Regional Resource Stewardship Council (RRSC) Minutes
Tennessee Valley Authority
November 18, 2024 (Noon to 5:15 p.m. ET)
November 19, 2024 (8:30 a.m. to 12:30 p.m. ET)

Meeting location:
Brasstown Valley
Young Harris, Georgia

The Tennessee Valley Authority (TVA) Regional Resource Stewardship Council (RRSC, or Council) convened for the 2nd meeting of the 13th term, beginning at noon Eastern on Monday, November 18, 2024. The meeting was held at Brasstown Valley in Young Harris, Georgia. Meeting presentations are available at www.tva.gov/rrsc.

Council members attending in-person:
Ronne Adkins*, Ryan Brown, Alan Gates, Richard Holland, Cline Jones, Kim Klinker, Ron Lambert, Whitney Lipscomb, Tom Littlepage (Chair), Will Nelson, Ron Robertson, Danette Scudder, Randy Wiggins
**Newly nominated by Governor of Tennessee*

Council members in attendance virtually:
Catherine Via

Designated Federal Officer: Melanie Farrell
Designated Federal Officer Alternate: Althea Jones
Facilitator: Jo Anne Lavender

- Appendix A – TVA staff and stakeholders who attended the meeting
- Appendix B – Agenda

Purpose
The purpose of the meeting was to provide information to the RRSC on the River Management Climate Change Study and to obtain an Advice Statement based on an advice question posed to the Council. TVA also provided a report on its river management efforts during Tropical Storm Helene in the Tennessee Valley region and offered updates on its 2025 Integrated Resource Plan (IRP), Natural Resources, River Management and Cultural Resources work.

Day 1

1. Welcome and Introductions

A. Jo Anne Lavender welcomed everyone to the meeting, reviewed the agenda and facilitated introductions with Council members and TVA staff.

B. Melanie Farrell, Designated Federal Officer and Vice President, TVA Valley Engagement & Support, and Tom Littlepage, RRSC Chair, welcomed everyone to the meeting.

2. Designated Federal Officer Briefing — Melanie Farrell, Vice President, Valley Engagement and Support

Melanie Farrell briefly discussed Tropical Storm Helene, noting that representatives from TVA's River Management and Dam Safety would provide more detail. Farrell also offered the following updates:

- TVA's Annual Report was recently published. It is organized around TVA's strategic priorities and covers highlights during fiscal year 2024, from Oct. 1, 2023, through Sept. 30, 2024.
- TVA's 2025 Integrated Resource Plan, which looks out to 2050, identifies future worlds TVA might face and the strategies it can apply to meet energy demand. TVA is holding 10 public open houses and two virtual webinars during its 75-day IRP public comment period from Sept. 23 to Dec. 11, 2024.

3. Helene Update – Tom Barnett, Vice President, River Management and Dam Safety

(Presentation is available at www.tva.gov/rrsc.)

Hurricane Helene hit the Tennessee Valley on Friday, Sept. 27, as a tropical storm. It had rained for two days prior to the storm, and some parts of the region received more than 19 inches of rain – the equivalent of two months of rainfall – in those three days. The flooding caused tremendous loss to communities in East Tennessee and Western North Carolina. There is a long road to recovery, and TVA is working with local, state and federal partners to support these communities. Tom Barnett said TVA employees spent countless hours preparing for and responding to the event. Based on forecasts, in preparation, TVA started lowering mainstem reservoirs to create flood storage capacity. TVA had 160% of flood storage allocation when it went into this event. TVA and stakeholders coordinated efforts to ensure community safety, reduce flood damage, minimize downstream flooding and keep the public informed.

TVA River Management escalated its response as the event unfolded, continuously monitoring conditions and adjusting as needed to actively manage the water. During the storm, TVA experienced circumstances outside of normal flood control operations, including damaged gages that led to loss of communications with certain dams. It initiated its emergency communications protocol, which requires non-routine methods to communicate and operate dams. It used redundant communications such as satellite, radio, cellular and domestic satellite communication for its gaging network, and performed drone surveys as needed.

TVA's Dam Safety team performed inspections at eight dams. At the Nolichucky Dam on the Nolichucky River in East Tennessee, a risk assessment indicated marginal stability at a threshold flood stage. As conditions worsened and there was concern that the water would exceed the stability threshold, TVA exercised its Emergency Action Plan and worked with local emergency management agencies to evacuate populations downstream of the dam. The dam never failed. Later, when the river crested and assessments determined the dam was stable and secure, TVA transitioned to advanced monitoring mode. As the river level receded, the focus shifted to stabilizing areas around the dam and removing the old powerhouse, which had not been in service since 1972. Debris from the storm also was a significant issue, particularly at Douglas Dam on the French Broad River in East Tennessee. TVA installed a debris boom and coordinated further assessment and action. Across its system, TVA initiated an After-Action Review to include updates and enhancements to its hydrologic analyses.

QUESTIONS/ANSWERS/COMMENTS

How significant was your outage, since some of these sites are remote? How vulnerable are you when you have such a significant communications outage and widespread loss?

***Barnett**: It presented a significant challenge. We had to rely on Starlink and cell phones and radios. At Nolichucky, it was the middle of the night and we were flying a drone at 2 a.m. because we couldn't lay eyes on the dam anymore. Communications in an emergency is probably the most significant challenge. We learned that Starlink is beneficial. It is definitely something we are going to looking at to build additional reliability and resiliency. The other thing is that we were hydro blind in some cases. Gages that have been in place for a long time were washed out. For example, there was one gage on at Nolichucky, and that's what is used to calibrate and adjust inflows. We have had interesting conversations with some providers about making virtual river gages using AI-informed inflow technologies.*

What are virtual river gages?

***Barnett**: AI will simulate a gage and the inflow. You can specify a point, and that could be your gage point. It can develop flood stages and warnings and notifications.*

In 2019, there were three days of flooding at Pickwick and Highway 57, and both sides of our facility was flooded. The next time, our corporate folks in Chicago said they'd heard about all of the flooding in East Tennessee, and they wanted to know if we were getting hit. I called James Everett and he assured me that TVA could control it, and indeed, that's what happened. I told the TVA Board that the River Forecast Center did a great job.

In 2019, the RRSC wrote a resolution of support for River Management to the Board. I took the liberty to write one. If the Council reviews it and is in support of approving that resolution, we can send it to the Board. This was a historic event. Possible impacts were mitigated by TVA planning and response.

With that amount of debris in Douglas, where does it go?

***Barnett**: We dropped the reservoir level 25 to 30 feet now. Most of the debris that was floating in the water is now on dry land. We will have to go out with heavy equipment along the shorelines, recover it and load it onto barges. There is a ramp at Douglas, and we are segregating materials there. We are disposing of the hazardous material and trash, and we're working with the state air pollution office to consider burning woody debris to reduce some of the landfilling.*

What about sunken debris? What about capacity in reservoirs?

***Barnett**: When we get to winter pool, we can survey it. I don't expect a significant level of storage loss. In Douglas proper, it is 160 to 180 feet deep, and we expect most of the loss to be in the dead storage zone in the bottom. Unless it presents a hazard to community boating or water quality, it probably can stay there.*

The Tennessee Bureau of Environment estimated 700 vehicles in the water through aerial photography and GIS. We are working with TVA to address that. The fuel and oil has to come out, too.

***Barnett**: Most of the automobiles I am aware of are up the rivers themselves. In Erwin, Tennessee, there is a significant amount of cars and underground storage tanks. We have to get them out, identify what is in them and dispose of them properly.*

4. River Management Climate Change Study – Patrick Massey, Program Manager, TVA Dam Safety; Sean Turner, Hydropower Engineer, Oak Ridge National Laboratory; Miles Yaw, Program Manager, TVA River Management (Presentation is available at www.tva.gov/rrsc.)

RRSC members were asked to consider the advice question they'd be discussing after the presentation: "Based upon the preliminary findings of TVA's study of climate change impacts to river system management, what additional considerations should be factored in to ensure TVA continues to balance river system benefits?"

In their presentation, Patrick Massey of TVA, Sean Turner of Oak Ridge National Lab and Miles Yaw of TVA described the purpose and background of the River Management Climate Change Study; provided an overview of climate change; described climate change's impact on TVA River Management's six benefit areas; outlined modeling limitations, assumptions and variability/uncertainty; and discussed planned communications and future considerations.

Massey discussed the risk and frequency of extreme weather events and the purpose of the River Management Climate Change Study, which is to address the question: "How will climate change affect the Tennessee River System as we know it?" He described different climate change studies and noted that this particular study is a broad, general study focused on the six benefit areas of TVA river management: power generation, flood control, water supply, water quality, navigation and recreation. The study evaluated 1) a sample of Global Climate Models (GCMs) from around the world that were modified to best capture how events could impact the Tennessee Valley region and 2) four Shared Socioeconomic Pathways (SSPs) that project carbon emissions. One of the SSPs – SSP2-4.5 – appeared the most practicable and less extreme.

The study projected the future climate 40 years out. Although the projections varied, SSP2-4.5 predicted a 4-degree (Fahrenheit) increase in air temperature and a 6% increase in precipitation. The study concluded that the prediction could lead to a 15% increase in mean natural water flow in the Tennessee River at Chattanooga. Reviewing each of the six benefit areas of TVA's river management, Massey, Turner and Yaw reviewed each benefit area's objective, measure of success and current performance, and measure of success and performance in the future. They also discussed how climate change could impact each benefit. For example, for power generation, an increase in water flow could lead to an estimated 8% increase in TVA's hydropower production ability. Another example: TVA has averted more than $10.1 billion in flood damage since its inception in 1933, and projected scenarios show the value of damages averted increasing by as much as 250%.

The team said, in summary:

- The study shows that future climate in the Tennessee Valley may be wetter than historically observed conditions, but droughts are still likely.
- In addition to change in amounts of rainfall, patterns could be different than historically observed.
- Early findings indicate that moderate operational changes may not have sizable impacts on future flood risks.
- Equally as important is understanding the uncertainty, limitations and variability of current climate change modeling done to date.
- Current best practice is to rely on adaptive management, sound engineering judgment and how society perceives acceptable risk.

QUESTIONS/ANSWERS

When we're talking about the Valley, we have control of emissions. I understand that China and India are building coal faster than the United States can mitigate. How does that kind of global carbon emission factor into the modeling that you're doing and how does that impact the Valley?

Massey: *If we were to see that those emissions would stay constant or even increase, the SSP that we may look to in projections might be a higher class. But that may be fortune telling, too. We would have to consider will they keep it constant? But it is a balancing act, because we also would have to consider what will the U.S. be doing as well as other countries. As world groups create new models, they take that into consideration. If the models didn't do that, we can offset that in our analysis.*

When you talked volume, is that more of a risk tolerance variability when you look at tweaking the model? How do you tie it from an academic projection to a true business case?

Massey*: We have resources with ORNL. I am not a climate change expert; I am a water resource engineer. That is why it is important for us to have good partners. We work to pick reasonable models so we don't overdesign. We take these global models and do some work to downscale so they better capture how these events could impact us here.*

Since TVA's River Management and hydropower generation is impacted based on coordination with the U.S. Army Corps of Engineers, has there been consideration given to the Corps' plans to invest in their dam infrastructure and their river management practices? Or is it solely focused on TVA?

Massey*: For this study, we kept it as simple as possible. That is something for a deeper study.*

When you talked about the 8% increase in TVA's hydropower production ability, does that factor in pumped hydro?

Massey*: No, it does not.*

For recreation, have you looked at keeping the water levels higher for longer? It would make a big difference if you looked at holidays. People travel up here, and it would help us out in our area.

Massey*: We could look at it. It is a balancing act. If we do that, it could impact something elsewhere.*

It is difficult in Hardin County, where all water flows through our county. When we get into harvest season, it could come straight up the Valley. We need that flood control. We have had many hurricanes hit in August. We need that flood storage to protect us.

Massey*: Yes. We are managing water in seven states. If we offset something, it might have impact somewhere else. We get those questions quite a bit, and we look at that to better understand where we have flexibility and how it might impact places like Hardin County.*

The flooding could have taken out half our campground. When you look out 40 years and are looking at climate change, and it appears the forecasts are to get abundant rainfall, what happens when there's a drought out west? Would there be requests to TVA to supply water out west?

Massey*: We have thought about that. We meet with the Corps and other organizations and hear what they are trying to do. The west is a different story from what we are seeing here. The Valley has been water-rich. In the west, it is almost the opposite. Water is a limited resource. We'll have to see what that looks like. That is a little bit of fortune telling at this point. It is the same way with industry, too. We have seen a lot of industry move to the Valley. That could play a major role in the future.*

Did you factor in water withdrawal for agricultural purposes?

***Massey**: We didn't get into water supplies for agriculture. We can gauge from industry more than agricultural. We kept it baseline for the initial analysis. A good phase 2 study would be, given that, what are areas we should highlight for future analysis? We need to do a good job of estimating current consumption of water reservoirs and then look at the future.*

5. Advice Question and Discussion

RRSC members were asked to consider the advice question, ask questions if they wanted clarifying information and provide comments that would contribute to the formation of the Advice Statement. The discussion began on Day 1 of the meeting and was continued on Day 2. Early in the meeting on Day 2, the Council discussed the draft Advice Statement that was written by a couple Council members with review by TVA staff. The members voted unanimously to accept the Advice Statement, which will be shared with the TVA Board of Directors.

Advice Question

Based upon the preliminary findings of TVA's study of climate change impacts to river system management, what additional considerations should be factored in to ensure TVA continues to balance river system benefits?

Discussion

A good, common-sense approach doesn't happen overnight. When Helene was coming, who made the decision to take action?

***Miles Yaw, Program Manager, TVA River Management**: River Management made the decision in collaboration with partners. In the leadup to Helene, the storm tracks were showing it come up a little bit west of the Appalachian Mountains. As the week progressed, it marched farther east and ended up hitting the French Broad. Our operational preparedness depends in part on the fidelity of the weather forecast and on the fidelity of the inflow forecast. Those are two things we're trying to make better to enhance our community preparation in terms of warning time.*

Can you expand a little bit on the challenges of translating long-term climate projections in events?

***Yaw**: We talked about uncertainty in global climate models. They tend to be most valuable over long temporal scales and over larger spatial scales. As you hone in on smaller areas and smaller times, the uncertainty and scale of global climate models goes up. Sometimes, you can't even tell if rainfall is increasing or decreasing. Waverly had 12 inches of rain in 6 hours. A global climate model doesn't predict a 6-hour rainstorm; that is not what it is made for. Climate models evaluate climate over long periods of time. Then, engineers downscale them and use them for things they not meant to do, like analyze events. The science is not at a place to come up with those changes in frequency.*

How does TVA interact with state and local emergency management agencies?

***Yaw**: We have a robust program where we coordinate with them through Dam Safety. Every year, Dam Safety gets together to do functional tabletop exercises with emergency management agencies downstream from all of the different dams. They postulate scenarios for flooding or things like a dam breach. TVA has emergency action plans for all of our dams. The plans list the different thresholds*

and procedures, and they are delivered to the EMAs by hand. Each EMA is different, and we do as much as we can to support them.

What do you do if they aren't prepared?

***Massey**: Each emergency management agency is its own entity. They have their own funding mechanisms to support their staff and programs. We work with them on developing exercises and educating them on our resources and what an emergency might look like. They are in individual states and counties, and they have their own governments and programs.*

***Yaw**: EMAs are not generally engineers. At Nolichucky, we sent a dam safety engineer to the EMA office and sat with them through the event to help them process what was going on and understand the actions they needed to take.*

***Everett**: Partnerships are crucial when thinking about flood control. We did a water supply study that looked at what it means for drought. We identified communities that would be impacted by drought and we notified them. We can give them information that will allow them to be more resilient.*

At Wilson, the main chamber can accommodate nine barges at a time. When it went down, the lock was closed due to concerns about the gate. They found cracks in the ball, so they stopped operations to look at them and dewater. They will replace that part. They could process nine barges to 15 barges in 2½ hours, and it is now taking 1.6 hours to get one barge through the auxiliary. Tow boats cost $500 to $600 to operate, and we have tow boats sitting for 10 days waiting to access the lock. These towing companies are not absorbing all of that cost; it is passed along into the economy. TVA has an all-hands-on-deck attitude toward this to refabricate that ball. TVA is taking it on themselves to do it, and the anticipated one-year lead time is going to be cut to 12 weeks. That is going to be a tremendous savings to the Valley. Somebody's waiting on that barge to refill somewhere down the line, and it has ripples through the entire economy of the United States. It is a big issue, and TVA is taking on the responsibility to build that part. It is very much appreciated.

Is there a measurement of how much storage has been lost due to silting, and where is that headed?

***Yaw:** When TVA built the dams, they implemented a periodic program of silt range profile. So we could go back to all our major reservoirs and collect silt ranges on a periodic basis. In the early '70s, they did a reservoir loss calculation and showed that because watershed sediment yields in the Tennessee Valley are so low, most of the reservoirs had fill times to winter pool of several hundred years. When they found that, they suspended the silt range program. Except for a few cases, there haven't been recent collections of silt range profiles. That said, when you have large events that create a lot of debris, you get a lot of sediment, and we need to do periodic surveys to understand the loss rates.*

In terms of how TVA works with local agencies, we've been in contact with TVA since Helena. Cherokee County wasn't impacted to any real degree of loss of communications. But looking at what happened to our neighbors, TVA provided inundation mapping to their emergency services to look at areas that could be problematic during a flood. This made us wonder, how can we partner with TVA to get access to that level of modeling? That may help us better determine in the future when we need to place things to better protected.

***Yaw:** Yes. Having these plans can help communities plan for emergencies. That's how we get to community resiliency.*

We're now 20 years into TVA's Reservoir Operations Study (ROS), and it was designed to balance the multiple purposes of the system with the requests of local projects to maximize recreational value.

Looking at the ROS, does it still provide that umbrella of system management with the specific project level information needed? How much is the ROS informed year to year as we go through these unusual events. My understanding is that the ROS is adaptable so you can take those events and blend them into the ROS to make sure you're able to make day-to-day management decisions. How flexible is the ROS to build and adapt on the changes that occurred with the last five years?

Everett*: The Reservoir Operations Study, which is policy to which we operate the reservoir system today, was completed in 2003 and put into operation in 2004. It was built upon a 30-year planning horizon. We have brought it back to the Council twice now, and we intended to do that in another couple years. The ROS drives all of the benefit areas you heard about today. It sets the policy and it serves as the guardrails while offering a lot of flexibility. The policy affords that flexibility that if something has changed or we think something is going to change, we have the tools available to adaptively manage and adjust as necessary. These types of events provide new data points to test the resiliency of these benefits. Extreme events and climate changes are things that I see in separate ways. With extreme events, we're managing and incorporating those new data points into flexible operations and developing better data, better modeling, better tools and resiliency to communities. Climate change has a longer horizon and lead time.*

Barnett*: We would like to get the full mileage of the plan. We're doing modeling and studies along the way to help verify, and I see those all as precursors to the next ROS. I think it is operating well and still giving us the flexibility we need.*

Are there things in the ROS that are based on climate change predictions that you see as institutional barriers? Does the ROS inhibit your ability to adjust?

Everett*: We know we're going to potentially have more floods, but we're also going to avert more damages. In the ROS, TVA made the decision when we did the modeling to say we're going to adapt some higher winter pools at locations to give us a better shot at reaching summer pool as long as it doesn't increase the downstream 500-year flood risk. There are institutional barriers that we adopted as lines in the sand. As we're approaching the end of this horizon, we might ask, is that institutional barrier still applicable? Some tradeoffs are difficult. This is exactly the type of feedback we were hoping to get from the Council on a topic that has a lot of uncertainty. We are not going to kneejerk and make big ROS-level policy changes because of this. But there are things we can inform communities about, like "Hey, it looks like it might be a little more wet near you. You might want to build more flood resiliency into your planning."*

The technology we have today is good, and it is going to get better. We're able to mitigate a lot of damages now with the technology we have. I was not expecting to hear that climate change could be a good thing. For the future, I am not really concerned as far as TVA goes. TVA mitigates flood damage and makes good decisions, and I've got really good faith in what you do.

How do we educate folks on what risk really represents? You can't have 100% certainty that you're going to resolve every risk for everybody in the Valley. TVA doesn't need to shoulder this alone. It can be built into stakeholder interactions with local governments, states and individuals, especially those individuals who live along the water. There is an inherent risk associated that climate change represents a variability and a limitation to your ability to absolve them of any risk. FEMA is instituting what they call a federal flood management standard that now dictates that certain federal funding programs for critical facilities have to be 3 feet above the Base Flood Elevation. Communities have to ensure they're building in a resilient way to anticipate the potential impacts associated with flood risk. TVA needs to actively figure out or work to communicate this concept and what it represents.

When there is a water shortage in the Southeast, people look to the Tennessee River. As the population grows, we could see manufacturing come back from places like China. Not just our population here will be growing, but outside the Valley in our neighboring regions that are having water issues. Atlanta and Birmingham had preliminary engineering drawings of pipelines run to the Tennessee River. That was in 2006 or 2007. If you take droughts out of the picture, these communities are growing and in some cases have outgrown their ability to provide the water they need. That's something we are looking at in the future, with or without climate change.

Why does it say flows are likely to increase if all of the global climate models pointed in the same direction?

***Yaw**: When we look at, for instance, the World Bank document, it says we don't really know enough to quantify the magnitude explicitly, but we know enough from climate science to have an interpretation of the direction that those changes will be. When we look out toward the future and all of those climate models sort of converge on the same thing, that says there's going to be more water. That gives us confidence that we should expect some more water and be willing to adapt to it.*

I've completed TVA's disaster plan, and I am glad we got guidelines. If you are forecasting so much more water in 40 years, is this a requirement of all public organizations and facilities that are on the shoreline?

***Barnett**: It is only a requirement on TVA land where we have the authority. Most are county EMAs, and they should have plans. They have all of the necessary mapping to figure out where to go and how to get out of there. It is about community resilience. How can we better prepare communities? We have a partnership with the Weather Service, and they are responsible for weather notifications. I think people don't always understand the importance of evacuating, so we can work with the Weather Service to help build awareness in the community.*

Is it required for TVA permitting or any business using the Tennessee River?

***Barnett**: Typically they do. We have criteria for structures.*
***Lea**: It is site-specific. We review it through our floodplains.*

Does rain water hurt the water quality? On one chart, it looked like the temperature was rising?

***Lea**: That specific result was reporting release temperatures from Norris Dam under a future simulation comparing model results in the first half of the century to the latter half of the century. If we look at the last 40 years, we don't see something like that. There isn't really a strong trend in temperatures, and the capabilities of Norris Dam to continue providing that cold water have not really been affected. It's not necessarily something that's going to be a long-term trend, because what really affects the ability of Norris to continue to release cold water is that the reservoir stratification is a threshold. So you push the temperature and inflow temperatures enough that the threshold could eventually start to occasionally get breached. It requires a future where the inflows coming into the dam are a lot warmer and the air temperature affecting the reservoir is a lot warmer, and then you might start to hit those thresholds in occasional warmer summers. Regarding water quality, the overall catchment area might be 50 times the size of the actual reservoir surface. So, what's the temperature of the water that's coming in from the catchment? There might be more rain, but if you know the air temperature is higher, that rainwater is warmer and the ground is warmer, these are all margins that are going to lead to a warmer inflow.*

How is TVA weighing in on the need for new maps?

***Everett**: That will intersect with what FEMA decides to do. Our role is to do this study and if we implement operational change, determine how that will influence the footprint of these flood zones. We don't know right now how it is impacting the flood zone. It exposes the opportunity to use the information to partner with communities. If we've got area that is vulnerable and we expect more flooding, how can we work closely with that community? As we're sharing this information, it is an opportunity to look at vulnerabilities and prepare communities to be more resilient in the future.*

The problem with a model is that it's a model. Is TVA looking into the effects if the model is wrong? Are you looking at reversal of what model is saying?

***Yaw**: All models are wrong, but hopefully what we get out of them is useful. The explicit answer to your question in this context is, "No." One of the reasons that we implement an ensemble approach where we use eight GCMs across all of the different pathways is that hopefully the actual result 40 years from the future is encompassed with what we have evaluated. That said, there was an earlier version of this study where instead of taking climate models and simulating rainfall and going to the reservoirs, what you actually do is take the historical record and scale it up or down arbitrarily. You say, "We'll go from 10% drier to 20% wetter and we'll go from 5 degrees cooler to 10 degrees warmer." Then, we basically have a matrix of different simulations that helps us encompass all of the possible outcomes and that lets you identify vulnerabilities in your system. Then you come back with this other approach and take the global climate models and run from rainfall out to the system and see what happens. So you take a phased approach to identify vulnerabilities and come up with a plan of what to look at in a rainfall simulation. In this study, it is not as explicit as it has been in the past.*

Most dam design criteria is based on probable maximum precipitation (PMP). Could you look at and design PMPs of the projects in place versus current PMPs, and would that be a baseline to assess this question of "is the current system adequate"? Can you take that scientifically established criteria of a PMP and apply it to the design of a current dam and see how your criteria stacks up against it as a fundamental analysis?

Regarding interagency involvement, you have to recognize that what you're going to see in the future is competing information with flood maps that have a designated floodplain associated with a risk factor. The Weather Service is putting out a new service of inundation mapping, which is real time analysis of an event and where they think it's going. You're going to have that versus TVA assessments of what's going to happen on the system. There needs to be recognition of the need to coordinate all these sources of information that the public and stakeholders are going to see and make sure that there's some level of consistency or error checking or communication about the nature of these different sources. How are other agencies involved? I'd recommend you take a look, to the degree you can, at how you can standardize or coordinate that effort.

Is the projection an average rate per year or the total of the whole period?

***Massey**: It is 15% modeled in Chattanooga compared to today. The average annual flow volume for the years 2040-2079 would be 15% greater than the last 40 years. It is for the average annual flow rate at Chattanooga.*

Is it year over year?

***Farrell**: Based on various models, the study focused on projects looking 40 years into the future, from 2040 to 2079.*

***Barnett**: The study focused on projections, and they predict the annual natural flow rate in Chattanooga may be 15% greater during the 2040-2079 timeframe.*

What is the idea behind this Advice Statement? What picture are we painting for the Board?

> ***Farrell****: This is a preliminary study. Sometimes, TVA will do a full study and bring it to the group after it is done. We are considering this as a preliminary study, and we are sharing the work done to this point. We are not saying this is useable today, but we are asking this group for your thoughts as we continue to evolve and study the future using these tools. We also want to educate stakeholders on this work, and we want to build partnerships.*

It is important to collaborate with state partners, particularly with environmental and wildlife agencies, because we all are involved in water-related activities. My agency is looking at the future of water storage. I'd like to acknowledge the collaborative nature of this work, so we're taking all of the information together and hopefully we're all using that information together. It would be important to include business development, too. Some companies are looking at climate change, and they are coming to Tennessee because they think the state is better positioned for climate change for their business purposes.

I heard during the presentation that climate change science doesn't provide concrete direction and there is a lot of uncertainty. How do we see uncertainty in terms of water management? The ROS is a living, breathing policy that expresses how to direct the staff to respond to different conditions.

I don't think TVA needs to make changes because of a 1,000-year flood. Human nature is, "This happened, therefore we need to take action." There are consequences if you choose to build in a floodplain. We need to be careful how we do that. Ratepayers shouldn't see rate increases or more expenses because of climate change. Don't change the ballgame because we had a big flood.

When we're looking down the road, what will sedimentation look like? Sediment is going further into the lake, and people are losing recreation. If this study says we will get more water, we will also get more sediment. We need to do something about sediment in the reservoirs.

After comprehensive discussion on both days of the meeting, the members voted unanimously to accept the Advice Statement, which will be shared with the TVA Board of Directors.

6. 2025 Integrated Resource Plan – Candy Kelly, Senior Manager, TVA Resource Strategy, and Hunter Reed, TVA IRP Project Manager (Presentations can be found at www.tva.gov/rrsc)

Candy Kelly explained that the draft 2025 Integrated Resource Plan (IRP) is a study of how TVA could meet customer demand for electricity between now and 2050 across a variety of futures. A draft programmatic Environmental Impact Statement (EIS) accompanies the IRP to evaluate its environmental effects. The IRP provides strategic direction on how TVA will continue to provide low-cost, reliable and increasingly cleaner electricity to residents and businesses across the Valley region for years to come. The IRP process begins with evaluating scenarios (future worlds outside TVA's control), developing strategies TVA could employ in those scenarios and evaluating resource options. TVA modeled five strategies in six scenarios, generating 30 unique potential resource "portfolios" – the power supply mix that results from assessing a particular strategy in a particular scenario. Ultimately, the study will lead to a recommended strategic portfolio direction that would guide TVA decisions for decades to come.

Hunter Reed reviewed the specific ranges for power generation resources that resulted from initial IRP modeling:

- 9 to 26 gigawatts of incremental firm capacity needs between now and 2035
- 3 to 20 gigawatts of solar nameplate additions
- 4 to 19 gigawatts of natural gas, hydrogen, and carbon capture and storage additions
- 1 to 4 gigawatts of energy efficiency and demand response additions
- Up to 6 gigawatts of storage nameplate additions
- Up to 4 gigawatts of wind nameplate additions
- Up to 1 gigawatt of nuclear additions
- 75 to 90% projected reductions in carbon dioxide intensity from 2005 baseline.

He described key themes based on initial IRP analysis:

- New capacity is needed in all scenarios to replace retiring and expiring capacity, support economic growth, and enable further electrification of the economy.
- Firm, dispatchable technologies are needed to ensure system reliability throughout the year.
- Solar expansion plays an increasingly substantial role, providing economic, carbon-free energy.
- Gas expansion serves broad system needs, with the potential for emerging carbon capture and hydrogen options to enable deeper decarbonization.
- Energy efficiency deployment reduces energy needs, particularly between now and 2035, and demand response programs grow with the system and the use of smart technologies.
- Storage expansion accelerates, driven by evolving battery technologies and the potential for additional pumped storage.
- Wind additions have the potential to add more diversity and carbon-free energy to the resource mix.
- New nuclear technologies, with continued advancements, can also support load growth and deeper decarbonization.

Reed also covered highlights of the draft EIS observations:

- **Air quality**: Long-term reductions in air emissions of all types with expected coal retirements
- **Climate and greenhouse gases**: Long-term reductions in carbon emissions and intensity
- **Water resources**: Reductions in water use from 2025 to 2050, except in Scenario 5, which has the most nuclear expansion
- **Land resources**: Increases in land use primarily driven by solar expansion
- **Solid and hazardous waste**: Coal combustion residuals production drops to zero by 2035
- **Overall observations**: Strategies B and C, which promote carbon-free resources, have the lowest emissions; Strategy C has the lowest water and highest land use.

QUESTIONS/ANSWERS

If you lean toward 26 gigawatts of incremental firm capacity needs between now and 2035, if you look at the higher numbers of each asset, we're looking at 50-plus, I think. How much gas do you need to build up solar?

***Reed**: In general, solar does not provide us dependable capacity that we can count on year-round. So, it is added in concert with a firm dispatchable resource like gas or storage.*

Is that a consideration?

***Reed**: It is. The model is doing two things: It's got to maintain reliability, so we start with forecasted load. We have an additional reserve margin above that that accounts for risk, extreme weather, unit outage, etcetera. We have to meet enough firm resources. Beyond that, it is optimizing for cost. In this case, oftentimes, it will see that the lowest cost solution is to add a peaking-type gas unit that is there for reliability, but not expected to operate a whole lot of hours throughout the year. It will add solar for energy (kilowatt-hours) across the day, but then it will add something like a gas resource or storage to maintain reliability during those high load times.*

That is a lot to build. How much consideration is given to the debt ceiling?

***Reed**: The debt ceiling is beyond the IRP. With IRP modeling, the main goal is how do we reduce the present value of our future revenue requirements and how we actually procure those assets. It could be a buy decision, it could be a lease or purchase power agreement, but all that sort of comes afterward. This is setting strategic direction on the types of resources that we see best serve the needs of the Tennessee Valley. Then we'll figure out implementation beyond the IRP. That will be something the Finance organization takes on after the IRP is final.*

***Farrell**: There will be a finance report after IRP.*

When retiring one fuel source and becoming more dependent on another, are you looking at the risk to TVA or to the end-user?

***Reed**: When we talk about risk metrics, these are primarily financial. We've got stochastic analysis, which is a probabilistic study, and we look at key variables that are unknown in the future. Each of our scenarios includes a forecast for natural gas prices, but then we also perform that stochastic analysis to understand the financial risk around it. So that is certainly a key consideration. Things like adding solar energy for those kilowatt-hours across the year can help reduce some of that risk, because we're relying on those natural gas resources less now. They're there for reliability, but we're relying on them less for energy across all hours, which actually does reduce volatility in the rate.*

Day 2

7. Discussion on RRSC Resolution to acknowledge TVA's role in protecting human health and safety during Tropical Storm Helene in the Tennessee Valley region

RRSC member Danette Scudder wrote a draft resolution to acknowledge TVA's role in protecting human health and safety during Tropical Storm Helene in the Tennessee Valley region. The Council discussed the role TVA played, which members said took "an extraordinary level of effort" for TVA to understand what was happening with the storm and to take action that saved human life and reduced impacts to communities and the environment. After discussion and review of the resolution, the RRSC voted unanimously to adopt the resolution. The resolution is available on Page 18 of these minutes.

8. Natural Resources Update — Scott Lea, Senior Manager, Shoreline Management, Natural Resources (Presentation can be found at www.tva.gov/rrsc)

Scott Lea spoke on behalf of Rebecca Hayden, Director, Natural Resources. He reviewed FY 2024 Natural Resources accomplishments as well as plans for 2025. Lea provided updates on TVA's Section 26a activities. Section 26a is an amendment to the TVA Act that ensures the unified development and

regulation of the Tennessee River System and provides TVA with the regulatory authority necessary to protect the development and regulation of the river system and TVA operations. Lea said TVA received 1,683 Section 26a applications and issued 1,431 Section 26a permits in FY 2024. It also issued 114 land use permission agreements. Natural Resources is focused on public outreach and partnerships, and in this past fiscal year, it held 678 public outreach events and fielded 10,292 Public Land Information Center (PLIC) inquiries. From FY 2022 to FY 2024, TVA and its partners contributed $48.9 million in projects that had a positive impact on the region. TVA supported 53 community cleanups, with nearly 1,550 volunteers removing 220,061 pounds of trash in 30 Tennessee counties and in one county each in Georgia, Alabama and Virginia.

Lea also highlighted Natural Resources environmental stewardship work in FY 2024. For example, he discussed the Watts Bar Fish Habitat Improvement Project – a partnership between TVA and Tennessee Wildlife Resources Agency (TWRA) to work on mitigation efforts associated with the eastern dike stabilization at Kingston Fossil Plant. The partners installed 40 sites covering six acres, and structures made from PVC will provide fish and nursery habitat for many years to come. Lea highlighted TVA's management of aquatic plants and its assessments of 10,005 acres of public land, inspection of 3,107 Natural Resources assets across 34 reservoirs and completion of 1,716.8 miles of shoreline inspections. He also provided an update on its latest work to manage floating cabins and offered additional perspective on TVA's work with the Helene storm.

Regarding FY 2025, Lea said that effective January 6, 2025, TVA will raise the Section 26a standard application fee from $500 to $1,000 for minor construction activities. Additionally, certain activities that require more effort to review will be moved to full cost recovery status. Lea also reviewed an ongoing project to revise the 2000 Tims Ford Reservoir Land Management Plan (RLMP), which guides land use approvals, private water use facility permitting and resource management decisions. TVA completed the public scoping effort for updating the 2000 RLMP in FY 2024. A second public comment period for review of the draft RLMP and Environmental Assessment will be held in 2025. Lastly, Lea discussed efforts to increase public awareness of TVA's stewardship work to manage public lands and waterways.

QUESTIONS/COMMENTS

How many floating cabins abandoned?

***Lea**: I don't know that we have a figure on the abandoned cabins. We have reached out to people to document that they do own one, so we can establish a relationship. We call them registrations. We were up about 80% that we've reached out to and gotten contact back. It is a challenge with us to ensure we can have a contact for every person.*

Your charts show that you get 30 to 40 Section 26a applications a week. Will raising the fee help you get to full-cost recovery?

***Lea**: The flat fee of $1,000 doesn't recover the full cost. It is variable; there are a lot of considerations.*

Is TVA anticipating negative feedback?

***Lea**: It's a fair question, but let's let the people requesting these structures help cover the cost.*

9. River Management Update — James Everett, General Manager, River Management (Presentation can be found at www.tva.gov/rrsc)

James Everett began his presentation by thanking the RRSC for recognizing the River Management and Dam Safety teams and for drafting the resolution. He also expressed thanks for the Council's thoughtful dialogue about the draft climate change study. Everett said the region experienced 108% of normal rainfall and 89% of normal runoff through November 7, 2024. He noted that TVA focuses on being a mindful steward of runoff, and that reduced runoff is a challenge because runoff drives the system.

Everett described the low water conditions on the Ohio River in October. TVA augmented flows from the Kentucky and Barkley lakes to maintain a stage near 8 feet at the Ohio-Mississippi rivers confluence to support navigation. TVA worked with the U.S. Army Corps of Engineers to finalize a Memorandum of Understanding around low-flow coordination responsibilities. Everett discussed two challenges at Wilson Lock at TVA's Wilson Dam in northwest Alabama. The main lock chamber at Wilson closed to traffic on September 26, 2024, due to damage to the gate hinge system. The auxiliary lock was placed into service the following day, but there has been a decrease in lockage efficiency. Temporary and long-term repair plans are being evaluated and communicated to the navigation industry. Additionally, TVA continues to address infrastructure challenges with the Wilson Lock guard wall, a floating component of the navigation lock at Wilson Dam that was damaged beyond repair in 2021. TVA is continuing to support lock operations through modified lockage procedures, special spillway flow operations and a helper boat. It is fabricating an interim solution spud barge with installation completion planned for Fall 2025. TVA is working with the Corps of Engineers to develop a permanent solution.

Everett said River Management is using new AI weather prediction tools that provide more lead-time for actionable decision-making, improved accuracy, increased spatiotemporal resolution, the ability to improve performance and increased update frequency.

Everett described stewardship and outreach efforts, and highlighted examples:

- A reopening event for Hibbs Island below Norris Dam. A berm was constructed between the left and right channel weirs to redirect all flow over the two weirs to protect the island, the functionality of the weirs, and ensure minimum flows and protection of aquatic habitat.
- TVA staff members from multiple departments attended the biennial State of Tennessee Partnering Meeting to continue cooperation and communication between federal partners, state agencies and key stakeholders to achieve mutual water resource goals that enhance the quality of life for Tennesseans.
- TVA hosted University of Alabama students in the National Science Foundation Research Traineeship (NRT) program.
- TVA conducted numerous public and stakeholder briefings throughout the year, including virtual and in-person River Forecast Center (RFC) tours. Thus far in 2024, River Management has hosted 66 tours and briefings, reaching over 1,500 stakeholders.
- It is preparing to host the Mekong River and Mississippi River Commissions for a leadership summit and interagency delegation of international visitors.

QUESTIONS/ANSWERS

A friend in Canada has a boat registered for a specific lake, and they can't go to another lake. I thought, I hope we never get to that point, but certainly, with the longer growing season, aquatic vegetation could become a bigger issue.

***Everett**: It is a consideration. Once invasive vegetation takes root, it can spread if a boat isn't washed before it goes to another reservoir. The same is true for wade fishermen. When they come in contact with aquatic organisms specific to a river, they can spread them if they don't wash those boots before going to another river. Grass carp has been introduced into Parksville Lake, and it is a management tool we have used. They keep the grass levels down.*

10. Reinterment and Protection Project Update — Paul Avery, TVA Cultural Resources (Presentation can be found at www.tva.gov/rrsc)

Paul Avery presented information on the Native American Graves Protection and Repatriation Act (NAGPRA), a federal law that requires TVA to return Ancestral remains and associated funerary objects to the appropriate Tribes. TVA has repatriated over 14,000 Ancestors. It is now working to physically return them to the descendent communities. TVA committed to reinterment in 2007, and it established an interdisciplinary team of employees and tribal members in 2016. It executed the memorandum of agreement in 2020 and committed to three locations across the Tennessee Valley: West Tennessee, East Tennessee and North Alabama. It committed to returning Ancestors to the original location when feasible. It signed permanent easement with The Muscogee (Creek) Nation for reinterment on TVA property in North Alabama, and the ceremony is planned for 2025.

He said the NAGPRA team works in cooperation with staff at the University of Alabama, where many of the Ancestors are protected. For the first reinternment, more than 1,800 individuals and tens of thousands of artifacts will be returned to Tribes. It is a team effort that includes Tribal partners and TVA staff from Cultural Resources, Construction Services, Natural Resources, TVA Police, Dam Safety, Facilities, Transportation and Communications. TVA has worked to increase awareness of the importance of this work across the agency. Avery said TVA also is committed to protecting archaeological sites, and he described ways that TVA has covered open-air sites that had been looted and closed up sites that continued to be bothered.

11. Closing Remarks

Melanie Farrell thanked the RRSC for its important discussion and Advice Statement. She said the RRSC's guidance is important to the Board of Directors, and she encouraged Council members' feedback and suggestions on topics for future meetings.

Tom Littlepage, Chair, thanked everyone as well. He said it was a pleasure to see everyone and that he appreciated everyone's efforts to provide advice.

Appreciation of Tennessee Valley Authority River Management & Flood Control

The Tennessee Valley Authority (TVA) Act of 1933 assigned the agency the multipurpose role of river management, including flood control.

In September 2024, portions of East Tennessee and Western North Carolina were devastated by flooding in the aftermath of several weather-related events and the tropical storm associated with Hurricane Helene. Historic rainfall amounts caused catastrophic, record-breaking flooding across the area.

TVA's River Management & Dam Safety staff effectively led efforts to coordinate with federal, state, local and private partners to create a comprehensive response strategy to minimize the negative impacts of flooding and to begin recovery efforts.

While damage to impacted communities was extensive from the unprecedented weather events, TVA's River Management & Dam Safety strategy, including comprehensive operational and communications efforts to control the river system and exercise the emergency action plan to ensure dam safety, along with continuous efforts to keep the public and stakeholders informed, resulted in $406 million in averted property and asset damages.

More significantly, TVA's efforts minimized the negative impacts on health, human safety and the environment in the region, including reducing loss of life and community vulnerabilities.

The membership of the Regional Resource Stewardship Council gratefully acknowledges the outstanding performance of the TVA River Management & Dam Safety staff and expresses its gratitude.

RESOLUTION – The members of the Regional Resource Stewardship Council (RRSC):

1. Express appreciation to TVA's River Management & Dam Safety staff, other TVA employees, and partners who mitigated the severity of the impacts of the significant rainfall and flooding events in September 2024;
2. Commend TVA's comprehensive effort to prepare for and manage the flood event and keep the public and stakeholders safe, educated and informed; and
3. Acknowledge ongoing efforts to engage in recovery and restoration of TVA facilities and provide support to impacted communities and organizations.

BE IT FURTHER RESOLVED THAT:

A copy of this Resolution of Appreciation shall be conveyed to TVA Board Chair, Joe Ritch, and TVA President & CEO, Jeff Lyash, as a token of our appreciation.

This **18th and 19th** day of **November, 2024.**

Thomas M. Littlepage
Chair of the RRSC

RRSC Advice Statement – November 19, 2024

The RRSC provided advice to this question during their meeting, held at Brasstown Valley Resort & Spa in Young Harris, Georgia on November 19, 2024.

- Based upon the preliminary findings of TVA's study of climate change impacts to river system management, what additional considerations should be factored in to ensure TVA continues to balance river system benefits?

The RRSC held a discussion following a summary presentation of findings of the River Management Climate Change Study conducted by TVA, Oak Ridge National Lab and the Research Triangle Institute.

The objective of the study is to evaluate how climate change may affect TVA's hydrological risk and what the tolerance is to these changes. The study focused on the impact to the role of the river in the Tennessee Valley based on six multipurpose benefit areas. The areas of navigation, flood control and electric energy generation were established in the TVA Act of 1933. Water supply, water quality and recreation are also benefit areas TVA influences.

Based on various models, the study focused on projections which predict that average annual natural flow rate in Chattanooga may be 15% greater during the 2040-2079 time frame. It was noted that these are projections. As a result, there is deep uncertainty surrounding the future of climate change and its impacts on the river system.

Recognizing that projections predict an increase in rainfall, it was noted as an example that flood risk reduction and drought resiliency are not complimentary. In addition to change in amounts, rainfall patterns could be different than historically observed.

The study is not intended to result in drastic action informed by these long-term projections but to identify potential vulnerabilities to weigh possible actions and operational changes to mitigate impacts. The goal is to continue to provide a robust, reliable, resilient and redundant river system focused on adaptive management, community resilience and resilient design.

The RRSC recognizes TVA's history of operating the river system to successfully balance competing objectives to optimize the role of the river in the Tennessee Valley and the challenge in optimizing the benefits to all stakeholders in all benefit areas. RRSC members have confidence in the expertise and focus of TVA staff to follow the Reservoir Operations Policy (ROP) and make educated and informed decisions to minimize the negative impacts of the effects of climate change. The RRSC recommends that TVA staff continue the current approach to managing the river system, proactively exploring and taking into consideration new information as it becomes available and understanding the implications of trends as they are validated.

The RRSC noted that it is important to consider behaviors and factors not included in climate change models in the decision-making process. For example, the potential impact of growth in the region and associated regional water resource challenges to the Tennessee River system. The RRSC suggests TVA take an incremental, common-sense approach when making decisions to address evolving impacts of climate change on river management and evaluating the feasibility of any solution that is presented.

Additionally, given that there is deep uncertainty surrounding the future of climate change and its impacts on the river system, the RRSC encourages consideration of how the behaviors of contributors to global climate change outside the Tennessee Valley and the United States could limit the effectiveness of efforts to mitigate against the projected impacts of climate change.

Appendix A
Non-Council Meeting Attendees

TVA Staff Members – In-Person	
Nathaniel Andrews	Mike Kitzman
Paul Avery	JoAnne Lavender
Tom Barnett	Scott Lea
Robert Boharic	Kendra Mansur
Rebecca Brinkley	Patrick Massey
James Everett	Michael McLead
Ashley Farless	Millie Callaway Parkes
Melanie Farrell	Barbie Perdue
Bekim Haliti	Hunter Reed
Michaelyn Harle	Marylee Sauder
Ben Heath	Logan Stephens
Althea Jones	Amanda Turk
Candy Kelly	Miles Yaw
TVA Staff Members – Virtual	
Amy Edge	
Rebecca Hayden	
Amy Reagan	

Stakeholders – In-Person	
Shih-Chieh Kao	
Wolf Naegeli	
Sean Turner	

Appendix B
Meeting Agenda

Regional Resource Stewardship Council (RRSC) Meeting
Tennessee Valley Authority
November 18, 2024 (Noon to 5:15 p.m. ET)
November 19, 2024 (8:30 a.m. to 12:30 p.m. ET)

Meeting location:
Brasstown Valley
Young Harris, Georgia

Advice Question

Based upon the preliminary findings of TVA's study of climate change impacts to river system management, what additional considerations should be factored in to ensure TVA continues to balance river system benefits?

Day 1 – November 18

12:00 - 12:10	Welcome/Call Meeting to Order
12:10 - 12:30	Introductions and Agenda Review
12:30 - 12:45	Helene update
12:45 - 3:00	Climate Change Study
3:00 - 3:15	Break
3:15 - 4:15	IRP Update
4:15 - 5:15	Public Listening Session

Day 2 – November 19

8:30 - 8:40	Day 1 Recap, Day 2 Agenda Review
8:40 - 10:00	Advice Statement Discussion
10:00 - 10:15	Break
10:15 - 11:15	Natural Resources, River Management Update, and Cultural Resources Updates
11:15 - 12:15	Finalize Advice Statement
12:15 - 12:30	Final Comments and Meeting Wrap Up
12:30	Adjourn Meeting