

Drinking Water Emergency: Public Health Table Top Exercise

This TTX was adapted from a Virtual Table Top Exercise (VTTX) “City Without Water” created by CDC for use on the FEMA Emergency Management Institute.

Acknowledgments: CDC: Rob Blake, Jonathan Yoder, Tom Jones. FEMA: Douglas Kahn

CONTENTS

INTRODUCTION	1
EXERCISE OBJECTIVES	3
EXERCISE STRUCTURE	4
EXERCISE GUIDELINES	5
MODULE 1: RESPONSE	6
Scenario: Release – Initial Response and Recognition	6
Key Issues.....	7
Questions.....	7
MODULE 2: EXTENDED RESPONSE	9
Scenario: Continued Response – Follow-on effects and aftermath.....	9
Key Issues.....	10
Questions.....	10
MODULE 3: RECOVERY	9
Scenario: Recovery to Safe Water Supply and Public Health Implications.....	9
Key Issues.....	9
Questions.....	10
APPENDIX A: ACRONYMS	A-1
APPENDIX B: DRINKING WATER ADVISORY COMMUNICATION TOOLBOX (DWACT) AND EMERGENCY WATER SUPPLY PLAN (EWSP)	B-1
APPENDIX C: ADDITIONAL RESOURCES FOR SAFE WATER AND SAFE WATER PREPAREDNESS	C-1
APPENDIX D: GLOSSARY	D-1
APPENDIX E: AGING INFRASTRUCTURE INFORMATION	E-1
APPENDIX F: PARTICIPANT FEEDBACK FORM	F-1

INTRODUCTION

Background

The Centers for Disease Control and Prevention (CDC) is sponsoring, in conjunction with the Emergency Management Institute (EMI), a series of Tabletop Exercises (TTX) that are designed to help prepare organizations in the event of a public health emergency. Each TTX presents a different scenario based on anticipated seasonal events and/or potential threats. One of the goals of this series is to increase preparedness for these threats through the collaborative exercises among participating agencies. Successful exercises lead to an ongoing preparedness process for improvements.

CDC serves as the national leader for developing and applying disease prevention and control, environmental health, and health promotion and health education activities designed to improve the health of the people of the United States.

In collaboration with State and local partners, CDC works to strengthen and support the nation's health security by saving lives and protecting against public health threats. Public health preparedness involves a cycle of outreach, planning, capability development, training, exercising, evaluation, and improvement. CDC collaborates with partners at the national, state, local, tribal, and territorial levels to prevent, protect, respond to, mitigate, prepare for, and recover from public health emergencies.

This TTX uses a major water main break of a city's drinking water supply as the scenario to establish a learning environment for participants to exercise their emergency response plans, policies, and procedures for this scenario.

Purpose

The purpose of this exercise is to provide participants with an opportunity to assess their preparedness, response, and recovery protocols, plans, and capabilities for a TTX scenario.

Scope

Players will participate in facilitated discussions within their organizations to address the challenges presented by the scenario, and share those outcomes with the community of participants. Discussions will focus on response coordination, critical decision-making, and the integration of resources necessary to prepare for, respond to, and recover from the loss of a city's drinking water supply.

Core Capabilities

The National Preparedness Goal (September 2015) has directed the focus of homeland security planning toward a capabilities-based approach. Because the timing and specificity of the next disaster is uncertain, this type of planning uses an all-hazards approach to build capabilities that can be applied to a wide variety of incidents. States and urban areas use capabilities-based planning to identify a baseline assessment of their homeland security

efforts by comparing their current capabilities against the Core Capabilities. This approach identifies gaps in current capabilities.

The Core Capabilities are essential for the execution of each of the five mission areas: Prevention, Protection, Mitigation, Response, and Recovery. These capabilities provide the foundation for development of the exercise design objectives and scenario. The purpose of this exercise is to measure and validate performance of these Core Capabilities. The selected Core Capabilities are:

Common to All Mission Areas

Planning - Conduct a systematic process engaging the whole community as appropriate in the development of executable strategic, operational, and/or community-based approaches to meet defined objectives.

Public Information and Warning - Deliver coordinated, prompt, reliable, and actionable information to the whole community through the use of clear, consistent, accessible, and culturally and linguistically appropriate methods to effectively relay information regarding any threat or hazard and, as appropriate, the actions being taken and the assistance being made available. When targeting a specific population (e.g. the elderly, pregnant women, immunocompromised individuals, etc.), identify the communications channel(s) that are most appropriate and impactful.

Operational Coordination - Establish and maintain a unified and coordinated operational structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities.

Response Mission Area: Response includes those capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.

Infrastructure Systems - Stabilize critical infrastructure functions, minimize health and safety threats, and efficiently restore and revitalize systems and services to support a viable, resilient community.

Mass Care Services - Provide life-sustaining services to the affected population with a focus on hydration, feeding, and sheltering to those who have the most need, as well as support for reunifying families.

Situational Assessment - Provide all decision makers with decision-relevant information regarding the nature and extent of the hazard, any cascading effects, and the status of the response.

Environmental Response/Health and Safety – Conduct appropriate measures to ensure the protection of the health and safety of the public and workers, as well as the environment, from all-hazards in support of responder operations and the affected communities.

Recovery Mission Area: Recovery includes those capabilities necessary to assist communities affected by an incident in recovering effectively. It is focused on a timely restoration, strengthening, and revitalization of the infrastructure; housing; a sustainable economy; and the health, social, cultural, historic, and environmental fabric of communities affected by a catastrophic incident.

Economic Recovery - Return economic and business activities (including food and agriculture) to a healthy state and develop new business and employment opportunities that result in a sustainable and economically viable community.

Health and Social Services - Restore and improve health and social services networks to promote the resilience, independence, health (including behavioral health), and well-being of the whole community.

Infrastructure Systems - Stabilize critical infrastructure functions, minimize health and safety threats, and efficiently restore and revitalize systems and services to support a viable, resilient community.

Exercise Objectives

The following exercise objectives were created so the exercise players can develop an effective response based on the scenario and identify opportunities for future improvements related to the scenario.

1. Discuss the ability to conduct a systematic planning process which has engaged the whole community.
2. Discuss the capability to deliver coordinated, prompt, reliable, and actionable information to the whole community using appropriate communications channels.
3. Discuss the capability to establish and maintain a unified and coordinated operational structure and process that integrates all critical stakeholders.
4. Discuss the capability to provide life-sustaining services to the affected population.
5. Discuss the capability to provide decision-makers with decision-relevant information regarding the nature and extent of hazards.
6. Discuss the capability to restore and improve health and social services networks.

Assumptions and Artificialities

In any exercise, assumptions and artificialities may be necessary to complete play in the time allotted. During this exercise, the following apply:

- The scenario is plausible, and events occur as they are presented.
- There is no hidden agenda, and there are no trick questions.
- All players receive the same information at the same time.

MODULE 1

Scenario:

Tuesday, April 17th

Anytown USA, - Tuesday, April 17th: It is an overcast day; the temperature is 50 degrees Fahrenheit with colder weather expected over the next few days.

0430AM- A call comes into the utility about a significant pressure drop.

0445AM- Firefighters and police respond to flooding just north of a busy highway. Cars are attempting to pass through the standing water.

0500AM- The fire department is unable to stop the flow of water from the broken main and call the water utility department for an emergency response.

0530AM- The utility department responds but is also unable to stop the flow of escaping water. In their initial research they find out that a break occurred in a 48 inch water transmission line running directly from the water processing facility.

0630AM- A wastewater pipe near the incident site is also damaged, leading to the possibility of contaminated water.

0700AM- The water utility phone line is overwhelmed and the line remains busy. Inconsistent information about a boil advisory is being spread on social media. Some areas are reporting having no water, while others are reporting a reduced flow.

There have been posts on social media claiming the water is running out, and some are saying there is a strange color and odor in the water. People have begun to go to the stores to buy their own supplies of bottled water. Isolated reports are being made of individuals feeling nauseous and vomiting.

0720AM- A few schools in the area have set a delayed opening, and businesses in the immediate area are altering their hours of operation.

0830AM- The water utility makes a decision to isolate the leaking pipe by shutting off the 48 inch water main transmission line. The utility also puts out a public service announcement that residents should boil their water for consumption, and should conserve water. The utility begins extra sampling.

0930 AM- Some businesses and government offices are being forced to close due to the lack of water. All schools and universities in the county have been closed for the day. Services offered by the local health departments and laboratories are limited.

Eight water tankers have been contracted to bring water to the county to supply fire protection and water needs at hospitals.

Healthcare clinics are closing, and elective surgery cases are being rescheduled by the local hospitals.

The highway is closed in both directions due to flooding.

10 AM - The Community's Chief Executive Officer decides to activate the Emergency Operations Center (EOC) and asks staff to contact key individuals. At noon, the Chief Executive Officer calls an initial meeting of the key individuals. Initial contact is made with appropriate state agencies.

1030 AM – A call comes in to county dispatch stating sinkholes are appearing along a major road next to the main water break.

1130 AM – County workers have isolated the main water break, and have begun to assess the damage to restore pressure.

Key Issues

- There has been a break in the drinking water transmission line that appears to be affecting the county with reduced water pressure or no water.
- Initial response to the scene by the emergency responders and the utility department have been able to turn off the water flow and isolate the problem.
- Rumors on social media are beginning to surface that the water will be out for days and bottled water supplies are being rapidly purchased
- The decision maker for the governing authority has activated the Emergency Operations Center
- Isolated reports of illness are being circulated.
- Key services are unavailable due to the water outage, including medical care with limited functioning.
- The water utility phone lines are overwhelmed, and limits their information dissemination.

Questions

The following questions are provided as suggested general subjects that you may wish to address as the discussion progresses. Please feel free to identify any additional requirements, critical issues, decisions, or questions that should be addressed at this time.

1. What are your priorities as you respond?
2. What are the appropriate local and/or state agencies to involve in your area?
3. What potential public health hazards are beginning to emerge in this event?
4. How do you address water taste and odor complaints?
5. How would you address the reports from local hospitals about the isolated incidents of vomiting?
6. What critical infrastructure could be affected by a water outage? What response procedures will be impacted by the water outage?
7. Is there a message to the public at this point beyond the boil water advisory? How do you communicate with various audiences (general public, schools, vulnerable populations, jail, hospitals, food service and processing, other large users of water in your community)?
8. Can businesses remain open without proper sanitation procedures? Are businesses responsible for providing bottled water for employees?
9. Do you have those messages already prepared? If not, who will help you prepare them?
10. Have you done any community planning (beyond the water utility) for a major drop in water pressure in your water system?
11. Who have you included (or who will you include) in your community planning process, and also in this response?

Module 1 Outbrief

Best Practice and Information Sharing

Considering the preparedness, initial response, continued response and recovery phases discussed during this TTX, please identify elements of your organization's operations that are unique, or could be considered a best practice. Feel free to share strategic, operational, or tactical elements of your response that could benefit others participating in the TTX.

MODULE 2

Scenario:

Tuesday, April 17

12PM- News crews are now coming to the government administration building as well as to the cordoned off area around the scene, and want interviews to explain the situation to their viewers.

County water utility workers move in their largest pumping equipment, but are not able to make much progress on the excavation, given the equipment they have at their disposal, the close proximity of other nearby utility lines.

1 PM- All government offices remain closed. Water cooled IT Servers across the county are failing, limiting local government and businesses capabilities.

130 PM- Residents have now cleared the shelves of bottled water in the stores. Alternate supplies are needed.

200 PM- Downtown businesses are affected including restaurants. Restaurants are questions procedures regarding the use of tap water and ice, as well as necessary changes to dish washing procedures.

345 PM- An increasing number of illnesses have been reported by healthcare facilities that have remained open, as well as on various social media platforms.

930 PM- Crews are able to partially pressurize the system. Most people have water at a reduced pressure, but are still under a boil water advisory.

Key Issues

- The water main break has affected many residents, many businesses, and very large users of water in the community
- Bottled water supplies are exhausted at the stores
- Key public health and healthcare operations are being impacted because of the crisis
- Water is flowing at a lower rate, still providing concern about water for fire suppression.
- There is an increasing number of illnesses reported, but no definitive evidence that it is directly related to the water break.
- Vulnerable populations (e.g., homebound, elderly, immunocompromised) may be experiencing hardship

- Continued questions about a Boil Water Advisory from individuals and businesses.
- Stress from the lack of water crisis is starting to show on the affected individuals. Rumors are circulating that the break was intentional due to the resignation of utility management one week prior.

Questions

The following questions are provided to stimulate discussion. Please feel free to identify any additional requirements, critical issues, decisions, or questions that should be addressed at this time.

1. What are your priorities for the response at this stage?
2. How do you reach specific groups? What are the specific messaging strategies for reaching different populations and groups of people? How do you make sure they hear your message?
3. What resources do you still need during this stage?
4. How do response agencies coordinate messaging to the public?
5. What new public health issues are surfacing?
6. Who is working on public messaging from what agencies? Is there a good Joint Information Center (JIC)? What agencies are located in the JIC? How is this achieved?
7. What systems do you have to determine the cause of suspected illnesses? How do you communicate with healthcare providers?
8. Now that most households and businesses have water, how do you communicate that a Boil Water Advisory is still in affect?
9. How do you address rumors saying the water break was intentional? Who is the best figure to portray this message?

Module 2 Outbrief

Best Practice and Information Sharing

Considering the preparedness, initial response, continued response and recovery phases discussed during this TTX, please identify elements of your organization's operations that are unique, or could be considered a best practice. Feel free to share strategic, operational, or tactical elements of your response that could benefit others participating in the TTX.

MODULE 3

Scenario:

Wednesday, April 18th

5AM – pipes are now replaced and an early test is being conducted to see if there are leaks. Pressure to the water distribution system is gradually being restored. Water sampling is continued. Residents are now calling in about rusty colored water. Flushing of the system is done through fire hydrants. The boil water advisory continues until sampling shows that it can be lifted

8AM- Although the situation is improving, the water is still discolored and the boil water advisory is still in place. There is a growing sense of agitation and dissatisfaction in the community.

9AM- Schools and businesses are reopened. Schools are not allowing students to wash their hands after using the restroom, and students are required to bring their own water from home to drink.

10AM- The health department opens an investigation regarding illnesses potentially related to contaminated drinking water.

1030 AM- The hospital has run out of their reserve of water resources.

11AM- Labs utilized by the utility are unable to process samples due to health and safety concerns about not being able to use the eyewash station in the event of an emergency.

12PM- Some restaurants in town have reopened, while others remain closed. The local news has started reporting on why certain restaurants remain open.

1230 PM- Individuals on social media are saying pitcher or faucet water filters are safe to use in lieu of boiling water.

Key Issues

- Key water users (e.g. hospitals, schools) have had to use alternate water supplies or have run out
- Distribution issues for bottled water to the community is limited and not readily available
- Boil water advisory holds until water pressure is restored
- Follow up on if the illness outbreaks are related to water contamination

- Guidance on handwashing is unclear

Questions

The following questions are provided as suggested general subjects that you may wish to address as the discussion progresses. Please feel free to identify any additional requirements, critical issues, decisions, or questions that should be addressed at this time.

1. What public health protective measures are needed?
2. What resources are still needed at this stage of response?
3. How do you investigate illness outbreaks?
4. Is there a need for flushing the pipes after the boil water advisory is lifted?
5. What policy changes, if any, are needed? What response partners would have been useful during this response?
6. Has your community addressed the effects of an aging water system? What remedies have been discussed?
7. Are there facilities that can remain open during a boil water advisory?
8. How do you communicate with schools about proper hygiene during a boil water advisory?

Module 3 Outbrief

Best Practice and Information Sharing

Considering the preparedness, initial response, continued response and recovery phases discussed during this TTX, please identify elements of your organization's operations that are unique, or could be considered a best practice. Feel free to share strategic, operational, or tactical elements of your response that could benefit others participating in the TTX.

MODULE 4

Scenario:

Thursday, April 18th

9 AM - The boil water advisory is lifted in conjunction with the state regulatory agency. An emergency meeting of the elected board of officials is held to publicly discuss the incident and why it took so long for the city water supply to be restored. Angry residents show up in force wanting to make comments about the incident.

Questions

The following questions are provided as suggested general subjects that you may wish to address as the discussion progresses. Please feel free to identify any additional requirements, critical issues, decisions, or questions that should be addressed at this time.

1. How do you know when to change the operation from response to recovery?
2. How will your public messaging need to change?
3. What reassurance will the public and businesses need to use the water?
4. When will you know that you no longer need support from resources?
5. Were there any resources not included in this response that should have been considered?

Module 4 Outbrief

Best Practice and Information Sharing

Considering the preparedness, initial response, continued response and recovery phases discussed during this TTX, please identify elements of your organization's operations that are unique, or could be considered a best practice. Feel free to share strategic, operational, or tactical elements of your response that could benefit others participating in the TTX.

APPENDIX A: ACRONYMS

Acronym	Term
AAR	After Action Report
AWWA	American Water Works Association
CDC	Centers for Disease Control and Prevention
DHS	US Department of Homeland Security
DWACT	Drinking Water Advisory Communication Toolbox
EEG	Exercise Evaluation Guide
EMI	Emergency Management Institute
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EWSP	Emergency Water Supply Plan
FEMA	Federal Emergency Management Agency
HSEEP	Homeland Security Exercise and Evaluation Program
ICS	Incident Command System
JIC	Joint Information Center
LEPC	Local emergency planning committee
PIO	Public Information Officer
POC	Point of Contact
SA	Situational Awareness
SME	Subject Matter Expert
USG	US Government
TTX	Tabletop Exercise

APPENDIX B: DRINKING WATER ADVISORY COMMUNICATION TOOLBOX (DWACT) AND EMERGENCY WATER SUPPLY PLAN (EWSP)

DWACT:

The Drinking Water Advisory Communication Toolkit (DWACT) is a collaborative effort by several agencies and other partners. The goal of the DWACT is to provide a protocol and practical toolbox for communicating with stakeholders and the public about water advisories. The project addresses the range of situations that generate drinking water advisories, but the current DWACT mainly focuses on microbiological contamination. An updated version of the DWACT addressing other forms of contamination will be available soon.

Link: <http://www.cdc.gov/healthywater/emergency/dwa-comm-toolbox/>

EWSP:

The Emergency Water Supply Plan (EWSP) is developed for health care facilities to prepare for, respond to, and recover from a partial or total disruption of normal water supply. Health care facility staff, as well as representatives from external partners, created the EWSP. After development, the document is normally revised annually. The EWSP is designed to help health care facilities comply with the facilities' Emergency Operations Plans (EOP). Elements of a EWSP include: a facility description; a water supply description; water demand during normal and emergency situations; an equipment and materials list; a backflow prevention plan; a maintenance plan; copies of all contracts and other agreements related to supplying emergency water and other supplies that would be used in an emergency; a menu of emergency supply alternatives; operational guidelines and protocols that address treatment process and water quality testing; an implementation timeline during an emergency; a recovery plan; a post-incident surveillance plan; and a EWSP evaluation and improvement strategy.

Link: <http://www.cdc.gov/healthywater/pdf/emergency/emergency-water-supply-planning-guide.pdf>

APPENDIX C: ADDITIONAL RESOURCES FOR SAFE WATER AND SAFE WATER PREPAREDNESS

CDC's **Water, Sanitation, & Hygiene (WASH)-related Emergencies & Outbreaks** webpage <http://www.cdc.gov/healthywater/emergency/drinking/index.html>

http://www.cdc.gov/healthywater/drinking/public/water_quality.html is the CDC page on Drinking Water

EPA provides some guidance for the safe emergency disinfection of drinking water <https://www.epa.gov/ground-water-and-drinking-water/emergency-disinfection-drinking-water>

EPA Drinking Water Standards and Regulations may be found here: <https://www.epa.gov/dwstandardsregulations>

FDA has included a water focused exercise in The Food Related Emergency Exercise Bundle (FREE-B). **Wat'er You Thinking** is a scenario that focuses on the investigation of the possible contamination of the water supply in an industrial town and illustrates the importance of water safety from all parties involved in the treatment, storage, and distribution of water. The exercise also highlights the significance of collaborating in a diverse team of professionals, establishing roles and responsibilities, and responding to an urgent event.

<http://www.fda.gov/Food/FoodDefense/ToolsEducationalMaterials/ucm295902.htm>

Wat'er You Thinking (ZIP, 2.61MB) - This scenario focuses on the investigation of the possible contamination of the water supply in an industrial town and illustrates the importance of water safety from all parties involved in the treatment, storage, and distribution of water.

Technical Guidance applicable to Continental US (CONUS) Army water systems classified as Public Water Systems can be found here:

[https://phc.amedd.army.mil/PHC%20Resource%20Library/TG179 ComplyingwiththeSafeDrinkingWaterAct April2015.pdf](https://phc.amedd.army.mil/PHC%20Resource%20Library/TG179%20ComplyingwiththeSafeDrinkingWaterAct%20April2015.pdf)

APPENDIX D: GLOSSARY

Advisory: Communication to water users about specific actions to take regarding water use.

After Action Review (AAR): A structured and facilitated discussion among participants in an event to compare what actually happened with what was intended to occur.

Boil Water Advisory: Communication to customers of a water system about the need to boil water before using it.

Contaminant: An unwanted and/or undesirable chemical or microbe found in drinking water.

Corrective Action: The activities taken by a water system to fix an identified deficiency.

Crisis communication: A communication approach that relays the risks and benefits of different actions to agencies, consumers, and other stakeholders during an emergency or disaster.

Drinking Water Advisory: Water systems and state or local agencies issue drinking water advisories when they believe water quality is or may be compromised. Advisories tell individuals, schools, hospitals, businesses, and others about the situation and how to take immediate action.

Debriefing: An informal, semi-structured discussion with stakeholders, partners, and other participants, after an advisory, exercise, or event, used to obtain useful information and improve or enhance operations.

Do Not Drink advisory: Communication to customers of a water system to avoid tap water and to use other sources of water for human consumption. A Do Not Drink advisory is used if boiling the water will not kill, inactivate, or remove the contaminant of concern, or if boiling would concentrate or release it into the air.

Do Not Use advisory: Communication to customers of a water system not to use tap water for any purpose, including sanitation and fire protection.

Emergency Operations Center (EOC): a central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management functions at a strategic level during an emergency

Emergency Response Plan (ERP): a plan of action for the efficient deployment and coordination of services, agencies and personnel to provide the earliest possible response to an emergency.

Fecal coliform indicators: Groups of microbes, such as *E. coli*, enterococci, and coliphage, used under the Groundwater Rule to indicate possible water contamination.

Flapper Valve: a valve which opens and shuts upon one hinged side

Groundwater: Water from wells, springs, or aquifers used by water systems for drinking water.

Hot Wash: An after-event discussion and evaluation.

Joint Information Center: A location where personnel with public information responsibilities perform critical emergency information functions, crisis communications, and public affairs functions.

Mandatory advisory: A notice or communication required by federal or state law and issued to protect public health.

Notification: The process of communicating information to audiences per Environmental Protection Agency (EPA) requirements.

The National Preparedness Goal: “A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk.”

Precautionary advisory: Communication to customers of a water system issued when contamination is suspected but not confirmed.

Primacy agency: The agency that regulates and enforces community water systems under the Safe Drinking Water Act. Drinking water programs can be located in a state department of health, a state department of environment, or at the regional Environmental Protection Agency (EPA) level.

Transmission Line: (See also: Water Main) A principal pipe in a system of pipes for conveying water, especially one installed underground. A principal pipe in a system of pipes for conveying water, especially one installed underground.

Spokesperson: An individual responsible for interfacing with the public, the media, and/or other agencies requiring information about an incident.

Surface water: Water that collects on the ground and in an open body of water, such as a lake, stream, river, or pond.

Vulnerable Populations: Groups of people with conditions or medical needs that make them more vulnerable to the adverse effects of poor water quality. Susceptible populations include babies and young children, pregnant women, and people who are immunocompromised, elderly, or on dialysis.

Water Main: (See also: Transmission Line) A principal pipe in a system of pipes for conveying water, especially one installed underground.

APPENDIX E: AGING INFRASTRUCTURE INFORMATION

Aging water infrastructure is a growing problem in the US; EPA estimates that 240,000 water main breaks occur in the US each year¹. The high number of breaks is indicative of a water distribution system in a dire situation. Water infrastructure installed in the late 1800s has an average lifespan of 120 years²; in the 1920s, 100 years³; and after World War II, 75 years⁴. Unfortunately, these variations in lifetime, due to changes in construction and materials, fall so that a large portion of the US water distribution infrastructure is near the end of its life. Since the number of breaks increases near the end of a system's service life⁵, water main breaks are expected to be a significant challenge in the future.

Aging infrastructure has wide-ranging effects. Research in Britain suggest that low-pressure events, typically caused by water main breaks, increase the incidence of gastrointestinal illness⁶. In addition to causing harmful health effects, the state of water infrastructure in the US has economic consequences as well. An estimated 1.7 trillion gallon of water is lost from distribution systems each year⁷, at cost of \$2.6 billion per year.

Solving the problem is as expensive as it is complex; the American Water Works Association estimates that the investments needed for buried drinking water infrastructure total more than \$1 trillion over the next 25 years⁸.

¹ "Aging Water Infrastructure Research Program Addressing the Challenge through Innovation." <http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=6000012A.txt>. EPA, 2007. Web. 30 June 2016.

² "Reinvesting in Drinking Water Infrastructure." American Water Works Association, May 2001. Web. 30 June 2016.

³ Ibid.

⁴ Ibid.

⁵ "Aging Water Infrastructure Research Program Addressing the Challenge through Innovation."

⁶ Hunter, P. R., R. M. Chalmers, S. Hughes, and Q. Syed. "Self-Reported Diarrhea in a Control Group: A Strong Association with Reporting of Low-Pressure Events in Tap Water." *Clinical Infectious Diseases* 40.4 (2005): n. pag. Web. 30 July 2016.

⁷ Ibid.

⁸ "Buried No Longer: Confronting America's Water Infrastructure Challenge." (n.d.): 2. American Water Works Association, 2011. Web. 30 June 2016.

APPENDIX F: PARTICIPANT FEEDBACK FORM

Please enter your responses in the form field or check box after the appropriate selection.

Name: _____ **Title:** _____

Agency
:

Role: Player Facilitator Observer Evaluator

Part I: Recommendations and Corrective Actions

1. Based on the discussions today and the tasks identified, list the top three strengths and/or areas that need improvement.

1. _____
2. _____
3. _____

2. Identify the action steps that should be taken to address the issues identified above. For each action step, indicate if it is a high, medium, or low priority.

Corrective Action	Priority

3. Describe the corrective actions that relate to your area of responsibility. Who should be assigned responsibility for each corrective action?

Corrective Action	Recommended Assignment

Corrective Action	Recommended Assignment

4. List the policies, plans, and procedures that should be reviewed, revised, or developed. Indicate the priority level for each.

Item for Review	Priority

Part II: Assessment of Exercise Design and Conduct

Please rate, on a scale of 1 to 5, your overall assessment of the exercise relative to the statements provided below, with 1 indicating strong disagreement with the statement and 5 indicating strong agreement.

Assessment Factor	Strongly Disagree					Strongly Agree				
The exercise was well structured and organized.	1	2	3	4	5	1	2	3	4	5
The exercise scenario was plausible and realistic.	1	2	3	4	5	1	2	3	4	5
The multimedia presentation helped the participants understand and become engaged in the scenario.	1	2	3	4	5	1	2	3	4	5
The facilitator(s) was knowledgeable about the material, kept the exercise on target, and was sensitive to group dynamics.	1	2	3	4	5	1	2	3	4	5
The Situation Manual used during the exercise was a valuable tool throughout the exercise.	1	2	3	4	5	1	2	3	4	5
Participation in the exercise was appropriate for someone in my position.	1	2	3	4	5	1	2	3	4	5
The participants included the right people in terms of level and mix of disciplines.	1	2	3	4	5	1	2	3	4	5

Part III: Participant Feedback

What changes would you make to this exercise? Please provide any recommendations on how this exercise or future exercises could be improved or enhanced.
