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Responding to Threats and Incidents of Intentional Drinking Water Contamination

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Both water contamination *threats* and intentional water contamination *incidents* could be designed to disrupt the delivery of safe water to a population, interrupt fire protection, create public panic, or cause disease or death in a population. A water contamination threat occurs when the introduction of a contaminant into the water system is threatened, claimed, or suggested by evidence. A water contamination incident occurs when a contaminant is successfully introduced into the water supply. A water contamination incident may be preceded by a threat, but not always. Both water contamination threats and incidents may be of particular concern due to the range of potential consequences:

1. Creating an adverse impact on public health within a population
2. Disrupting system operations and interrupting the supply of safe water
3. Causing physical damage to system infrastructure
4. Reducing public confidence in the water supply
5. Long-term denial of water and the cost of remediation and replacement.

Some of these consequences would only be realized in the event of a successful contamination incident; however, the mere threat of contamination can have an adverse impact on a water system if improperly handled.

In characterizing any threat, both the *possibility* and *probability* should be considered. A general assessment of the threat of intentional contamination of drinking water indicates that it is possible to cause varying degrees of harm through contamination of the drinking water supply. However, an evaluation of past incidents at drinking water facilities would indicate that the probability of an actual contamination incident is relatively low, but the probability of a contamination threat is relatively high. Many of the apparent security breaches at drinking water utilities that have occurred since 9/11 have been perceived as potential contamination incidents. Although a few threats have been verbal, most have been circumstantial, such as a low-flying airplane over a reservoir or a lock cut from the hatch of a distribution system storage tank. Given the possibility of contamination, many utilities choose to treat these security breaches as potential contamination threats.

Vulnerabilities to intentional contamination exist in all drinking water systems. While it may be possible to improve security at some critical system locations to reduce the level of vulnerability, it is impossible to eliminate all vulnerabilities. Thus, the contamination threat may be most effectively managed through thorough planning, careful evaluation of any specific threats, and implementation of appropriate response actions.

Managing a Contamination Threat

Management of a contamination threat involves: 1) planning for the response prior to an incident, 2) evaluating the credibility of the threat, and 3) implementing appropriate response actions based on available information and the circumstances of the situation. This article provides an overview of the

process for managing a contamination threat, while more detailed guidance is available from the *Response Protocol Toolbox: Planning for and Responding to Drinking Water Contamination Threats and Incidents* (EPA 2003a). This toolbox is organized into six modules, which discuss water utility planning (EPA 2003b), water contamination threat management (EPA 2003c), site characterization and sampling (EPA 2003d), sample analysis (EPA 2003e), public health response, and water system remediation and recovery. Additional resources for drinking water security in general may be found at the EPA Water Security Division website (http://www.epa.gov/safewater/security/).

1. Planning a Response to Contamination Threats

Planning is the foundation of making good response decisions. For water contamination threats and incidents, planning takes on a special meaning because of the multitude of potential and/or threatened contaminants, whether they are biological, chemical, or radiological. However, to paraphrase the World Health Organization, it is neither possible nor necessary to specifically plan for attack with all possible contaminants, but increasing preparedness to counter the effects for such an attack by planning and preparation can provide the capabilities to deal with a wide range of possibilities (WHO 2003).

Planning for any type of emergency, including water contamination threats and incidents, begins at the local level. Officials within the utility and local government will have a collective knowledge of the organizations and systems that exist to provide support during an emergency. During this planning, the utility and local or state authorities will need to determine:

1. Who will respond to the initial threat?
2. Who will determine if the threat is possible or credible?
3. Who will evaluate the site and collect samples?
4. Who will perform analyses?
5. Who will make public health decisions?
6. Who will manage remediation and recovery activities?

In many cases, the answers to these questions will not be immediately evident, or may vary with the circumstances of the situation. This is especially true in the case of drinking water contamination threats where it is unclear whether or not the water has been contaminated and presents a threat to public health. Proper planning should establish roles and responsibilities of various parties under a variety of scenarios. There are many planning activities that a drinking water utility can undertake to improve preparedness and the ability to respond effectively to a drinking water contamination threat or incident, and several are briefly described below.

1. Know your water system: This includes documentation of construction, design, operation, and personnel; assessment of vulnerabilities to contamination threats; and identification of critical customers.
2. Update Emergency Response Plans: Many utilities have existing Emergency Response Plans (ERPs); however they may need to be updated to cover terrorist threats, including intentional contamination.
3. Develop Response Guidelines: A set of Response Guidelines (RG) is a streamlined, action-oriented, easy-to-follow document that is intended to support responders and decision officials in the midst of a crisis. An RG might include organizational charts, notification trees, contact information, standard operating procedures, decision trees, and reporting forms among other tools.
4. Establish Structure for Incident Command: The leadership and chain-of-command must be clearly established prior to an actual threat or incident. There is a formal *Incident Command System* that has been adopted by many response organizations (FEMA 2003). Incident Command for drinking water response is intricate because the water utility may be handling the early stages of the threat evaluation, while other parties, such as law enforcement, may be in charge during later stages (EPA 2003b).
5. Develop Information Management Strategy: Timely and accurate information will be key to evaluating the credibility of a threat and taking steps to protect public health as necessary. A system should be in place to manage the flow of this critical information.
6. Establish Communication and Notification Strategy: Predefined communication pathways and notification trees are essential to the effectiveness of any incident command

structure and will help to ensure that important parties are notified at the right time.

7. Perform Training and Conduct Desk/Field Exercises: Training and practice are essential to the proper application of any emergency plan (e.g., ERP, RG). Desk-top or field exercises that involve all of the key players are a valuable test of the plan.
8. Enhance Physical Security: Enhancements to physical security at sites identified as particularly vulnerable to contamination, or which have been subject to intrusion in the past, may significantly reduce false alarms that would otherwise expend utility resources.
9. Establish a Baseline Monitoring Program: Unusual water quality data or consumer complaints may indicate a potential problem, but only if the results can be compared against an established baseline that accounts for normal fluctuations.

2. Evaluating a Contamination Threat

A contamination threat is typically triggered by an occurrence or discovery that indicates the potential for water contamination. Several potential *threat warnings* are summarized in Figure 1. Threat warnings occur on a regular basis if they are monitored; however, the vast majority are due to harmless activity and require no response. Nonetheless, every threat of potential drinking water contamination should be evaluated in order to identify the handful of credible threats that might exist among the large number of threat warnings.

The overall response to a contamination threat is schematically depicted in Figure 2 and indicates two parallel and inter-related activities: the threat evaluation and response actions. A fundamental principle of this process is the concept of expanded response actions as the credibility of the threat increases. This is intended to avoid both under- and over-response to a contamination threat since both have potential adverse consequences to the public. For example, a complete lack of response to a credible threat might put the public at an unacceptable risk of exposure to a harmful contaminant. On the other hand restrictions placed on water usage, such as a notice not to drink the water, in response to a threat that has not been determined to be credible carries its own consequences.

A *threat evaluation* is a process that considers available information about a contamination threat to determine if it is "*possible*," "*credible*," or a "*confirmed*" incident. Each of these stages is depicted in Figure 2 as a decision point and described in more detail below:

1. Stage 1: "Is the threat possible?" A water contamination threat is characterized as "possible" if the circumstances of the threat

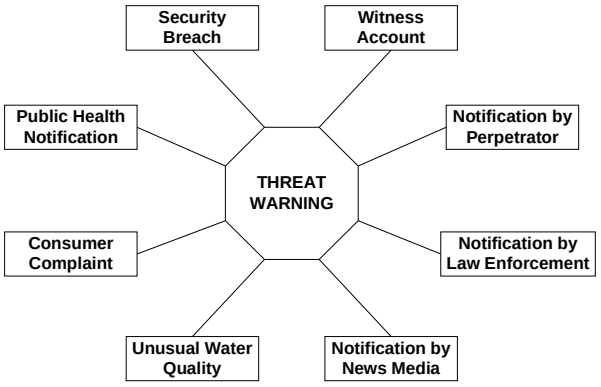

Figure 1. Summary of Threat Warnings

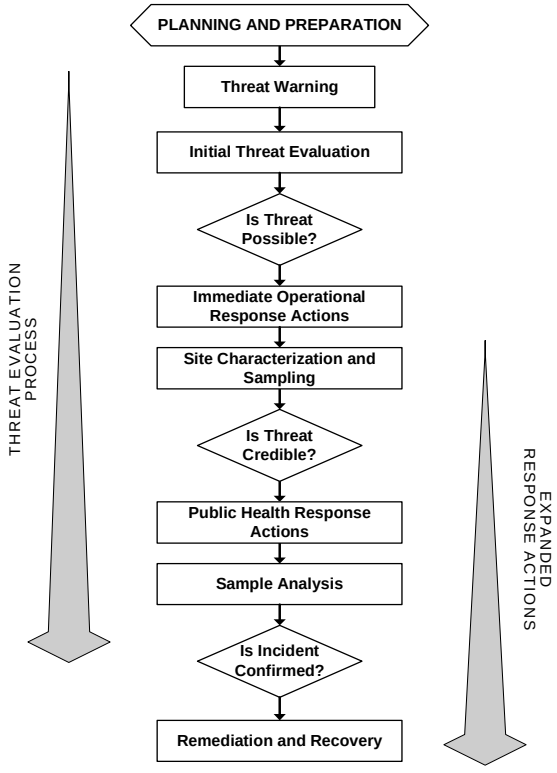

Figure 2. Overview of Response to a Contamination Threat

warning appear to have provided an opportunity for contamination. Response to a "possible" threat might include immediate operational response actions in an attempt to contain the water, and collection of additional information to help establish whether or not the threat is "credible." Site characterization activities are designed to collect additional information to support this determination.

2. Stage 2: "Is the threat credible?" A water contamination threat is characterized as "credible" if information collected during the threat evaluation process (e.g., site characterization activities) corroborates information from the threat warning. The threshold at the credible stage is higher than that at the possible stage, thus more significant response actions might be considered, such as restrictions on public use of the water (e.g., issuance of a "do not drink" notice). Furthermore, steps should be initiated to confirm the incident and positively identify the contaminant.
3. Stage 3: "Has the incident been confirmed?" A water contamination incident is "confirmed" if the information collected over the course of the threat evaluation provides definitive evidence that the water has been contaminated. Response actions at this point include all steps necessary to protect public health, supply the public with an alternate source of drinking water, and begin remediation of the system.

3. Responding to a Contamination Threat

Figure 2 illustrates the elevation of potential response actions as the threat evaluation progresses through the "possible," "credible," and "confirmed" stages. In addition to the results of the threat evaluation, consideration should be given to the potential consequences of the suspected contamination incident as well as the impact of response actions on consumers. The consequences of contamination are a function of contaminant properties (e.g., toxicity, infectivity, persistence in water, etc.), the concentration profile of the contaminant through the system, and the population within the contaminated area. In many cases, it will be difficult to accurately assess the potential consequences since the identity of the contaminant may be unknown and the information necessary to estimate the spread of the contaminant through the system may be unavailable. Nonetheless, even an estimate of potential consequences within a couple orders of magnitude may be useful in making decisions regarding response actions (e.g., are tens or thousands of people potentially affected?).

Various response actions will have different impacts on consumers. For example, immediate operational response actions such as containment may go unnoticed by the public. On the other hand, restrictions on water usage could have a substantial, negative impact on consumers. Consumers may need to find an alternate supply of water for consumption and food preparation. For the most severe restrictions, sanitation and fire fighting may also be adversely impacted.

Early in the response to a contamination threat, before credibility has been established and consequences evaluated, relatively low impact response actions would be appropriate. For example, isolation of a storage tank, reservoir, or small area of the distribution system might be a suitable response to a 'possible' contamination threat. Once a threat has been deemed 'credible' it may be necessary to take steps to limit public exposure. This might involve more extensive isolation, or if the suspect water cannot be contained, it may be necessary to notify the public and place restrictions on water usage (i.e., issue a "do not drink" order). Finally, once a contamination incident is confirmed, all actions necessary to limit exposure and protect public health should be initiated. Furthermore, it will be necessary to arrange for an alternate water supply and begin planning for remediation activities.

Summary

All drinking water systems have some degree of vulnerability to contamination, and analysis shows that it is possible to contaminate drinking water at levels causing varying degrees of harm. Furthermore, experience indicates that the threat of contamination, overt or circumstantial, is probable. Thus, there is a clear need to address the contamination threat. While certain steps may be taken to reduce the vulnerabilities and prevent intentional contamination, it is impossible to completely eliminate this vulnerability, although a utility could spend a lot of resources trying to do so. Instead, it may be more effective to plan for responding to contamination threats that do arise.

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