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## Anne Castle: Our worn out water security blankets

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The Assistant Secretary for Water and Science at the U.S. Department of the Interior cautions we can no longer rely on the concept of stationarity, big reservoirs, and the no injury rule to buffer our water supply issues

Anne Castle is a senior fellow at the Getches-Wilkinson Center for Natural Resources, Energy, and the Environment at the University of Colorado, focusing on western water issues. Previously, Ms. Castle served as the Assistant Secretary for Water and Science at the U.S. Department of the Interior from 2009 to 2014 where she oversaw water and science policy for the Department and had responsibility for the U.S. Bureau of Reclamation and the U.S. Geological Survey.

Ms. Castle gave this opening keynote speech at the University of Arizona Water Resources and Research Center's annual conference earlier this year. Her speech addressed the pillars of our water management

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system and the support structures that we all have come to rely on.

"These 'security blankets' as I call them are looking a little worn out and a little

frayed around the edges," she said. "I'm not talking about the prior appropriation legal system, but some of the trappings that we've grown accustomed to being part of that legal system, and that's what I'm calling the security blankets. They may not be able to give us the same kind of comfort in the future as they have in the past."

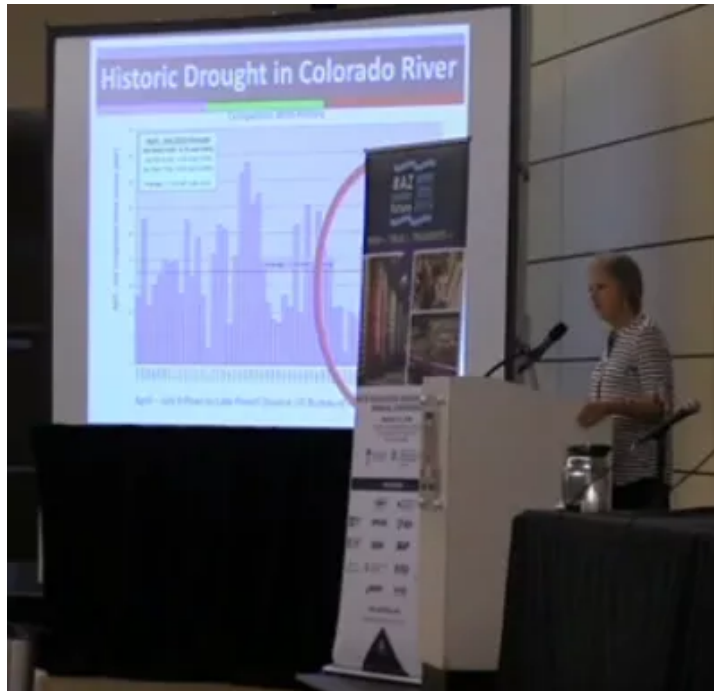
## SECURITY BLANKET #1: RELIANCE ON THE HISTORICAL RECORD

### Reliance on Historical Record

- Look at the past to predict the future
- Stationarity



past to predict the future," Ms. Castle said, presenting a picture of a



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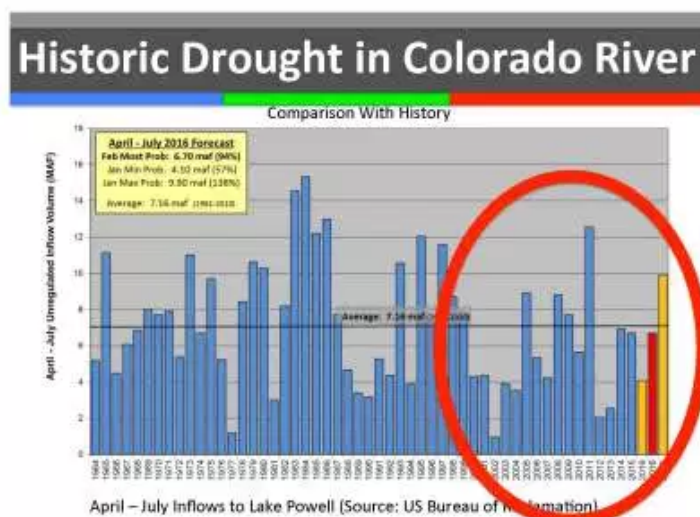
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stream gauge record from 1924 in the state of Colorado on the Delores River. "The scientific name for it is stationarity. This is the time honored way that we use to estimate how much water our water rights are going to produce. We take a look at the historical record, and the idea is that we compile all the records we can get past 30 years, past 50 years – whatever is available to us, and we see how much flow there has been in the rivers or streams. We look at the average, the median, and the range of flows, and then we use that to predict what we're going to see in the future."

"But now we're finding that the historical record isn't all that accurate in telling us what to expect," she said. "It's as they say in the financial disclosures: 'past performance is not a guarantee of future results.' And nowhere is that more apparent than in the Colorado River basin."

She presented a graph of inflows to Lake Powell for the past 50 years for the months of April through July.



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"Those are the months that capture the bulk of the spring runoff, that's a good proxy for overall flows into Lake Powell through the year, and flows into Lake Powell are a good proxy for overall flows in the Colorado River system," she said, noting that the black horizontal line in the middle is the average over the 50 year period. "Average inflows are a little more than 7 million acre-feet, just during those three months. The problem is the last 16 years. This has been a period of historic drought – it's actually the driest 16 year period on record."

Ms. Castle said that the records go back to the late 1800s, and tree ring studies have produced a paleorecord going back 1100-1200 years which can be used to estimate what flows were in the Colorado River system during that period of time. "This 16 year period is less than the 1 percentile in the entire paleorecord," she said. "On the far right are the

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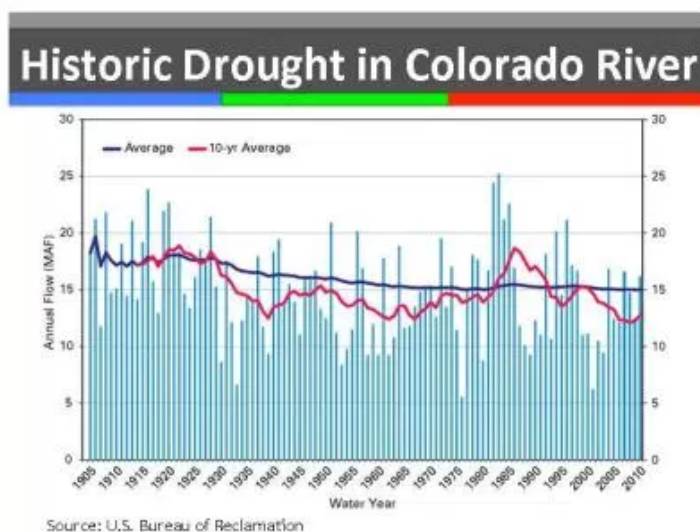


MORE WAYS TO STAY IN TOUCH



projections for 2016. The red bar in the middle is the most probable forecast, that's showing a little less than average – it's about 500,000 acre-feet less than the average."

She noted that this was the projection from February, but newer projections are worse. "We have lost a million acre-feet in the projection, now the most probable projection for inflows into Lake Powell is about 5.7 million acre-feet, about 80% of the average. We were feeling really good because we are almost at the average before, now we're not there anymore. The point being that these last 16 years of drought could not have been predicted from the historical record, but this is what we have to deal with right now."



blue line is the average and the red line is a 10-year moving average.

"Over the past 20 years or so, we've had a steady decline," she said. "We can see from the Colorado River system that climate change is wreaking havoc with our ability to project water flows in the future, and unfortunately, the latest and greatest predictions tell us that we've haven't yet felt the full impact of climate change on water supplies."

There have been climate change studies that have looked at warming temperatures and how warming temperatures affect runoff, Ms. Castle said, noting that there is a lot more certainty that temperatures are going to warm, but the impacts on precipitation are less certain. "These new studies look at temperatures and the correlation to runoff, which is different than precipitation," she said. "Warming seems to have a multiplier effect on runoff, meaning that a relatively small increase in temperature has a disproportionately larger decrease effect on runoff. There are a lot of these studies and the ranges are wide and the

Ms. Castle next presented a graph of annual flows in the Colorado River system from 1905 to 2010, noting that the



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uncertainties are pretty great because they all depend on global climate circulation models and those are imprecise, but the ranges seem to center around 5 to 20% less runoff by the year 2050, which isn't that far away."

"The studies that go out farther and look at decreases in runoff by the end of the century are even more scary with the upper ranges being over 50% in some cases and even higher, so those are things that we're going to have to figure out how to deal with," she said.

"So stationarity – that used to be such a helpful tool for us and one that we still rely on to a great extent, but it just isn't that helpful anymore," Ms. Castle said.

## SECURITY BLANKET #2: BIG RESERVOIRS ARE GOING TO PROTECT US

"The second security blanket is the concept that our big reservoirs are going to protect us," Ms. Castle said. "Unlike the Hohokum, we have these huge reservoirs and the Colorado River system is a great example. There is 60 million acre-feet of overall storage capacity in the system with the two biggest reservoirs in the United States, Lake Mead and Lake Powell. Those are intended to buffer us from the volatility in our supplies, the kinds of extended droughts that caused the Native Americans to leave the scene."

"Water supplies in both the upper basin and the lower basin are to be protected because we have a big reservoir in each place, but no matter how big your reservoir is, if you take more out on average than you put in, then you've got a problem, and that's what's happening in the Colorado River system," she said.

She then presented a water budget for Lake Mead, noting that it's much like a monthly bank account statement. "The inflows on average to Lake Mead are 9 million acre-feet; the outflows are 9.6 million acre-feet which includes the deliveries to entitlement holders in the Lower Basin, plus the amount of water that's required to get those deliveries to the point of diversion, so if you need to deliver 2 MAF to the Central Arizona Project, it takes more than 2 MAF being released from Lake Mead to get it there, so there are system losses along the way. So we get to 9.6 MAF and that also includes our delivery to Mexico. Then there is 600,000 acre-feet of evaporation from Lake Mead, and you add that all up and you have a deficit on average of 1.2 MAF per year. That's a lot of water."

"All the normal releases from Lake Powell and Lake Mead, and normal

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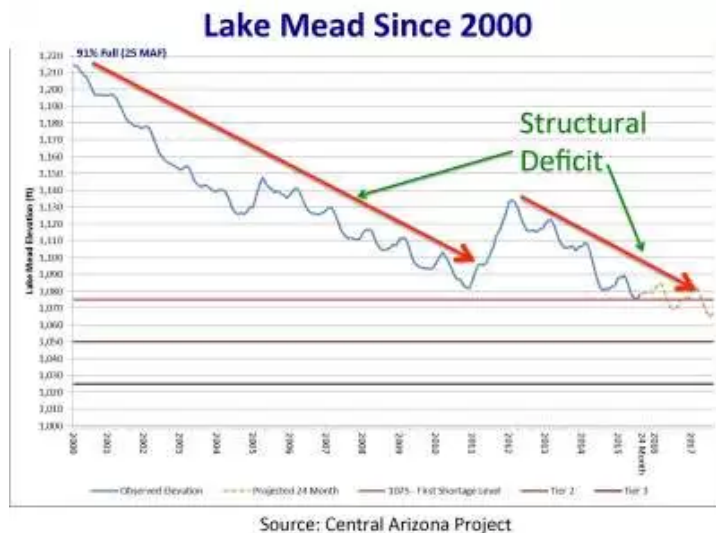
deliveries  
to the  
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Mexico,  
1.2 MAF  
annually  
translates  
to a loss  
in  
elevation  
of 12 feet

per year in Lake Mead," she said. "We started in 2000 in this graph with Lake Mead relatively full, 91% full, but since then the trend has been dramatically downward. These are actual lake elevations from 2000-2015, and you don't need to be a water resources engineer to see that we've got a downward trend."

"The anomaly was in 2011, and that was a really good water year in the upper basin, and the rules of the river require an equalization of lake levels between Lake Powell and Lake Mead, and so there was a lot of water coming into Lake Powell and therefore there was a big release from Lake Powell to Lake Mead, but after 2011, we were sort of back to business as usual, and this graph of elevations is roughly 12 feet per year, which is exactly what was predicted in the water budget. This is what we call the structural deficit, so it's a deficit in our bank account which is built into the way that we are running into the system."

"There's a similar problem although smaller in the upper basin," said Ms. Castle. "The natural inflow into Lake Powell over the past 15 years has averaged 12 MAF. The release obligations are around 8.2 MAF, and that's the deliveries to the lower basin entitlement holders and half of the obligation to Mexico, so we have about 4 MAF remaining. The problem again is that over the past 5 years at least, upper basin usage has averaged 4.5 MAF, so we've got half a million acre-feet of deficit in the upper basin as well."

"That's on average and we buffer those problems with releases from Lake Powell, but long term, you can't use more than you put in, and that's one of the reasons that we're seeing elevations in Lake Powell dropping," she said.



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Another example of major reservoirs not

functioning as expected is in California. California alone has 42 MAF of storage, many of which were built to protect the State Water Project and the federal Central Valley Project, she said. "After the construction of those systems, fish species in California were listed as endangered and threatened and the operation of the water supply system including the reservoirs was identified as one of the causes. So now those reservoirs have to be operated for fish and environmental flows, as well as for water supplies, and the capacity then that's available for water supplies is not the same as what was expected when the systems were first put together and the reservoirs were constructed. And of course, they are affected by climate change and the lack of stationarity as well."

"So the overriding point here is that the water operations that we felt were reliable because we have this massive storage capacity just aren't as reliable as we thought they were," said Ms. Castle. "The security blanket that the big reservoirs provides still exists, but it's not as warm and fuzzy as it was originally."

## SECURITY BLANKET #3: THE 'NO INJURY' RULE

"My last example of a worn out security blanket is the 'no injury' rule, which is the holy grail of water right owners and water lawyers," Ms. Castle said. "It protects existing water rights against adverse effects, against diminishment of the amount of water that they are receiving. This is the standard that is used throughout the west whenever a water right holder wants to change something about their water right, whether it's in the change in the type of use, say from irrigation to municipal use, or it might be a change in the place of use from one farm to another. It's



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referred to differently in the different states. There are various ways to phrase it, but the overall concept is the

same. You can't do something new with your water right if it's going to have a negative impact on somebody else's water right."

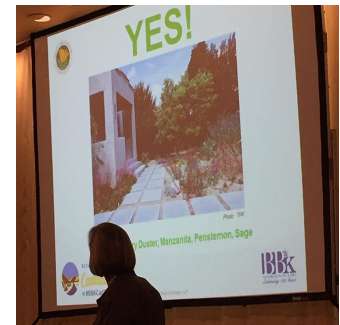
"It's a very good rule," she acknowledged. "It's the only rule that makes sense. It protects vested water rights, it protects private property interests, and it's a very good, very helpful security blanket. The problem, the reason this one is looking a little worn out is the way that it's sometimes implemented. Our systems for examining injury tend to be very time consuming and very, very expensive."

## No Injury Rule

- Standard used to judge a proposed change of water right
  - Change in type or place of use
- Can't injure or harm other water rights



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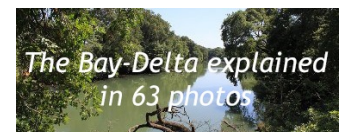
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## No Injury Rule - Problems

- Proving a negative
- No recognition of uncertainty
- No scaling of process relative to potential for adverse impact
- Can create risk to water right itself

"Sometimes the process of going through a change of water right examination creates a risk to the water right itself," she said. "As an applicant for a change in water right, it's your responsibility to prove that there is no injury, so right off the bat, you are trying to prove a negative, which can be difficult. It means that you have to figure out all the



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possible injuries that could occur, and then prove that they don't exist. You also need to establish what the historical consumptive use of the water right has been so that you can ensure that the new thing that you want to do won't consume more water out of the river and leave less water for the other water rights holders. But our methods of determining consumptive use are not precise, they have significant margins of error, and frequently our change in water right practices don't take that water right uncertainty into account, so we could end up measuring injury in tea cups, when the margin of error or the uncertainty is measured in acre-feet or tens or hundreds of acre-feet."

"In addition, the process for the examination of injury is the same, whether your water right is producing 1 AF per year or 1000 AF per year, so we're examining injury to a gnat's ass, regardless of the size or the length of the transaction or the potential for negative impact on somebody else. And finally, in some proceedings, the evidence on historical consumptive use can result in a determination that the water right part of it has been abandoned or forfeited, so you could go into a change proceeding and come out with a smaller water right less valuable than what you started out with, so that creates a risk, obviously. And it creates unintended consequences."

All of that adds up to significant time and expense for a change in water right proceeding, said Ms. Castle. There was a study out of Stanford recently that looked at the time required to go through a change of water right proceeding in 10 different western states to change agricultural water rights to environmental purposes, just a subset of the spectrum of change in water rights proceedings. "It found that with some exceptions, the amount of time required to go through that change and get it approved was measured in years – one to six and a half years in the different states, with my home state of Colorado being the worst offender at 6 ½ years," she said.

"So in our examination of injury, we've created this very time consuming very expensive system and the unintended consequence is that only large permanent transfers of water rights are worth taking through the change proceeding because of the cost and because of the risk," she said. "That puts a lot of pressure on what we call 'buy and dry' deals with agricultural water rights owners. Most of our western states are very concerned with taking agricultural land out of production, not only because we want to maintain that agricultural production but also because we don't want to lose our agricultural heritage, but our water rights system isn't helping to solve this problem, and in fact in some

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cases, it's making it worse."

## SOLUTIONS

So what can be done? Ms. Castle had some suggestions. "Because we can't count on conditions in the future to look the same as we've seen them in the past, we need to have strategies for dealing with a whole range of changing conditions," she said. "There are lots of different ways to describe that kind of thought process, such as scenario planning or contingency planning, but the idea is that you spin out all the realistic possible futures and figure out what you're going to do to address each one of those."

"You need to have triggers or events that will then cause response actions to go into place," she said.



"The city of Tucson uses a trigger system for its drought response stages. They look at actual flows in the Colorado River system and elevations in Lake Mead, and that determines the level of drought response in the city's water system."

"Denver Water has a similar type of trigger system," she said. "They look at their internal water storage, so if the contents of their reservoirs are x percent, then you can only water your lawn three days a week. If the contents drop to y percent, then outdoor irrigation is prohibited, and there's all sorts of interim steps in there, but the point is that we have triggers that tell us what to do when certain conditions occur. And that's what scenario planning or contingency planning can do for you."

In addition to local scenario planning, we need to look at the overall watersheds, not just those individual providers, she noted. "And in the Colorado River basin where we know we have those structural deficits, we have to reduce overall demand on the system, as well as have

triggers that then generate short-term emergency responses."

"That's what's going on in the planning that's occurring now among those seven Colorado River basin states and the major entitlement holders and the federal agencies," she said. "They are looking at how to reduce overall demand on the system and what those triggers should be. There are elevation triggers already in Lake Mead; they are looking at elevation triggers in Lake Powell to generate response actions in the upper basin. Those are the kinds of things that we need to be doing."



"As the deputy secretary of the Interior Mike Connor recently said, El Nino is not a drought

contingency plan," Ms. Castle said. "We need to be prepared for a range of future conditions and not pray for a wet year as our planning."

"Because our change of water rights processes can have unintended consequences like 'buy and dry' transactions, we need to develop flexible procedures that provide an alternative to those existing systems. We need to uphold the no injury standard but to do it in ways that better reflect the size and the length of transactions. There are mechanisms that we're familiar with that we can expand – things like water banks, water trusts, split season leases, that allow us to generate water short-term to meet an emergency and can also be used as pilots for longer term demand reduction, so we need to incorporate those into our overall system."

"So in closing I will say that our water security blankets are definitely still there, but they are just not as warm or as safe as they've been in the past, as we're accustomed to," she said. "We need to knit them together again; we can do that with new technology, by addressing tradeoffs, by incorporating the kinds of alternative mechanisms – contingency planning, triggers, all the things I've been talking about. We need to use what we've learned, plan for a range of possible futures, and maybe



most importantly, we need ourselves to get used to different kinds of procedures, different kinds of protections than the ones we were accustomed to, because the one thing we know for certain is that we can't count on the future to be the same as the past."

"Thank you."

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The diary of a confessed obsessive-compulsive California water news junkie

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