



Secure Tomorrow Series

Alternate Futures: Water Availability Controller Guide

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Cybersecurity and Infrastructure Security Agency

WELCOME AND INTRODUCTIONS

[The instructions in this guide are built around a virtual execution of the workshop, using a virtual meeting platform.]

Hello. My name is [name], and for the next three hours I will be your game controller for *Alternative Futures: Water Availability*. My role is to guide you through the game.

Before we get started, let's do a quick round of introductions. [Ask players for their name and a quick summary of their background.]

The Cybersecurity and Infrastructure Security Agency (CISA) National Risk Management Center (NRMC) has developed this game to assist stakeholders across the critical infrastructure community to self-facilitate and conduct foresight activities that will enable them to derive actionable insights about the future, identify emerging risks, and proactively develop corresponding risk management strategies to implement now. One goal of the *Secure Tomorrow Series* is to develop a repeatable and defensible process that (1) identifies emerging and evolving risks to critical infrastructure systems, and (2) identifies and analyzes the key indicators, trends, accelerators, and derailers associated with those risks to help critical infrastructure stakeholders direct their risk management activities.

As such, today you will be playing as yourselves, bringing your knowledge, experience, and perspectives to debate strategies that will shape critical infrastructure resilience and security in light of potential challenges in maintaining sufficient water resources in the future. Hopefully, the game will be a fun and interactive way for you to think broadly about future threats and opportunities, learn from your peers, and identify strategies to inform preparedness activities.

The game consists of three rounds, each of which will present you with a scenario that could plausibly occur within the next three to seven years. During each round, you will play one of three unique roles. [Display placemat document on camera and point to the appropriate column header for each role as you name them.] The three roles are the *Innovator*, the *Devil's Advocate*, and the *Judge*. [Assign which player has what role for Round 1. If there are more than three players participating, assign them to be additional *Innovators*.] We will rotate roles after each round.

What do these roles entail?

- ***The Innovator(s)***: Your job is to propose initiatives that will help critical infrastructure owners increase the security and resilience of their systems in preparation of future issues that could arise in the availability of sufficient quantity and quality of water. Initiatives could be policies, programs, investments, public-private partnerships, research and development, or other actions that, if successfully put into motion today, you believe will better position and prepare one or more critical infrastructure sectors for the future. You will have 15 minutes to think of and present up to three initiatives and up to three supporting arguments per initiative. When proposing an initiative, please consider both its potential effects and the feasibility of implementation. [Note: If there is more than one *Innovator* per round, each *Innovator* will introduce at least one of the three initiatives. All *Innovators* will develop these initiatives collaboratively, attempting to bolster the supporting arguments. Please be flexible on the 15-minute time limit, especially in cases in which there are multiple *Innovators* and during the first round.]
- ***The Devil's Advocate***: Your job is to "stress test" the ideas of the *Innovator(s)*. After the *Innovator(s)* finish(es) presenting the initiatives and supporting arguments, you will identify counterarguments as to why these initiatives may not be successful. In total, you will have

10 minutes to present up to three counterarguments for each of the proposed initiatives. Your counterarguments can target one or more of the supporting arguments or can underscore a new concern that may cause the initiative to fail. You can choose to debate the effects the ideas will have or highlight challenges with implementation. Please note that the Innovator who proposed the initiative gets one last chance to rebut your counterarguments once you are finished.

As you've probably guessed by now, these two roles are competing against each other through your arguments and counterarguments. Depending on your role, you can score points for either successfully implementing your initiatives or denying your opponent's initiatives. Meanwhile, each successful initiative increases resilience to possible social, technological, economic, environmental, or political (STEEP) disruptions. [Display the STEEP Disruptors & Odds Poster on camera.]

- **The Judge:** Your job is to weigh the arguments versus counterarguments for each initiative and determine whether it has a high, medium, or low chance of success. [Display placemat document on camera and point to a row in the Judge's column that lists "Chance of Success."] To be clear, "success" means the initiative can be implemented and, if implemented, will substantially increase security or resilience against possible threats arising from the described scenario. As the Judge, you may interject at any time for clarification, but please be careful not to influence or aid the other players' arguments or counterarguments.

The Judge will determine the success of each initiative by rolling this virtual 20-sided die: <https://rolladie.net/roll-a-d20-die>. The die simulates the unpredictability of the supporting environment for initiatives and the game's inability to account for all positive and negative factors that might influence success. [Display the STEEP Disruptors & Odds Poster on camera.]

- An initiative with a **high** likelihood of success will be successful with a roll of 6 or higher (75 percent chance).
- An initiative with a **medium** likelihood of success will be successful with a roll of 11 or higher (50 percent chance).
- An initiative with a **low** likelihood of success will be successful with a roll of 16 or higher (25 percent chance).

Are there any questions so far?

As a final note about these roles, please understand that this game **does** encourage you to compete with one another, but the **purpose** of this game is to generate discussions that develop well-conceived and thought-provoking initiatives. Regardless of the outcomes of each round, it is your collective insights that matter.

Please use the placemat document you received to take notes and sketch out your arguments or counterarguments for each initiative.

PRACTICE ROUND

To familiarize yourself with the three roles, let's walk through a practice round with one initiative using a completely unrelated topic. As the topic, let's use "reducing the number of car accidents in the United States."

[Motion to Player 1.] What is one initiative that you think might help reduce the number of car accidents occurring nationwide each year? Now, provide a supporting argument why you think that

this initiative would be successful, considering both how the initiative would affect the number of car accidents and how it could be implemented feasibly.

Normally, you would provide two more supporting arguments for this initiative, as supported by your fellow Innovators. You would then repeat this for up to two more initiatives. For this practice round, I'm going to move on to the Devil's Advocate.

[Motion to Player 2.] *As the Devil's Advocate, what is one reason why Player One's initiative might fail?*

Normally, you would identify up to three counterarguments for each initiative. After you come up with your counterarguments, we would go back to the Innovator(s) for a rebuttal.

[Motion to Player 1.] *Do you have a quick rebuttal?*

[Motion to Player 3.] *Now, Judge, do you think this initiative has a high, medium, or low likelihood of success? Why? Finally, let's roll the die to see whether the initiative is ultimately a success or failure.*

[Determine whether successful.]

*Now that we've done a practice round, are there any final questions? Does everyone understand the flow of the game? How about the odds? **[Answer any questions.]***

If there are no more questions, let's move on to the actual game.

PRESENT STATE

Demand for water is increasing nationwide. However, neither demand for nor supply of water is distributed evenly across the country. Some areas are water rich, while others are water poor. Water demand, in particular, is often concentrated in specific regions because of trends in demographics (i.e., urbanization) and economics (i.e., water-intensive industries, such as agriculture and manufacturing). In many areas of the country, both surface water and groundwater sources are now over-allocated, causing competition for the rights and access to water among farmers, ranchers, cities, towns, oil and gas companies, other industries, and the environment. Groundwater pumping, in particular, has increased and often exceeds groundwater recharge, which can lead to land subsidence, affect surface water sources, and increase concentrations of contaminants in groundwater sources.

Water stress occurs across the Southwest and the Great Plains regions of the United States, and aging infrastructure and weak cybersecurity are common throughout the sector. These conditions present physical risks, including inefficiencies, vulnerabilities to extreme weather, and service interruptions, as well as cyber risks, including risk of interference with operations at the hands of malicious actors.

Many of the same trends shaping the current risks in water availability will persist and become more pressing in coming years, including the following:

- *Demographic shifts that will affect localized demand for water.*
- *Climate change impacts that will alter historical weather patterns.*
- *The presence of novel contaminants (e.g., pharmaceutical byproducts, perfluorinated compounds, nanoplastics) that are often poorly monitored, difficult to remove, and whose health effects are inadequately understood.*
- *Competition over water resources leading to divisiveness.*
- *Aging infrastructure that results in water loss and increasing water system failures.*

Select a STEEP Disruptor

[Point to the STEEP Disruptors & Odds Poster.] As I mentioned before, this poster outlines a popular framework for scanning the future. It covers five dimensions—social, technological, economic, environmental, and political—which make the acronym STEEP.

Each disruptor will force players to explore strategies to mitigate risks to critical infrastructure during a plausible future scenario that could arise pertaining to water availability. These scenarios may limit player actions, reflect new capabilities or technologies, or require players to consider the implications of an event. [Identify the first player to log on by name.] As the first player to log on, you can choose which STEEP category you would like to explore for Round One. [See Appendices I–V. Please note that each disruptor ends with a question that should be announced to the group after reading through the disruptor narrative, to clarify the issue that players will be addressing for the disruptor. Additional discussion questions are included in each appendix to serve as prompts or as questions for open discussion periods.]

LET'S PLAY

Round 1

As a reminder, for Round One you are considering initiatives that, if successfully begun today, you believe will help prepare critical infrastructure owners for potential risks arising in these future scenarios.

[Turn to the Innovator(s).] I am going to begin your turn by giving you five minutes to gather your thoughts about potential initiatives. After that point, I will encourage you to share your thoughts aloud so that the other players can get a sense of what you're thinking. I'll be engaging you in a dialogue to help you flesh out your initiatives and develop the supporting arguments. [If there are multiple Innovators, you may want to encourage the Innovator team members to begin sharing their ideas with each other after two minutes, before asking them to announce their first initiative after 5 minutes has elapsed.]

As a recommendation, try to stay away from sweeping generalizations. With such statements, I will push you to provide an example of what you are alluding to or ask you to give an anecdote to explain or demonstrate your idea. Innovator(s), your turn starts now.

[Start the timer from 15 minutes. After five minutes, prompt an Innovator to begin verbalizing their first initiative.]

Try to have the Innovator(s) frame arguments by explaining:

- How their idea addresses security and resiliency
- How the idea can be implemented
- What will change if the idea is implemented

Some questions to help the Innovator(s) develop supporting arguments include the following:

- Is there a precedent for the type of activity you are proposing?
- Are there major risks that need to be addressed in your supporting arguments?
- Are multiple steps necessary for implementation? What do you think might realistically be achieved in the next three to seven years?
- Who are the stakeholders necessary for implementation to be successful (i.e., whose support do you need)?

- What conditions exist today that make you believe this initiative will succeed (as opposed to in the past)?

Throughout the Innovator(s) round, or after 15 minutes, recap the Innovator(s) initiatives and supporting arguments and look to each Innovator to validate.

[Reset the timer to 10 minutes.] Ask the Devil's Advocate to begin thinking aloud and presenting their counterarguments. Start the timer.

Throughout the Devil's Advocate's round or after 10 minutes, recap the points made by the Devil's Advocate and look to the Devil's Advocate to validate.

[Reset the timer to five minutes.] Ask the Innovator(s) to begin their rebuttal and start the timer.

After the rebuttal period, ask the Judge to select the likelihood of success for each initiative and to present their rationale. Afterwards, direct the Judge to roll the die once for each initiative.

Declare the winner for Round One. [If there was a good discussion among participants during the round, you may want to include a short open discussion period (less than 10 minutes) following judgment to continue this discussion. This is also an opportunity to discuss how the initiatives could be strengthened.]

[Gesture to the Round One winner.] As the winner of Round 1, you get to choose the STEEP disruptor category for Round Two.

Subsequent rounds

Assign new roles.

Present the new scenario based on the STEEP disruptor chosen (see Appendices I–V). [Please keep in mind that depending on what players present in the prior round, you may want to preclude them from selecting certain STEEP categories, since the discussion may become repetitive. Use your best judgment.]

Follow the instructions listed under Round One.

Declare the winner for Rounds Two and Three based on the results.

Direct the winning player or team to select a STEEP disruptor (Round Two only).

[You can adjust the number of disruptors explored as desired, but you will need to consider the corresponding increase or decrease in time commitment and modify the gameboard, as necessary.]

WRAPPING UP AND FINAL DISCUSSION

[After rolling the die for the final round of the game:] Before we conclude with some wrap-up questions, I would like to thank you all for participating today. I know some parts of this game can be frustrating, especially when... [Controller chooses whichever phrase is the most appropriate.]

- ...a well-conceived initiative fails due to the roll of a die, OR
- ...a poorly conceived initiative succeeds due to the roll of a die.

[Controller chooses to say this or not, based on all Devil's Advocate performances.] Additionally, we recognize that the Innovator's position is a little more challenging. The Devil's Advocate has more time to think through what to say, and it's easier to point out the flaws in the Innovator's ideas. We purposely designed the game to encourage this type of interaction because it pushes players not

only to identify potential ideas for preparing for the future, but also to think critically about how these ideas can be executed and in what timeframes they can be achieved, and to begin to address major risks.

Although we've set up the game to encourage competition among players, it's important to stress that we are playing this game to generate ideas that will lead to more resilient and secure critical infrastructure systems in the future. I want to reiterate that it's your collective insights and subject matter expertise that matter. So, let's walk through what happened during each round today.

Walk through the outcomes of each round, and then move the gameboard marker to its new position as follows:

- If all three initiatives pass in a round, move the marker up two positions.
- If two initiatives pass in a round, move the marker up one position.
- If one or no initiatives pass in a round, move the marker down one position.

Declare whether critical infrastructure systems have become more resilient as a result of the players' initiatives.

Some questions to ask during the open discussion include the following:

- What were your key takeaways?
- What was the most surprising or unexpected initiative presented?
- What was the most enjoyable part about playing the game? The least? Are there any improvements you would suggest?
- What would your organization do differently, given what was discussed during the game?

The Cybersecurity and Infrastructure Security Agency (CISA) has produced these scenarios to initiate and facilitate discussion. The situations described here are hypothetical and speculative and should not be considered the position of the U.S. government. All names, characters, organizations, and incidents portrayed in these scenarios are fictitious. Any positions expressed by fictional characters herein regarding any particular issues or technologies do not represent the positions of CISA or the federal government.

APPENDIX I: SOCIAL DISRUPTOR

LOSING TRUST IN WATER

Between 2023 and 2030, bodies of water have continued to warm globally and there has been increased frequency of intense rain events. These changes, combined with excess phosphorus applied as fertilizer that leaches from surrounding agricultural land, cause harmful algae blooms (HABs). HABs have been a chronic issue for Lake Erie, and the problem has been spreading gradually across the Great Lakes region with rising intensity.

In turn, HABs can lead to clogged infrastructure and drinking water contaminated with cyanotoxins that can be more toxic than strychnine. However, monitoring and treating for HABs and the related toxins is very costly (tens of millions of dollars), and many newly affected water utilities in the region are not equipped to manage these contaminants.

In 2028, Great City, situated along Lake Huron, experiences a significant spike in toxins from a HAB that has sickened local residents, causing stomach pain, headache, muscle weakness, dizziness, vomiting, and diarrhea. Without more advanced techniques, the city water utility's only option is to dilute the contaminated water until toxin levels are below recommended limits, which takes weeks to achieve.

What initiatives could be put in place to mitigate the loss of public trust in the water supply?

Additional discussion questions

[These questions can be used to prompt the Innovator(s) if they get stuck or during the open discussion period following the die rolls. Facilitators can also tailor these questions or ask new ones to meet the matrix game sponsor's specific needs.]

- *What activities can prevent the loss of trust? What can be done to restore it? Who are the key actors that should be involved in these activities?*

APPENDIX II: TECHNOLOGICAL DISRUPTOR

DIGITIZATION AND EXPANDING CYBER RISK

After years of infrastructure modernization efforts, smart water technologies have become ubiquitous throughout the water sector. By 2025, many of the nation's 150,000 public drinking water systems have installed digital monitors that allow them to track water levels and potential contaminants throughout their infrastructures. These systems have seen an increase in water efficiency, early detection of leaks, and improved water quality.

Unfortunately, cybersecurity remains problematic for the water sector. Longstanding issues are exacerbated by the rapid shift toward digitization and convergence of information technology and operational technology. In 2027, a rash of ransomware attacks leverages a vulnerability in a popular digital asset management software to target water systems across the country. Many—but not all—water utilities install the software patch released. As a result, two years after the ransomware incident, criminals exploit a similar software vulnerability to access a water treatment facility's supervisory control and data acquisition system, damaging water pumping and treatment equipment, and prompting an emergency shutdown of their system.

What initiatives could ensure that cybersecurity protocols and assessments are implemented within the water sector?

Additional discussion questions

[These questions can be used to prompt the Innovator(s) if they get stuck or during the open discussion period following the die rolls. Facilitators can also tailor these questions or ask new ones to meet the matrix game sponsor's specific needs.]

- *How can the urgent need for digitization be balanced against the need to proceed in a secure manner?*
- *What can be done to improve the cybersecurity talent pipeline in the water sector?*
- *How should small water systems, which tend to have fewer cyber resources, be supported?*

APPENDIX III: ECONOMIC DISRUPTOR

THE COST OF EXCESS

By 2028, overuse of the groundwater in the valley west of Freonic nearly exhausts the city's water supply. To reduce usage, regional utilities implement a new rate model: each household is allocated a lump sum of water per resident at the usual rate with any overages charged as much as five times the standard rate. Although many residents implement water conservation practices, industries such as agriculture continue to rely heavily on the groundwater. As a result, the continued groundwater depletion degrades the water quality, making any remaining water unusable. With no surface water to turn to, the city has to source water from outside the valley at exorbitant costs. The city is able to secure purchased water, delivered by truckload. However, the water is expensive and must be divided among many stakeholders.

Officials in Freonic are faced with finding a more sustainable solution to the city's water woes. The costs prove to be prohibitive, particularly for the agricultural sector, which can no longer afford to irrigate crops. As a result, growers begin to abandon their land. Other industries also experience interruptions to business operations. Hospitals are forced to transport patients elsewhere for medical care. New construction is completely shut down because the state requires developers to prove there is enough water to support future residents for 100 years. In addition, land subsidence resulting from depleted groundwater damages homes and buildings.

What initiatives can you think of to address the high cost of water and related economic impacts in water-stressed areas?

Additional discussion questions

[These questions can be used to prompt the Innovator(s) if they get stuck or during the open discussion period following the die rolls. Facilitators can also tailor these questions or ask new ones to meet the matrix game sponsor's specific needs.]

- *How should locations that lack alternative sources of water go about ensuring long-term access to water resources?*
- *How should limited water be prioritized among stakeholders (e.g., households, businesses, public services)?*

APPENDIX IV: ENVIRONMENTAL DISRUPTOR

IMPACTS OF WILDFIRES ON WATER INFRASTRUCTURE

Rising temperatures and longer dry seasons have contributed to an increase in wildfires in the Southeastern United States. In 2029, lightning activity near the end of the dry season ignites a wildfire in the Southern Appalachian Trail region. The wildfire grows rapidly, feeding on the dried fuel left behind by hemlock trees, which have been decimated in a decades-long battle with an invasive species in the Smoky Mountains.

In the town of Ravenshearth, the local fire department works with other firefighters to keep the wildfire at bay, and their efforts save most of their town. However, the fire does damage the eastern side of town. In particular, the local water distribution system is damaged as components located on the surface (e.g., valve boxes, meters, plastic components) melt or burn. Power distribution lines are also destroyed, cutting off power to the water utility.

In addition, the massive volumes of water used for fighting the wildfire depressurize the water distribution system. Days after the fire, the water utility is able to secure generators from a nearby town and work to repressurize the system. However, the utility faces several challenges in restoring water availability. Houses destroyed in the fire have damaged service lines that leak water, keeping the system depressurized. Eventually, pressure is restored, but the water lines are contaminated because there are no backflow prevention devices to prevent contamination when pressure is lost. Smoke from the wildfires deposit heavy metals and particles that further degrade local water quality.

What initiatives do you think will help the water sector prepare for the environmental impacts of wildfires?

Additional discussion questions

[These questions can be used to prompt Innovator(s) if they get stuck or during the open discussion period following the die rolls. Facilitators can also tailor these questions or ask new ones to meet the matrix game sponsor's specific needs.]

- *What measures can be put in place to facilitate response and recovery efforts for water utilities?*
- *How might preparation and response vary according to different environmental threats?*
- *What role might redundancy play in water infrastructure resilience to environmental threats?*
- *How might collaborative relationships be developed and leveraged to improve water infrastructure resilience to environmental threats?*

APPENDIX V: POLITICAL DISRUPTOR

NAVIGATING COMPETING NEEDS

City officials in the City of XYZ are facing several issues that are causing increased concern about water availability:

- *Rapid aridification has led to a persistently dry climate that is punctuated by instances of drought.*
- *The manager of the city's public water utility recently presented her concerns about the city's aging water infrastructure and its deferred maintenance. According to her, water infrastructure within the city has already begun to fail at an increasing rate.*
- *A recent exposé by a local news organization revealed the presence of low levels of polyfluoroalkyls¹ in the city's main reservoir, leading to fears about potential health effects.*

More broadly, the reduced availability of water has underscored the city's many competing interests for water, which officials are concerned will lead to future tensions. Officials are seeking to avoid the political backlash observed in a neighboring jurisdiction that had implemented highly restrictive policies and approved a large rate hike for city water and sewage bills the previous year. As a result, XYZ officials have established a working group of experts and community leaders to explore different options that might help them navigate current competing demands for water and improve the city's future water situation.

What initiatives can help officials resolve the city's water availability concerns, including balancing the water needs of diverse stakeholder groups?

Additional discussion questions

[These questions can be used to prompt the Innovator(s) if they get stuck or during the open discussion period following the die rolls. Facilitators can also tailor these questions or ask new ones to meet the matrix game sponsor's specific needs.]

- *How can decisions about water policies and initiatives be better communicated?*
- *What actions will ensure that the city's water needs are addressed not only in the present, but also in the next three to seven years?*

¹ Polyfluoroalkyls, often referred to as “forever chemicals,” are difficult to treat and remove using conventional water treatment processes.

APPENDIX VI: GAME SCHEDULE

Table 1: Schedule for conducting the Matrix Game

MATRIX GAME STAGES (~3 HOURS)			
Introduction	- Welcome participants and discuss game purpose (Controller)	3 Min	18 Min
	- Explain game rules (Controller)	5 Min	Total
	- Practice round	7 Min	
	- Introduce current state and potential implications (Controller)	3 Min	
Round 1	- Introduce future scenario based on STEEP disruption (Controller)	5 Min	41-51
	- Craft initiatives and present arguments (Innovator(s))	15 Min	Min
	- Present counterarguments (Devil's Advocate)	10 Min	Total
	- Rebuttal (Innovator(s))	5 Min	
	- Adjudicate arguments and roll die (Judge)	5 Min	
	- (Optional) Open discussion period	< 10 Min	
Round 2	- Select STEEP disruptor	1 Min	
	- Introduce future scenario based on STEEP disruption (Controller)	5 Min	41-51
	- Craft initiatives and present arguments (Innovator(s))	15 Min	Min
	- Present counterarguments (Devil's Advocate)	10 Min	Total
	- Rebuttal (Innovator(s))	5 Min	
	- Adjudicate arguments and roll die (Judge)	5 Min	
Round 3	- (Optional) Open discussion period	< 10 Min	
	- Select STEEP disruptor	1 Min	
	- Introduce future scenario based on STEEP disruption (Controller)	5 Min	40-50
	- Craft initiatives and present arguments (Innovator(s))	15 Min	Min
	- Present counterarguments (Devil's Advocate)	10 Min	Total
	- Rebuttal (Innovator(s))	5 Min	
Wrap Up	- Adjudicate arguments and roll die (Judge)	5 Min	
	- (Optional) Open discussion period	< 10 Min	
	- Determine final game status of critical infrastructure security and resilience (Controller)	5 Min	20 Min
	- Open discussion period (Players)	15 Min	Total