development of plans, as well as the development of the science, something that's now known in academia as co-production.

Robert Mace [00:21:33] So Texas was ahead of its time and I really liked it. I really liked interacting with, with the people out in the field, hearing their perspectives and concerns. I liked communicating the science to them. And, and ultimately, due to several different things happening, when the opportunity came out for me, came up for me to jump from the Bureau to the Water Development Board, I went ahead and took it and wound up leading the state-wide program for developing groundwater models across the state.

Robert Mace [00:22:09] It was interesting. I got a call from my Ph.D. advisor, who is Jack Sharp, when, when word got out that I joined the Water Development Board, and he called me up and told me I had destroyed my career by doing that because the Water Development Board did not have a good reputation. Jack had, had graduated some students who had gone over to the Water Development Board and not had a, had a good experience. And I told him, I said, "Well, it's changed over here since Senate Bill 1. You know, a lot of, it got reorged, a lot of pep in the step. There's a lot of people over there." And a few years later, to Jack's credit, you know, he called me up and he goes, "No, you made the right decision."

Robert Mace [00:22:48] And while I was at the Board, you know, I, I like to say through the Peter Principle, but it was mostly I was kind of concerned who was going to be my boss. And so I wound up being the boss. So, so I wound up kind of moving up the ranks and honing management skills because I could write well and speak well, that that opened up doors for me to learn more and more about a broader array of topics. And by the time I retired from the state, I was at a vice president level, deputy executive administrator level, in charge of all the science programs, which included groundwater, surface water, water conservation, desalination for storage and recovery flood programs. And I loved that, because, because I love learning about all kinds of different things.

David Todd [00:23:47] Wow, well, that's, that's an interesting niche to be in. I mean, it's a, of course, you're a, at a state agency which has lots of political pressures on it, but then you are dealing with the scientific realities. And I guess there are collisions from time to time between the two and you're in the middle of it.

Robert Mace [00:24:09] Yes, that was the other thing was I really loved the, the science policy component. So it was satisfying to work on policy, relevant science another way, saying that it's like working on science that people care about. It's not a dig at basic science. You know, I did a little bit of that when I was at the Bureau, but I personally got a lot more satisfaction of doing the policy-relevant science. And like you alluded to, you know, sometimes I could get pretty heated and hot, and I liked, and I even like that, you know, like it's almost like a chess game of, of, you know, making moves and making sure that, that, you know, I could protect myself and my staff if somebody got upset by a scientific outcome. You know, how could we defend ourselves or, you know, who do we need to be talking to before this goes out, to make sure we have their buy-in? That was, that was all fun.

Robert Mace [00:25:09] And I was there for 18 years. I like to tell folks that that was not part of my five-year plan. You know, I told myself I would leave once I got bored. And I never got bored there because, as you know, water in Texas is not boring.

David Todd [00:25:27] Contact sport! Well, and then I gather that the next stop on your your career was at Texas State, at the Meadows Center for Water and the Environment. And how did you end up there and what, what are your responsibilities been there?

Robert Mace [00:25:49] So, so there are three things that happened, getting on four years ago. One was I turned 50. Two, was I was becoming eligible to retire from the state, which actually seemed crazy. And David Bowie died. And, and I'm being serious. You know, and it's not like I'm a huge David Bowie fan, but I don't know, it's just something about, you know, childhood music hero kicking the bucket. That combined with turning 50, and also like what, I'm eligible to retire? Just made me feel old and made me start thinking about, geeze, I'm getting to the, towards the end of my career. And, you know what do I want to do with myself? You know, do I want to stay at the Water Development Board? And, you know, I loved that job. And the people I'm working with, the Legislature, just really loved everything about it. But at the same time, I'd been there for 18 years and I thought, well, the comfortable way is just stay in this position.

Robert Mace [00:26:58] But you know, but I started thinking, like what, what would be better? And, and what I thought was, well, you know, if I could get an academic position that, that would be better. And what would be neat about that would be being able to kind of, you know, work on the things I want to work on. That's not absolutely true in academic settings. But if you can find the money or the support, you can, you can work on it.

Robert Mace [00:27:27] And after I came to that conclusion, the Board members had invited in the different universities to come in and brief them at a public Board meeting about their water programs. And Andy Sampson, who I'd known for a long time, you know, one of the most loveliest people you'll ever meet. He used to run Texas Parks and Wildlife Department and, and went from Parks and Wildlife Department to here at Texas State and ultimately, you know, forming the Meadows Center. He talked about what their future plans were, one of which was bringing on a professor in hydrogeology. And so I was like, huh! That's interesting. So I reached out to him and I said, you know, you mentioned blah, blah, blah, blah, blah. You know, I might be interested in that.

Robert Mace [00:28:15] And so that started a conversation that ultimately led to me coming to Texas State University and the Meadows Center. And as you heard at the top of the hour, you know, and then, and Andy was kind of looking for an heir apparent. So I became that heir apparent. And so, as you heard at the top of the hour, I'm now the executive director here.

David Todd [00:28:41] Neat. Well, I think you've sort of set the stage for lots of experiences, lots of skills, and those are all sort of pieces of your background that you directed towards Comanche Springs in the recent couple of years. And I was hoping that you could talk a little bit about this book, this report, that came out in 2020, "Bringing back Comanche Springs", which I think has been a dream and a hope for a lot of people who marveled at the Springs as they were in, I guess, the era prior to World War II. Maybe a place to start to talk about your studies out there and the report that you that you prepared is to just give us an idea of the hydrology of the area around and, and contributing to Comanche Springs and to Diamond Y Springs, which, of course, is the current habitat for this pupfish that we, we've been talking about.

Robert Mace [00:29:52] Sure. So, so as you, if you heard I'm a hydrogeologist. So I've got that geeky part of me - worked in Texas for 30 years on different hydrogeologic aspects and groundwater modeling. I have, have almost always had, I call it hydro history, but kind of an interest in the historical aspect of things. And then also just a fascination with springs. There is not typically not a whole lot to see when you talk about aquifers. But, but springs are one of those things to see. And, and they can be amazing, you know, like Barton Springs, for example. Or as I look out my window right now, San Marcos Springs. They can just, just be amazing things, that they, they themselves have an incredible amount of history wrapped around them.

Robert Mace [00:30:47] And, and so, you know, Comanche Springs is infamous in the kind of Texas water subculture for having gone dry due to pumping back in the 1950s. And, you know, I always try to drop in and look at these historical sites. And as my wife would say, just like, why are we looking at another dried-up spring? Because a lot of springs, particularly in west Texas, have been dried up. And so I would often, on the way to Big Bend, stop in and pay respects to Comanche Springs and then head on down.

Robert Mace [00:31:26] I then saw this, this is about three years ago. Somebody posts somewhere on a social media that the Springs are flowing. And I was like, what? It just so happened that we were going into spring break here at Texas State University, and we get that week off, and I'm like, I'm going to drive out to Fort Stockton to go see this with my own eyes. And I knew it was a glorious thing to see. I just can't explain how giddy I felt. You know, a spring that I had visited at least a dozen times before that was now flowing.

Robert Mace [00:32:08] Started kind of poking around on what's going on here. And, and, you know, it turned out that the Springs have been coming back during the winter months for, for a few years. And, you know, and there was, I was aware that there were battles between the Williams family and the groundwater district - legal battles, as well as legislative battles and different agreements and whatnot. And just kind of poked around and asked some questions.

Robert Mace [00:32:40] And then, and then I was I've been friends for a while with Sharlene Leurig, who's, she wouldn't call herself an economist, but she's familiar with economics and financial mechanisms for, for, for, you know, making, making deals and stuff. And she also, is, you know, feels a connection to Texas springs and then particularly Comanche Springs, because her dad worked for the newspaper there in Fort Stockton for, for a short while. And she has some crazy pictures of her dad, at Goodenough Springs, which is now under 40 feet or more of water of Lake Amistad.

Robert Mace [00:33:23] And so, you know, we started talking about a project to look at, you know, what would it take to bring these springs back, year-round? You know, didn't, didn't seem, didn't seem so hopeless - the fact that they were coming back in the winter months, you know, something had changed. And, and, and we thought, let's just, let's just see if we can raise some money to make this happen and sure enough, we were able to, to raise funding. Emily Warren, who is with the Meadows Center at the time and is now with the Mitchell Foundation, played a key role in getting that funding. And then and then in her current role at the Mitchell Foundation has continued to play a role. The Mitchell Foundation, has a big interest in Trans-Pecos and the Big Bend area in general.

Robert Mace [00:34:15] And so we put together a study and really it was just it's just the ask the question, you know, what would it take? You know, is this, is this even in the realm of possibility? You know, how close or how far are we? You know, people have talked about

trying to bring the Springs back in the past, but nobody had done what I would call a multi-disciplinary approach where, not only looking at the science, which had been done in the past, but looking at the policy, as well as the economics and then what the options, you know, financial options, are to bring it back.

Robert Mace [00:34:52] It's also interesting to me that despite the importance of Comanche Springs in the, in the story of groundwater in Texas, because you always hear about it, very little had been written about kind of what actually happened. And so for me, I was like, well, that'd be a cool thing to, to dive into. And, you know, with lots of stuff being online now. The local paper had just been scanned and posted online, by one of these newspaper companies. And so I knew I could kind of keyword search through, through those old documents. And so off we went to, to do this study.

David Todd [00:35:37] That is great. It's interesting how some of these little curiosities start to burrow into people's minds and you find partners who, who feel the same way, some who have skills, some who have money. And out of that comes this, this wonderful report.

David Todd [00:36:00] What, what did you learn about the hydrology of that area? Is that something that you could sort of lay out for, for a layperson?

Robert Mace [00:36:09] Certainly. So, so the, the Comanche Springs and Diamond Y Springs both issue and then Leon Springs (we'll talk about Leon Springs as well), all of them issued from the Edwards Trinity Plateau Aquifer, which is the official name of the aquifer bequeathed by the Texas Water Development Board. And really in Edwards-Trinity, it's like Edwards rocks sitting on top of Trinity rocks. Edwards tend to be limestones. Trinity rocks tend to be sandstones. The action is really up in the Edwards portion, kind of similar to here in central Texas, where Barton Springs flows out of the Edwards. San Marcos, Comal Springs flows out the Edwards aquifer.

Robert Mace [00:36:59] But the Plateau extends from kind of the western regions of the Hill Country, clear out past through Fort Stockton. And, and although it's a decent aquifer, it's not known to be prolific, say, say, like Barton Springs segment of the Edwards aquifer, or the San Antonio segment. However, locally, there in the Leon Springs area, there's a, it's called the Monument Draw Trough and the Belding Cohanosa Trough, which is due to faulting in the rocks. It's, it's created a trough where the rocks have basically slipped downward due to faults. And because it's all cracked up like that, that's allowed the limestone to be more easily dissolved, which is called "karst", which means you can get a lot of water through there, and you tend to see your massive springs like you see in the Edwards aquifer that feeds Barton Springs, which is also associated with the faults on the Balcones Fault Zone.

Robert Mace [00:38:20] But also, those faults are deep enough that they tap into deeper aquifers there, one of which is the Rustler Aquifer and another of which is the Capitán Reef Aquifer. And it connects to those aquifers so well that water from them is upwelling, flowing upwards into that, into that Trough. There's a similar trough over at St. Solomon's Springs in Balmorhea. So it's also why we have Balmorhea Springs, where we see Balmorhea Springs.

Robert Mace [00:38:57] This, this Trough is just like a, like a hog trough. It's a linear feature. And so that Trough pretty much goes north south through the Leon Springs / Belding area, and it connects up to the Glass Mountains, to the south. And so there's water coming in, recharge, coming in from the Glass Mountains and flowing through these fractures and faults in the Leon / Belding area. And then you have it merging with water upwelling from the

deeper aquifers, mixing, which also makes that, tends to make that water more aggressive for dissolving the limestone, and then coming out spectacularly (at the time) out of Leon Springs, which, which is also referred to as Leon Wells, in part because there were three separate springs with vertical shafts 30 to 40 feet deep.

Robert Mace [00:39:54] And then kind of went off of a fault towards, eight miles, towards Comanche and pops out at Comanche Springs. Diamond Y Springs is not part of that exact same flow system. But, but it is in that Trough and it's receiving more water from, from the deeper formations, believed to come from the Rustler Aquifer.

David Todd [00:40:25] I love the way you explain it, that, that there's, there's something sort of, I don't know, hidden and, and difficult to discover, in these, these troughs and upwelling areas and faulting zones. And you get this one area where it all becomes manifest, whether it's in Comanche Springs or Leon Springs.

David Todd [00:40:54] I guess though that that the Native Americans may not have understood the aquifers as you did, but, but did know that there were springs there that they could rely on. Can you talk a little bit about their early use of those spring waters to, to farm in this, I guess, semi-arid, almost desert land?

Robert Mace [00:41:16] Sure. There's been some excavations at what's called San Pedro Springs. They are a bit downstream from Comanche Springs. I believe that they're connected to Comanche Springs in the sense that Comanche Springs, when it flowed, prolifically, it flowed down the creek and then drained back into the ground and then came back up at several springs, the largest of which was San Pedro Springs. And there's been a dig, archeological dig, at San Pedro Springs, by a, by a Mr., actually, I think it's a Dr. Warnock, which is kind of cool because he's a local boy. If you're out in the area, there's like Warnock Road, he's, he's associated with that family. And he found evidence of mammoths, camels and sloths from the last ice age and also found evidence of early human occupation going back 20,000 years.

Robert Mace [00:42:26] So not, not surprising, at least to me. You know, people know where the springs are. I kind of imagine, you know, the first folks strolling into Texas and probably following animal trails because the animals know where the springs are, particularly if it's dry. And humans kind of following those trails to the springs, and then, and then ultimately the Europeans following those trails, and then, and then suddenly you have Interstate 35 following those trails too, that maybe perhaps were put into place by the mammoths, at least at least Native Americans.

Robert Mace [00:43:09] Springs were, back in those days, were like nature's 7-11 corner stores. You know, you could pop in for a drink, you could find something to eat because again, there's a lot of animals around that you could hunt. And then you could you could be on your way, down the road, probably heading toward the next spring so you could continue to get a drink.

Robert Mace [00:43:32] When the Europeans first, first arrived and it was the Spaniards for this, this part of the country, there are reports of Jumanos at Comanche Springs as well as San Solomon's Springs. And there were some observations that the Jumanos were irrigating with spring water at San Solomon's Springs. There wasn't, there isn't written documentation of that happening at Comanche Springs, but it doesn't take too much of a leap of faith to think that those Native Americans were also tapping into the spring water.

Robert Mace [00:44:09] The Jumanos were associated with the Pueblo Indians in New Mexico. And so they were kind of more, more farmers. You know, they weren't nomads. They, they put down roots with adobe buildings, which were also described built by Jumanos at Comanche Springs.

Robert Mace [00:44:36] When the, when the Europeans first arrived, the Apaches were already causing the Jumanos problems. All these different Native American tribes were in power struggles with each other. And so the Jumanos and the Apaches were already kind of at it. And, and the Jumanos were holding them off. But it was probably inevitable the Apaches were going to take them over. But once the Europeans arrived and the horses got away and the Apaches learned to ride horses, that was pretty much it for the Jumanos. From what I've read, they were pretty much absorbed into the Apaches. And then, of course, the Comanches came later and repaid the Apaches with a taste of their own medicine, pretty much driving the Apaches up to the mountains because the Comanches were more Plains Indians.

Robert Mace [00:45:34] But, you know, the Comanches had kind of their famous war trails that went down to Mexico and it passed through Comanche Springs. It's a rest area - get some water, you know, had some grasslands for, to feed your horses. And then you could continue on your way to the next spring as you were heading south into Mexico. Or after raiding season heading north back up onto the Staked Plains.

David Todd [00:46:05] I love this this idea of the, the role that Springs played in everything from camels and mammoths, to Jumanos to Apaches to Comanches, and then to to Westerners.

David Todd [00:46:21] Maybe you can bring us up to the, I think it's the latter part of the 19th century. And I think that in your report, you talk a little bit about how the state of Texas, the Legislature in the 1870s passes legislation to try to, I guess, leverage the water in the Fort Stockton area by granting land to people who are willing to, to build canals. Is that something you can talk about, just to help us give an idea of how the state was involved in developing these, these springs in the Fort Stockton area?

Robert Mace [00:47:03] Sure. So probably the first big event was Texas joining the Union and in that the subsequent war with, with Mexico and then the gold rush in California in 1849, the Forty-Niners and people suddenly, you know, wagon training, in a rush to get to California, but having to navigate through hostile Indian territory. And so the US government, concerned for the safety of those travelers, as well as putting in a deeper claim on the property that they had essentially conquered from Mexico (although the Texans would disagree, you know, that Texans had laid claim to it, but they really didn't have control of it), they built Fort Stockton, as well as a number of forts out along the way.

Robert Mace [00:48:08] And so, so that was kind of the start of, of, you know, the United States, you know, moving in and establishing control of the Springs. And of course, when you had control of the Springs, you, that was a power move as well, back in that day, because you controlled the watering hole. You can now interfere with the Comanches coming or going into Mexico because you now control the, the water source.

Robert Mace [00:48:41] So, so along with that, was kind of the first, and then once the fort was there and you had some U.S. troops to provide safety, well, that then was an invitation for non-military folks to, you know, look at forming a town or move out there and establish their

homestead. And so the first evidence that I find of, of a non-native American to irrigate out there was, was George Frazier, who, he did that over at Leon Springs in 1865. And then Cesaria Torres from San Antonio (and, of course, San Antonio has, had at that time tapped into their San Pedro Springs, as well as San Antonio Springs, for their acequias and irrigation and all that jazz, so he's quite familiar, I'm sure, with the technology, and was the first to tap in the Comanche Springs in 1868 and irrigated about one hundred acres for the fort by 1870.

Robert Mace [00:49:57] And a couple of dudes, Peter Gallagher and John James, you know, seeing the potential for irrigation in the area over a decade or so, wound up buying up the, the fort after it was abandoned because the Indian problem had been solved. And it was after the Civil War, bought Comanche Springs, bought San Pedro Springs, as well as land along Comanche Creek. And they did that through the 1870s. Cesario Torres hooked up with Bernardo Torres. It wasn't his brother. I'm forgetting what the familiar, familial connection was. And then also Feliz Garza bought land.

Robert Mace [00:50:46] And then they're the ones that built the first serious irrigation canal. They hand-dug - and I'm sure they, they had other people do it, not them - a nearly 3000-yard long ditch that was six feet wide, three feet deep, as well as a diversion dam to to irrigate to the east of Comanche Creek. One cool little side tidbit is if you know what you're looking for and you look at, say, Google Earth or turn on the satellite imagery and Google Maps, you can see the remnants of that ditch that they built, which is pretty amazing. And then I had the pleasure earlier this year to hike up Comanche Creek and I was able to find the remnants of their original diversion dam. Again, you know, gosh, it's getting on to one hundred and fifty years ago, which is pretty cool.

Robert Mace [00:51:47] Some other folks started coming in and digging ditches and by 1875, there were five main irrigation canals off of Comanche Creek. And the report has a has a cool and amazing map showing where the irrigation canals were at that time.

Robert Mace [00:52:04] Texas was land-rich because that's how Texas paid for the construction of the state capitol building was, you know, gave away a bunch of land for a company to build the Capitol building. And so they used, somewhat the way the United States used, land as an incentive to get people to settle or to do things. And so in 1875, the Legislature passed an incentive program where if you dug irrigation canals, you could get a land grant correlated to the length of your canal. So an easy way to get land was to go out and dig canals, irrigation canals. And so a number more canals were dug. There were irrigation companies that were created because they were looking for speculators to invest in irrigation projects and then, you know, and then get, get dams.

Robert Mace [00:53:03] But miles and miles of new irrigation ditches were built. Some of them, I would argue, quite crazy in terms of how far they went. And not only in Comanche Springs and Leon Springs, but also along the Pecos river as well. There, by 1913, pretty much the full flow of Comanche Springs was being used to irrigate about 6000 acres. And also by that time, Leon Springs was pretty much being captured to irrigate about 3000 acres.

David Todd [00:53:45] And that was the, the, the bulk of how the water was being used, this was for, I guess, raising, what would be, alfalfa and milo and corn and fruits, pecans maybe?

Robert Mace [00:54:02] I didn't you know, I didn't see pecans, but today they do pecans. But I didn't see in my research that they were growing pecans back, back at that time. But, but there was a lot of alfalfa that was, that was grown.

David Todd [00:54:19] OK, so I guess there were a lot of firms that were digging wells and digging canals, and I guess it was inevitable there would be some disputes. I understand that in 1921, the Pecos County Water Improvement Irrigation District number one was formed. And I think it'd be interesting to, to hear what you can tell us about the origins of that District and just the idea of having a water district, which I guess at the time was, was somewhat novel.

Robert Mace [00:55:02] So, so the Legislature started allowing for the creation of, of, under broad term, "water conservation districts", I want to say in 1917, the, the state constitution was amended to allow for the creation of these, these districts. Unfortunately, the history gets a bit hazy. There was, there was a handful of different irrigation companies, like privately-held irrigation companies by 1913. But it gets hazy in terms of what happened between 1913 and 1921. And I wasn't able to find a lot of information on the, the history of the Water Improvement Irrigation District. You know, I was able to find, you know, the bills filed in the Legislature, filed and passed in the Legislature to create the district, which is kind of why I know when it was created. But, but it's a little hazy in there.

Robert Mace [00:56:08] I do have some speculation if that's OK.

David Todd [00:56:10] Yeah, I'd love to hear it.

Robert Mace [00:56:12] There there's this relates to Leon Springs. You know, Leon Springs, there was activity over there, and you may be asking me about this in a bit. There was some activity over there. You know, they, they, there was a private company that came in pretty much bought up the entire works. And then they set about to make improvements. And one of their improvements was to lower the spring outlets, 10 and a half feet. So they dug these massive channels from a lower elevation to kind of cut through these springs. Now, if you're a lover of the Leon Springs pupfish, you'd be horrified because they weren't too concerned back in those days with environmental impacts, but that the way Springs work is, you know, if you can lower the outlet, you can get more water. More water will come out. It's hydraulics. And so, so they lowered, through digging, the spring orifices in these three springs that made up Leon Springs 10 and a half feet. And they were able to increase the flow a bit. They then followed up drilling five flowing artesian wells and they were able to increase the flow at Leon Springs from about 7000 gallons per minute to 12,000 gallons per minute.

Robert Mace [00:57:50] Nobody knew, or understood the hydrogeology out there at the time, but there was also a drop in flow at Comanche Springs. And this drilling of wells and increasing the flow at Leon Springs occurred between 1915 and 1919. And so my, my speculation is that the Water Improvement District was formed in response to the spring flow decreasing at Comanche Springs from 30,000 gallons per minute to 20,000 gallons per minute, which would have been a horrific drop, not as horrific for what was going to come in the '50s. But, you know, they lost a third of their flow over five years. And these systems were designed to pretty much use all the water that came out of the springs. And so they would have had to have changed their business operations or people would have gone out of out of business in response to that drop in spring flow at Comanche Springs.

Robert Mace [00:59:02] So my speculation is that was the trigger for consolidating everybody under kind of one authority created under the state constitution and then seeking financing to make improvements to the canal system, such as lining all the canals to increase efficiency and keep doing what they were doing with 6000 acres. So that's, that's my

speculation. I don't know if I'll ever get back to trying to track that down in more detail, but if not, somebody listening, perhaps can. That's a story that's still left to be told.

David Todd [00:59:46] I see. So, if I'm following you, the development of the Leon Springs and maybe lowering the orifice level, caused the Comanche Springs hydrology to shift and the flow that was being recognized at Comanche Springs to drop by about, what, do you say, a third.

Robert Mace [01:00:10] A third, yes.

David Todd [01:00:11] And so this course, I guess, disputes between people who were farming and pumping, moving water in the Leon area with those who were just a few miles away in the Comanche Springs area. Is that, do you think there was some kind of division there, some kind of disputes?

Robert Mace [01:00:29] I, you know, it doesn't it doesn't appear that there were any disputes. It's, you know, this, these observations I'm sharing with you, or what I was able to piece together, poking through kind of old newspaper accounts of what happened at Leon Springs (because there's not, not very much in the literature about Leon Springs). There's much more written about Comanche Springs. You know and I think, I get the sense that, you know, the folks, I don't think anybody realized the two systems were connected, although that was perhaps a clue. But they're, you know, eight miles apart from each other. So I don't think they realized that they were connected. And so I don't think the folks at, I think the folks in Comanche Springs were like, well, the Springs just suddenly dropped over the last five years and we don't know why. And nobody made that that connection. And so really, it's, it's this report that that we did is the first time someone has figured out that story. And that's digging through newspaper accounts, old USGS reports and looking at the data.

David Todd [01:01:49] Well, this might be a good opportunity to talk about this question of, of the, the ensuing drop in the, the flows at Comanche Springs, which I'm sort of using as a rough facsimile for Leon Springs problems, although there are certainly differences. But my understanding is that Comanche Springs was registering 64 CFS in 1904, drops to 45 in 1919, drops below 10 in 1951, and then goes dry for part of the year in 1955. And the thing that interests me, I mean, is why? And you sort of mentioned that I guess that, this, the hydrology just wasn't well understand. I think there's a court case that calls it "occult". You know, the old Houston case.

Robert Mace [01:02:45] Yes.

David Todd [01:02:46] You know, like there was something "witchy" going on - that some people thought that there was the diversions, the pumpage, and some people thought the climate was shifting. Some people might have thought that there were seismic problems, seismic shifts. What do you think was kind of the speculation at the time about what might have been going on with these big declines?

Robert Mace [01:03:09] So, so I don't, I wasn't able to find any speculation about why the flows at Comanche Springs dropped the way they did between 1915 and 1921. It's, you know, one thing that's interesting about newspapers from 100 years ago, and I certainly saw this in the Fort Stockton Pioneer, is that if it was good news, it was on the front page. If it was bad news, it didn't get written about or you had to look for other clues for what was really going on. And, and even up through that time, you know, the, there was land boosterism going on. So

they were still selling, trying to sell land to, to investors or farmers seeking to move out of the Midwest, for whatever reason, out there. And so the paper was very much trumpeting good news. And so, so it's not surprising that I don't find anything about the flows decreasing there.

Robert Mace [01:04:21] Subsequently, there was several academic papers that suggested that, that what, what we were seeing was a decrease in flow due to, you know, big regional impacts from the system still recovering from the last ice age. So the last ice age was wetter than normal. You know, the land look very different down here. We didn't, we didn't have the ice down here, but, but it was definitely wetter and cooler and there was more recharge. And other parts of the world have shown that, you know, some of those systems are still responding to that wetter system from 15, 30 thousand years ago. So that was that was one of the hypotheses that were put out there.

Robert Mace [01:05:22] But this work that we just did thoroughly disproves that because we can correlate what happened at Comanche Springs directly to what happened at Leon Springs and explain why there's there was this drop from 65 CFS around 1900, you know, to, to 45.

Robert Mace [01:05:44] And then, and then we get to the '50s which, which we'll talk about now. So, so then you get to the '50s (really it started in the late '40s) when some folks started putting wells out in the Leon-Belding area. There had been a well drilled back in, gosh, around 1920, probably inspired by the success of the wells drilled around Leon Springs that show that you could get really good wells. And it's, and this is a well, that got drilled near present day Belding. If you can get on Google and you can look and see where Belding is - not exactly a metropolis. But, but there is a dot on the map for Belding. And it came in at a thousand gallons per minute.

Robert Mace [01:06:34] However, unlike the wells at Leon Springs, which flowed through artesian pressures, they flowed on their own, this well, you had to pump to get a thousand gallons a minute. And that proved to be too expensive. And so the company that got put together to try and sell property around Belding went bankrupt. And, but some locals I'm sure they made note that, gosh, you know, they drilled a well and it produced a bunch of water. So by the late '40s, technology had come along enough with downhole centripetal pumps that it was affordable to pump water for irrigating. And so you started seeing some people wildcatting some wells out there, coming in really good. And then, you know, then it's like, well, gosh, I'm going to drill a well out there, too. I'm going to buy some land, drill a well out there, too.

Robert Mace [01:07:29] And folks that relied on the Springs started noticing the spring flows going down, then the pumping, I'm sorry, the well drilling and the pumping really took off in the early '50s and it became real clear to the spring irrigators that what was going on in the Leon-Belding area had a direct relationship to Comanche Springs.

Robert Mace [01:07:59] Now, one of the arguments has been there was a drought going on. And so, and there was. So it was the infamous 1950s drought. And so part of the thought is, well, the springs were going to go down anyways because of the drought. It's you know, that's possible. But, but I don't think I would have gone down that much. In fact, you know, between 1920 and the late '40s, you could count on 45 cubic feet per second average flow out of that spring coming out every year. And it was pretty consistent, indicating a large regional source of water. Even through the Dust Bowl, it was consistent at about 45 cubic feet per second.

Robert Mace [01:08:55] So it, to me, it's that it doesn't appear that the drought would have done that. And once the drought of the '50s was over, the springs didn't come back. They remained dry until the '80s when, when they came back for the first time during an off-, off-season, like during the winter months when they weren't irrigating as much. So that, that throws out the drought hypothesis.

Robert Mace [01:09:24] The other hypothesis was there was an earthquake that changed the plumbing and cut off Comanche Springs from the Leon-Belding area. Certainly possible. You know, there have, there's evidence of earthquakes affecting other springs, particularly geysers. And so that's, that's certainly possible. But the, the correlation between pumping and whether or not Comanche Springs flows or not, is the same now as it was back when they were flowing, suggesting that there wasn't a change in plumbing.

Robert Mace [01:10:09] So everything points to the, the pumping being the cause for the springs drying up.

David Todd [01:10:18] Well, I guess that was the surmise by a lot of the city fathers and mothers who, I understand directed the Improvement District to file suit in 1952 against Clayton Williams and some of the other irrigators out there for overpumping: that that was the cause of the decline of Comanche Springs. Is that the basis of that suit?

Robert Mace [01:10:52] Yeah, that's, that's the basis of the suit. You know, if you go look in the report and you look at the, the spring flow over time and you know, I think as the springs were starting to go down, people were debating, was it the drought? You know, maybe it's a drought. But once the spring, once the spring flows really came down in the early '50s, and, and people could see the correlation between the number of wells and pumping versus what was happening to Comanche Springs, it became, it became real clear.

Robert Mace [01:11:25] It didn't seem, you know, in the court case, the hydrogeology was not was not an issue. However, it might not have been an issue because the hydrogeology could have been perceived by the courts as a moot point. And that, you know, with the Rule of Capture, and you referred to the, the East case from 1904, that, that established the rule of capture for groundwater in Texas, under the Rule of Capture, groundwater pumpers can dry up a spring with no legal recourse to folks that rely on that spring for water supply.

David Todd [01:12:13] So the, I guess there wasn't really a factual question there. It was just a legal one - that people really weren't disputing whether there were some hydrologic connection between the Clayton Williams irrigators, and the other people in that industry, and the, the decline in the springs. It was just here's the, the Rule of Capture, and what it provides, and that there just wasn't liability there, even if you could have shown that there was some kind of factual connection.

Robert Mace [01:12:46] Right. You know, and there's, there's always the appropriate lawyer weasel words thrown in there that, you know, even if my client, you know, pumping caused the springs to dry, you know, it doesn't matter because we operate under the Rule of Capture.

David Todd [01:13:08] Well, and I gather it's interesting that the Williams family and others have been involved in water dispute since the '50s. I think in the late 1990s and even into, I think 2010, there were proposals to pump the aquifer out there. And then, and then I think nowadays it seems like the proposal is not so much for agricultural development out there, but more for maybe fracking or for exporting the water to municipalities like Midland and

Odessa, san Angelo and Abilene, and so on. Did you look much at that, some of those, you know, disputes about the water out there?

Robert Mace [01:13:53] I did. The first point I want to make is kind of back on the original lawsuit is one, one interesting part of kind of digging through the history of that lawsuit and the timing of things. And again, I couldn't find where someone had done that before. The Williams family, you know, Clayton Williams, was not the first to drill, he wasn't the second, he wasn't the third. And I'm not sure when, when he became, he and his brother, became active out there. But Clayton Williams, senior, was prominent in the community. He was politically active. I want to say he was on commissioners' courts. He was interested in running for judge, county judge. And so when the lawsuit came out, and he wasn't even the biggest pumper out there, not even close. When the lawsuit came out, it had three dozen people listed on it that were operating wells in the Leon-Belding area. They're all listed alphabetically, but they pull out Clayton Williams and stuck him at the top. My speculation is that they did that because he was the most prominent, prominent person and probably, you know, because of his prominence, became the de facto leadership for the groundwater pumpers.

Robert Mace [01:15:22] And quite frankly, it set up an awful situation. In Clayton Williams' biography, you know, he notes that he had no idea that pumping out there would have dried up Comanche Springs. And, and I believe him because, you know, when you're out there, like when I'm out there as a hydrogeologist and if Leon Springs was still flowing, comanche Springs was still flowing, not knowing anything else, I wouldn't have thought pumping over by Leon Springs would have dried up Comanche Springs eight miles away.

Robert Mace [01:15:55] So, so it's, so it was an awful situation because now you had a bunch of landowners who had invested a bunch of money in wells and irrigation canals and fields and all this jazz, and you had them drying up a spring where a bunch of, over 100, families were relying on the spring flow for their livelihoods down from the spring.

Robert Mace [01:16:23] So then between winning the case in the, the mid to late '50s and more recent times, you know, ownership has consolidated somewhat. And the Williams family, through Fort Stockton Holdings, are the primary holder of ground water rights and, and property out there. And so they may not have been prominent back when the case first started, but they're certainly prominent, prominent today.

Robert Mace [01:16:53] A groundwater district was formed, I'm forgetting exactly when, I want to say sometime in the '90s and, and the groundwater district is a way to supersede the Rule of Capture. And so they went through a historic use permitting exercise where they kind of look at what they think everybody, you know what the maximum amount of water that they've used in the past and give them a permit. And it turns out that, that those permits are about twice as much as what's currently being pumped. And so that creates an opportunity to maybe sell the, the other half of those permits, or use those other half of the permits you have for something else. And so the Williams family then sought for the ability to export the other half of their permits. And so through legal, I want to say, it was more than 10 years of legal wrangling, you know, threats of legislative action and all this jazz, the district finally agreed to give the Williams family an export permit.

Robert Mace [01:18:06] But part of that agreement turned that permit into the most junior groundwater right that's out there. And what that means is that if, if the aquifer starts getting over-pumped, that most junior right is going to be the one that gets cut first. And so the export permit will be on the chopping block first.

Robert Mace [01:18:37] As we were writing up that report that we've been talking about today, I want to say it was probably two weeks out from, from, you know, blowing on it to blow the ink dry, news hit that the Williams family had signed a export deal with Midland, San Angelo and Abilene, to, to where they're going to come in and drill their own oil field. So they're not actually replacing agriculture. The Williams family will still have their agricultural use. This will just be additional use. Build a pipeline and take that water up to Midland. And then Midland would then release some, kind of do a swap of surface water rights with San Angelo and Abilene, in order for them to meet future demands for water, particularly under drought.

Robert Mace [01:19:37] One thing we haven't mentioned is this water isn't really good quality, that, that water that's coming up from deeper down is, has, it's not fresh water. It's brackish groundwater. And so it has to be de-salted. And so Midland is going to have to build a desalination plant. Fort Stockton has wells out in Leon-Belding area, and they also have a desalination plant to de-salt that water.

David Todd [01:20:07] Boy, it is, it's so interesting, these, these springs, which, you know, by acreage, I guess, you know, where the water actually appears, are pretty small, you know. I mean, a lot of flow, I guess historically, but pretty small in in size. And yet their impact in that whole Trans-Pecos region, just huge through the, the water they can provide.

David Todd [01:20:40] You mentioned something about differences between the water rights that the Williams have and their actual pumping. And one of the things that really caught my eye is when you started to look at this issue, you started to realize that the actual pumping and the modeled pumping were very distinct. And I was curious what sort of ramifications flow out from that distinction.

Robert Mace [01:21:09] Sure. So, so I went to when I went into this project, I made a poor assumption, which was the existing groundwater model had monthly stress periods, which is groundwater modeler talk for, you know, simulating what's happening in the aquifer every month. But it doesn't. It has annual stress periods. So it's giving you an answer averaged for the year. And, you know, we've been talking about, you know, the main driver for this project was to look at what it would take to bring the springs back. And one of the things I had to do is figure out how much flow we would need to come out. And that we were going to determine based on health and human safety, to bring back the original natural pool. There would be other benefits that come with that, you know, ecological benefits, species benefits and things like that. But like what's the minimum flow? And came up with 10 cubic feet per second. And so I was hoping to use the model to then figure out how much we'd have to reduce pumping to achieve that minimum flow. But the model was off the table, so I had to come up with Plan B.

Robert Mace [01:22:31] And so Plan B fit in nicely with my interest in the history, in that I carefully went through all these old historical reports. There were like two reports done at the time the springs were drying up, by the state and by the U.S. Geological Survey. I pulled out their estimates of pumping. There's the groundwater model that we've been talking about. U.S. Geological Survey also generated a model. The model the District's using now is actually developed by consultants to Fort Stockton Holdings, i.e., the Williams family. And the Groundwater District's consultant looked at the USGS model and the Williams model and decided that the Williams model was the better model for, for what the District's needs were. And I actually agree with that decision. It's the better model.

Robert Mace [01:23:24] But I pulled out the pumping from that model as well as the U.S. Geological Survey model. And then also, although most aquifers don't work this way, I generated a simple water budget, almost like a checking account. You know, how much water is coming in, how much water is going out? I, kind of, I know from the research what the recharge is based on the spring flow. And then I also knew that the recharge with the water flowing into the aquifer is pretty consistent. And so any perturbation to spring flow then would be correlated to pumping. And then I also pulled the more recent numbers from the Groundwater Conservation District. And they've been doing metering and reported use. And so over the last 10, 15 years, which is probably the best data.

Robert Mace [01:24:13] What I found, when I plotted all this data up, was that the pumping in the groundwater model back during that critical part of the 1950s where the springs went dry has about twice as much pumping in it than it should have, compared to the spring flow. So, for example, it's real clear now, both from kind of my data analysis and the District's data, that about 50,000 acre feet per year pumping is, you know, if the pumping is greater than that, the Springs don't come back at all during the year. But once it falls below that, the Springs come back. When you go back to the 1950s, you can see that same relationship. But the groundwater model shows 100,000 feet of groundwater pumping and the Springs are still flowing, which is, I would argue, venomously, that that's just simply not possible.

Robert Mace [01:25:16] That's problematic because, without getting into too many details, you know, models are non-unique. So you can come up with different solutions to the same problem and you wind up kind of twisting some other knobs to make everything work. And so you can make that model work with 100,000 acre feet per year pumping. But it's not going to be accurate. It's going to show that you can pump a 100,000 acre feet rather than the 50 that it should be showing. And so that has consequences for management of the aquifer system going forward.

David Todd [01:25:58] So I guess what you're saying is that the models might suggest that that 100,000 acre feet of pumpage is sustainable, but the, the, the true data probably would estimate the sustainable level, maybe at 50,000 or at least that's the cusp where the Springs start flowing again. And is that what you're saying.

Robert Mace [01:26:24] Yeah, I think the sustainable amount of pumping is probably higher than 50, but I don't think it's at 100. Kind of the issue with my method is that I go blind once the springs go dry. And I do hope to do some additional work to look at water levels historically, out in Leon-Belding area and see if I can fill in the blank of what, what pumping actually looks like.

Robert Mace [01:26:56] The Williams family commissioned a study looking at crops and things like that from back in the day to come up with those estimates. But like another thing I learned from my historical review, is that shortly after the lawsuit was resolved against the spring irrigators, a bunch more wells went in and folks started having issues producing water out there. In other words, they were, they were getting beyond the sustainable yield of the system. So, so I think I think you can pump more than 50, but I don't think you can pump 100 sustainably.

David Todd [01:27:45] And what do you think the source of the of the, I don't know, misunderstanding of, of the pumpage levels might have been. Why do people think that there were 100,000 acre feet of water being pumped back in the '50s when it was probably, if not 50, it was much less than that. I mean, that seems more than a rounding error.

Robert Mace [01:28:10] Ultimately, I'm unsure. But interestingly, as I was getting ready for this interview, I was making some calculations, too, which I didn't use, by the way, calculations from cubic feet per second to gallons per minute, thinking that people listening would have a better sense for gallons per minute rather than cubic feet per second. And so I converting everything to gallons per minute. And I made that calculation for the 100,000 acre feet per year. And it's it actually comes in under the total spring flow of the sixty five cubic feet per second, which, which I thought was an interesting result. And I'm thinking that may be the source of the issue.

Robert Mace [01:29:11] Things might get too difficult here. But I think the the folks looking at the, trying to make estimates of how much was used for irrigation, were looking at things averaged over the whole year, which isn't necessarily the right way to do it, because pumping gets focused during the growing season rather than being uniform over the entire year. So at some point I'm going to have to look more into but, but, but I was just like, "Wow, that's interesting."

David Todd [01:29:44] Well, that's interesting. So, so if I'm following you, they might have looked at the data they had for, let's say, April or May when folks were releasing irrigation water to get their crops started. And they just extrapolated that over the other 12 months of the year, not realizing that that's going to give them a result on an annual basis that twice or, you know, it's a lot more than what it would be if you included the low irrigation levels of, say, January and February or, you know, October and November.

Robert Mace [01:30:20] Yep, yep.

David Todd [01:30:22] OK.

Robert Mace [01:30:22] So I can thank you for that.

David Todd [01:30:26] No, no, no, I, I. Thanks, thanks for helping me translate. I'm just trying to understand what you've been working on for so many years.

David Todd [01:30:40] Well, let's, let's talk a little bit about how you get to this goal that you and Sharlene Leurig have been working on. I mean, how do you get flows down to some more manageable level where the, the Springs might return to some appreciable level?

Robert Mace [01:31:01] So great, great question. And that's, that's where the rubber meets the road. And, you know, the good news is, is we think there's a way to get there. Bad news is, is it ain't going to be easy. You know, we feel like we have the science at this point to kind of understand how much pumping has to be reduced, but it is pretty substantial. So I mentioned earlier that, and I'm going to forget the numbers, but you know, I have mentioned there's a certain amount that is permitted, and what is actually being pumped is about half of that permitted amount. And we need to lower the actual pumping by half to bring spring flow back with a minimum flow of 10 cubic feet per second. So that's reducing permits 75 percent.

Robert Mace [01:32:01] However, you know, there's part of me that thinks the permitting was, was, that the system was over-permitted, because I don't know that the system can produce that amount sustainably, you know, with the full permitted amount. But that's another story.

Robert Mace [01:32:19] So, so now we have kind of this target of what pumping has to be to bring back a minimum of 10 cfs at Comanche Springs. And along with that, we would see flow come back at Leon Springs as well.

Robert Mace [01:32:41] So then the question is, well, what do we need to do that? Well, one of the key things we need to do is kind of change how the District permits. And, you know, if the, if someone out in that area hears me say that they're going to freak out, but don't freak out. The, you know, there needs to be a cap on permits, so, so the District right now, the way it permits is anybody that walks in the door, they'll get a permit. Now they've got to have some land out there, but they'll get a permit.

Robert Mace [01:33:17] And we can't buy down permits if, you know, we buy a permit and then someone can walk in the door after you leave the District's office and apply and get a permit for the water you just bought. And so I think that there can be a correlative rights approach applied to this particular area that would honor everybody's existing permits and therefore avoid a takings lawsuit by telling somebody who has property you can't get a permit and then put a cap there.

Robert Mace [01:33:53] So once the cap's there, then it's how do you reduce the pumping or reduce the potential for pumping? And you know that, that comes from reducing permits and reducing pumping. The most obvious way to do that is you buy out existing permits and so you find, find folks that are willing to sell their excess or even sell out completely. You know, from what, from what even Clayton Williams, Jr. has been quoted in the newspaper saying is that it's hard to make a living out there farming. You know, it's expensive to pump that water. The water is not real good quality.

Robert Mace [01:34:41] You know, there's still growing a lot of alfalfa. But you mentioned earlier pecans. There's a lot of pecan trees out there. And so, you know, catching somebody that's looking to get out of the business might be a way to do that. Sharlene is also looking at leasing: that maybe you, you lease the water and then just don't use it. Yeah, that could be an option.

Robert Mace [01:35:03] Another option is to, say, finance farmers or other users to go to the deeper aquifer like the, the Rustler or the Capitán Reef Aquifer, which is in the area, and, and then come up with, you know, money to, hey, we'll pay for a deeper well for you down there if you give up this right to, to the Edwards Trinity in the Leon-Belding area. So that's, that's another potential way. Although we do have to worry about "robbing Peter to pay Paul". I mentioned that there's water coming up from the Rustler. We'd have to make sure that pumping in the Rustler wasn't intercepting water that would come from the Rustler up into, into the aquifer. That, that warrants additional study, although my hypothesis is that I think there's enough water down there that we don't have to worry about it.

Robert Mace [01:36:02] Another thing that could be done is like an aquifer storage and recovery, where maybe you ... let me step back. When I talk about a minimum of 10 cubic feet per second at Comanche Springs, that means the peak flow, say, in December is about 30 cubic feet per second, because, you know, you lift all boats when you try to lift up the minimum. And so what could happen there is there could be a project set up where the flows above 10 cubic feet per second are pumped and injected into one of the deeper formations and then pulled out later for use. And again, it'd be coming up with a financing mechanism to make, make all that happen to where people moving from Edwards pumping to say, an ASR-type project, have their costs covered to do just that.

Robert Mace [01:37:02] Seems like I'm forgetting one.

David Todd [01:37:07] Was there an idea of switching to other crops that might not require as much water?

Robert Mace [01:37:14] Yeah, there's, there's, there's that as well. There's, there's also, you know, pecans are a potential issue because it takes a while to get pecans going. Yeah, so there's a lot of sunk cost in pecans. But, but that's, if you catch him at the end of a life cycle, maybe you make, you can make that happen.

Robert Mace [01:37:38] Or, I didn't mention it yet, but just simply buying the farm. So you've bought the farm along with the water rights and then choosing a use that doesn't interfere with maintaining year round flow at Comanche Springs.

David Todd [01:37:59] This is really interesting. I guess a lot of these things require admission that there's a cap and then maybe...

Robert Mace [01:38:11] Yeah.

David Todd [01:38:14] Can you just go back to something. You're talking about correlative rights. And when you say that, what I'm thinking is that, say, there's a hundred gallons of available water in that Leon-Belding irrigation area and that you would look at the historic use of the 25 farmers in that area and you would give each some sort of a percentage right, based on their historic use of that hundred gallons. Is that what you mean?

Robert Mace [01:38:50] No, what we would do is look at what has already been permitted and then essentially reverse engineer a methodology to where those permits are honored. And then folks who haven't exercised their permits are then given, given an allocation. So, so theoretically, at the end of the day, once, once we do this, the, the universe of, of total permit volume could go up from where it is today, but at least it would put a cap on it. And it would give every landowner a right to use the water. And the, the right to have to use the water will be informed by the local hydrogeology. And so areas that, that historically have, have been producing the whole time would get the largest permits.

Robert Mace [01:39:55] But then it's the flanks. So, like, if you go look at Google Earth Leon-Belding area, particularly on the east side, you can see abandoned farms that were, I believe, abandoned back in the '60s when the water levels in the aquifer were drawn too low and they couldn't produce enough water anymore. And they're in a part of that Trough that it isn't as deep as the stuff in the center. As we buy down permits and the water levels come back up. Well, that's going to become more viable. And so, so they would get a lower amount of allocation, if you will, than folks that are in the sweet spots that get a bunch.

Robert Mace [01:40:40] I think the only way it works is if everybody's permits are honored, whatever they have now are honored, because as soon as you take someone's permit back then you get, you're interfering with private property rights and that could turn into a takings lawsuit.

David Todd [01:40:57] OK, OK, so I guess if you're doing these correlative rights, they are not based on historic use, they're more based on permits, what their rights were.

Robert Mace [01:41:09] Yeah. So the, so the correlative rate would be correlated to surface acreage with a geologic component, but also factoring in what they've currently been permitted.

David Todd [01:41:24] OK.

Robert Mace [01:41:24] If that makes sense.

David Todd [01:41:27] You know, it's, it's, it's, I'm seeing a glimmer of this. And thank you for being so clear about it.

David Todd [01:41:37] So I was wondering if, if the mechanism for making these, these changes would be the, the local groundwater district or the state or some new entity. What do you, what are you thinking?

Robert Mace [01:41:54] It would, it would have to be the groundwater district to do it. The, you know, the state could do it. The Legislature could do it. But, but this is also something that could be doable by the District. And so I should preface all this stuff that one of the baseline considerations that Sharlene and I have with this project is, is if the locals don't want it, if individual landowners don't want it, we're not forcing this on anybody. We're just identifying the possibilities and the pathways that if the people and the landowners want to take it, to bring those springs back, they can.

Robert Mace [01:42:43] So what I was just describing to you on maybe going to a correlative rights process, that would be me doing a little study on, hey, here's how you could cap permitting. I would be doing this working with a water lawyer, but, but (because I'm not a lawyer) and then presenting that to the District is here's you know, if you want to do this, then here's a way that you can get there. And then at that point, they would vote or decide or work with stakeholders if they want to do that. I feel hopeful about that because the, it's, it protects everybody's current rights.

Robert Mace [01:43:29] And there's still a potential threat to existing rights for somebody to come in and, and really pump the heck out of that aquifer and cause a lot of problems for everybody else. And so I think, I think it could be an easy sell, certainly to the existing permit holders to, you know, engineer this cap. And then once it gets engineered, then it's a matter of, you know, chipping away at permits, kind of letting Sharlene work her magic on, on acquiring permits over time.

David Todd [01:44:08] OK.

Robert Mace [01:44:09] It's kind of a nifty way of like using the market, you know, to, using the market, willing seller, willing buyer, you know, if everybody's on board and then going forward and making it happen.

David Todd [01:44:21] Right. Well, I guess we're talking mostly about the, the people, whether they're farmers or, or they're people in the municipality. Can you just talk briefly about what, you know, the hydrology of, of this area is meant to, to some of these rare creatures that are out there, including this Leon Springs pupfish?

Robert Mace [01:44:53] Sure. The, you know, a bunch of unspeakable things have happened to the Leon Springs pupfish's namesake spring. You know, I mentioned the, the lowering of

the spring orifices, which was clearly a disturbance of their habitat there. I don't think I stuck them in the report, but there's, you know, invasive species were introduced out there. At one point, the place was overrun with carp and the Leon Springs irrigation company decided they were going to do something about it. And so they invited everybody from Fort Stockton to come out and fish to their heart's content in Leon Lake, which is where the Springs emptied into. And then they went in and basically dumped poison into the springs and then, you know, flowed it into the lake and out the canals to try and kill everything, to deal with the carp issue and then reintroduce an invasive species, bass, into the reservoir.

Robert Mace [01:46:22] So, so there's some speculation as to whether or not, you know, when Leon Springs pupfish were extirpated from Leon Springs. But Diamond Y is down the Leon Springs or Leon Creek drainage. And so, and they are, as you mentioned, in Diamond Y? So it's, it's clear they existed in a number of these in a number of little flow systems along there, perhaps even the whole flow system before, you know, humans came along and started messing with the hydraulics of that system.

Robert Mace [01:47:05] I forget what your original question was. I don't know if that answers it or not.

David Todd [01:47:09] No, that, that helps. I mean, I think that there's some really major economic and political issues at play with how the groundwater system is managed out in the Fort Stockton area. And, you know, one of the sort of collateral issues, of course, is this two inch long Leon Springs pupfish. And, and I think you addressed that, that this, you know, this lake and then the piscicide that was deployed, and the carp and the bass and it's, it's a whole variety of things.

Robert Mace [01:47:45] And I worry about Diamond Y. You know, I didn't spend a lot of time looking at Diamond Y Springs, because it's, it's ancillary to the study of Leon Springs and Comanche Springs. But, but I've done a little looking and I'm a little familiar with it out there. And it's you know, it's, it is a failing spring. And so I do worry about those species that are that are in that spring. And there's clearly a downward trend in spring flow. Some of the speculation is it's perhaps due to pumping related to hydraulic fracturing, you know, water supply for hydraulic fracturing operations out in the area. But there's still a lot to learn about that flow system, unfortunately, around Diamond Y Springs. And I don't know that we're going to, I hope, I hope we, I'll just spin it positive. I hope we learn enough, soon enough, to do something protective for those springs in those species, in those springs.

David Todd [01:48:53] Good. Well, I see that time marches on. I should just let you go soon. Is there anything that you would like to, to add in the few moments we've got left?

Robert Mace [01:49:10] Sure. Just you know, the report is online to, to look at. It's a bit of a different report. I sent it out for peer reviews. And I got a couple of comments back where they said it was the most unusual hydrogeologist report they've ever read because they couldn't put it down. Now, of course, these are people that are also kind of interested in the area. So that helps. But, but it's an interesting historical study. It's kind of like the Titanic, you know. You know what the ending is to a certain degree, but it ends with hope of you know, what might happen to bring those Springs back.

Robert Mace [01:49:50] Sharlene Leurig - you know, since we started this project, she's created a company called Texas Water Trade and is continuing to do a lot of work out in the, in the Comanche Springs / Fort Stockton area related to this project. And so you can go over to

their website and see what, what their activities are. They're trying to better understand the system, investigate if farmers are interested in markets, as well as looking at ways to increase conservation, to decrease pumping to the benefit of the springs.

David Todd [01:50:26] Well, I think it's great, you know, that you did this report and then you've got all these sort of creative options that hopefully some of the local people will find appealing.

Robert Mace [01:50:38] Thanks for explaining so much about this really complex issue and for telling us a little bit about your own background and how you came to be involved in it. So...

Robert Mace [01:50:49] Oh, my pleasure. And hopefully it was understandable.

Robert Mace [01:50:54] It was. You're a good teacher. And thank you for taking the time to, to walk us through it all.

Robert Mace [01:51:01] Very good.

David Todd [01:51:03] I think that that we're probably done here. I'd like to wait just a few moments to make sure that our recordings upload to the wonderful World Wide Web. And I think that we probably have managed that and I can turn off this recording.