Joe Trungale

Interviewed by Jen Brown
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Transcribed by Kenya Zarate

[Dr. Jennifer Brown]: Okay, it is November 5, 2021. This is Jen Brown. I'm in Austin, Texas, talking to Joe Trungale and talking about his work on Texas water issues and freshwater inflow. To start, do I have your permission to record?

[Joe Trungale]: Yes, of course.

[Brown]: Okay, thanks.

[Trungale]: Um-hm.

[Brown]: You know this is an oral history, so we always start with, what's your background, what's your early life, and you just mentioned you're from Dallas, can you tell me more about that?

[Trungale]: Sure. Well, I was actually born in Chicago, and we moved around the Midwest and different parts of the East Coast until I got to go high school until I was in Dallas for high school. I went to Jesuit High School in Dallas. My mother's a realtor, my father's in the restaurant business. I think Whataburger brought us to Texas. I have three brothers and a younger sister. I'm the oldest of five. Let's see, after college, or after high school, I came here to Austin for a year and then I transferred to Georgetown in Washington, D.C., and got an English degree. Should I just kind of go through the life story thing?

[Brown]: —Yeah, go ahead. Yeah, sure. (both speaking at once)—

[Trungale]: Okay. So, I got an English degree at Georgetown, wasn't really sure what I wanted to be when I grew up. I did some traveling, eventually did some volunteer work in Latin America for about a year in Nicaragua, where I worked a little bit on water issues, and I guess I thought when I came back, I was going to go to law school, but then after that traveling, I decided that I wanted to kind of get a technical skill that would maybe let me live abroad. That was sort of my plan. So, I came back and decided to go back to school and pursue engineering. And I came here for a year to thinking I was going to get another undergraduate degree until I realized I didn't need to get a full undergraduate degree and just took classes in science for a year or two, and then I went to the University of Washington where I got a master's in environmental engineering. My master's work was about developing kind of user-friendly models, so things that would allow stakeholders to experiment with alternatives. So, that project was based in the Southeast really around Atlanta, even though I was in Washington state. So, I developed these water budget models that would allow stakeholders to, you know, change the demand

patterns and see how that affected water available for navigation in Apalachicola Bay or things like that. When I finished my master's, I spent a couple years back in D.C. working for the Potomac River Basin Commission, doing water supply for Washington, D.C., in the metro area. Then around then my wife and I decided we were ready start to have a family. My family's all here. Her family was all in California, couldn't really afford to move to California at the time (laughs). So, we moved back here, thankfully. We've got two daughters, twenty-two and twenty-three. I took a job for HDR engineering and kind of got started getting involved in water issues in Texas then. This was about 1997 (coughs). This was right after the state had passed the first of the big three water bills. Senate Bill 1 was 1997, which kind of established the long-term planning process. I worked on that for a couple years at HDR. I developed some of the water availability models that are used, primarily I worked on the one for the Guadalupe and San Antonio Basins, and worked on water planning, worked with regional planning groups, worked with these models. Around 2001 or so, I took a job with Texas Parks and Wildlife as a surface water hydrologist, where I learned how to develop models to predict habitats in rivers. So, the way the models work is you tell the model what the inflow into a stream stretch is and it predicts depths and velocities and uses other mapping data to predict habitat to changing flows. So, the idea is if the flow in the river is 100 CFS, or cubic feet per second, you may have good habitat for one species of fish or other indicators of the water. But if the flow drops to 50 [CFS], that may change, and the model predicts how those things change. I did that for a couple years with Texas Parks and Wildlife. I continued to work on the water availability modeling stuff, the WAM is what it's called. I worked for Texas Parks and Wildlife about five years. Around that time, this was when the second water bill had passed, Senate Bill 2, which kind of established the program for doing studies on rivers to determine flow needs and I worked on those projects a bit, and then an attorney working for the San Marcos River Foundation approached me about supporting them on their application. The San Marcos River Foundation had applied for water right specifically for the protection of the river, the San Marcos and Guadalupe Rivers, and San Antonio Bay, where they were trying to basically get an authorization for environmental flows. Texas didn't allow that at the time. And so, I provided the technical support for them to help them. I left Texas Parks and Wildlife, started my own consulting business and started working for that. That has led to lots of other different kinds of projects (laughs). Right away I got involved with a big study on the Colorado [River] to do these models of rivers, to look at habitat changes to different flows. At the time, there was a big proposal between the Lower Colorado River Authority and the San Antonio Water Authority, LCRA-SAWS project, and so I started working on that as a consultant. I'll pause there for a second or keep going.

[Brown]: Well, let's go back. Why water?

[Trungale]: Okay.

[Brown]: What drew you to water?

[Trungale]: That's an interesting question. I suppose the international work is really where it started, when I was traveling around and thinking that would be the resource that I—I never

really thought about why I picked water over land. I mean, I obviously like rivers. I spend time on rivers. I like to kayak and canoe and all those kinds of things. But it was probably more just happenstance that I—when I was looking for programs to go back to school. I'd been at UT [University of Texas at Austin] and applied to a couple of programs and a professor at the University of Washington had this project. It was more about decision making and thinking about water supply. It was less about natural resources, really didn't kind of come at it from a sort of advocacy or activist background. I came at it as a wanting to make a positive contribution. You know, at the time that's what I was thinking about an environmental bent. So that's probably it (both laugh). I don't have a great answer for it.

[Brown]: Yeah.

[Trungale]: Yeah.

[Brown]: And you're right in the middle of all the senate bills. Can you talk about your experiences with those as they're being passed and the processes?

[Trungale]: Sure. Well, the first one was the Senate Bill 1, which is the regional water planning process. And so, the way that works is the state is divided up into somewhere around twenty regions, I think sixteen planning regions across the state. They're primarily based on basin areas or watersheds, but they're also guided by where big population centers are. So, like the Trinity has a group in the area up in the metroplex around Dallas, and it's also got a group in Houston. So, it's not strictly a watershed boundary, it's a population area. And then the idea with it is really kind of four steps. The first is to understand what the need is, long-term water supply need for all the different sectors of society, so for municipal needs, and agricultural needs, and power supply needs, and all those aspects. So, you determine what the water needs are. You use these water availability models for the second step to kind of understand what the available supplies are, and then compare the supplies to the needs and determine whether there's a surplus or a deficit, and then the groups are required to come up with strategies over a fifty-year plan for how to meet the shortfalls. So that's kind of the framework of it. My piece of it has been primarily in the water availability side of it to understand how the various water supply projects we've got in the state operated to meet needs. So, I started working on the one in the Guadalupe-San Antonio Basin when I was at HDR. When I went to Texas Parks and Wildlife, because I brought this experience, I then became kind of one of the agency experts on the process and ended up using the WAMs across the state and tried to think about how to use those Water Availability Models to think about environmental flows. The thing about the regional planning processes, although it identifies needs and comes up with strategies for all these other sectors of water use, it really doesn't include as a need, the needs of the environment. So, the planning process doesn't require each of these groups to look at how much water is needed for protecting rivers and bays? How much is available, what's the shortfall? What it does is it constrains the amount of water available to other needs, using at the time really kind of rule of thumb estimates of how much water rivers need. When Senate Bill 3 started the real dominant idea about rivers was this thought of minimum flows. So as long as you kept a certain amount of water in rivers, you keep rivers healthy. And that was sort of

the only piece, the big piece, that went into the regional planning process. So, when I worked at Parks and Wildlife, I tried to think about how we could use these long-term planning processes to think about how to—not only how to estimate how much is needed for the environment, but how much is available, and how do we develop strategies. And there are challenges to that. One of the chief ones is that the WAMs, or the water availability models, give you predictions on a monthly time step. But rivers respond to changes in flows on much shorter time step. So, I worked on some approaches to try to think about how to take a monthly model and say something meaningful about what might happen on a daily basis. That requires simplifications and shortcuts, and it's not perfect, but it was a—that was really kind of my focus or interest in it at the time. Fortunately, that was twenty years ago, when we started doing that, the state is now really moving towards developing daily versions of these water availability models. So, I think we can start to think more about the water shortfalls that might be expected in the future as a result for the environment as a result of increased out of stream use. So, my interest and involvement in much of the Senate Bill 1 has been how do you get environmental flows into Senate Bill 1. They're not really there but that they're working toward—I feel like we've made some advances towards that.

[Brown]: Just need to check this (referring to audio recorder) and make sure it's plugged in.

[Trungale]: Sure, yeah.

[Brown]: Here we go, okay. I just don't want it to run out of battery.

[Trungale]: Sure.

[Brown]: —while you're speaking.

[Trungale]: So, the second bill that happened while I was at Texas Parks and Wildlife was called Senate Bill 2, and what Senate Bill 2 is about is it directs the three big water agencies in Texas, the Texas Water Development Board, the Texas Parks and Wildlife Department and the TCEQ, the Texas Commission on Environmental Quality. It directed those three agencies to establish a program and conduct studies in rivers to determine flow needs for the protection of the rivers, and those studies are very time consuming to conduct. It's not the kind of thing where they can go out and do some sampling. It's things that require years and, you know, tens or hundreds of thousands of dollars to conduct these kinds of comprehensive studies. They're really sort of bottom-up studies. They start with thinking about developing habitat maps of rivers and understanding relationships of habitat to different aquatic species and thinking about how high flow pulses impact the recruitment response of different species of fish and move sediments through channels and get out in the floodplain and cause the kind of positive disturbances that are necessary for a healthy river environment. So, they're not the kind of things that have quick answers and can be done everywhere. But the agencies did establish this program, and around 2001, I think is when that started, and then by 2007, the third of the three big bills, the Senate Bill 3, came along, and what that did was established a program to kind of take the best available information we've got, bring experts together, have them review that information and

make recommendations across the state that could be done in a, well theoretically could be done in a year time frame, so I had just left Texas Parks and Wildlife not long after that was getting started and had worked a little bit on the Colorado study and done a couple other river studies by that point when they established the first of these group, the Senate Bill 3 environmental flow groups. The way that worked is they started in the eastern part of state and started moving west. The first year, they established groups for the Sabine and Neches, and one for the Trinity in San Jacinto-Galveston Bay. So two groups in that first year. I was a member of the Trinity group. And when—I should step back, there's this whole framework and process that goes around it, right? So, they established a state kind of policy group called the EFAG, [Environmental Flow Advisory Group] I think is what it was called. And then they appointed a group of scientists to look across the state called the SAC, or the Science Advisory Committee. I think they had seven or eight people. Paul Montagna was one of those folks. And then each of the basins established a stakeholder group made up of representatives from all the different interest groups, the cities, and the groundwater conservation districts, and the recreational interests, and environmental interests. I think they had a minimum of fifteen or sixteen members. Then those Basin and Bay Area Stakeholder Groups [Committees], or BBASCs, was the term for them, established a Basin and Bay Expert Science Team, and so, they assembled hydrologists and stream ecologists and water quality specialists, and geomorphologists, and you know, a range of folks from different disciplines who understand the ecological responses or ecological inputs to river health. So, I was chosen as one of the ten or fifteen members on the Trinity group. I should say, just previous to that, I had started working with a group in Caddo Lake in East Texas as part of a project that was initiated by the Nature Conservancy and the US Army Corps of Engineers to look at how they might change the operations of Lake O' the Pines Reservoir, which is the reservoir upstream of Caddo Lake. Caddo Lake is often referred to as the only natural lake in Texas. It's on the Texas-Louisiana border. It's this beautiful wetland place, and they had gotten together to think about what they could do to change release patterns from the Army Corps of Engineers reservoir to maintain health of the river and they brought in kind of national folks, primarily from the Nature Conservancy, who had advocated for this idea of what's called the natural flow paradigm. And what it basically says is that we may not be able to figure out all of the relationships between all the components of the flow regime and all the responses. And in the absence of those really strongly scientifically defensible relationships, what you should do is look to the natural flow regime, the historical patterns of flows that have been have occurred there before the dam started regulating flows. And the idea is not to restore the entire natural flow regime, it's to look at the critical components of it, the pulses in the springtime, the drier conditions in the summertime, how long those things last for, what are the magnitudes and frequencies of different kinds of flow events, and use that to guide the understanding. So, I'd been doing that for a couple years when Senate Bill 3 was getting going, and one of my contributions to the Senate Bill 3 was to, and certainly not the first one to think about natural flow regimes or any of that, but we took some of the experience that we got out of the Caddo process and tried to recommend that as a starting point in some of the Senate Bill 3 work, and that became the idea of using a natural flow paradigm and looking at historical patterns, especially when we had about a year, we weren't going to be able to collect all the data and do all the studies that was happening in Senate Bill 2. We adopted some of those

approaches in the Senate Bill 3 process and they ultimately, I think, sort of guided some of the preliminary recommendations or at least the starting places.

[Brown]: So, you were making these recommendations to the legislative advisory committee, or was it more on the kind of lobbying with individual legislators?

[Trungale]: The way the Senate Bill 3 was developed was it had some constraints on what the applicability of it was to be. Senate Bill 3 was really developed to provide guidance to the regulatory community, to the TCEQ, to allow them to have kind of a consistent approach when they look at new permits. To be able to say, you can take out this amount of water, but if the river gets this low, you need to start cutting back. So, TCEQ had either a less consistent or a less rigorous approach, I suppose, before Senate Bill 3 for how to implement special conditions for the protection of rivers and bays. There certainly were rules and there were certainly approaches, wasn't like there was nothing, but the idea with Senate Bill 3 is that you bring in the experts, they think about it and they come up with recommendations that are specific to the different basins that then TCEQ would use when someone came along for a new water right permit, you could say, here's what you need to leave in the river. We go into a lot of this. There are all kinds of challenges in in thinking about what the flow recommendations really mean because they only apply to future permits from this point forward. They really don't speak to the impacts that have already happened to rivers and streams. So, Senate Bill 3, in addition to doing this process and coming up with these numbers, it also intended that these stakeholder groups would take this information and try to develop strategies, voluntary strategies and a whole range of voluntary strategies, to restore, well, to maintain the health of these rivers. And in my mind, if the rivers are not currently being maintained, then the idea would be to develop strategies that would maybe restore some of the function of the rivers.

[Brown]: As a hydrologist kind of looking at, you know, you are saying you were around and working on these issues prior to this bill being passed, how would you evaluate, kind of, the recommendations and all of the suggestions going into the bill compared to what the bill actually passed? If that makes sense.

[Trungale]: Well, I don't know if this really answers the question, but I could say, I'd say the real benefit of the process for me, or one of the big benefits of the process, was in addition to collecting and assembling all this data, was to really move this state from a thinking about rivers that a single minimum flow is what you need to think about and thinking about rivers is much more dynamic systems that you need to think about the high flows and the low flows and the seasonality and the interannual variability between different years and that every year to, you know, sometimes you have droughts and those droughts you know, kind of like forest fires, they sort of reset systems. They're important parts of the whole process. So, it's not 100 cfs [cubic feet per second], and that's the right answer. We moved beyond that and I think Senate Bill 3 was a big part of moving beyond that. So that's the real benefit of it. I'd say one of the challenges in the way it was implemented and maybe if I were in charge, and could do it over again, the idea that the recommendations would then become statute, I think limited the extent that that people were willing to go on. If we're uncertain about what the right answer is,

some folks were, their response to uncertainty was, well, maybe we don't know enough to say anything. So maybe we shouldn't do anything. Whereas other folks would think, well, if you're uncertain about it, you should be precautionary and maybe be more careful. I don't know that there's necessarily a right—you know, it's a balance on those kinds of things. But I'd say the fact that that Senate Bill 3 was pretty prescriptive in terms of these numbers are then going to go into permits and they're going to last for perpetuity. There was the strategy side of it, but I don't, I don't think that was the focus as much at the time. So, I feel like the uncertainty about knowing things limited some of the groups from saying affirmatively, this is what we need to do to be protected. That and the fact that they would only apply to future permits. Although the science groups were directed not to think about, you know, the idea was we're supposed to look at the rivers and the science and think only about that, those understandings, I think, affected some of the decisions that were made, especially in the early parts when it was getting established. The Trinity group was the most contentious of the groups that I was involved in or saw, and it was, it was really this question of uncertainty about the answers and folks who were more concerned about ensuring that there's adequate water supply for future growth of cities looked at that question differently than folks who were more concerned about trying to maintain environmental health. And there was a mix of people on these groups.

[Brown]: So, and this is the expert science teams? Um, and the stakeholder committees appointed or just asked, how did the scientists get put together on those teams?

[Trungale]: Well, so for the first one, I would say that this was one of the more fortuitous meetings I ever went to for myself and my career. The first one they had a meeting in Conroe for the Trinity-San Jacinto group, I think it was in Conroe, and I had just been working on the Caddo Lake project and so I told somebody or volunteered somewhere that I would give a ten-minute talk about the Caddo experience and I kind of went through how we think about natural flows and what they how they have different responses. And then immediately after that, the stakeholder group, they, you know, the stakeholders were not new to water. They were representatives of water districts and they were representative of environmental groups and representatives of recreational interests. So, they all knew scientists, experts, consultants, that they can choose from. So, they brought nominees to the meeting. And the way I recall it happening is they went through a first round and they said, you know, here's the thirty people that have been nominated and they did a vote, and they picked the first set and they probably looked at it and decided whether they had the right balance of hydrologist, engineers, ecologists, the other specialists, and did a second round. I think I got the least amount of votes, but I made it on that one (laughs), and then after that, it often became a lot of the same people in the in the next round. So, I ended up serving on the Trinity-San Jacinto one and the one for Matagorda Bay, the Colorado-Lavaca one.

[Brown]: Um-hm.

[Trungale]: There were three or four people that served on a couple of them. And then there were experts in particular areas of the state or had had interest in, you know, they were sort of knew who the folks who had the experience in the different areas were.

[Brown]: Um-hm. So, in that first group, kind of science side of things. Did you all—how did you make the decisions, you know, what did you agree on? What did you disagree on? Can you talk more about that?

[Trungale]: Um-hm. So, kind of only, unfortunately, only in the Trinity were we unable to come up with a consensus decision and we ended up having two separate reports from that science group. And that bubbled up and they had two separate reports by the stakeholder group. And then it was up to TCEQ and the state Science Advisory Committee to kind of think about how to use these kinds of conflicting estimates. So, in the Trinity, I was on the group that argued for more flow levels and perhaps higher numbers, and more locations at which to measure things. So, I think our group picked seven or eight sites within the Trinity Basin where we develop the flow recommendation, a set of low flows to maintain health during drought periods, a set of base flows that varied from year to year to maintain the habitat conditions for diverse populations, a set of pulses that would happen, you know, in the springtime and seasonally. The other group was more conservative about their recommendations. So, they only picked two or four sites in the Trinity and maybe two sites in the San Jacinto. And then TCEQ had to make a decision about what to include, I think they ended up going with the less number of sites, so there's only a couple of sites in the Trinity that have flow recommendations, from my perspective. And it's not real clear to me what we do in places where there aren't recommendations. If you have a recommendation for the Trinity River, but you're wanting to divert water from a smaller, smaller tributary in the Trinity River, well, that might not cause you to violate the flow recommendation in the Trinity, but it may or may not be sufficient, it may not leave enough water in the tributary to keep it healthy. So, I think that some of these challenges still exist, and that that's why there's a whole adaptive management work plan process that continues on to hopefully try and address what I see as some shortfalls.

[Brown]: Was it contentious when you came up with two different reports?

[Trungale]: (laughs) It certainly was, that meeting when we seemed like we were getting close, and a group of us said, we got to put the brakes on here. This doesn't seem like we're meeting from our perspective, the objective and the mandate that we were given. So yeah, it got a little contentious.

[Brown]: Do you remember any of the—were their arguments or, I mean, what were the issues? Besides just the sites?

[Trungale]: It was really an uncertainty about, you know, in year you can't get a—it's just not enough time to fully understand the relationships and have really sound, strong, uh, numbers that say, it's really important to maintain a certain amount of riffles in the Trinity River where that system has already been heavily impacted by all the development in the metroplex area and all the water they bring in from East Texas. So, it's not very much like a natural system now. One group was trying to make recommendations based on a natural flow paradigm, you know, that would, you know, I actually don't think—I think the numbers we came up with would have

allowed for quite a bit of continued water development because it is actually, in some ways, the amount of water in that system is well above what it would have been naturally normally that system would have had many more times and much lower flows than it has now but because so much water gets returned from Dallas and Fort Worth, the river doesn't get to the kind of dry levels it would have gotten to historically. So, you know, it's a really complicated question, and I don't really want to suggest that there wasn't a good faith to try to develop good recommendations, but it was—I think it really came down to what do when you don't have certain answers and how do you make progress in that area? Do you lean toward a precautionary principle or do you lean toward a precautionary principle in terms of, you know, picking the bigger number because you want to make sure that you don't permit that water away before you understand what the, maybe, more certain number is? Or do you not limit development of water because you really don't know that it's that important? I think honestly, that's really what the challenge was.

[Brown]: Um-hm. What was going on in your head when you get to that meeting, and decide, oh we're going to have two reports?

[Trungale]: Um, it's hard to remember exactly. I mean, I think I felt—I knew that the folks who I'd been working in good faith with for some time were going to be disappointed. But I felt like it was the right answer, and that's where we needed to be, and so, you know, it wasn't like it was me that made the decision. It was a group of us kind of met separately and said, this is going down the wrong track, and we, we need to speak up.

[Brown]: So, can you tell me more—you were on two teams. Can you compare that experience with other basin team you were on?

[Trungale]: Well, I'd say after those first, after the first year, I think all of the other groups really kind of—I think we the first the other problem with the first year is nobody really knew how to go. During that first year, Texas Parks and Wildlife, working with some of the river authority, I believe the Brazos River Authority, was really involved in this, developed some tools to do this kind of characterization of natural flow patterns. They developed a piece of software that has the acronym HEFR, heifer is what it was referred to, and it took a time series of historical data and kind of parses out, and it was built on some other programs that had been built before that, and parses out what is a base flow condition look like when you strip out all the pulse events, and how do you characterize that, how often are flows in this kind of lower tier, how do they vary during wet dry and average years. So, it really kind of helped these groups have a good starting place. So, by the second round, this HEFR tool had really matured a bit, and I think at second group started the analysis with all right, we've at least got some numbers on the table that we can start thinking about. Once you have a starting place, they could begin to think about how do we overlay different components of ecological function? So how do we think about whether the flow in the river is 200 CFS or 100 CFS? What do we expect that to do to the habitat conditions and we're able to push a little bit beyond just how do we even get started, which is what happened in the, I think, in the first round. I think we spent a lot of time just trying to think about how get going on it. So, I think having those tools in place, really

established a pattern so that after the first two years, there were decisions made about how to parameterize things or what to put focus on or how to look at how regulated the stream had been before. There were questions to be asked, but at least everybody had a reasonably good starting place on the river side of things, and on the bay and estuary side of things, I think that some of that, um, I think we were making good progress on the Trinity. So on the on the river side of things, I would say the folks who are more on the, I'll divide it into the environment side and the water supply side, folks that were a little bit more on the environmental side were moving kind of along with the water supply folks, until we kind of had this break, but we were, we were, kind of coming closer to their side of things until we sort of stepped back and said no, it's not going to make it. I'd say the opposite was true on the freshwater, I think we were all moving in a direction on the freshwater that, when I say freshwater, I mean freshwater inflows, so the estuarine input flows. I'd say we were all moving kind of closer to agreement on that, and then when the split happened, everybody kind of weren't working on compromise anymore, were working on what they truly believed and probably went further apart. On the freshwater inflow side, we had tried to develop this approach where we looked at looked at estuaries a little bit more like you do in rivers where you look at habitat or ecosystem function stuff, rather than a direct relationship between flow and species response which had been the paradigm prior to Senate Bill 3. And so, we did some of that and I thought we were kind of closer on that. When it broke down, the water supply folks kind of reverted back to the studies that have been done prior to this sort of flow to fish response kind of analysis, and they put that forward as their recommendation and the other group went forward with the kind of more ecosystem habitat approach. By the second round, I think, well certainly for the Matagorda, and I think all the systems adopted this, we're going to try to make predictions about how we think salinity gradients and nutrient loads and sediment loads and all those factors, we're going to try and make recommendations based on that. And that kind of became more of the standard and in the Matagorda and the Nueces and the other estuarine systems.

[Brown]: Okay.

[Trungale]: So, I think it was I think it was like the first two years were really kind of working out the—I think if we were to go back and do it again with the same group of people, we'd probably come up with a consensus agreement in the Trinity much like was eventually happened in the Matagorda and other systems.

[Brown]: Okay, so, you know, we talked about this a little bit, maybe just to go back, can you—you mentioned before that the San Marcos River Foundation kind of provided a lot of impetus going into Senate Bill 3. Can you talk more about your work with them?

[Trungale]: Well, some of it was really a little bit kind of legal policy, it was looking at a lot of old permits and trying to understand if the state had already set some kind of precedent for granting permits for some type of environmental protection. It's been a long time (laughs). I can't—I found handfuls of things that were outside of the normal, what's called beneficial use to TCEQ grants permits for beneficial use in their defined beneficial uses, which are the kinds of things you think about municipal supply, agricultural use, manufacturing, there's a set of eight

or nine categories, and instream flow wasn't one of them, but they certainly have issued permits with some things outside of the normal beneficial use. So, I went looking for, I read a lot of permits and tried to understand what the whole history of that. What was I going to say? The, um—I've lost my thought on that. So, I spent a decent amount of time with that. I also really kind of learned the history of how the freshwater inflow estimates were originally generated. So, prior to Senate Bill 1, as I said, there was this kind of, um, they developed basically regression relationships between inflow and abundance of recreationally important sport fish. So, they looked at years of data of redfish catch in the bays, and they looked at the inflows that happened in those years, and they developed a relationship that said, you know, at some flow, you get so many pounds of redfish and at another flow, you get another pound, and draw a line through it, and develop that relationship. And they took these relationships and they put them into a computer program that tried to balance out with all these different kinds of constraints, hat's the flow that's going to provide the right mix of highs and lows that are protective of the range of fishes? So, I kind of learned that whole piece for San Marcos River Foundation to help them support their argument that the flow recommendations that have been developed in those studies were the appropriate number to protect that system.

[Brown]: And what did you want to change in those models when you got to the bay and basin science team?

[Trungale]: Well, I think it's the idea that these species that were identified in that earlier 1980s legislation on bays, the relationship isn't that direct. It's not like, uh, it's not really flow to pounds of fish. It's flow to estuarine conditions. It's flow to salinity gradients, and nutrient loads and sediment loads, which provide the food and the habitat that are needed and provide it for all the other parts of the food chain, and then that all kind of moves up into the sports fish that you're interested in protecting. So, I think the maturation of the science on this was about trying to do more of the understand more of the intermediate pieces. So, you go instead of from flow to fish, you go from flow to salinity, flow to nutrients, flow to sediments, the other pieces of it, and then try to understand how those relate to the different really the things that people kind of care more about, they don't really kind of care about the worms in the mud that the fish feed on, they care about the fish.

[Brown]: Right, yeah. Well, so can you—you told me a little bit about this before, but can you walk me through that process of computer modeling that you do currently, and you know what a hydrologist does—

[Trungale]: Sure.

[Brown]: —with the data points.

[Trungale]: Okay. Well, I, you know, there are lots of people in lots of different areas that that's way beyond my piece of it, but my piece of it is really trying to understand what the amount of water going into the bay systems are and then how does that change the conditions piece of it. And then that works with the ecologist to try to think about what that means. So, on the first

part of that, this kind of goes back to the water availability modeling stuff. So, the WAMs, or water availability models, are basically a kind of bank account of rivers. So, they start with, as input, the natural flows that would occur in the basin, and then they overlay that on that all of the operations and diversions and returns and reservoirs, how those all operate, to predict what the flows will be under a certain set of conditions or assumptions. And actually, the way they work, because they were built for permitting, is they assume everybody uses all the water that their currently allowed to use. And at the end, they will tell you on a on a monthly basis, how much water has flown into San Antonio Bay. If you were to use the water that's currently being used, or you were to use the water that might be used if you have all the water that's already been permitted in Texas. And that's a thing that I think people don't really maybe know about or think about at all, is that even though there's lots of water in our rivers, that water kind of has a barcode on it. Somebody already has a claim to much of the water. Most of the water in Texas has already been appropriated, it just hasn't been perfected or exercised. So anyway, you can use the WAMs to make an estimate of what the inflows to the base are and I do some of that with these groups.

[Brown]: Can I just ask a—for, you know, Texas is still like prior appropriation—

[Trungale]: Um-hm.

[Brown]: It's kind of like a use it, lose it. Is that something where people are, you know, you mentioned here's water in the river. Someone actually owns it, but it's not being used. Have people lost their water rights here?

[Trungale]: My understanding is that really doesn't happen very often there. It's called cancellation. And I'm sure there are examples of cancellation, but it hasn't. I haven't seen much of it. Yeah, so I think that's the law, but I don't, I haven't seen anybody hasn't been my experience that there's been a cancellation. It's water that's intended to meet future growth. So, you wouldn't actually expect them to have used it and I can see that. So yeah, I don't, I haven't seen any examples of, of losing it.

[Brown]: Are there examples, just going off of that, and I know I'm getting us off track here—

[Trungale]: No, that's all right (both talking at the same time)—

[Brown]: Are there examples of say speculation of people buying water rights, you know, cities from farmers or what have industry from cities? What goes on in terms of like thinking about in the planning process, thinking about all these different uses and who's getting the water?

[Trungale]: Yeah. I don't really, I mean, most of my work has to do with looking at what—so, most of water in Texas is managed through river authorities, is the way, it's been my experience with it. So the LCRA and the Brazos River Authority and all of them all over the there's four or five of them in the Trinity area. And they're thinking about ensuring that there's enough supply to meet long-term growth. The speculative part, I suppose is the way that you think about that,

that growth and those require assumptions and uncertainties, and, you know, it seems prudent to me that they would take a conservative approach to that as well, that, you know, those are all those are all plan for drought conditions to ensure that there's enough water to get through a serious drought. They are, you know, maybe they're a little, maybe they're inflated in some places, maybe they're not as high as they need to be in others, I suspect, that's probably true, but I'm not certain about it. But it's attempting to be prudent because they don't want to run out of water in the future. I tell you that what—we lack the flexibility to kind of manage more appropriately and in the interim. I think that there's probably a lot that can be done to better provide for our rivers, and until that build out happens, but I think there's probably concern that opening that door once that water is provided, even though someone may have the right for it, it might be hard for them to exercise it later if they've been establishing some other use for it in the interim. So, I think there's some, you know, I'm not a lawyer or policy maker, but I feel like there's opportunity there that these kinds of strategies and thinking about strategies, hopefully could get us to.

[Brown]: Um-hm. Yeah, sorry, to get us off track.

[Trungale]: That's all right (both talking at the same time)—

[Brown]: I was just curious, how you think about water use and permitting within your work, but I'll let you continue (laughs).

[Trungale]: Okay, well, so there's the question of how much water's coming into the bays. And you could either look at historical information and data from the USGS, or the US Geological Survey, who monitor at stream gauges all over the state and use that information to adjust it either up or down based on different assumptions. So, I may do that, or I may work with the WAM models and do some calculations with those outputs to try to estimate what inflows are going to look like. And then the second half of it is taking those inflows and trying to understand what they'll do, and for me, it's primarily looking at salinity. How will changing patterns of inflows affect the salinity in bays? So that's what I've done on the SB 3 processes. A couple of years ago, I was involved with the group called the Aransas Project, who, in I believe, it was 2008, in 2008, there were something like twenty-three whooping cranes that died in the Aransas Wildlife area [Aransas National Wildlife Refuge] or around there. And the Aransas Project argued that that was a result of mismanagement of the Guadalupe River to the state under the Endangered Species Act. And I was involved in that and worked for that group. I ran the WAM models, and I looked at the gauge data and tried to look at different alternative inflows, with the diversions that have happened, with future diversions that might happen, with what actually went in, and then used the state's models to predict how salinity changes the state. The Water Development Board has a computer model called TxBLEND, and it takes the inflows from all of the rivers and streams that flow into San Antonio Bay or the Guadalupe estuary. It also includes tides and winds and offshore salinity and rainfall and evaporation and predicts what the movement of water through the bay will be like and what the salinity values will be across the bay. So, at thousands of points in the model, it makes a prediction of salinity in response to these changing inflows and changing meteorological conditions. And so, I ran

that model, and I ran it with an assumption of less use, current use, and more use, and showed how the areas of the bay within certain salinity ranges that the ecologists told me were important for not only the whooping cranes themselves, but the blue crabs upon which they rely for most of their diet when they arrive in the wintertime, and some of the other food sources, how that salinity would change under these different scenarios, and you know, my part of it was to demonstrate the change in salinity patterns resulting from change in use, and that you ended up with more areas of the bay that were saltier and detrimental to the food sources, the whooping cranes, and maybe even the drinking water for the whooping cranes, because of how much water was used during these dry periods. And that case made it through several levels of appeals court and then was finally struck down, but I think the science part of it held together, even though it had lots of uncertainties and lots of difficult links to make from how much water gets taken out of rivers, how much makes it into bays, what that does to salinity, what that does to blue crabs, and ultimately what that did that whooping cranes, but at least in the first hearing, the finding was that the management contributed to the impact to the whooping cranes during that period. There was, I think, there was somewhere around 200 whooping cranes in the world at that time. So, a loss of twenty-three of them was a major, major blow.

[Brown]: We've been going for a little while. Do you need a break?

[Trungale]: I'm might take a sip of water.

[Brown]: Okay. I'll just pause it.

[pause in recording]

[Brown]: Okay, we are back. So, we were just talking about the Aransas Project and that court case, can you talk more about the significance of that case in terms of freshwater inflow and the, I guess, would it be the consequences or results of some of Senate Bill 3?

[Trungale]: Well, I don't think, I don't know what the results of that case are. I know that the Aransas Project and the river authority, have at times talked about working together on some type of habitat conservation approach. I don't know that it's a—I think that the goal of the Aransas Project was to actually have a formal habitat conservation plan, a plan in place to protect the whooping cranes. But I don't really know where it's ended up at this point. I don't know whether that's—I think that's continuing, but I don't really know the status of it. It has probably, to some extent, influenced some of the water development proposals in the lower Guadalupe, and required them to think a little bit more about what the potential, how the systems might be operated to, uh, mitigate or limit the likelihood that we'll see those kinds of really low flows coming into the bay. On the Senate Bill 3 side of things, the, let's see, the recommendations that were developed by the science teams, the way that process worked is the science teams were charged with developing a recommendation based purely on the best available science without considering all of the other needs for water. They weren't charged to say how much water should or how much water is needed for the environment if we want to

develop, they were charged with how much water is needed for the environment. And then the stakeholder groups were supposed to consider these other issues, in turn, including, you know, potential impacts to infrastructure or flooding or all the other kinds of things that need to be considered in this process. And then those recommendations go to the Texas Commission on Environmental Quality and they adopt a set of standards that then become part of the permit process. And so, standards have been developed for the major river basins in Texas from the Sabine to the Nueces, at least. I'm not sure that the Rio Grande standards were ever fully developed. And since the development of the standards, the Texas Water Development Board every year has funded, I'd say, I don't even know what the number is, some number of work plan or adaptive management studies. So, everyone, I think, recognized when the standards were developed, that there was a lot of uncertainty on the bay part and on the river part. So, the groups have tried to think about what the research priorities ought to be, and then funded studies to try and fill in those knowledge gaps. And those have been going on for three rounds, probably six or seven years since the last standards were developed. I think there have been something like thirty funded studies from the Water Development Board, both on estuarine and freshwater inflow pieces. I think it's a slow process, developing this, this science. On the instream side of it, I think it's been focused primarily on better understanding the ecological function or relationships between really more that higher flow pulse part of things, how does that affect riparian communities and fish spawning and oxbow connectivity and those kinds of issues. On the estuarine side, it's been a lot of different things, really trying to validate whether those original recommendations were correct, develop new tools to better analyze the information. Then, for both sides, there have been a number of studies to try and think about strategies that might be developed to implement protections. So, things like, in the Nueces system, looking at the connectivity in the upper part of that bay system to try and restore some of the health the Nueces Delta, which is one of the more impacted settings that was identified by through this process. So, a lot of water used to go through Rincon Bayou in the upper part of the delta. Now, that doesn't happen, they don't get the kind of flows through there that they used to. So, I think there's been a lot of work trying to think about, what would it take, what might be done to the landscape there to hold water in that delta and restore the native plant community that has been sort of impacted by those alterations.

[Brown]: Um-hm. Yeah. Can you tell me more about what you're going to write on about circulation and salinity patterns for the book?

[Trungale]: Well, the book when it was originally written, really was developing these tools now that had been used, but there wasn't a long established monitoring program in the estuaries at that time. So, there wasn't a lot of—the most of the, these relationships between inflow and species response was based more on what they call the harvest or catch data. So, it was it was the pounds of fish that were collected or brought in by fishing boats, which are influenced by all kinds of things beyond just freshwater inflow, the price of fuel and the demand for shrimp, maybe is the reason that would more pounds that year, not the change in flows. So, around the time this book was written, or started, at least it was in the late eighties, when they really established the coastal monitoring data program at Texas Parks and Wildlife. But now it's been in place for decades. So, there's just a lot more data to be able to look at and better understand

those relationships. So, part of the book is going to be, I think, documenting some of those relationships with the data that's been collected since then. At the time, this model TxBLEND was just being developed by the Water Development Board and hadn't—the original book by Longley really documents the development of this model, but now I'm going to apply it to all the bays with a long period of records. I'm running it from late 1980s to 1990 to current time. So, I've got you know, thirty or forty years' worth of flow salinity relationships. A lot of the work on the book is really updating, taking what was the beginning of a process and now using the tools that have been developed over that period of time.

[Brown]: What have you learned over the period of your career in working on these issues?

[Trungale]: What have I learned about?

[Brown]: Well, the modeling, the data?

[Trungale]: Um, well, let's see. On the modeling side of things, I would say, it takes a lot of water to change salinity patterns in bays. They're just a big bucket with a small stream coming into them. So, we're not going to, we're not going to cut off water use for some small diverter and change the salinity response in bays. What we need to be thinking about is how to maintain a kind of refugia habitat during really dry conditions. So, I think I've learned a little bit about better bang for the buck. You know, even in the Senate Bill 3 process, I think we probably took too much of a full bay look. We looked at how salinity patterns change in the middle of the bay. Things that we do are not likely going to have a huge impact on those things, what they're going to have an impact on is nursery areas in upper parts of bays where we might be able to change the inflow during those kinds of things. And I think the models really still aren't there, but they're slowly getting there, but they need to be able to sort of focus in on a finer spatial resolution in upper parts of bays rather than whole bays and be able to try to answer questions where there's some management that might have some impact. So that's one big part of again. I think if we were doing Senate Bill 3 again right now, probably much more focused on refugia in upper mouths of bays rather than salinity in the middle of Corpus Christi Bay.

[Brown]: And that's why you did the transects and what you do. And how, in terms of space wise, are all of your little data points, how far apart are they?

[Trungale]: They differ by the different systems. I don't really know that I could answer that very well. What I can tell you is that the models do a pretty good job. So, we do have also for the last thirty years, the Water Development Board has maintained monitoring devices across these bays so we can get a pretty good idea of how well the models predict the response. And I'd say at a reasonably coarse timescale, and spatial look, they do pretty good. I can plot what was actually observed versus what the model predicts, and they match pretty well. And I think probably well enough, given the uncertainty we've got on just the biological mean. It's kind of harder to say, a change in salinity from 20 parts per thousand to 22 parts per thousand has a certain response on the fish. I think we're within that level of precision and accuracy with these models. So, we don't really know what would happen if you were to retire, you know, and I'm

just picking on something, retire a water right somewhere and dedicate that water the river so that a certain amount more water makes it into the river. What we need to better understand is what would that do in places like Rincon Bayou or places where they're in delta areas of bays, is it possible to maintain those wetland areas and those nursery areas that are really important for blue crab among other things.

[Brown]: Uh-hm. What did we miss? I'm trying to look over my notes here and make sure I cover everything (both laugh) that I wanted to.

[Trungale]: You know, I'd say the policy thing that I would most like to see us do is better incorporate the environmental side into our long-range planning stuff. I think people care about the environment. And I think the stakeholders that are doing these Senate Bill 1 long-term planning processes would like to better incorporate environmental needs in it, but the process is not set up for that. It's set up to think about water supply for people, and I think there's got to be more flexible ways to try and incorporate the environmental side of it into the long-term planning side of it because I think people would make decisions. It does all come down to values of the folks who are making the decisions about things. The science only supports helping to make decisions. It doesn't give answers, I don't think.

[Brown]: Is it hard to, as a kind of scientist who's coming up with these models and just came from finding the data, is it hard to see what people do with it once you submit it? If that makes sense.

[Trungale]: I feel like there's a pretty good respect for science in the processes. I think like lots of people, I get the sense that that stakeholders are thirsty for better understanding. Nobody wants to make decisions on ignorance. They want to know as much as they can. But I think you know, there are challenges with balancing these two, these kinds of competing needs, and I think we just need more flexibility within how to be able to do things without tying hands forever to allow people to the comfort to feel like they can experiment and explore different things. And that the real benefit of working on this project in Caddo Lake is that it is, although the river below that dam is hugely different than what it was naturally, there is a bit of a surplus of water, and it allows us to do experiments called adaptive management, right? If you can—rather than being prescriptive and requiring that these things be done, you know, when it's wet, make a pulsed release and then go out and monitor what happens during those time periods. That's I think the most efficient way for us to advance.

[Brown]: Um-hm. I think that covers most of my questions or topics I wanted to cover. Did you want to, um, talk about anything else or, uh, reflect more on the kind of regulatory process? I think you kind of talked a little bit about that.

[Trungale]: I think I've just be repeating more what I've already said.

[Brown]: Yeah.

[Trungale]: I think I'm pretty good.

[Brown]: Okay. If that's the case, then I'll turn the recorder off then.

[Trungale]: Okay.

[Brown]: And we can stop. Thank you.

[end of recording]