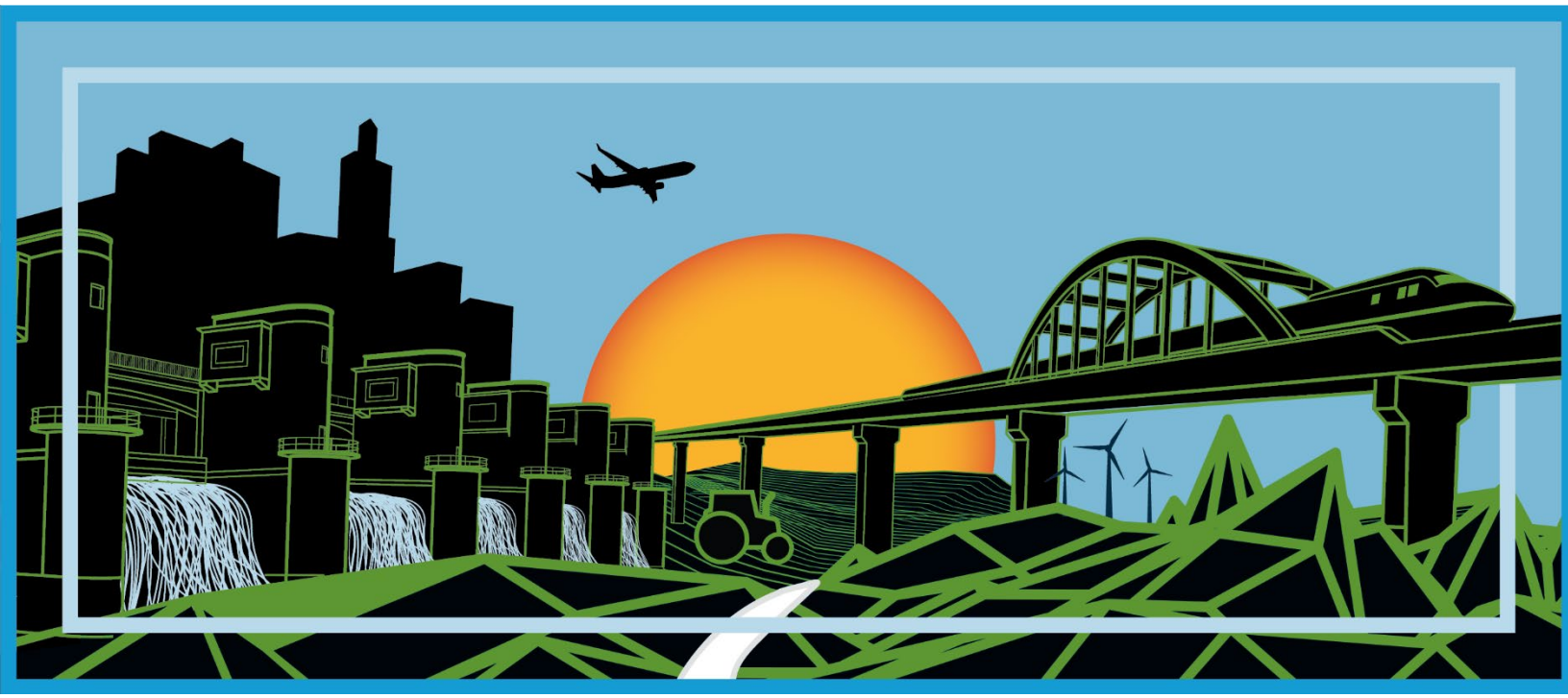

Secure Tomorrow Series

Alternate Futures: Water Availability Player Guide

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BACKGROUND

How prepared are critical infrastructure sectors in light of potential challenges in maintaining sufficient water resources in the future? *Alternative Futures: Water Availability* presents you with scenarios that could plausibly occur within the next three to seven years. During each round, you and your opponents will take turns proposing initiatives and debating strategies that will shape critical infrastructure resilience and security in light of current trends in water availability. How successfully you manage to present your arguments for (or against) these initiatives determines their chances of success. Depending on your role for the round, you can score points for either successfully implementing or countering initiatives.

The Cybersecurity and Infrastructure Security Agency's (CISA) National Risk Management Center 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.

For players, the game hopefully represents 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 takes about three hours to complete. This includes an introduction and description of the current state, three rounds of gameplay (each about 45 minutes long), and a final 20-minute open discussion period to collect any final feedback from players and wrap up the game.

PLAYER ROLES AND ASSIGNMENTS

At the start of the game, each player will be assigned one of three roles. Players will rotate roles in subsequent rounds, so that they fill different roles through the course of the game. The three roles are as follows:

- The Innovator(s): Responsible for developing initiatives and arguments in support of those initiatives.
- The Devil's Advocate: Responsible for developing counterarguments to the initiatives proposed by the Innovator.
- The Judge: Responsible for adjudicating the validity of the Innovator's arguments versus the counterarguments made by the Devil's Advocate for a particular initiative and determining the initiative's likelihood of success.

Players will bring their personal knowledge, experience, and perspectives to debate strategies that will shape critical infrastructure resilience and security in light of potential challenges in maintaining sufficient quantity and quality of water in the future. Players should consider policies, programs, investments, public-private partnerships, research and development, or other actions that, if successfully put into motion today, they believe will better position and prepare one or more critical infrastructure sectors for the future. In preparing for the game, players may want to think about the following questions:

- What risks and opportunities are associated with current trends in water availability?

- What are the implications for future critical infrastructure resilience and security?
- Are there specific ramifications for one or more critical infrastructure sectors?
- Are there other trends that may influence challenges in maintaining sufficient quantity and quality of water in the future?

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, 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.

PLAYING THE GAME

Alternative Futures: Water Availability has three rounds, each of which will present the players with a scenario that could plausibly occur within the next three to seven years. In Round One, the Innovator(s) will have 15 minutes to identify up to three initiatives that will support critical infrastructure resilience and security in response to the specified scenario disruptor. For each initiative, the Innovator(s) will then describe up to three supporting arguments for why the initiative will succeed. The Devil's Advocate will then have 10 minutes to describe up to three counterarguments for each initiative. Each counterargument can be directed at one or more of the arguments presented in favor of the initiative's success or underscore a new concern that may cause the initiative to fail. The Innovator(s) will then have five minutes to rebut any or all of the counterarguments. The Judge will listen to both sides of the debate and ultimately determine if each initiative has a high, medium, or low likelihood of success. The Judge will have five minutes to

present the rationale for his or her determinations and roll a 20-sided die to see if each initiative succeeds or fails.

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.

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

An open discussion period may occur after resolving the success or failure of the initiatives to continue any discussions cut short by previous time constraints.

In Rounds two and three, the participants will rotate roles.

DISRUPTORS

Social, technological, environmental, economic, and political (STEEP) influences have the potential to alter the trajectory of future trends or disrupt them altogether. For example, urbanization is a social disruptor that has the potential to significantly affect the resilience of lifeline sectors and cyberattacks are a technological disruptor with a wide range of cascading implications for all critical infrastructure sectors.

To account for a changing future environment, each round features a STEEP disruptor scenario that may limit player actions, alter the trajectory of current trends in water resources, or require players to consider the implications of an event. The possible scenarios to choose from during the game are described in Appendices I–V. As an added incentive for players to craft compelling arguments and counterarguments, the winning player of each round is awarded the ability to select the STEEP disruptor category for the next round.

WINNING THE GAME

If the Innovator(s) successfully implement(s) a majority of the initiatives, the Innovator(s) win(s) the round. Alternatively, if the Devil's Advocate counters a majority of the initiatives, he or she wins the round. While the game is designed to encourage competition between the players, its main purpose is to generate discussions that develop well-conceived and thought-provoking initiatives. Your collective subject matter expertise is what matters, regardless of the outcomes of each round.

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 Total
	-	Explain game rules (Controller)	5 Min	
	-	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 Min Total
	-	Craft initiatives and present arguments (Innovator(s))	15 Min	
	-	Present counterarguments (Devil's Advocate)	10 Min	
	-	Rebuttal (Innovator(s))	5 Min	
	-	Adjudicate arguments and roll die (Judge)	5 Min	
	-	(Optional) Open discussion period	< 10 Min	
	-	Select STEEP disruptor	1 Min	
Round 2	-	Introduce future scenario based on STEEP disruption (Controller)	5 Min	41–51 Min Total
	-	Craft initiatives and present arguments (Innovator(s))	15 Min	
	-	Present counterarguments (Devil's Advocate)	10 Min	
	-	Rebuttal (Innovator(s))	5 Min	
	-	Adjudicate arguments and roll die (Judge)	5 Min	
	-	(Optional) Open discussion period	< 10 Min	
	-	Select STEEP disruptor	1 Min	
Round 3	-	Introduce future scenario based on STEEP disruption (Controller)	5 Min	40–50 Min Total
	-	Craft initiatives and present arguments (Innovator(s))	15 Min	
	-	Present counterarguments (Devil's Advocate)	10 Min	
	-	Rebuttal (Innovator(s))	5 Min	
	-	Adjudicate arguments and roll die (Judge)	5 Min	
	-	(Optional) Open discussion period	< 10 Min	
Wrap Up	-	Determine final game status of critical infrastructure security and resilience (Controller)	5 Min	20 Min Total
	-	Open discussion period (Players)	15 Min	

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?

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?

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?

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 deposits 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?

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 polyfluoroalkyls[1] 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?

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