EPA
United States
Environmental Protection
Agency

Wastewater Response Protocol Toolbox:
Planning For and Responding To Wastewater Contamination Threats and Incidents

December 2011

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Note to Readers

The U.S. Environmental Protection Agency (EPA) prepared the Wastewater Response Protocol Toolbox (WWRPTB) to assist utilities, government agencies, and emergency responders in protecting wastewater systems from contamination events. This document is designed to be a preparedness tool but does not impose legally binding requirements on EPA, states, or utilities. Additionally, the guidance may or may not apply to a particular incident. EPA and state decision-makers retain the discretion to adopt approaches on a case-by-case basis that may differ from these guidelines. Any decisions regarding a particular wastewater system should be made based on the applicable statutes and regulations. Therefore, interested parties are free to raise questions and objections about the appropriateness of the application of this guide to a specific situation, and EPA will consider whether the recommendations or interpretations in this guide are appropriate in that situation based on the law and regulations which are not discussed in this document.

EPA may modify this guide in the future. To determine whether EPA has modified this guide, or to obtain additional copies, visit EPA's Water Security website at http://www.epa.gov/watersecurity.

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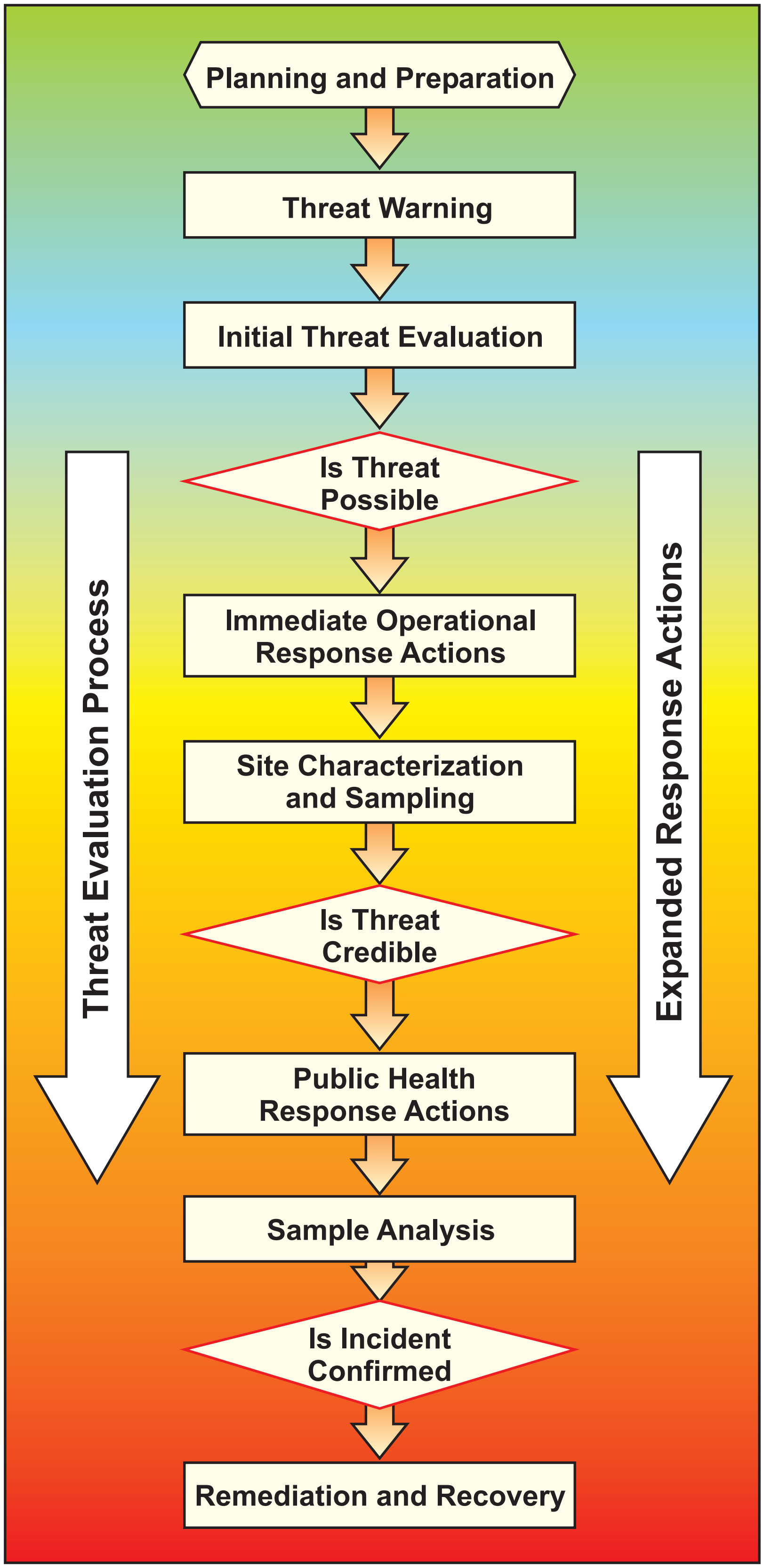
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Introduction

In 2004, the United States Environmental Protection Agency (EPA) published guidance on planning for and responding to threats and incidents of intentional contamination of public drinking water supplies. This document is entitled the *Response Protocol Toolbox: Planning for and Responding to Drinking Water Contamination Threats and Incidents* (RPTB) (EPA-817-D-03-007, December 2003). EPA prepared detailed guidance specifically for the intentional contamination scenario because of the scenario's potential for a rapid and direct impact on public health. EPA subsequently released a condensed version of the RPTB, entitled the *Water Security Handbook* (EPA-817-B-06-001, April 2006), to reach a wider audience. While the shorter document does not include all of the details examined in the comprehensive version, it summarizes the most essential information. Additionally, EPA published the *Response Guidelines* (EPA-817-D-04-001, August 2004), a condensed document which includes forms and checklists from the RPTB. The *Response Guidelines* is an easy to use field document for responders managing an ongoing contamination threat or incident. All of these documents are available at EPA's Water Security website www.epa.gov/watersecurity.

Wastewater utilities are also potentially targets of malevolent acts including contamination. They may be a direct target of intentional contamination, or an indirect target by receiving water from a contaminated drinking water system or wash water from decontamination efforts directed toward contaminated people, buildings, etc. The document contained herein, the *Wastewater Response Protocol Toolbox* (WWRPTB), addresses the preparedness and response needs for threats and contamination events

in wastewater systems. These events can include contamination with toxicants as well as infectious, flammable, explosive, or radioactive substances. As an "all hazards" document, the WWRPTB discusses the response to accidental and negligent contamination events in addition to its primary focus on intentional contamination.

Rather than produce both an extended version and a condensed version, an attempt has been made with the WWRPTB to develop a mid-sized document that contains some detailed information but is still of a manageable size. The *Wastewater Response Protocol Toolbox* was developed as a collaborative effort between EPA and the wastewater industry. The following utilities and industry organizations took part in this process:

- Metropolitan Water Reclamation District of Greater Chicago
- New York City Department of Environmental Protection
- Pittsburgh Water and Sewer Authority (PWSA)
- San Antonio Water System (SAWS)
- Water Environment Federation
- Water Environment Research Foundation

In addition, the following individuals assisted with the preparation of this document:

- Jeffrey Brenner - Minnesota Department of Health
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- Homer Emery - San Antonio Water System
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- Matthew Magnuson - United States Environmental Protection Agency
- Joshua Novikoff - United States Environmental Protection Agency
- John Petito - New York City Department of Environmental Protection
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- Roy Ramani - Water Environment Research Foundation
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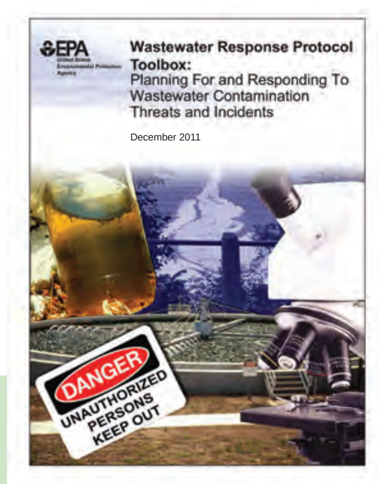
Overview of the Response Protocol Toolbox



The format of the *Wastewater Response Protocol Toolbox* is identical to that of its drinking water counterpart. The guidance document is composed of six interrelated modules (Modules 1-6) in addition to this introductory section.

The six modules that constitute the Wastewater Response Protocol Toolbox are:

Toolbox Module

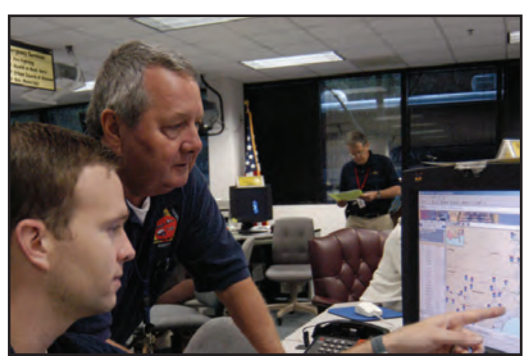
1. Wastewater Utility Planning Guide
2. Contamination Threat Management Guide
3. Site Characterization and Sampling Guide
4. Analytical Guide
5. Public Health and Environmental Impact Response Guide
6. Remediation and Recovery Guide

Module 2 is considered to be the hub of the Toolbox in that it describes the overall recommended management process for response to a contamination threat.

The WWRPTB is designed to be a planning tool. It is not intended to be a reference document for use during an actual emergency when decisions need to be made rapidly. Rather, it should be read ahead of time and integrated into a utility's Emergency Response Plan. The Toolbox is not prescriptive, but consists of broad guidance that should be adapted to local conditions. Furthermore, the WWRPTB is not based on any statutory authority and, therefore, contains no mandatory requirements. Use of the Toolbox is voluntary. It is merely provided as a tool to aid utilities in planning for contamination threats and events.

The WWRPTB offers recommendations on the following emergency response issues:

- Who to notify
- What actions to take
- How to conduct a threat evaluation
- How to safely collect and ship samples
- How to analyze samples
- Steps to recover from a contamination event



However, the WWRPTB does not attempt to answer questions concerning who will be involved in the various stages of response such as:

- Who should respond
- Who should sample
- Who should conduct analyses
- Who should make public health decisions
- Who should manage remediation and recovery efforts

These questions are best answered by utilities and municipal, county, state, and Federal authorities who have direct knowledge of local and regional capabilities for responding to contamination threats, the scope and extent of the incident, as well as information regarding any applicable legal or regulatory requirements and standard operating procedures.

There are several ways in which utilities can use the information contained in the WWRPTB:

- Planning a utility's response to contamination threats and incidents
- Revising Emergency Response Plans
- Developing Response Guidelines

An Emergency Response Plan (ERP) is a utility's overall standard operating procedure for dealing with a variety of emergencies including natural disasters and accidents as well as manmade events. Response Guidelines, also known as Action Plans, are tailored to ERPs that address specific major events. They describe the response actions to take for events that may occur at specific facilities (e.g., treatment plant, lift stations).

In addition to serving as a planning tool for utilities, the WWRPTB can be used as a reference by laboratories, regulatory agencies, health departments, and emergency response organizations when they are preparing their response plans for dealing with wastewater contamination incidents.

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Wastewater Response Protocol Toolbox:

Planning For and Responding To Wastewater Contamination Threats and Incidents

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Module 1:
Wastewater Utility Planning Guide

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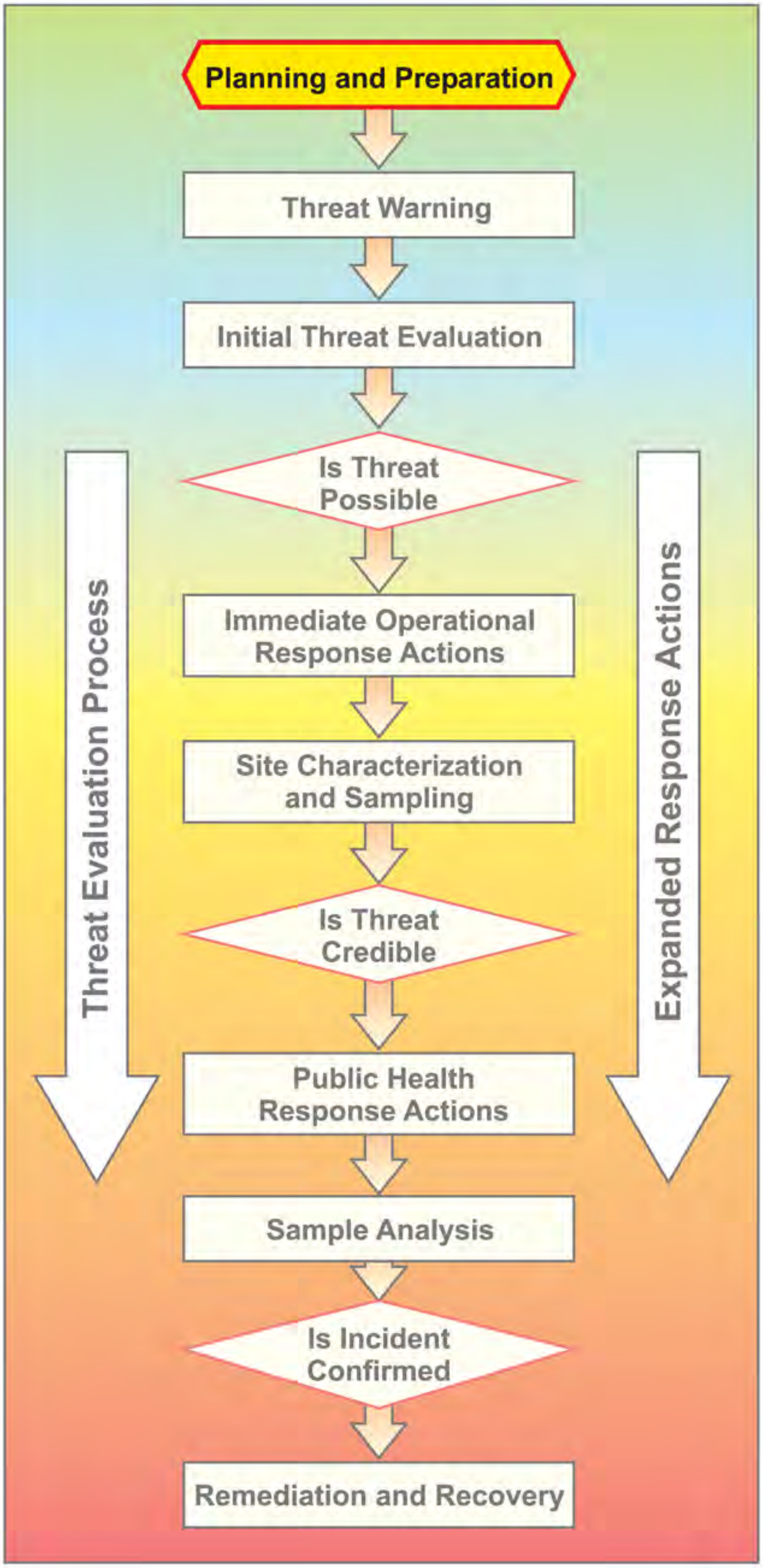
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1 Introduction

Module 1 is an overall guide to utility planning for contamination threats and incidents involving wastewater systems. The module provides a brief discussion of the nature of contamination events and describes the planning activities that a utility may undertake to prepare for a response. All stakeholders involved in planning for or responding to a contamination threat or incident should review this module. This includes utilities, emergency responders, regulators, and health agencies. Modules 2 through 6 provide information that expands on Module 1.

Specific topics covered in Module 1 include:

1. Introduction
2. Contamination threats and incidents
3. Considerations in responding to contamination threats
4. How to prepare for a contamination threat or incident

2 Contamination Threats and Incidents

2.1 Overview of Contamination Threats and Incidents

A wastewater contamination **threat** occurs when the introduction of an atypical contaminant, or abnormal volumes of a more common contaminant, is threatened or suggested by initial evidence. A contamination **incident** occurs when a contaminant has actually been added to a wastewater system. An incident may be preceded by a threat, but not always.

Intentional or accidental contamination threats and incidents are of concern to wastewater utilities due to the range of consequences that may result. These include:

- Injury, illness, or death among utility workers or the public if flammable or explosive substances are involved, or if harmful vapors or aerosols are released.
- Disruption of system operations and interruption of the collection, treatment, and disposal of wastes. This could result, for example, from the introduction of toxic substances that inactivate the microbial community that is an essential component of secondary treatment.
- Physical damage to the wastewater infrastructure. This may be caused by the introduction of flammable or explosive substances into the collection system or treatment plant. There could also be damage to streets, private property, and other utility infrastructure (drinking water, gas, electric, etc.) located near the sewer system.

- Damage to the environment or downstream users of receiving waters such as drinking water treatment systems. This could occur if contaminants were not removed by the wastewater treatment process and passed through the plant.

- Significant costs incurred for decontamination or replacement of portions of the wastewater system. These costs could result from the introduction of long lasting and difficult to remove contaminants such as radionuclides or pathogenic bacterial spores.

- Economic impact on the wastewater utility and the community associated with interruption of sanitary services.

A key question is whether it is **possible** for accidental or intentional contamination of a wastewater system to result in serious consequences. A review of documented incidents indicates that contamination events have caused significant damage in the past. Some of the events documented below were accidental while others were the result of either negligent or malevolent acts. Several major incidents have involved the introduction of **flammable** or **explosive** substances into wastewater systems:

Akron, Ohio 1977. **A deliberate, malevolent** injection of flammable substances resulted in a series of sewer explosions. A police investigation revealed that at least 3,000 gallons of petroleum naptha and isopropyl alcohol had been discharged into the sewer during the night by vandals at a strikebound rubber plant. Officials believe that when the material entered the wastewater collection system it was too rich to ignite, but as it flowed further through the system it became diluted to explosive range and finally ignited 3.5 miles from the point of introduction. Approximately one mile of sewer line was damaged. Remediation costs exceeded $10 million.

Louisville, Kentucky 1981. Around 5AM on February 13, 1981, two women going to work at a hospital drove under an overpass on Hill Street in Louisville. There was a large explosion and their car was hurled into the air and onto its side. At the same time, a police helicopter flying overhead observed a series of explosions erupting along the streets of the city. More than two miles of streets were pockmarked with craters where manholes had been located. Several blocks of Hill Street had fallen into the collapsed 12 foot diameter sewer line (Figure 1-1). Fortunately, no one was seriously hurt, but homes and businesses were extensively damaged and a number of

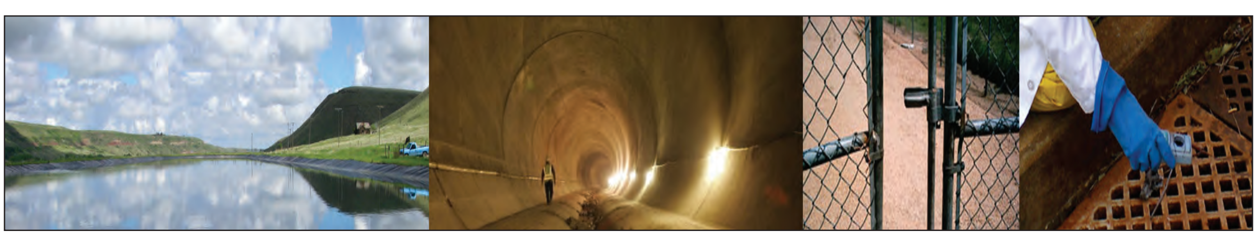


Figure 1-1. Louisville, KY explosion, February 13, 1981. (The Courier-Journal)

people had to be evacuated. The cause of the explosions was traced to a soybean processing plant where thousands of gallons of the flammable solvent hexane had **accidentally** spilled into the sanitary sewer. The fumes were presumably ignited by a spark from the car as it was being driven under the overpass. It required 20 months to repair the sewer lines, and several additional months to complete the street repairs.

Guadalajara, Mexico 1992. There was an especially tragic accident in Guadalajara in April 1992. Nine separate explosions occurred, over a four hour period, in the sewer collection system beneath the city's downtown area. The explosions were caused by gasoline **accidentally** leaking from an underground pipeline into the sanitary sewer. Local residents had complained for several days about a strong gasoline odor wafting up from the sewer drains. Officials could not find the source of the problem, did not order an evacuation, and called off their investigation several hours before the series of explosions began. The explosions killed 206 people, injured 1,460 persons, damaged 1,148 buildings, destroyed 250 businesses and 500 vehicles, left 15,000 people homeless, and forced the evacuation of a total of 25,000 people. Seven miles of sewer pipe were destroyed, some of which was 18 feet in diameter (Figure 1-2). A number of victims were buried alive. Damages exceeded $75 million United States dollars. It was eventually concluded by investigators that the ultimate cause of the explosions was the installation of a drinking water main, several years earlier, which leaked onto the gasoline line lying underneath. The

Figure 1-2. Gasoline-sewer explosion, Guadalajara, Mexico, April 22, 1992. Reprinted with permission from the Disaster Recovery Journal (Vol 5, #3).

subsequent corrosion of the gasoline pipeline caused leakage of gasoline and allowed vapors to accumulate in the sanitary sewer system.

A number of victims were buried alive. Damages exceeded $75 million U.S. dollars.

Conroe, Texas 1994. The owner of a convenience store/gas station learned that his 8,000 gallon underground storage tank was cracked and ground water was infiltrating the tank. Rather than dispose of the diluted gasoline properly, the business owner rented a small pump and **intentionally discharged** a mixture of approximately 5,000 gallons of gasoline and 500 gallons of water onto the street in front of his store. The gasoline/ water mixture entered both the sanitary and storm water collection systems and essentially formed a three-mile long pipe bomb.

Fortunately, there was no explosion. However, several schools were evacuated the next day as a precaution. The gasoline in the storm water collection system flowed into a creek. Utility officials were able to divert the gasoline in the sanitary sewer collection system to a lagoon to protect the wastewater treatment plant. The perpetrator was prosecuted for violation of the Clean Water Act.

Documented incidents have also occurred that involved the introduction of **toxicants** into the wastewater system:

Louisville, Kentucky 1977. Workers at a municipal wastewater treatment plant reported a strong chemical odor that was making them ill. After more than a week of investigation it was determined that the odor was coming from a mixture of hexachloropentadiene and octachlorocyclopentene, two highly toxic chemicals used in the manufacture of pesticides. The mixture had been **intentionally** discharged into a sewer system manhole by a local chemical disposal company improperly dumping industrial waste. The contaminated sewage treatment plant had to be shut down for a three month period during which time 100 million gallons per day of raw sewage was released to the Ohio River.

Philadelphia, Pennsylvania 2006. Employees at a suburban wastewater treatment plant noticed fluctuations in the chlorine levels in the plant's discharge. Shortly thereafter, a fish kill was observed downstream of the plant. It was subsequently determined that a pharmaceutical company had **inadvertently** discharged to the sanitary sewer approximately 25 gallons of potassium thiocyanate. It is believed that the cyanate compound combined with the chlorine used to treat the wastewater plant discharge and formed cyanogen chloride, a chemical highly toxic to fish. The unexplained fish kill forced drinking water officials to temporarily close one of the City of Philadelphia's downstream drinking water plant intakes as a precaution.

In addition to the well publicized cases described above, there are numerous smaller scale incidents that have resulted in contamination of wastewater systems across the United States. For example, many accidental discharges to sanitary or storm water collection systems have occurred as a result of spills from chemical tanker trucks involved in highway accidents and railroad tank cars involved in derailments.

2.2 Malevolent Acts

As illustrated by the deliberate introduction of flammable substances into the Akron, Ohio sewage collection system described above, contaminants may be intentionally added to a wastewater system as part of a malevolent act. The intentional contamination could be carried out by vandals as in the Akron incident. It is also conceivable that domestic or international terrorists could attack a municipal wastewater system to harm people or property.

Possible reasons why terrorists might target a wastewater system include:

- Wastewater systems are a major part of the infrastructure of this country.
- Interference in the collection, treatment, or disposal of sanitary wastes would impact public health, disrupt daily life for the affected populations, result in significant economic losses, and negatively affect the environment.
- Wastewater systems have many components, are spread out geographically, and are therefore difficult to protect.
- Wastewater systems, like drinking water systems, are perceived to be associated with the government.

Although the focus of the WWRPTB is contamination events, it should be noted that wastewater systems, like drinking water systems, are also potentially susceptible to other types of deliberate attacks. These could include physical assaults on facilities or staff, cyber attacks, or the intentional release of hazardous treatment chemicals like chlorine gas.

2.3 Wastewater Systems as an Indirect Target

Wastewater systems also could become the indirect victim of an intentional act aimed at another target in the community. For example, an intentional contamination of the public drinking water supply would almost certainly result in contaminants eventually flowing into the wastewater collection and treatment system. This could occur through normal use of drinking water or remedial flushing of the drinking water system. Similarly, should people or buildings in the community become

contaminated as a result of a chemical, biological, or radiological (CBR) attack, spent wash water used in the decontamination process may find its way into the municipal wastewater collection and treatment system.

Wastewater systems are a major part of the infrastructure of this country.

2.4 Candidate Contaminants

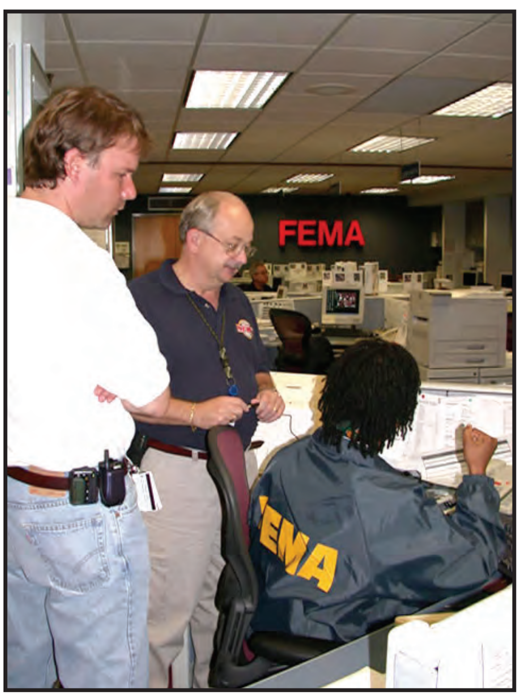
A candidate list of contaminants could include various flammable, explosive, infectious, toxic, and radioactive substances. If injected or released into a sanitary or storm water collection system, these contaminants could cause injury or death to the public or utility workers, damage to the wastewater infrastructure and nearby property within the community, damage to the biological components of the wastewater treatment process, and impacts on downstream water users if the contaminants managed to pass through the wastewater treatment plant.

To support emergency management of wastewater and drinking water contamination threats and incidents, EPA has developed a resource for contaminant-specific information for use by the drinking water and wastewater sectors. The Water Contaminant Information Tool (WCIT) is an Internet database that provides detailed information for potential contaminants on key factors such as contaminant toxicity and infectivity, chemical characteristics, clinical symptoms of exposure, drinking water and wastewater treatability, and decontamination approaches among others. Access to this database is available to utilities, regulators, health agencies, and others by registration with EPA. Information on registration procedures can be obtained at http://www.epa.gov/wcit.

3 Considerations in Responding to Contamination Threats

With the events of 9/11, continued threats against the homeland, and the realization that drinking water and wastewater systems could potentially become the targets of intentional contamination, questions have arisen concerning the role that utilities should play in responding to threats or actual incidents.

One question that could reasonably be raised by wastewater utilities is: **"I'm just a utility – why do I need to do anything at all?"**



Wastewater utilities play an essential role in the safe collection, treatment, and disposal of sanitary wastes, industrial wastes, and storm water. A growing number of utilities are also processing reclaimed water for use in irrigation, cooling, lake or stream augmentation, groundwater recharge, and other non-potable uses. These functions have obvious public health ramifications. Wastewater utilities take their public health responsibilities very seriously. Either accidental or intentional contamination of a wastewater system with flammable, toxic, infectious, or radioactive substances may pose a risk to the health of the community, utility employees, and the environment. Utilities may be subject to legal and regulatory requirements associated with the contamination. Utilities should consider an effective response to a contamination event as being part of their mission.

Presidential Policy Directive 8 is aimed at strengthening the security and resilience of the U.S. against threats that pose the greatest risk to the Nation (e.g., terrorism, catastrophic natural disasters). In the Directive, "response" refers to those capabilities that save lives, protect property and the environment, and meet basic human needs after an incident. The water sector plays an important role in response by providing safe drinking water and wastewater sanitation services.

A second potential question among utilities is: **"What should I be doing to protect against and respond to contamination threats?"**

Specific actions to protect against and respond to a contamination threat are warranted, due to the public health and public safety consequences of wastewater system contamination, and need to be conducted in accordance with applicable legal and regulatory requirements. The wastewater system should work with applicable local, state, and federal agencies and emergency officials to determine the appropriate actions. This document can help a wastewater utility evaluate issues involved in determining the appropriate actions and integrate the relevant information into documents such as utility Emergency Response Plans. Effective planning will assist the wastewater utility to conduct a careful evaluation of any threat and take appropriate response actions based on that evaluation.

4 How to Prepare for a Contamination Threat or Incident

There are a number of steps that utilities can take to prepare for contamination threats. These include:

- **Use the WWRPTB to develop an updated Emergency Response Plan**

  Utilities are encouraged to use the recommendations presented in this document that are appropriate for their local needs. Utilities should feel free to 'cut and paste' protocols, forms, and other information from the Toolbox and customize them for their own response plan. Again, use of the Toolbox is not mandatory.

- **Conduct a Vulnerability Assessment (VA)**

  Under the Public Health and Bioterrorism Preparedness and Response Act of 2002, drinking water utilities serving more than 3,300 persons were required to conduct a formal Vulnerability Assessment. While wastewater utilities were not mandated to conduct VAs, a wastewater system can gain an enhanced perspective on their risks and susceptibilities from this type of effort. A VA can be used to define risks from both intentional and accidental contamination events as well as from natural disasters, accidents, and other intentional acts (e.g., physical attacks, cyber attacks, and intentional release of harmful treatment chemicals such as gaseous chlorine).

  EPA and several wastewater industry organizations have produced vulnerability assessment and consequence analysis tools to assist wastewater systems in conducting their assessments. These tools can be accessed from EPA's Water Security website at http://www.epa.gov/watersecurity.

- **Know your wastewater system**

  A detailed knowledge of the hydraulic and chemical characteristics of the wastewater collection and treatment system will assist utility officials in determining the credibility of suspicions that a contamination event has actually occurred. It will also help utility personnel predict which portions of the wastewater system may be compromised by an event.

  EPA has made available, free of charge, a security hydraulic model (SewerNet) that wastewater utilities can use to predict the transport and fate of contaminants in a wastewater collection system.

- **Include intentional and accidental contamination scenarios in your utility's Emergency Response Plan**

  Even if the risk of a contamination event is not deemed to be particularly high when a utility conducted its VA, the potential consequences of such an incident may be serious enough to warrant contingency planning.

- **Develop utility specific Response Guidelines for intentional contamination**

  Response Guidelines are condensed field guides for responding to specific emergencies. They should be action oriented, easy to use in the field under emergency conditions, and contain all the necessary forms and information. They are composed of written procedures, report forms, templates, and checklists, examples of which can be found in Modules 2 thru 6 of the WWRPTB.

- **Establish a structure for incident command**

  Ideally this structure should be based on the **Incident Command System** (ICS) and the **National Incident Management System** (NIMS). ICS is the system that has been adopted throughout the United States to manage emergencies ranging from natural disasters to terrorist events. NIMS is a nationwide template that enables all government and non-government organizations to work together during an incident requiring the use of ICS. If the ICS structure is already being used as the model for emergency management at the utility level, it will be much easier to coordinate the utility's response with the efforts of outside agencies should a situation expand in

  complexity. Utility personnel can access free, online ICS/NIMS training courses through FEMA at http://training.fema.gov/is/crslist.asp. Also, EPA provides on-line and in-person ICS training targeted to water and wastewater utilities at http://water.epa.gov/infrastructure/watersecurity/emerplan/index.cfm.

- **Develop an information management strategy**

  During a threatened or actual incident, information will be received from multiple sources including those performing site characterization, law enforcement agencies, and health officials. The effectiveness of incident response will be determined, in large part, by how effectively this volume of information is collected, analyzed, and disseminated within the utility, and between the utility and other responding agencies.

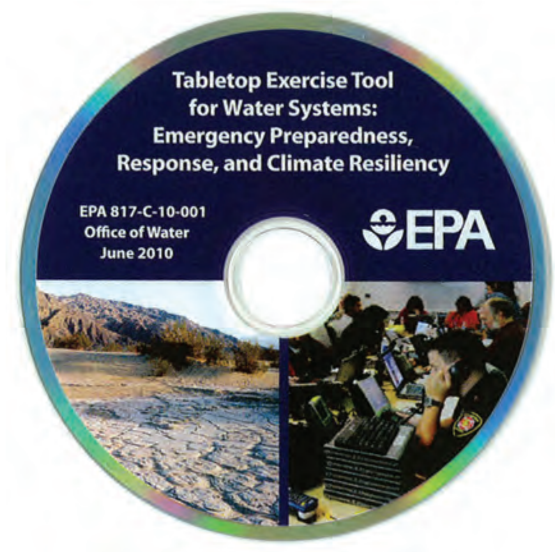
- **Establish a communication and notification strategy**

This includes timely and accurate notifications of personnel within the wastewater utility, the public, and other organizations such as emergency responders, regulators, health officials, neighboring wastewater utilities, and downstream drinking water plants in accordance with all regulations and requirements.

- **Conduct training**

A well-written Emergency Response Plan may not be effectively executed if key players are not familiar with their roles and how they are expected to coordinate with other responders (e.g., law enforcement, fire department, and health department). Training should begin with classroom instruction on utility Emergency Response Plans, guidance such as the WWRPTB, and the ICS. It should then progress to tabletop exercises and finally to field exercises so that the utility and outside response agencies can practice their interaction with each other.

EPA's *Tabletop Exercise Tool for Water Systems: Emergency Preparedness, Response, and Climate Resiliency* (EPA-817-C-10-001, June 2010) allows utilities to conduct their own customized incident response training. The Tool can be obtained from the following website: www.epa.gov/watersecurity.



- **Enhance physical security of the wastewater system**

While physical protection systems alone cannot guarantee security, enhancement of physical barriers through such measures as fences, intrusion detection systems, and closed-circuit TV surveillance is an important first step in improving the overall security of a wastewater system.

The Water Infrastructure Security Enhancements (WISE) program has produced a guidance document to assist wastewater utilities in improving their physical security. The document is entitled *Guidelines for the Physical Security of Wastewater/Stormwater Utilities* (December 2006) and is available at: http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Security/WISE-Phase3WastewaterStormwaterUtilityGuidelines.pdf

- **Establish a baseline monitoring program**

The ability to detect significant excursions from the normal chemical characteristics of wastewater within the collection system and through the various stages of treatment is an important means of determining whether a contamination event has actually occurred. Evaluating the significance of water quality excursions requires comparison with established baseline wastewater chemical data. For example, what is the usual pH range for a utility's wastewater? What are the typical concentrations of various organic compounds in the wastewater (e.g., toluene or benzene)?

- **Use and understand on-line monitoring**

  While current online monitoring capabilities are limited, the technology is improving. Online monitoring of water quality is a means for detecting accidental and intentional contamination events. The resources to purchase, operate, and maintain monitoring systems will be enhanced if the monitoring can be used not only to bolster security, but also to provide multiple benefits such as improving the utility's process control and regulatory compliance.

- **Participate in Mutual Aid Programs**

  Drinking water and wastewater utilities, in conjunction with EPA, state regulatory agencies, and water industry organizations, have developed mutual aid and assistance agreements for almost all 50 states. This initiative, Water and Wastewater Agency Response Networks (WARNs), involves wastewater and drinking water utilities within a state signing a mutual aid agreement pledging to support other utilities during emergencies. Support can involve the sharing of personnel, equipment, and supplies. Additional information on the WARN initiative, including specific information about wastewater utilities in WARN, is available at http://water.epa.gov/infrastructure/watersecurity/index.cfm.

5 Summary

A number of wastewater system contamination events have occurred in this country and elsewhere. Most of these have been accidental but some have occurred intentionally. Several of these have resulted in loss of life, injuries, and significant damage to both wastewater infrastructure as well as private property. These incidents underscore the vulnerability of wastewater systems to accidental or intentional contamination. They also illustrate the potential risk to public safety, public health, private property, and the wastewater infrastructure, as well as the large amounts of time and money needed to repair the damage. Wastewater utilities have a responsibility to prepare for and respond to contamination threats. A number of practical suggestions have been offered in this module for steps that wastewater systems can take to improve their ability to manage contamination incidents. Again, these are only general suggestions that may be tailored to the needs and resources of individual utilities consistent with any applicable laws and regulations.

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Wastewater Response Protocol Toolbox:

Planning For and Responding To Wastewater Contamination Threats and Incidents

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Module 2:
Contamination Threat Management Guide

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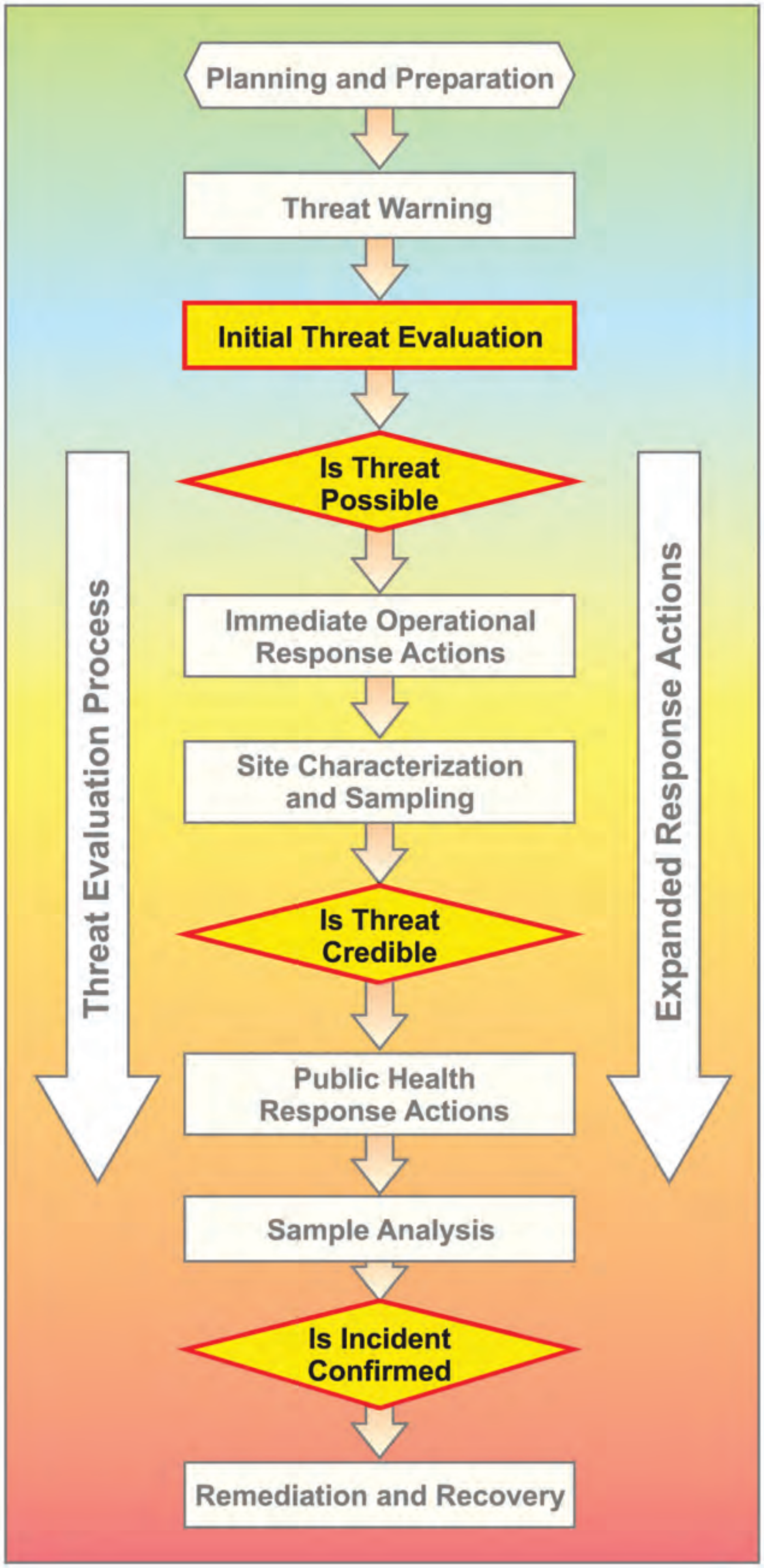
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Threat Evaluation Process
Expanded Response Actions

1 Introduction

As discussed in Module 1, accidental and intentional contamination events involving wastewater systems have occurred in the past. In some cases, such as Guadalajara, Mexico in 1992, the results have been devastating in terms of the impact on human lives and property. Therefore, in the event of either an accidental or intentional contamination threat, there is a need to be able to evaluate the credibility of the threat and identify appropriate response actions. Also, because a large number of people and a significant amount of infrastructure and private property can be exposed to a contaminant passing through a collection and treatment system within just a few hours, there is a need to evaluate and respond in a short amount of time.

While it is desirable to have complete information prior to making response decisions, the reality is that this will almost certainly not be the case when responding to contamination threats. Typically, there will not be time to conclusively determine whether the wastewater has been contaminated or definitively identify the contaminant prior to making decisions to protect health and property. However, it is also necessary to avoid false alarms that would result in undue stress on the public. Therefore, a delicate balance must be achieved between actions taken to protect public safety and property, and limiting overreaction to a perceived threat.

Module 2, the Contamination Threat Management Guide, provides a framework for making decisions based on available, yet incomplete, information in response to a contamination threat. It represents the hub of the WWRPTB. The objectives of this module include:

- Present a framework for evaluating a wastewater contamination threat and making appropriate decisions
- Describe the type of information that may be used for conducting a threat evaluation
- Describe the actions that might be implemented in response to a contamination threat (giving appropriate consideration to the potential consequences of an incident and the impacts that may result from the response actions)

Based on these objectives, Module 2 is divided into the following sections:

1. Introduction
2. Overview of the Contamination Threat Management Process
3. 'Possible' Stage of the Threat Management Process
4. 'Credible' Stage of the Threat Management Process
5. 'Confirmed' Stage of the Threat Management Process
6. Contamination Threat Management Matrices
7. Summary
8. Appendices

Many of the concepts described in Module 2 are similar to those for the Water Security initiative, which addresses drinking water security. In particular, the *Interim Guidance on Developing Consequence Management Plans for Drinking Water Utilities* (CMP) (EPA 817-R-08-001, October 2008) provided for the Water Security initiative addresses the various stages of the threat management process for drinking water (possible, credible, and confirmed). See http://www.epa.gov/safewater/watersecurity/pubs/guide_interim_cmp_wsi.pdf for additional information about the CMP.

2 Overview of the Contamination Threat Management Process

2.1 Roles and Responsibilities

As discussed in Module 1, the Incident Command System (ICS) is the national model for managing emergencies, including contamination threats, involving public drinking water and wastewater systems.

Organizations that may Assume Incident Command Responsibility During an Intentional Contamination Situation

Wastewater Utility. May be responsible for incident command during the initial stages of an event since it will often be the first party to become aware of the threat warning. The utility will retain this responsibility, by default, unless/until another organization (with proper authority) assumes command. The Utility Incident Commander would probably serve as overall Incident Commander while the utility maintains primary responsibility for managing the crisis.

Local Fire Department/HazMat Team. May assume incident command if hazardous materials are involved.

Wastewater Permitting Agency. May assume incident command, especially when a smaller utility lacks the resources to manage the threat.

Public Health Agency (state or local). May assume incident command if the situation is a public health crisis.

Local Law Enforcement. May assume incident command when criminal activity (excluding federal crimes) is suspected.

FBI. Will assume incident command (of the criminal investigation) when there is a terrorism incident or a credible threat of terrorism. In this case, EPA's Criminal Investigation Division (CID) will have a role in working with the FBI. If it is determined that a contamination threat or incident is not an act of terrorism, EPA's CID will typically be the lead federal agency for law enforcement in the response.

Under this management system, incident command has overall responsibility for managing the crisis. The organization that assumes responsibility for incident command will vary with the nature and severity of the situation. During the course of managing a contamination threat, the individual designated as Incident Commander may change as different organizations assume responsibility for managing the situation. In the event of a more complex emergency, a Unified Command may be set up in which the incident command consists of representatives of the key stakeholders with jurisdictional or functional authority.

The organization that assumes responsibility for incident command will vary with the nature and severity of the situation.

If an organization other than the wastewater utility assumes incident command, the utility will play a supporting role during the threat management process. Regardless of which organization is in charge of managing the overall situation, the utility will always have a responsibility for the wastewater system.

2.2 Response and Consequence

Response decisions regarding a wastewater system contamination threat may have consequences that significantly affect the community. While the health and safety of utility workers and the public will always be the primary concern during a contamination incident, it should be realized that the response actions taken to deal with the threat may have serious ramifications. For example, if the decision is made to completely shut down a municipal wastewater system due to concerns over a contaminant, this would seriously impact the public health of a community that can no longer safely treat sanitary waste. Additionally, any decision to bypass the wastewater treatment plant must be consistent with applicable laws and regulations including 40 CFR 122.41(m). This could seriously impact the environment and downstream water users when raw sewage containing the contaminant is released untreated into a receiving stream.

Criteria for Response Decisions

Response decisions concerning contamination threats and incidents should be based on the following three criteria:

1. Is the contamination threat ‘Possible,’ ‘Credible,’ or ‘Confirmed?’

2. What are the potential consequences of the contamination on human health and safety, the environment, the economy, and the wastewater infrastructure?

3. What is the potential impact of the response action on public health, the economy, and the environment?

A Response Planning Matrix is a tool that can help officials weigh these three criteria when making response decisions. The matrix is a simple tabular summary that lists the three levels of a threat evaluation, the potential consequences of a threat (including the number of people affected and health effects), and potential response actions along with their impacts on the public and the environment. A blank Response Planning Matrix is included in Appendix 1 at the end of the toolbox.

2.3 Contamination Threat Management Decision and Response Tree

The overall threat management decision process is summarized in Figure 2-1. The remaining sections in this module describe the various steps in this decision and response tree.

3 Stage I: 'Possible' Stage of Threat Management Process

A wastewater contamination threat is characterized as 'Possible' if the circumstances of the threat warning (threat warnings are discussed in section 3.1) indicate that there was an opportunity for contamination. This is the lowest threshold determination in the threat evaluation process and is the point at which a decision is made regarding whether or not to initiate an investigation. If the threat is determined to be impossible, there is no need to continue the threat evaluation or consider any response actions. However, it is likely that most contamination threats will meet this relatively low threshold and thus warrant investigation.

The target time period for determining whether or not a contamination threat is 'Possible' is within **one hour** from the time the threat warning is received by the utility. Given the potentially severe consequences of failing to respond to an actual contamination incident in a timely and appropriate manner, it is important to determine whether or not a threat is 'Possible' in this relatively short time frame. The one hour target, however, should be treated as a flexible goal since the circumstances of a particular threat may dictate a shorter or longer period.

As with all stages of the threat management process, the Incident Commander usually is responsible for determining whether or not the contamination threat is 'Possible.' In most cases, this determination will be made by the utility Incident Commander, although others may become involved in the initial evaluation as appropriate. For example, if the threat warning is reported by a law enforcement agency, they would likely play a role in determining whether or not a threat is 'Possible.' Also, the wastewater permitting agency may need to be informed about all threat warnings and may participate in this initial stage of the threat evaluation. However, given the short target time frame for the initial evaluation, the utility Incident Commander might make this determination, initiate an investigation, and initiate some preliminary operational responses.

Relevant and timely information is key to determining whether or not a threat is 'Possible' in the target time period. In most cases, the information considered at this stage will be derived directly from the threat warning (e.g., nature of warning, location, time of discovery, suspected time of incident, and other details). Under some circumstances, additional information beyond the threat warning may be considered. However, there may not be sufficient time to do so in most cases, and the determination regarding whether or not the threat is 'Possible' will be based primarily on details of the threat warning.

A Threat Evaluation Worksheet is provided in Appendix 2 to help organize the information used throughout the threat evaluation, beginning with a summary of information about the threat warning itself.

3.1 Information from the Threat Warning

A threat warning is an unusual event, observation, or discovery that indicates the potential for intentional or accidental contamination and suggests the need for actions to address the concern. Threat warnings

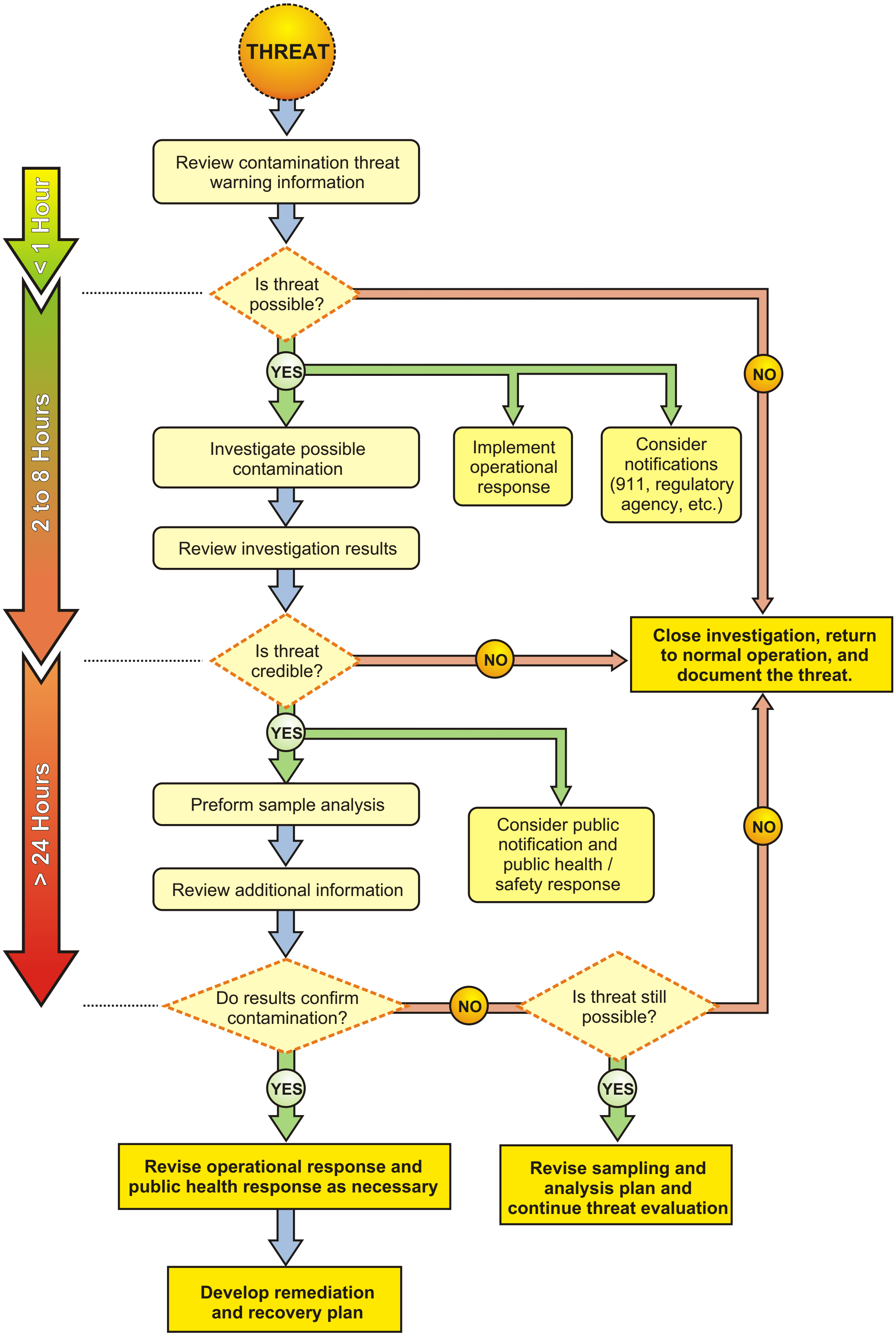

Figure 2-1. Contamination Threat Management Decision Tree for Wastewater

Figure 2-2. Types of Threat Warnings

may come from several sources both within and outside of the wastewater utility. Figure 2-2 summarizes the most likely threat warnings that a wastewater utility may expect to receive.

Security Breach

A security breach is an unauthorized intrusion into a secured facility or the collection system that may be discovered through direct observation (for example, through an alarm, cut fence, or open manhole). A Security Incident Report Form is included in Appendix 3 to assist in documenting the available information about a breach and support the threat evaluation.

Witness Account

A witness account is a threat warning from an individual who directly witnesses suspicious activity. A Witness Account Report Form is included in Appendix 4 to help document a witness account.

Direct Notification by Perpetrator

A threat may be made directly to the utility by a perpetrator, either verbally or in writing. Report forms for telephone and written threats are provided in Appendices 5 and 6, respectively.

Notification by Law Enforcement

A utility may receive notification about a contamination threat from a law enforcement agency.

Notification by News Media

A contamination threat might be made to the media, or the media may learn of an accidental contamination before the utility is alerted.

Unusual Wastewater Chemical Characteristics

Unusual wastewater chemical results could come from on-line monitoring or routine grab sampling indicating a possible contamination event.

Degradation of Treatment Organisms

Should a contaminant enter the treatment plant from the collection system, the first indication of its presence could be a degradation in the abundance or activity of microbes in the secondary treatment process.

Public Complaints

Public or utility employee complaints about unusual odors associated with the sewer system (e.g., petroleum products or industrial chemicals) may suggest the presence of a contaminant. Wastewater system personnel reporting unusual health symptoms may also indicate a threat.

Notification by Public Health Agencies

Notification from health agencies or health care providers that people are being negatively affected by fumes emanating from domestic sewer systems, catch basins, or the wastewater treatment plant may suggest a contamination event. A Public Health Information Report Form included in Appendix 7 is intended to organize information from public health entities to support this evaluation.

3.2 Additional Information

Information extracted from details of the threat warning is critical to determining whether or not a contamination threat is ‘Possible.’ Different types of warnings will have different levels of initial believability. For example, widespread complaints of solvent-like odors wafting up from sanitary sewer manholes would have a higher degree of initial believability than a report of unusual wastewater chemistry based on changes in a few general parameters (e.g., pH or alkalinity). Some warnings may be judged so reliable that the threat is deemed ‘Credible’ solely on the basis of information about the threat warning, while others may be almost instantly dismissed as impossible.

Regardless of the nature and source of the threat warning, it is critical that protocols be in place to report the warning to the utility Incident Commander as quickly as possible. Utilities should develop communications procedures to ensure that threat warnings can be rapidly and accurately reported on a 24/7 basis.

While the threat warning will likely provide the most immediate and relevant information, several other resources might be considered to help make the determination as to whether a threat is ‘Possible.’ These may include: internal information from utility staff that are knowledgeable of the operation of the wastewater system, information from the utility’s VA that is relevant to the current situation, and real time water chemistry data that might be used as an indicator of wastewater contamination.

3.3 Response Actions Considered at the 'Possible' Stage

Once a contamination threat has been deemed 'Possible,' relatively low level response actions are appropriate since this is a very early stage in the threat management process. Two response actions that might be considered at this stage include site characterization and operational response.

Site Characterization

This is the process of collecting information from the site of a suspected wastewater contamination incident. This is a key activity in the ongoing threat evaluation and is intended to help determine whether or not the 'Possible' threat is 'Credible.' Site characterization includes the following activities:

- Site investigation
- Field safety screening
- Rapid field testing of wastewater
- Sample collection

Detailed procedures for conducting site characterization are described in Module 3: Site Characterization and Sampling Guide.

Immediate Operational Responses

These are actions intended to limit the potential exposure of the public to the contaminant and reduce the risk to private property, the wastewater infrastructure, and the environment while site characterization activities are conducted. An example operational response would be diverting the flow of untreated wastewater to temporary storage, rather than exposing the treatment process, until the nature of the possible contamination event can be better characterized. Emergency pretreatment of the influent wastewater may also be

considered consistent with any applicable laws and regulations. This may include the addition of powdered activated carbon, a strong oxidant such as chlorine or potassium permanganate, or the addition of caustic to neutralize or precipitate a toxic chemical.

If a flammable substance is in the collection system, the utility, working with the fire department, may attempt to remove the substance using vacuum trucks and/or oil spill remediation equipment. If the flammable substance is in the plant influent, the utility may decide to turn off pumps to the treatment basins and assist the fire department in dispensing aqueous film forming foam.

The decision to implement these response actions may need to be made very quickly for the actions to have their desired effect. For example, in order for diversion and storage of untreated wastewater to be effective, it may need to be implemented as quickly as feasible after a threat is deemed 'Possible.' To facilitate this, the utility Incident Commander should be aware of the regulatory and legal considerations that may apply to decisions, and be empowered to implement such response actions at the 'Possible' stage. However, the immediate response actions should then be shared with utility management.

If an operational response is not feasible, the threat evaluation process should be accelerated to determine whether or not the threat is 'Credible.'

4 Stage II: 'Credible' Stage of Threat Management Process

A wastewater contamination threat should be considered to be 'Credible' if additional information collected during the investigation (initiated after the 'Possible' decision was made) corroborates the threat warning, and the cumulative information indicates that contamination is likely. For example, if the threat warning comes in the form of a security breach and additional convincing signs of contamination (e.g., abnormal wastewater chemical values) are observed during site characterization, the threat could be considered 'Credible.' While many warnings may result in 'Possible' contamination threats, only a small percentage of those 'Possible' threats are expected to be elevated to the 'Credible' level.

It is important to move quickly from the 'Possible' stage to the next stage of the threat management process to determine whether or not the threat is 'Credible' and warrants an elevated response. The target time period for determining whether or not a contamination threat is 'Credible' is within **2 to 8 hours** from the time that the threat was deemed 'Possible.' The decision to elevate a threat from 'Possible' to 'Credible' is significant since elevated response actions may be necessary to protect public health and safety. The elevated response measures may fall outside of the authority of the utility Incident Commander, and the organizations that would be involved in these response decisions would need to be engaged in the threat evaluation process at this stage. This might include wastewater utility management, the regulatory agency, and the public health agency. If there is a possibility that the contamination event was deliberate, law enforcement may also need to be involved. The individual typically responsible for determining that a contamination threat is 'Credible' is the Incident Commander, who may not be the utility Incident Commander at this point in the threat management process.

4.1 Information Considered at the 'Credible' Stage

Many of the information resources used to determine that a threat is 'Possible' may also prove relevant at the 'Credible' stage. It is important to view the investigation as a continuum. Information collected through the 'Possible' and 'Credible' stages of an investigation should be evaluated in its entirety.

Additional information that might be considered to support the threat evaluation and determine whether or not a contamination threat is 'Credible' include site characterization results, previous threats and incidents, and information from external sources.

Site Characterization Results

This includes observations from the site investigation such as physical evidence (e.g., discarded equipment and containers) and environmental indicators (e.g., dead animals, dead vegetation, and unusual odors). This also includes results from field safety screening and rapid field testing of the wastewater. If it is suspected that a contaminant may have already entered the treatment plant, it may be useful to examine archived samples from a continuous automatic sampling program if the utility operates one.

Previous Threats and Incidents

Summary information derived from analysis of previous incidents similar to the current threat warning may be considered. This can include incidents that have occurred at this utility as well as incidents that have occurred previously in other parts of the country.

Information from External Sources

Information can also be obtained from external sources to assist incident command in determining whether a threat is 'Credible.' Some potential external information sources include:

- Wastewater Permitting Agency
- EPA
- Water ISAC - (Water Information Sharing and Analysis Center) http://www.waterisac.org
- NRC (National Response Center): Has experts trained to provide assistance in the case of a terrorist threat or incident. Also serves as a central point of contact for federal resources (1-800-424-8802).
- Law Enforcement Agencies (from all levels of government)
- FBI: The focus of the FBI's investigation will be the terrorism aspects of the threat. However, if the FBI determines that the event is 'Credible' from a terrorism perspective, the threat will likely also be considered 'Credible' from a utility and public health/safety perspective.
- Neighboring Utilities and WARNs
- Public Health Agencies
- 911 Call Centers
- Homeland Security Warnings and Alerts

If a specific contaminant is suspected during a threat, information about that contaminant should be consulted to help establish the 'Credibility' and potential consequences of the threat (e.g., toxicity and water solubility). A resource for contaminant specific information is EPA's Water Contaminant Information Tool (WCIT) at http://www.epa.gov/wcit.

4.2 Response Actions Considered at the 'Credible' Stage

Once the decision has been made that the threat of contamination is 'Credible,' the response actions that are taken are designed to minimize risk to public health/safety, private property, the economy, infrastructure, and the environment. The response is also aimed at gathering additional information to ultimately decide whether the contamination threat can be 'Confirmed.'

The response actions taken at the 'Credible' stage may have a greater impact on the public than those taken at the 'Possible' stage. Four response actions that may be considered at the 'Credible' stage, in conjunction with applicable laws or regulations, include the following:

Sample Analysis

Once a threat has been deemed 'Credible,' one of the first steps taken in an effort to confirm a contamination incident should be the analysis of samples that were collected during site characterization. The recommended analytical procedures for confirming the presence of tentatively identified contaminants, or analyzing wastewater samples for unknown contaminants, are presented in Module 4: Analytical Guide.

Continuation of Site Characterization Activities

Once a threat is deemed 'Credible,' additional site characterization and sampling activities may be implemented in an attempt to confirm a contamination incident. In cases where a 'Credible' contamination threat is not confirmed, the additional site characterization and sampling activities will help verify that the wastewater has not been contaminated and support the decision to return to normal operations.

Law Enforcement Notification

If at this stage of the threat management process it appears that an intentional act may have been associated with the apparent contamination event, law enforcement should be contacted if they have not been contacted previously.

Public Notification and Public Health/Safety Response

As with the immediate operational response actions taken following the decision that a threat is 'Possible,' the goal of the public health response actions taken after a threat has been deemed 'Credible' is to minimize risk to the population. However, the public health response and safety actions at this stage are elevated with respect to the impact on the public. It is at this point that officials may need to notify the public of the emergency under existing laws or regulations or they may decide to notify the public anyway in the absence of a legal requirement to do so. For example, if significant levels of flammable or explosive chemicals have entered the wastewater collection system, either accidentally or due to an intentional act, the nearby population may be instructed to evacuate the area. If the contaminant has entered the treatment plant, plant personnel may be instructed to evacuate. If the contaminant has passed through the treatment plant, or the contaminated wastewater has been released to the receiving stream, downstream users, such as drinking water treatment plants, should also be contacted.

The Incident Commander (or Unified Command) will typically make decisions regarding actions taken in response to

a 'Credible' wastewater contamination threat. Due to the elevated level of actions considered at this stage, responsibility for incident command may shift from the utility Incident Commander to another individual or organization. Additionally, at this point local government may choose to activate their Emergency Operations Center (EOC) to help facilitate a coordinated response among the participating agencies. Activation of the EOC may be full or partial depending upon the circumstances.

The EOC is the physical location or headquarters in which the coordination of information and resources to support incident management takes place. It is the support arm of the response effort. It is typically maintained by a community or jurisdiction (city, county, state) as part of their emergency preparedness program. The EOC is usually located in a central, permanently established facility situated some distance from the incident. It is from this location that elected officials, top agency representatives, and EOC staff coordinate information and resources to support on-scene management of the incident which occurs at the Incident Command Post.

The Incident Command Post (ICP) is usually where the Incident Commander or the Unified Command, and their staff, are physically located. The ICP is normally located as close as possible to the site of the emergency. It is from this location that incident command may exercise tactical command and control over the emergency response effort.

5 Stage III: 'Confirmed' Stage of Threat Management Process

Confirmation represents the transition from a contamination threat to a contamination incident and requires definitive proof that the wastewater has been contaminated. The most reliable means of confirming a contamination incident is through analytical confirmation of the presence of a contaminant. However, under some circumstances, it may be necessary to confirm a contamination incident in the absence of definitive analytical data. This is particularly true in cases where there are challenges in collecting a representative sample due to uncertainty about the point of contaminant introduction, or due to a significant amount of time having elapsed between the introduction of the contaminant and receipt of the threat warning. In cases where analytical confirmation is not possible, it will be necessary to rely upon a preponderance of evidence to confirm an incident. It may take several days to collect sufficient evidence (analytical or non-analytical) to confirm a contamination incident.

If the threat evaluation yields no conclusive evidence of contamination, then there should be a determination as to whether the threat still appears to be credible. If it is still 'Credible,' then additional investigation and analysis are warranted. On the other hand, if incident command decides that the threat is no longer 'Credible,' then the incident could be brought to a close. However, the investigation at this point will have to be sufficiently thorough to demonstrate that the wastewater is safe and the system can be returned to normal operation.

5.1 Information Considered at the 'Confirmed' Stage

The types of information that might help confirm a contamination incident include the following:

Analytical Results

Positive identification of a contaminant through sample analysis can confirm a contamination incident and provide the basis for making decisions about public health/safety responses and remediation activities.

Additional Site Characterization Results

At the 'Confirmed' stage of the threat management process, there will likely be results from site characterization activities performed at multiple locations. These results should be reviewed collectively to explore any potential trends in the data.

Information from External Sources

At this stage, external resources can be specifically targeted in light of the information already collected. Information from these resources may help to build the 'preponderance of evidence' to confirm an event in the absence of laboratory identification of a contaminant.

5.2 Response Actions Considered at the 'Confirmed' Stage

Once a contamination incident has been confirmed, it should be moved into full response mode. At this point, depending on the level of risk posed by the contamination event, city, county, and/or state EOCs may be activated in order to support an effective and coordinated response (Figure 2-3). Other organizations that may be actively engaged in the response include: the wastewater permitting agency, public health officials, emergency response agencies, law enforcement, and the WARN network. All of the participating organizations will likely be coordinated under existing incident command structures designed to manage emergencies at the local or state level. One agency will likely be designated as a lead agency and be responsible for incident command. In some cases a Unified Command may established. If federal agencies are involved in the response, their roles are defined by the National Response Framework (http://www.fema.gov/emergency/nrf/). In any case, the utility will still have a role in the implementation of full response actions.

Figure 2-3. Emergency Operations Center

Effective implementation of response actions at this stage is enhanced by positive identification of the contaminant and knowledge of contaminant properties. In particular, the appropriate public health protection strategies, and selection of treatment technologies, will depend on the nature of the specific contaminant. It is vital to perform a thorough investigation in order to have confidence in any decisions about response actions. This is especially true if response actions are implemented on the basis of a preponderance of evidence rather than analytical confirmation.

Once the incident has been confirmed, and available information about the incident has been analyzed, the public health response measures already implemented should be reassessed and revised if necessary. This might include revisions to containment strategies or public notifications. Once the immediate public health crisis is under control, efforts will likely focus on remediation and recovery.

6 Contamination Threat Management Matrices

Listed below is a series of Contamination Threat Management Matrices. There is a matrix (tabular summary) provided for each of the nine threat warnings discussed in Section 3.1. Each matrix lists the following items at each stage of the threat evaluation:

- Information that should be considered in assessing the threat
- Factors that should be considered in evaluating this information
- Potential notifications
- Possible response actions

While these matrices are generic, they can be tailored to the needs of a specific utility and to very specific incidents (e.g., security breach at a particular wastewater facility). The actions in these matrices or additional actions may be required by any laws or regulations that apply to the situation. The customized Contamination Threat Management Matrices could then be used as an aid in development of a utility's Emergency Response Plan and site specific Response Guidelines.

6.1 Security Breach

Table 2-1: Recommendation for Threat Evaluation Stage - Security Breach

	Possible	Credible	Confirmatory
Information	• Location of security breach • Time of security breach • Information from alarms • Observations when security breach was discovered • Additional details from the threat warning	• Results of site characterization at location of security breach • Previous incidents • Real time wastewater chemical data from location of breach • Input from local law enforcement	• Results of sample analysis • Contaminant information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• Was there an opportunity for contamination? • Has normal operational activity been ruled out? • Have other "harmless" causes been ruled out?	• Do site characterization results reveal signs of contamination? • Is this security breach similar to previous security incidents? • Does other information (e.g., wastewater chemical characteristics) corroborate threat? • Does law enforcement consider this a credible threat?	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility • Local law enforcement agencies	• Wastewater primacy agency • State/local public health agency • FBI (if contamination appears to be deliberate)	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Isolate affected area • Initiate site characterization • Estimate spread of suspected contaminant • Consult external information sources	• Implement appropriate public health/safety protection measures • Consider steps to protect wastewater system (e.g., diversion of contaminated wastewater) consistent with applicable laws and regulations	• Characterize affected area • Revise public health/ safety protection measures as necessary • Plan remediation activities

6.2 *Witness Account*

Table 2-2: Recommendation for Threat Evaluation Stage - Witness Account

	Possible	Credible	Confirmatory
Information	• Location of the suspicious activity • Witness account of the suspicious activity • Additional details from the threat warning	• Additional information from the witness • Results of site characterization at location of suspicious activity • Previous incidents • Real time wastewater chemical data from the location of suspicious activity • Input from local law enforcement	• Results of sample analysis • Contaminant information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• Was there an opportunity for contamination? • Is the witness reliable? • Has normal operational activity been ruled out? • Have other "harmless" causes been ruled out?	• Do site characterization results reveal signs of contamination? • Is the suspicious activity similar to previous security incidents? • Does other information (e.g., wastewater chemical characteristics) corroborate threat? • Does law enforcement consider this a credible threat?	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility • Local law enforcement	• Wastewater permitting agency • State/local public health agency • FBI (if contamination appears to be deliberate)	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Isolate affected area • Initiate site characterization • Estimate spread of suspected contaminant • Consult external information sources • Interview witness for additional information	• Implement appropriate public health/safety protection measures • Consider steps to protect wastewater system (e.g., diversion of contaminated wastewater) consistent with applicable laws and regulations • Analyze samples • Perform site characterization at additional sites	• Characterize affected area • Review public health protection measures as necessary • Plan remediation activities

6.3 *Direct Notification by Perpetrator*

Table 2-3: Recommendation for Threat Evaluation Stage - Direct Notification by Perpetrator

	Possible	Credible	Confirmatory
Information	• Transcript of phone (or written) threat • The who, what, where, when, and why of the threat • Additional details from the threat warning • Vulnerability assessment	• Law enforcement assessment • Primacy agency assessment • Previous threats at this utility or other utilities • Results of site characterization at selected investigation sites • Real time wastewater chemical data • Reports from ISAC, EPA, etc.	• FBI assessment • Results of sample analysis • Contaminant information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• Is the threat feasible? • Has the wastewater already been contaminated? • Is the location known or suspected? • Is the identity of the perpetrator known or suspected? • Have there been personnel problems at the utility?	• Do site characterization results reveal signs of contamination? • Does other information (e.g.,wastewater chemical characteristics) corroborate threat? • Does law enforcement consider this a credible threat? • Does the permitting agency consider this a credible threat?	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility • Local law enforcement • Wastewater permitting agency	• FBI (if contamination appears to be deliberate) • State/local public health agency • EPA Criminal Investigation Division	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Isolate affected area if identified in the threat • Identify sites and initiate site characterization • Consult external information sources • Gather information from law enforcement assessment	• Implement appropriate public health protection measures • Consider steps to protect wastewater system (e.g., diversion of contaminated wastewater) consistent with applicable laws and regulations • Analyze samples • Perform site characterization at additional sites • Estimate spread of suspected contaminant	• Characterize affected area • Revise public health protection measures as necessary • Plan remediation activities

6.4 Notification by Law Enforcement

Table 2-4: Recommendation for Threat Evaluation Stage - Notification by Law Enforcement

	Possible	Credible	Confirmatory
Information	• Law enforcement report • The who, what, where, when, and why of the threat • Additional details from the threat warning • Vulnerability assessment	• Law enforcement assessment • Previous security incidents • Results of site characterization at selected investigation sites • Real time wastewater chemical data • Reports from ISAC, EPA, etc.	• FBI assessment • Results of sample analysis • Contaminant information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• How did the threat warning come to law enforcement? • Is the threat feasible? • Has the wastewater already been contaminated? • Is a specific location targeted?	• Do site characterization results reveal signs of contamination? • Does other information (e.g., wastewater chemical characteristics) corroborate threat? • Does law enforcement consider this a credible threat? • Does the permitting agency consider this a credible threat?	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility • Wastewater permitting agency	• FBI (if contamination appears to be deliberate) • State/local public health agency	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Isolate affected area if known • Identify sites and initiate site characterization • Work with law enforcement to assess threat credibility • Consult external information sources	• Implement appropriate public health protection measures • Consider steps to protect wastewater system (e.g., diversion of contaminated wastewater) consistent with applicable laws and regulations • Analyze samples • Perform site characterization at additional sites • Estimate spread of suspected contaminant	• Characterize affected area • Revise public health protection measures as necessary • Plan remediation activities

6.5 Notification by News Media

Table 2-5: Recommendation for Threat Evaluation Stage - Notification by News Media

	Possible	Credible	Confirmatory
Information	• Details of media report • The who, what, where, when and why of the threat • Additional details from the threat warning • Vulnerability assessment	• Additional details from media • Law enforcement assessment • Previous security incidents • Results of site characterization at selected investigation sites • Real time wastewater chemical data • Reports from ISAC, EPA, etc.	• FBI assessment • Results of sample analysis • Contaminant information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• How did the threat warning come to the media? • Is the threat feasible? • Has the wastewater already been contaminated? • Is a specific location targeted?	• Do site characterization results reveal signs of contamination? • Does other information (e.g., wastewater chemical characteristics) corroborate threat? • Does law enforcement consider this a credible threat? • Does the permitting agency consider this a credible threat?	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility • Local law enforcement • Wastewater permitting agency	• FBI (if contamination appears to be deliberate) • State/local public health agency	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Isolate affected area if known • Identify sites and initiate site characterization • Contact news media for additional details • Consult external information sources	• Implement appropriate public health protection measures • Consider steps to protect wastewater system (e.g., diversion of contaminated wastewater) consistent with applicable laws and regulations • Analyze samples • Perform site characterization at additional sites • Estimate spread of suspected contaminant	• Characterize affected area • Revise public health protection measures as necessary • Plan remediation activities

6.6 Unusual Water Quality

Table 2-6: Recommendation for Threat Evaluation Stage - Unusual Water Quality

	Possible	Credible	Confirmatory
Information	• Unusual wastewater chemical data • Baseline wastewater chemical data • Real time wastewater chemical data • Operational information corresponding to the time of the unusual water quality	• Results of site characterization at selected investigation sites • Previous threat warnings triggered by changes in wastewater chemistry • Contaminant information • Public complaints	• Results of sample analysis • Contamination information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• Are the unusual wastewater chemical values significantly different from an established baseline? • Could operational changes be the cause? • Are there similar results at other monitoring locations?	• Do site characterization results reveal signs of contamination? • Are these unusual data substantially different from previous episodes involving changes in wastewater chemistry? • Are the unusual wastewater chemical data indicative of a specific contaminant? • Are the unusual wastewater chemical results clustered in a specific area? • Are there any unusual public complaints in the area? (e.g., odors)	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility	• Wastewater permitting agency • State/local public health agency • Local law enforcement • FBI (if contamination appears to be deliberate)	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Identify sites and initiate site characterization • Begin analysis of available wastewater chemical data • Investigate any unusual public complaints • Consult external information sources	• Implement appropriate public health protection measures • Consider steps to protect wastewater system (e.g., diversion of contaminated wastewater) consistent with applicable laws and regulations • Analyze samples • Perform site characterization at additional sites • Estimate spread of suspected contaminant	• Characterize affected area • Revise public health protection measures as necessary • Plan remediation activities

6.7 Degradation of Treatment Organisms

Table 2-7: Recommendation for Threat Evaluation Stage - Degradation of Treatment Organisms

	Possible	Credible	Confirmatory
Information	• Extent of degradation • Time of degradation • Additional signs of contamination	• Results of site characterization at location of suspected contamination • Previous incidents • Real time wastewater chemical data • Input from local law enforcement	• Results of sample analysis • Contaminant information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• Was there an opportunity for contamination? • Has normal operational activity been ruled out? • Have other "harmless" causes been ruled out?	• Do site characterization results reveal signs of contamination? • Is this degradation of treatment organisms similar to previous contamination incidents? • Does other information (e.g., wastewater chemistry) corroborate threat?	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility	• Wastewater permitting agency • State/local public health agency • Local law enforcement and FBI (if contamination appears to be deliberate)	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Isolate affected area • Initiate site characterization • Estimate spread of suspected contaminant • Consult external information source	• Implement appropriate public health/safety protection measures • Consider steps to protect wastewater system (e.g. diversion of contaminated wastewater) consistent with applicable laws and regulations	• Characterize affected area • Revise public health protection measures as necessary

6.8 Public Complaints

Table 2-8: Recommendation for Threat Evaluation Stage - Public Complaints

	Possible	Credible	Confirmatory
Information	• Compilation of public complaints, including geographic distribution (e.g., unusual odors emanating from sewers) • Recent wastewater chemical data that may be associated with complaints • Operational information corresponding to the time of the unusual complaints	• Results of site characterization at selected investigation sites • Summary of historic public complaints • Contaminant information	• Results of sample analysis • Contaminant information • Results of site characterization at other investigation sites • Input from permitting agency and public health agency
Evaluation	• Are the complaints unusual? • Could operational changes be the cause? • Are the complaints clustered in a specific area? • Are complaints from habitual complainers?	• Do site characterization results reveal signs of contamination? • Are other people in the area making similar complaints? • Are the unusual complaints significantly different from typical complaints? • Are the complaints indicative of a specific contaminant? • Is there anything unusual about the water quality in the area?	• Were unusual contaminants detected during analysis? Do they pose a risk to the public? • Do site characterization results reveal signs of contamination? • Is contamination indicated by a "preponderance of evidence?"
Notifications	• Notifications within utility	• Wastewater permitting agency • State/local public health agency • Local law enforcement • FBI (if contamination appears to be deliberate)	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Identify sites and initiate site characterizations • Begin analysis of available wastewater chemical data • Interview people in area with high numbers of complaints • Consult external information sources	• Estimate affected area and isolate if possible • Implement appropriate public health/safety protection measures • Consider steps to protect wastewater system (e.g., diversion of contaminated wastewater) consistent with applicable laws and regulations • Analyze samples • Perform site characterization at additional sites • Estimate spread of suspected contaminant	• Characterize affected area • Review public health protection measures as necessary • Plan remediation activities

6.9 Public Health Notification

Table 2-9: Recommendation for Threat Evaluation Stage - Public Health Notification

	Possible	Credible	Confirmatory
Information	• Details of notification from public health sector • Symptoms of health effects and causative agent, if known • Contaminant information	• Geographic distribution of health effects • Recent wastewater chemical and operational data • Reports of public complaints • Contaminant information	• Results of site characterization at selected investigation sites • Results of sample analysis • Contaminant information • Law enforcement and/ or FBI assessment
Evaluation	• Why is wastewater under investigation as a possible source? • Are the reported symptoms consistent with exposure to the contaminant via wastewater? • If causative agent is known, is it stable in water?	• Is the geographic pattern of exposure consistent with exposure to contaminated wastewater? • Is there a recent occurrence of unusual water quality data or public complaints? • Does additional information about the potential contaminant indicate wastewater as a potential source?	• Has the public health agency concluded that wastewater is the cause of the health effects? • Did sample analysis detect the causative agent? • Was another contaminant detected during sample analysis that could be the cause of the health effects?
Notifications	• Notifications within utility • State/local public health agency • Wastewater permitting agency	• FBI (if contamination appears to be deliberate) • Local and State law enforcement agencies	• Emergency response agencies • National Response Center • Other state and federal assistance providers • WARN network • Downstream users if receiving stream was contaminated
Response	• Consult with public health agency and permitting agency • Consult external information sources	• Estimate affected area and isolate if possible • Implement appropriate public health/safety protection measures • Identify additional sites and initiate site characterization • Analyze samples	• Characterize affected area • Revise public health/ safety protection measures as necessary • Plan remediation activities

7 Summary

Because of the potentially serious impacts of a wastewater contamination event on public safety/ health, private property, and wastewater infrastructure, contamination threats should be evaluated and managed in a timely and systematic manner. Improper management of a threat can lead to overreaction to a false alarm or underreaction to a dangerous situation. Module 2 of the WWRPTB presents recommendations to systematically process a suspicion of intentional or accidental contamination of a wastewater system. Utilities can use these suggestions for evaluating threats and responding accordingly when they prepare or upgrade their Emergency Response Plans and Response Guidelines.

8 Appendices

The following are examples of forms that may be used to facilitate the public health response:

- Response Planning Matrix
- Threat Evaluation Worksheet
- Security Incident Report Form
- Witness Account Report Form
- Phone Threat Report Form
- Written Threat Report Form
- Public Health Information Report Form

These forms can be found in the Appendices located at the end of the Toolbox.

United States
Environmental Protection
Agency

Wastewater Response Protocol Toolbox:

Planning For and Responding To Wastewater Contamination Threats and Incidents

December 2011

Module 3:
Site Characterization and Sampling Guide

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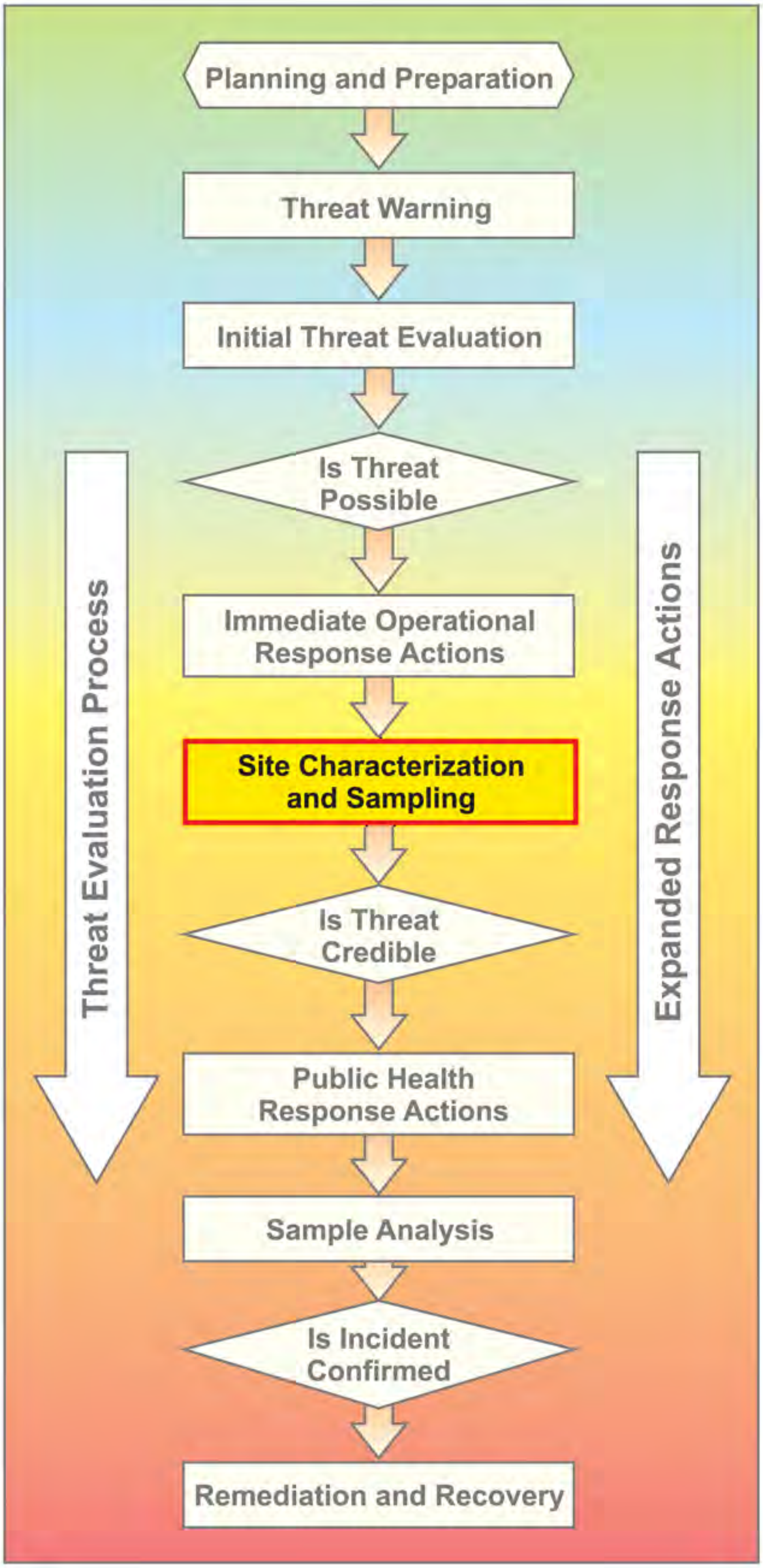
Planning and Preparation
Threat Warning
Initial Threat Evaluation
Is Threat Possible
Immediate Operational Response Actions
Site Characterization and Sampling
Is Threat Credible
Public Health Response Actions
Sample Analysis
Is Incident Confirmed
Remediation and Recovery
Threat Evaluation Process
Expanded Response Actions

1 Introduction

Site characterization and sampling are activities that should be initiated in response to a 'Possible' contamination threat in order to determine whether or not the threat is 'Credible.' Site characterization is the process of collecting information concerning a 'Possible' contamination event. If a suspected contamination site has been identified, it will likely be designated as the primary investigation site. Additional or secondary sites may be identified to investigate the potential spread, or source, of a suspected contaminant. For example, this could include monitoring of the influent pump station wet well at the treatment plant headworks if contamination is suspected in the wastewater collection system. The results of site characterization are critically important to the threat evaluation process. Note that in some cases, the evidence or observations gathered during the site characterization could be sufficient to elevate the threat evaluation from 'Possible' to 'Credible' and even 'Confirmed.'

Module 3 describes recommended procedures for carrying out the site characterization activities. These procedures may be adapted to a utility's specific needs consistent with any applicable laws or regulations.

There are two broad phases of site characterization: planning and implementation. The Incident Commander is typically responsible for planning while the Site Characterization Team is typically responsible for actually implementing the Site Characterization Plan. This module provides information for those involved in either the planning or implementation phases of site characterization. While the target audience is primarily wastewater utility managers and staff, other organizations may be involved in site characterization. Therefore, this module may also be useful for a variety of first responders including police, fire, HazMat responders, FBI and EPA criminal investigators, National Guard Civil Support Teams, and environmental response teams from EPA and other government agencies.

2 Overview of Recommended Site Characterization Process

Process Overview

The recommended site characterization process includes five stages. These are shown in the flowchart in Figure 3-1, and are described in the narrative that follows.

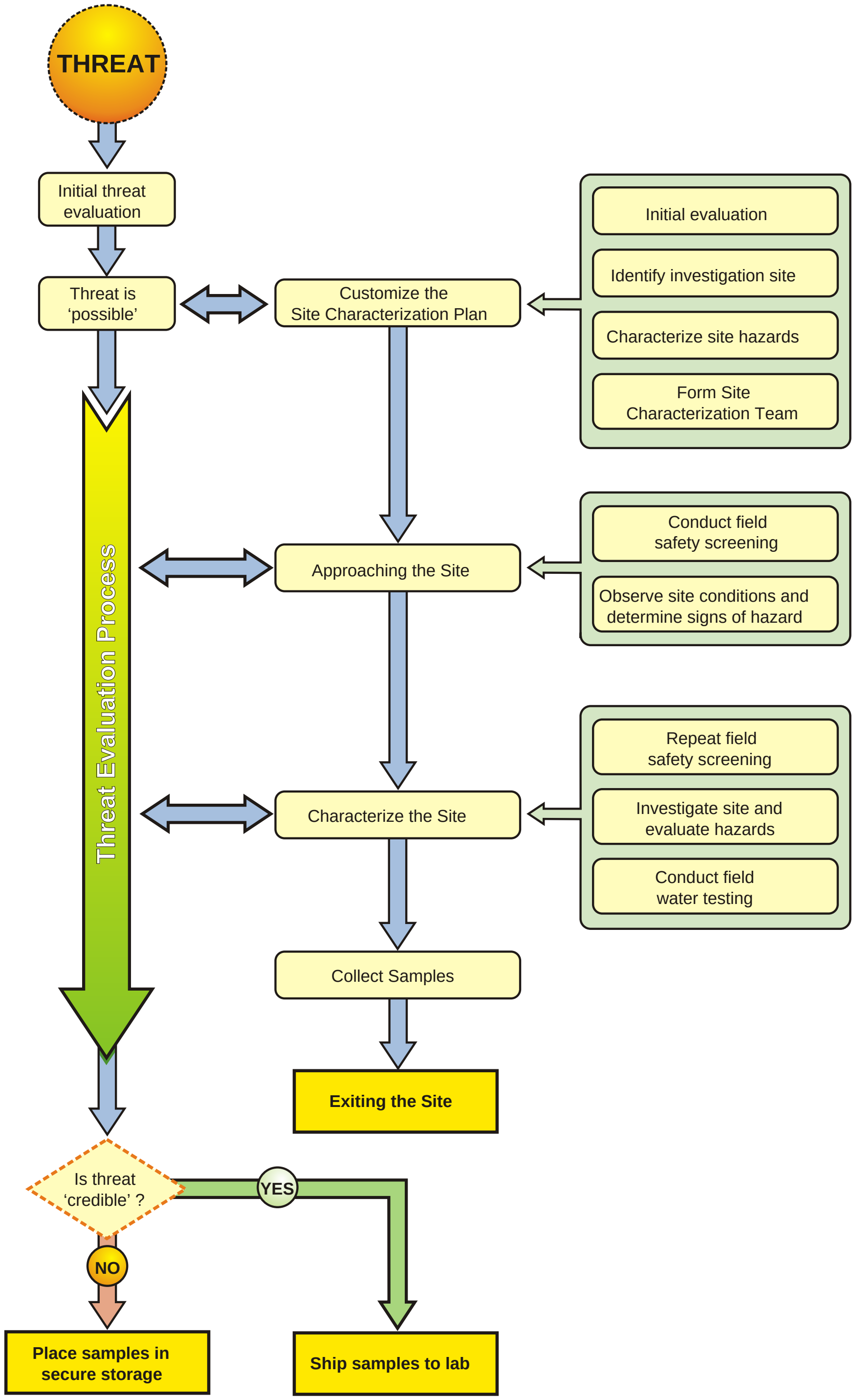

Figure 3-1. Site Characterization Process

Customize the Site Characterization Plan

A Site Characterization Plan should be customized for a specific threat, from the utility's generic Site Characterization Plan. The generic Site Characterization Plan should be developed as part of a utility's prior preparation for responding to both intentional and accidental contamination threats, and should be designed to be adaptable to a variety of situations. The generic plan may contain information on pre-entry criteria (i.e., under what circumstances a particular team, such as a utility team, may execute the site characterization), communications, team organization and responsibilities, safety, field testing details, sampling details, and a protocol for exiting the site. The customized plan should guide the team during site characterization activities and be based on the specific circumstances of the current threat warning. The Site Characterization Team typically will use the customized plan as the basis for their activities at the investigation site. A template for the development of a Site Characterization Plan is provided in Appendix 8.

During the development of the customized plan, it is important for the Incident Commander to conduct an initial assessment of site hazards, which is critical to the safety of the Site Characterization Team.

The initial assessment of site hazards will impact the makeup of the team. Under low hazard conditions, a utility team may perform site characterization. If there are obvious signs of more hazardous conditions (radiological, chemical, or biological contamination), then teams trained in hazardous materials safety and handling techniques (HazMat) may need to conduct an initial hazard assessment and clear the site for entry by utility personnel. Alternatively, the HazMat team may decide to perform all site characterization activities themselves. The composition of the Site Characterization Team should be consistent with the role that the utility has assumed beforehand in threat/incident response. Obvious signs of hazard would provide a basis for determining that a threat is 'Credible.' Furthermore, the site might be considered a crime scene if there are obvious signs of hazards and human intervention. In this case, law enforcement may take over the site investigation.

Four hazard categories are considered in the context of site characterization:

Low Hazard - no obvious signs of radiological, chemical, or biological contaminants present at the site (i.e., in the air or on surfaces). Contaminants that may be present are assumed to be dilute and confined to the wastewater.

Radiological Hazard - presence of radiochemical isotopes or emitters tentatively identified, at the site, in the air or in the wastewater (i.e., through the use of field radiation detectors).

Chemical Hazard - presence of highly toxic chemicals (e.g., chemical weapons or biotoxins) or volatile toxic industrial chemicals, tentatively identified at the site in the air or in the wastewater, with a potential risk of exposure through dermal or inhalation routes.

Biological Hazard - presence of pathogens, tentatively identified at the site, with a potential risk of exposure through dermal or inhalation routes.

Figure 3-2 illustrates how information from recommended site characterization activities may be used to refine the hazard assessment, which in turn may influence the course of the site characterization.

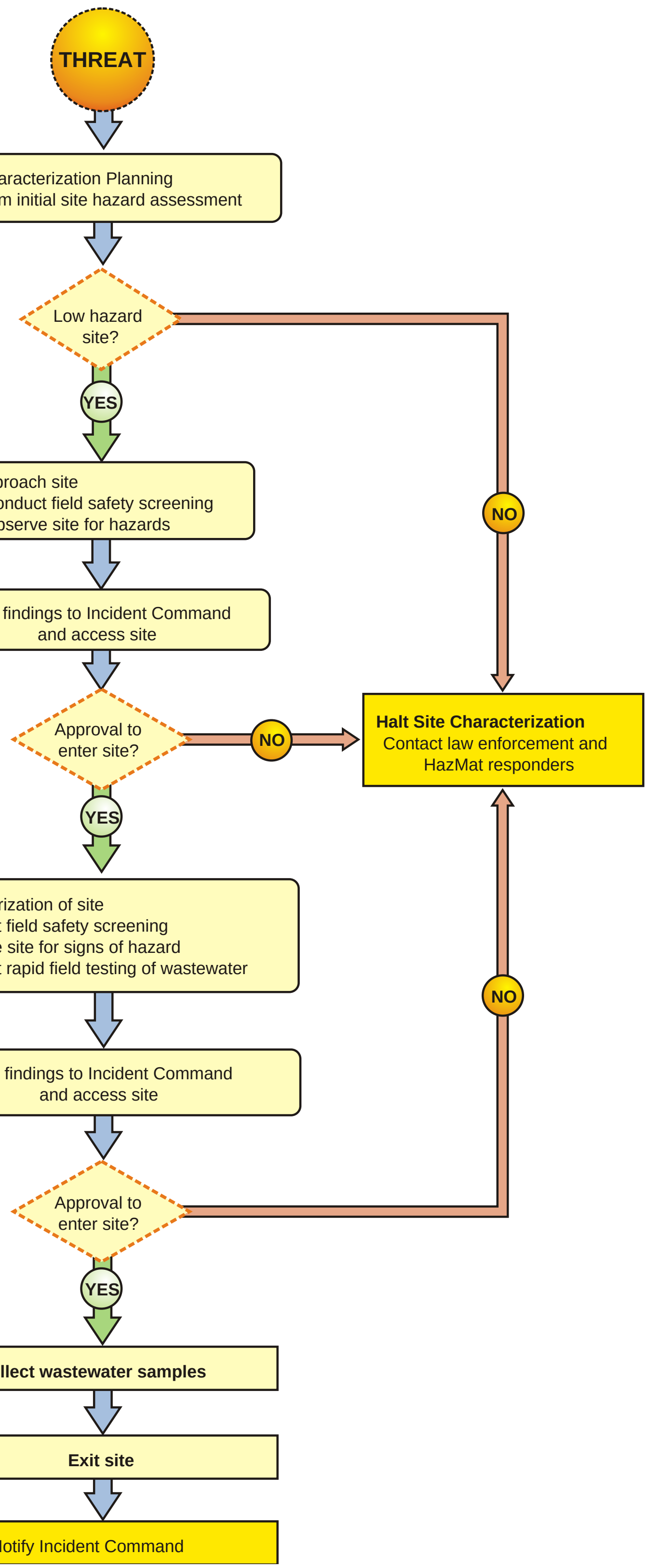

Figure 3-2. Integration of site hazard assessment into site characterization process

Approach the Site

Before entering the site, an initial assessment of conditions and potential hazards should be conducted at the site perimeter. As part of this assessment, the Site Characterization Team, upon arrival at the perimeter, should conduct a field safety screening and observe site conditions.

The purpose of the field safety screening activities is to identify potential environmental hazards that might pose a risk to the Site Characterization Team. The screening may include tests for radioactivity and atmospheric screening for ambient combustible gases, toxic gases, and volatile organic compounds (VOCs). Flammable or explosive gases can be detected using a Lower Explosive Limit (LEL) meter and/or a combustible gas detector. Non-specific VOCs can be detected with a Photoionization Detector (PID) Total Organic Vapor Detector. Specific VOCs can be detected and identified with field portable gas chromatography (GC) or gas chromatography-mass spectrometry (GC-MS). The team should also conduct a visual inspection of the site to detect signs of hazard (e.g., dead animals, dead vegetation, discarded equipment, gloves, and containers).

If the team detects signs of hazard, they should stop their investigation and contact the Incident Commander to report their findings. If no immediate hazards are identified during the approach to the site, the Incident Commander will likely direct the team to enter the site and perform the site characterization (Figure 3-3).

Observations made during the approach to the site should be documented using a form such as the Site Characterization Report Form in Appendix 9. The results of the field safety screening should be documented using a form such as the Field Testing Results Form included in Appendix 10.

Figure 3-3. Operator Using a Field Meter for Site Characterization.

Characterize (Investigate) the Site

During this stage, the team should repeat the field safety screening (at the site itself), conduct a detailed visual investigation of the site, and perform rapid field testing of the wastewater that is suspected of being contaminated. Rapid field testing may include the collection of samples based on the process outlined in the section below. Details observed during the visual inspection of the site can also be documented using the form in Appendix 9.

Rapid field testing of the wastewater has three objectives:

1. Provide additional information to support the threat evaluation process.
2. Provide tentative identification of contaminants that would need to be confirmed by laboratory testing.
3. Determine if hazards tentatively identified in the wastewater require special handling precautions for sample collectors.

The field testing performed on wastewater should be based on the circumstances of the specific threat and should be consistent with the training and resources of the Site Characterization Team. A core set of rapid field tests includes measurement of pH, conductivity, and radioactivity (including alpha, beta, and gamma radiation). Abnormal pH, conductivity, or radioactivity values may indicate a problem.

In addition to the core tests, the Site Characterization Team may conduct expanded field testing of wastewater commensurate with their training and resources (Figure 3-4).

Expanded field testing may include screening for combustible gases in the headspace of a wastewater sample using an LEL gas detector. It may also include non-specific screening for VOCs using a sample headspace total organic vapor PID detector, or specific detection and identification of VOCs using a portable GC/MS. Screening for gases in a manhole can include measurements at two inches below the lip and repeated measurements after lowering the probe to a point just above the wastewater surface. Toxicity screening may be conducted using acute toxicity screening tests, and biotoxins and pathogens may be detected using Polymerase Chain Reaction (PCR) technology.

It is important to note that negative rapid field test results are not a reason to forgo sample collection since field testing is limited in scope and can result in false negatives. This is especially true given the complicated analytical matrix presented by wastewater. It is also important to emphasize that any field detectors or kits used during an emergency should be evaluated and characterized with respect to performance, and a baseline established before an emergency for the monitored parameter. Use of detectors or equipment that have not been characterized may lead to greater uncertainty with respect to how to respond, especially if the tests produce false positive results.

Results of rapid field testing of the wastewater can be documented using the Field Testing Results Form in Appendix 10.

Figure 3-4. Operator Conducts Field Testing at a Treatment Plant.

Collect Samples

Following rapid field testing of the wastewater, samples of the suspect wastewater should be collected for potential laboratory analysis. The purpose of sampling from a suspected contamination site is to obtain and preserve a sample of the wastewater at a particular time and location so that it can be analyzed later if necessary. The decision to send samples to a laboratory for analysis should be based on the outcome of the threat evaluation. If the threat is determined to be 'Credible,' then samples should be immediately delivered to a laboratory for analysis. On the other hand, if the threat is determined to be 'Not Credible,' then samples should be secured and stored for a predetermined period in the event that it becomes necessary to analyze the samples at a later time.

In order to sample effectively, sampling requirements should be considered during the development of the customized Site Characterization Plan. Factors to consider during the development of the sampling approach include:

- Which contaminants or contaminant classes will be analyzed for?
- What type of samples will be collected (i.e., grab or composite)?
- When and where will samples be collected?
- Are any special precautions necessary during sample collection?

Under low hazard conditions, no special sampling techniques may be necessary beyond good safety practices as outlined later in this module. If the site is characterized as a radiological hazard during field safety screening or the rapid field testing of wastewater, then samples should be collected for radiological analysis by personnel trained and equipped to work at radioactive contamination sites. If the site is characterized as a chemical hazard, dilution of samples collected for chemical analysis may be an appropriate sampling strategy to reduce risk during sample transport and analysis. Finally, if the site is characterized as a biological hazard, pathogen sampling may require the collection of a large volume of wastewater for subsequent concentration in the lab.

Critical information for each sample should be documented. The same information captured on the sample labels should be transferred to a sample documentation form to serve as a sample inventory. Appendix 11 contains an example documentation form. Additionally, sample custody should be closely tracked and documented using a chain of custody form. See Appendix 12 for an example of this form.

EPA has recently published additional guidance on sample collection entitled *Sampling Guidance for Unknown Contaminants in Drinking Water* (EPA-817-R-08-003, November 2008) (see www.epa.gov/watersecurity; search under Water Laboratory Alliance). While this document is intended for drinking water applications, it may also be useful for wastewater sampling.

Table 3-1 presents an example of a sample collection kit, while Table 3-2 provides a detailed listing of the sample containers included in the kit. The sample collection kit described in this section is intended to illustrate the types of materials and supplies that might be useful during sampling activities. However, the design of a specific kit should be tailored to the needs and sampling objectives of the user.

Table 3-1: Example Design of an Emergency Wastewater Sample Collection Kit

Item	Quantity	Notes
Field Resources and Documentation		
Field Guide	2	Resource for field personnel
Health and safety plan	2	If required for the site
Sample labels	48	Waterproof (filled out in advance, if possible)
Sample documentation forms	24	For recording sample information
Custody tape (or seals)	2 rolls	Used on sample or shipping containers
Chain of custody forms	24	For documenting sample custody
Lab marker	2	Waterproof, 1 red, 1 black
General Sampling Supplies		
Sample containers	Table 3-2	For collecting samples
Device for grab sampling	1	For sampling large water bodies
10 liter HDPE container	4	For collection of large volume water samples
Lab grade tape	3 rolls	For temporary labeling in the field
Miscellaneous glassware	N/A	Beakers, graduated cylinders, spatula, etc.
Collapsible cooler	1	For sample storage
Rigid shipping container	1	For shipping by overnight service if needed

Table 3-1 (cont.): Example Design of an Emergency Wastewater Sample Collection Kit

Item	Quantity	Notes
1 qt. zippered freezer bags	1 pack 100	For double bagging ice and sample containers
Thermometer	2	For checking water temperature
Paper towels	2 rolls	Wiping wet containers and containing spills
Reagents (may need to be kept separate from the rest of the kit)		
Laboratory grade water	5 liters	For sample dilution in the field
6 Molar ACS grade hydrochloric acid (HCl)	25 mL	In dropper bottle for preservation of samples for organic analyses
6 Molar trace metal-grade nitric acid (HNO_3)	25 mL	In dropper bottle for preservation of samples for trace metals analysis
10 Normal sodium hydroxide (NaOH)	25 mL	In dropper bottle for preservation of samples for cyanide analyses
pH paper in ranges from 0 – 4 and 10 – 14	50 strips	For checking pH of samples preserved with acid or base (sensitive to 0.5 pH units)
Safety Supplies		
Splash resistant goggles	2	One per individual (minimum)
Disposable gloves	1 box	Nitrile or polyethylene, powder-free
Disposable shoe covers	2 pairs	One pair per individual (minimum)
Disposable laboratory coats	2	One per individual (minimum)
Clear, heavy duty plastic trash bags	4	For disposal of lab coat, gloves, etc.
Rinse water	20 liters	For general use and first aid
Antiseptic wipes	1 container	For cleaning hands, sample containers, etc.
Bleach solution (at least 5%)	1 gallon	For decontamination if necessary
Squirt bottle	2	For use with rinse water or lab grade water
First aid kit	1	For general first aid
Flashlight/headlamp	3	For working at night or in dark locations

If the threat is determined to be 'Credible,' then samples should be immediately delivered to a laboratory for analysis.

Table 3-2: Sample Containers for Emergency Wastewater Sample Collection *

Sample Type	Container Size	Container Type	No.	Preservative	Analytical Technique	Reference Methods
CHEMISTRY – BASIC SCREEN (Established Techniques)						
Organic Analytes						
Volatiles	40 mL	Glass w/Teflon faced septa	5	1:1 HCl to pH < 2 See method	P&T – GC/MS	8260B
					P&T – GC/PID/ELCD	8021B
Semi-volatiles	1 L	Amber w/Teflon-lined screw caps	4	6M HCl. See method	SPE GC/MS	8270D 3535A
Quarternary nitrogen compounds	1L	Amber PVC or silanized glass	4	Sulfuric acid to pH2	SPE HPLC – UV	8321B
Carbamate Pesticides	40 mL	Glass w/Teflon faced septa	4	Potassium dihydrogen citrate sample pH to ~ 3.8	HPLC-fluorescence	8318
Metals/Elements	125 mL	Plastic (i.e., HDPE)	2	Trace metal grade nitric acid. See method.	ICP-MS	6020A
					ICP-AES	6010C
					AA	7010
Organometallic compounds	125 mL	Plastic (i.e., HDPE)	2	Nitric acid to pH 2. See method	AA – cold vapor	7471B
Cyanide	1 L	Plastic	2	Sodium hydroxide to pH 12. See method.	Wet Chemistry	9012A
Radiological	2 L	Plastic	2	None – mark samples not preserved	Gross alpha, gross beta, gamma isotopes, specific radionuclides	7110B

* Analytical techniques and reference methods are covered in more detail in Module 4.

Table 3-2 (cont.): Sample Containers for Emergency Wastewater Sample Collection

Sample Type	Container Size	Container Type	No.	Preservative	Analytical Technique	Reference Methods
CHEMISTRY – EXPANDED SCREEN (Exploratory Techniques)						
Unknown organics (volatile)	40 mL	Glass w/Teflon faced septa	5	None – mark samples not preserved	P&T-GC/MS	See Module 4
Unknown organics (general)	1 L	Amber Glass	4	None – mark samples not preserved	**Prep**: SPE, SPME, micro LLE, direct aqueous injection, headspace **Analysis**: GC/MS. GC, HPLC, LC-MS	See Module 4
Unknown inorganics	1 L	Plastic	2	None – mark samples not preserved	ICP-MS	See Module 4
Immunoassays	1 L	Amber Glass	2	Consult manufacturers instructions	Consult manufacturers instructions	None
PATHOGENS – EPANDED SCREEN (Established and Exploratory Techniques)						
Pathogens –culture	100 mL	HDPE (plastic)	2	TBD	Per target pathogens	See Module 4
Pathogens – PCR	100 mL	HDPE (plastic)	2	TBD	Per target pathogens	See Module 4
BASELINE WATER QUALITY PARAMETERS (See Section 3-4)						
Water quality: Chemistry	1 L	Plastic	1	None – mark samples not preserved	Conductivity, pH, alkalinity, hardness, turbidity	Standard methods
Surrogates	1 L	Amber Glass	2	None – mark samples not preserved	TOC, ultraviolet absorbance, color, chlorine demand	Standard methods
Toxicity	125 mL	Glass	2	Consult manufacturers instructions	Rapid toxicity assay (several vendors)	None

Exit the Site

Upon completion of site characterization activities, the team should prepare to exit the site. At this stage, the team should make sure that they have documented their findings, collected all equipment and samples, and re-secured the site (e.g., locked doors, hatches, and gates).

If the site is considered to be a hazardous site, special procedures for exiting the site may be required by HazMat officials. For example, personnel and equipment may be required to undergo decontamination prior to exiting the site, and access to the site is likely to be tightly controlled.

If the site is considered a crime scene, the site may be secured by law enforcement, and qualified investigators may be responsible for collecting and preserving any physical evidence (such as empty containers, or discarded equipment).

The site characterization activities presented in this module range from relatively simple activities, such as visual inspection of the site, to complex activities, such as field testing of the air, environmental surfaces, and wastewater for unusual contaminants. The wastewater utility should decide in advance the extent of site characterization activities that they will perform within their own organization and those that would be provided by external organizations. For example, a utility may choose to develop a capability for performing the visual inspection and core field testing at low hazard sites. The utility may make arrangements with HazMat responders to provide support during the characterization of potentially more hazardous sites. The utility may also arrange with a contract lab to provide sample kits and sample containers. It is critical that the utility plan ahead of time for those

site characterization activities that they will take responsibility for, and make arrangements with agencies that will support the utility in the event that a situation exceeds the utility's resources and capabilities. Tabletop and operational-based drills and exercises provide training opportunities to improve coordination between the utility and response agencies.

3 Safety and Personnel Protection

Proper safety practices are essential for minimizing risks to the Site Characterization Team and must be established prior to an incident in order to be effective. Field personnel involved in site characterization activities should have appropriate safety training to conform with applicable laws and regulations including work safety regulations under the Occupational Safety and Health Administration. These include OSHA 1910.120 (http://www.osha.gov), which deals with hazardous substances.

Basic good safety practices should be incorporated into a set of concise safety guidelines for personnel responsible for performing site characterization activities. These guidelines may be formalized into a health and safety plan (HASP).

The appropriate level of personal protection necessary to safely perform site characterization activities will depend on the assessment of site hazards that might pose a risk to the Site Characterization Team. Site hazard assessment is conducted during the development of the customized Site Characterization Plan and continues throughout the period of time that the team occupies the investigation site. Two general scenarios are considered, one in which there are no obvious signs of immediate hazards, and one in which there are indicators of site hazards.

In most cases the investigation site will not present a significant hazard and basic equipment and training will be sufficient to conduct site characterization activities safely. This would typically be the case for a routine security breach such as an open manhole cover. Under these conditions it may be reasonable to presume that any contaminants that might be present are confined to the wastewater and are present at dilute concentrations. Risk to personnel may be minimized through the use of good safety practices, including:

- Do not eat, drink, or smoke at the site
- Do not smell wastewater samples
- Use basic personal protective equipment –
    - Splash proof goggles
    - Disposable gloves
    - Disposable foot covers
    - Disposable lab coat
- Avoid skin contact with wastewater
- Fill sample containers slowly to avoid volatilization or aerosolization of contaminants
- Minimize time that personnel are on site

In other cases obvious signs of hazards may be observed at the time the threat is discovered or during the approach to the site. Under these conditions, only personnel with proper equipment and training (e.g., HazMat teams) should enter the site.

4 Roles and Responsibilities for Site Characterization

The Incident Commander, Operations Section Chief and the site characterization Team Leader are key personnel in site characterization. The Incident Commander should have overall responsibility for managing response to the threat, and is responsible for planning and directing site characterization activities. The Incident Commander may also approve the Site Characterization Team to proceed with their activities at key decision points in the process. The Operations Section Chief is responsible for all field activities and serves as the liaison between the Incident Commander and the Site Characterization Team Leader. The Site Characterization Team Leader should be responsible for implementing the Site Characterization Plan in the field and supervising site characterization personnel.

Depending on the nature of the contamination threat, other agencies and organizations may be involved or assume responsibility during planning and implementation of site characterization activities. Some of these organizations and roles are described below.

Wastewater Utility

The utility may provide the Incident Commander unless another organization is so designated to provide that role.

HazMat Response Teams

In coordination with utility staff, these HazMat Teams may assume responsibility for oversight of site characterization activities in situations where hazardous materials are suspected.

Technical Assistance Providers

The wastewater primacy agency, EPA hazardous material responders, or other specially trained response teams may be consulted for technical assistance and in some cases be requested to take responsibility for planning, oversight, and implementation of site characterization activities.

Laboratories

Laboratories are responsible for timely analysis of samples collected by the Site Characterization Team in response to a contamination threat.

Local Law Enforcement Agencies

These agencies may assume responsibility for incident command in situations where criminal activity, excluding a federal crime, is suspected.

FBI

The FBI is expected to assume incident command for the investigation aspects of the situation when terrorism is suspected. If the FBI becomes involved they would likely make the credibility determination.

EPA

The EPA may provide technical advice for site characterization or other components of the Threat Management process, and may provide personnel for site characterization if requested by a state regulatory agency. In cases where a contamination threat or incident is not an act of terrorism, EPA's CID will typically be the lead federal agency for law enforcement in the response.

5 Summary

Once the determination has been made that a contamination event is 'Possible,' it is appropriate to conduct a site characterization to help determine whether the threat is 'Credible.' Site characterization is the investigation of the suspected site of contamination as well as other locations where contaminants may have spread or originated. Site characterization should be carried out systematically and involves customization of a general Site Characterization Plan followed by the actual investigation. The investigation includes physical inspection of the site, field safety screening of the environment, rapid testing of the suspect wastewater, and sample collection. While it is important to conduct a thorough investigation of the site and collect representative samples, it is also important to minimize the risk faced by the Site Characterization Team. Module 3: Site Characterization and Sampling Guide suggests a protocol to accomplish all of these goals.

6 Appendices

The following are examples of forms that may be used to facilitate the public health response:

- Site Characterization Plan Template
- Site Characterization Report Form
- Field Testing Results Form
- Sample Documentation Form
- Chain of Custody Form

These forms can be found in the Appendices located at the end of the Toolbox.

United States
Environmental Protection
Agency

Wastewater Response Protocol Toolbox:

Planning For and Responding To Wastewater Contamination Threats and Incidents

December 2011

Module 4:
Analytical Guide

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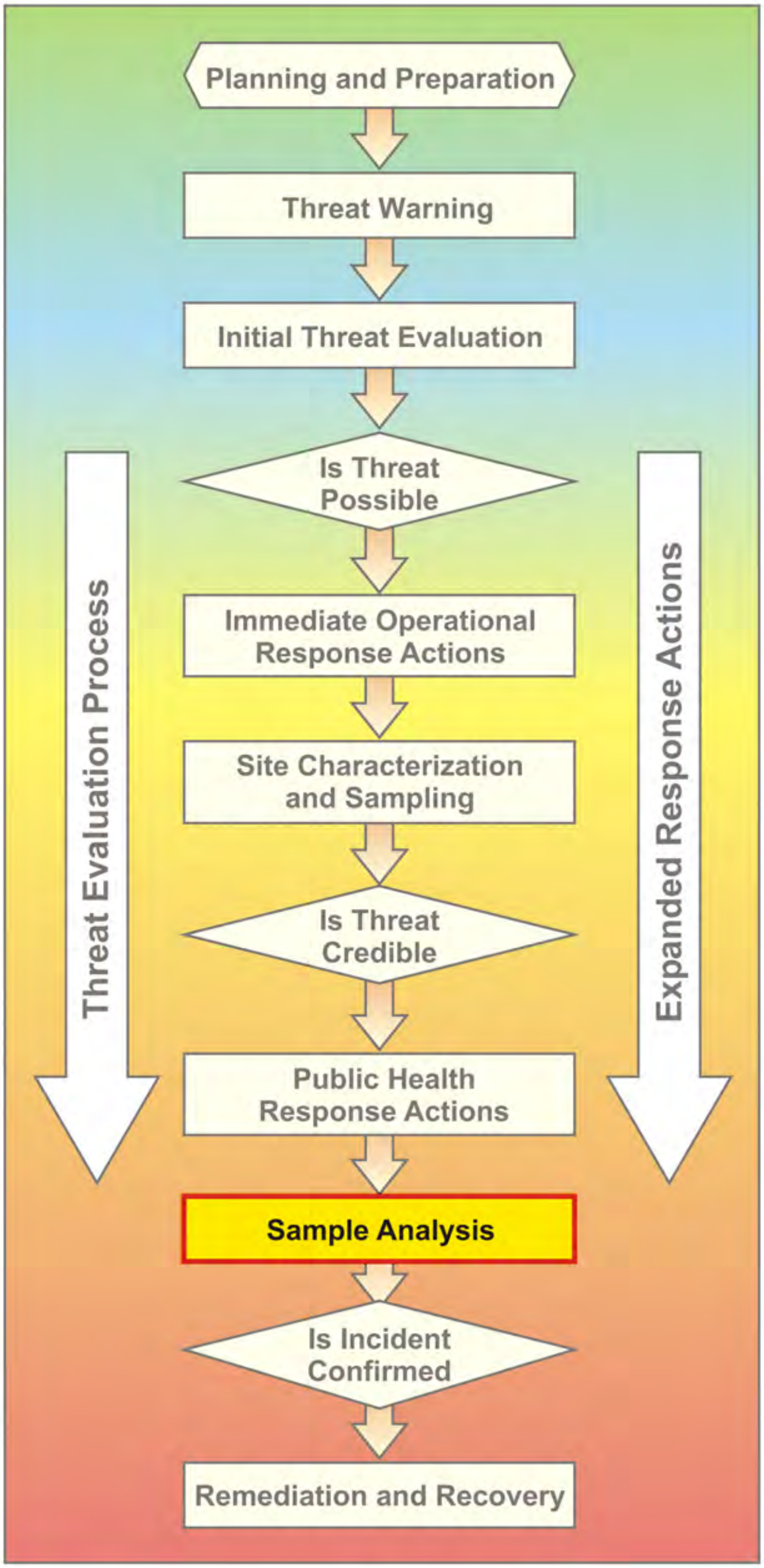

Planning and Preparation
Threat Warning
Initial Threat Evaluation
Is Threat Possible
Immediate Operational Response Actions
Site Characterization and Sampling
Is Threat Credible
Public Health Response Actions
Sample Analysis
Is Incident Confirmed
Remediation and Recovery
Threat Evaluation Process
Expanded Response Actions

1 Introduction

1.1 Objectives of this Module

The primary intended users of this module include laboratory personnel and planners who would provide analytical support to a wastewater utility in the event of a contamination threat. This module is intended to be a planning tool for labs rather than a how-to manual for use during an actual incident. As part of planning for such an incident, laboratories may want to prepare a detailed 'Laboratory Guide' specific to their needs and capabilities. Also, laboratories may want to consider how they coordinate with networks of other laboratories so as to provide added capability and capacity.

The objectives of this module include:

1. Describing how laboratories can respond to contamination events.
2. Describing special laboratory considerations for handling and processing emergency wastewater samples suspected of contamination with a harmful substance.
3. Presenting model approaches and procedures for analysis of wastewater samples suspected of contamination with a known or unknown substance. These analytical approaches are intended to take advantage of existing methodologies and infrastructures.
4. Encouraging planners to develop a site-specific analytical approach and Laboratory Guide that conforms to the general principles of the model approaches presented in this module.

Roles of Laboratories in Response to Contamination Threats

While utility labs, especially at larger utilities, may become quite involved with preliminary screening and preliminary analysis of samples from suspected contamination events, most will not be able to implement all of the analytical protocols described in Module 4. Federal, state, and commercial labs may be called upon to provide more sophisticated, in-depth analyses.

2 Current Laboratory Infrastructure in U.S.

The analytical approach described in this module was developed under the assumption that it would be implemented using the existing laboratory infrastructure in this country. EPA established the Environmental Response Laboratory Network (ERLN) to assist in addressing chemical, biological, and radiological threats during nationally significant incidents. The Water Laboratory Alliance (WLA), which launched in October 2009, is the water component of the ERLN and provides the Water Sector (drinking water and wastewater systems) with an integrated nationwide network of laboratories. The WLA provides additional analytical capability and capacity to an event involving intentional and unintentional water contamination involving chemical, biological and radiochemical contaminants. For more information, visit http://www.epa.gov/erln/water.html.

Also, the WLA has a *Water Laboratory Alliance – Response Plan* (WLA-RP) (EPA 817-R-10-002, November 2010) that outlines the processes and procedures for a coordinated laboratory response to water contamination incidents that may require more analytical laboratory capability and capacity than a typical laboratory can provide. It addresses analytical demand during the emergency response, remediation, and recovery phases of a natural disaster, accident, or terrorist incident affecting the water sector. (http://water.epa.gov/infrastructure/watersecurity/wla/upload/WLAResponsPlan_November2010.pdf)

EPA has constructed a Laboratory Compendium to assist utilities and other responders in locating appropriate labs for analysis of contaminants during a contamination incident. The Laboratory Compendium is a database of laboratory capabilities for environmental analysis in water, air, soil, sediment, and other media. Instructions on acquiring access to the Laboratory Compendium are available at the following website: http://www.epa.gov/compendium.

The ERLN is also part of a larger federal network of laboratories called the lntegrated Consortium of Laboratory Networks (ICLN). The Department of Homeland Security established the ICLN to coordinate laboratory networks to respond to acts of terrorism and other major incidents. ICLN is composed of networks of Federal laboratories from U.S. Department of Agriculture, Department of Health and Human Services (Centers for Disease Control and Prevention, Food and Drug Administration), Department of Defense, and the Environmental Protection Agency.

Analytical Goals

In responding to contamination incidents (intentional or unintentional), keep in mind the following analytical goals or points:

- Protect laboratory personnel and provide timely, accurate results.
- Confirm or rule out the presence of significantly elevated levels of certain types or classes of contaminants.
- Check for the presence of additional contaminants, not just one.
- Report accurate results and not misidentify an instrumental response, which could lead to a false positive result.
- Focus on harmful contaminants including radionuclides, biotoxins, pathogens, and high concentrations of industrial chemicals.
- Consider background concentrations of a contaminant in a specific location when analyzing the data from wastewater samples.

The networks of laboratories analyze clinical and environmental samples for chemical, biological, and radiological analytes associated with terrorist as well as natural events.

It is likely that most emergency wastewater samples will be sent for analysis on the basis of a probable contamination threat. Samples sent to a laboratory as a result of a probable contamination threat should be treated as if they contain a potentially harmful substance. However, the site characterization process, along with the threat evaluation process, should result in most highly hazardous samples being screened before they reach the laboratory. Some organizations have an "All Hazards Receipt Facility" (AHRF) which is activated to screen unknown samples before those samples are sent to a laboratory. From a safety standpoint, it is important for a laboratory to realize that it will not be expected to determine every potential contaminant. For instance, utility laboratories typically may expect to receive samples from 'possible' incidents. The utility labs may need additional laboratory support for 'credible' incidents, and specialty laboratories likely would be called into service for 'confirmed' incidents.

Figure 4-1 and the narrative below summarize the typical laboratory infrastructure, as it currently exists, for the analysis of environmental samples.

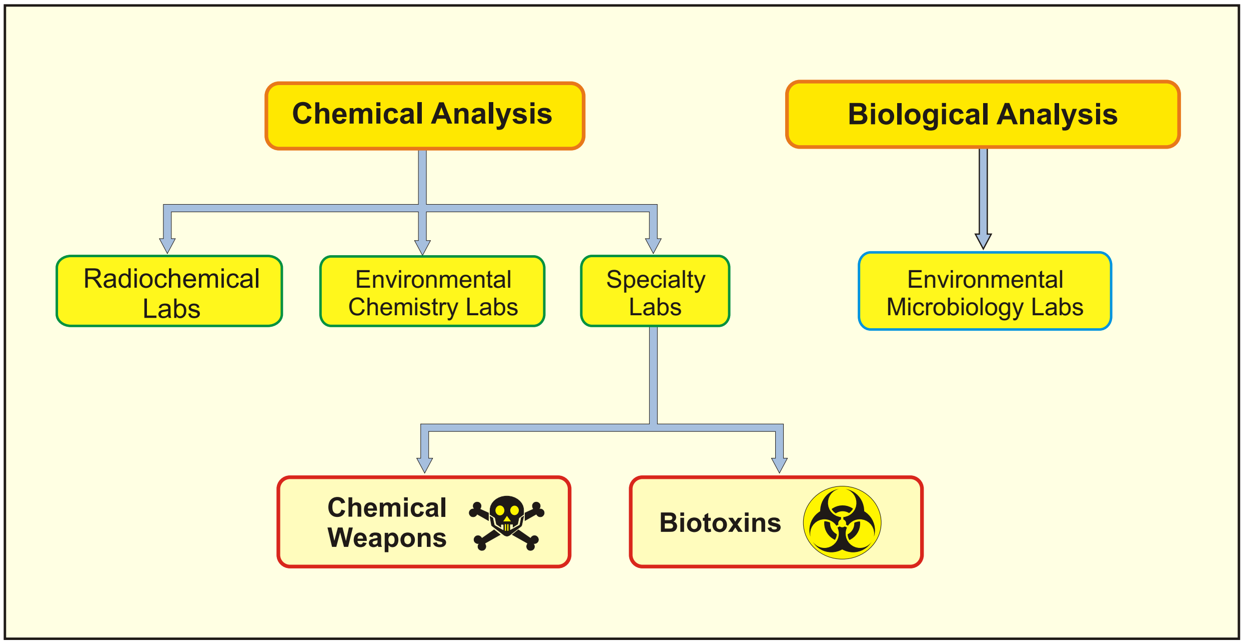


Figure 4-1. Types of Laboratories for Analysis of Environmental Samples.

2.1 Environmental Chemistry Labs

This group includes many EPA, state, utility, and commercial water analysis labs. Most environmental chemistry labs are set up to perform analysis of wastewater samples for compliance with the Clean Water Act and/or the Resource Conservation and Recovery Act, as well as some state and local regulations. Because these laboratories are typically certified to utilize regulatory compliance methods, unless the lab tests for a particular analyte on a routine basis, they may not necessarily be able to utilize a method for a specific contaminant without advance notice.

There are also a number of research laboratories within the government and academic sectors that may be available on a limited basis. These labs may be equipped with advanced instrumentation and highly trained analysts who can implement exploratory techniques.

2.2 Radiochemistry Labs

If a radioactive contaminant is suspected, analysis should be performed by a laboratory specifically equipped to handle such material and analyze for a range of radionuclides. EPA, Department of Energy (DOE), states, and some commercial firms have labs specifically dedicated to the analysis of radioactive material. Information concerning EPA's radiological emergency response and laboratory services is available at http://www.epa.gov/radiation/emergency-response-overview.html. Another source of support is the Federal Radiological Monitoring and Assessment Center (FRMAC) operated by the Department of Energy:
http://www.nv.doe.gov/nationalsecurity/homelandsecurity/frmac/.

2.3 Biotoxin Labs

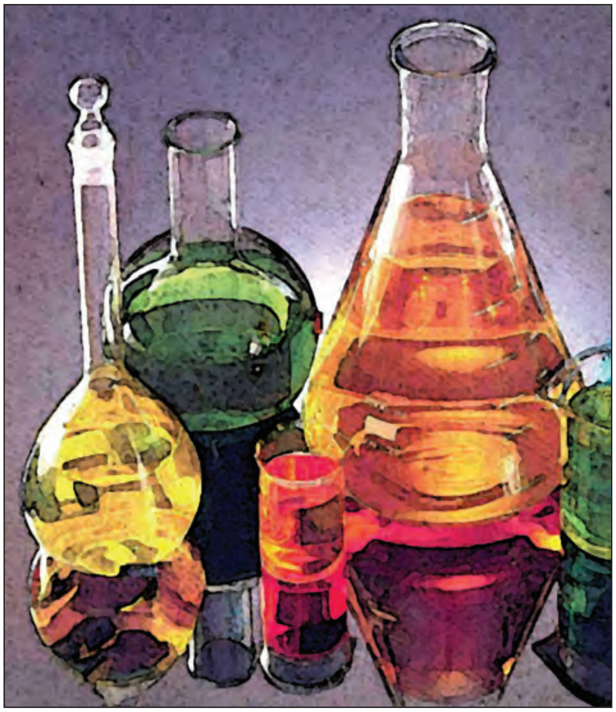
Currently, few laboratories are set up specifically for the analysis of biotoxins. There are a number of laboratories in government and academia that perform biotoxin analysis, usually for matrices other than wastewater (e.g., seafood and agricultural products). It is possible that some biotoxin analyses could be performed in qualified environmental chemistry labs using techniques such as gas chromatography-mass spectrometry (GC/MS), high performance liquid chromatography (HPLC), immunoassay, and possibly liquid chromatography-mass spectrometry (LC/MS). However, this capability is not currently widespread.

2.4 Chemical Warfare Labs

Chemical Weapons are those weapons that the Chemical Weapons Convention (CWC) has placed on a list known as Schedule 1. These are toxic chemicals with few or no legitimate uses other than for military purposes. There are only a handful of laboratories in the U.S. that are qualified and permitted to perform analysis for Schedule 1 chemical weapons material. Among other qualifications, these labs possess appropriate analytical instrumentation, are supplied with analytical standards of Schedule 1 chemical weapons material, and have implemented necessary safety measures. Some of these labs can only be accessed via certain federal agencies such as the FBI and include the U.S. Army Edgewood Laboratory and the Lawrence Livermore National Laboratories. EPA is developing capability and capacity to analyze environmental samples potentially contaminated with chemical warfare agents and degradents at seven fixed laboratories and two mobile laboratories.

2.5 Microbiological Laboratories

The analysis of waterborne pathogens will likely be performed by an environmental microbiology lab. Environmental microbiology laboratories (including those of EPA, state environmental agencies, utilities, and the commercial sector) routinely analyze water samples for indicators of fecal contamination (e.g., fecal coliform bacteria, total coliform



bacteria, and *E. coli*). An analytical limitation is that specific culture analyses for waterborne pathogens such as *Salmonella* spp. and *Shigella* spp. are not routinely performed in most environmental microbiology laboratories. In the event that a contamination threat or event involves select agents such as *Bacillus anthracis*, *Brucella* spp., *Yersinia pestis*, *Francisella tularensis*, and *C. botulinum* toxins, among others, samples would probably be transported by federal authorities to a lab within the Centers for Disease Control and Prevention Laboratory Response Network.

As discussed later in this module, the presence of microbiological pathogens in wastewater typically does not constitute the same health risk as when these pathogens are found in drinking water. Therefore, there may not be the same need to analyze potentially contaminated wastewaters for harmful microbes as there is for chemical contaminants.

3 Health and Safety

It is important to realize that details important for laboratory safety are integrated into the Threat Evaluation (Module 2) and Site Characterization (Module 3) processes even though they occur outside of the laboratory setting. The threat evaluation and site characterization processes help to define the hazard conditions at the site of sample collection, identify who should collect the samples and determine which laboratories should analyze them.

The following are some important considerations for the safety of personnel who will be processing laboratory samples that may contain unknown, possibly dangerous substances.

Currently, laboratories should have a plan in place to ensure worker safety. Some laboratories may wish to treat certain emergency wastewater samples as hazardous material, whether they be chemical, biological, or radiochemical in nature. They may also decide to develop a specific health and safety plan (HASP) to address this potential risk, although there is currently no requirement to do so in most cases.

Laboratory personnel involved in the handling and analysis of wastewater samples should have appropriate current safety training that will allow them to adhere to applicable regulations. Laboratories may wish to explore some of the measures contained in regulations for the handling of hazardous materials, such as OSHA 1910.120 (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9707).

Additionally, there is health and safety suggestions contained in various government publications including *Biosafety in*

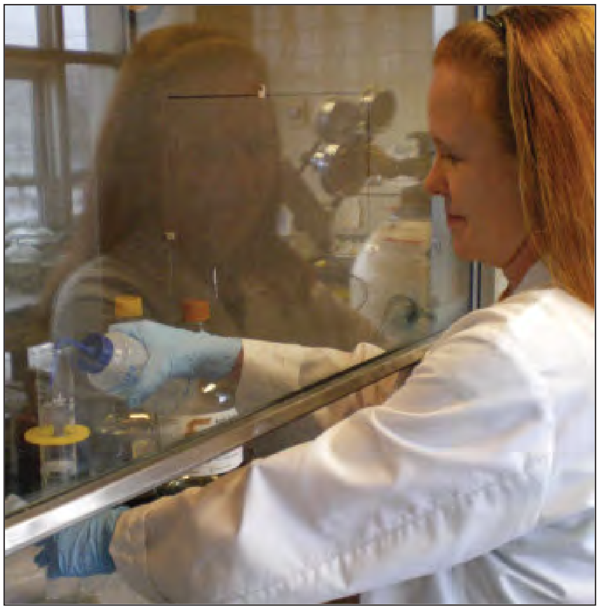


Figure 4-2. Lab Personnel Using a Protective Lab Hood.

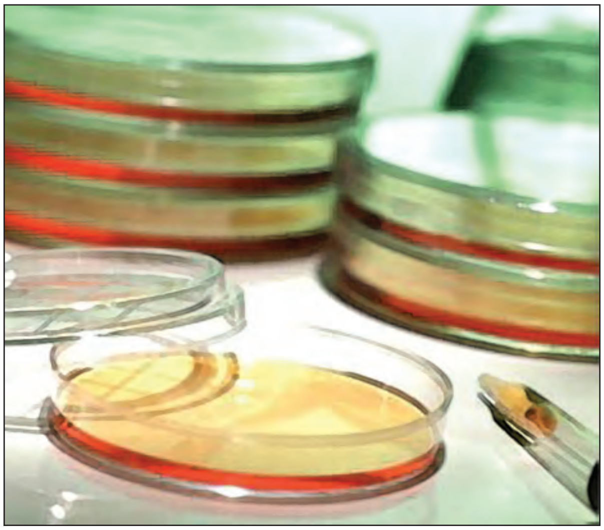
Microbiological and Biomedical Laboratories, 5th Edition. National Center for Infectious Diseases, Centers for Disease Control and Prevention, Office of Health and Safety, 2009. http://www.cdc.gov/biosafety/publications/bmbl5.

Analysis of potentially hazardous samples during an emergency situation may require additional personal protective equipment (PPE) above that normally used in the laboratory. These PPE requirements should be determined during the creation of the site-specific HASP. These may include, among others, the use of butyl gloves and full face shields especially during pouring and splitting of non-volatile samples.

Appropriate hoods (Figure 4-2) and other physical control measures should always be utilized when handling samples containing potentially hazardous unknown contaminants. The laboratory should also be outfitted with safety equipment such as eyewashes, safety showers, spill containment devices, and first aid kits. The laboratory should be fully informed about the sample collection and site investigation procedures, including any field safety screening and rapid field testing results. However, to reduce risks associated with potential, undetected hazards, laboratories may wish to screen the sample for various hazards upon receipt at the laboratory, regardless of the reported field safety screening results.
The water solubility of potential contaminants sometimes contributes to their safe handling. Steps should be taken to avoid volatilizing or aerosolizing wastewater samples, which would then increase the inhalation risk. Accordingly, separatory funnel liquid-liquid extractions, which may release aerosols when vented, are not recommended unless laboratories utilize appropriate hoods or other precautions.

Dilution of a hazardous wastewater sample with laboratory-grade water helps reduce risks associated with handling of the sample and its analysis for chemical contaminants. Dilution, however, may interfere with the ability to detect and quantify contaminants. If dilution is desired, ‘log dilutions’ may be utilized. For instance, a 1/1000 dilution may be analyzed first, followed by a 1/100 dilution if nothing is detected in the highest dilution. These can be followed by a 1/10 dilution, and finally the undiluted sample.

Like dilution, reducing the volumes of sample handled may help minimize exposure for both chemical and biological contaminants. Certain analytical techniques involve using smaller sample volumes. For example, micro-liquid extraction utilizes only about 40 ml compared with large volume extractions which utilize 1L or more. Selecting analytical approaches requiring smaller volumes of sample may help to limit risk to lab personnel dealing with suspect samples.



Approaches to limiting the potential exposure to unknown pathogens prior to chemical analysis may be to irradiate (UV or gamma), or pasteurize, the samples. Currently there is no general consensus on proper use of irradiation to reduce risk associated with sample handling and analysis while maintaining the integrity of the sample and analysis. Therefore, these techniques for reducing pathogen exposure are not validated methods and are experimental at best. However, they could be utilized by the laboratory, on portions of the sample, as an exploratory technique. It should be noted that UV sterilization or heat sterilization may also alter the identity or quantity of some chemicals.

4 Analytical Approach for Unidentified Contaminants in Wastewater

In the case of a complete unknown, the problem of identifying and quantifying a specific contaminant presents a significant challenge. The difficulty arises from the large number of potential contaminants of concern, and the impracticality of screening for all of them. To address this issue, EPA recommends using an analytical approach for unknowns that is based on contaminant classes derived from a prioritization of chemicals and pathogens of concern if present in a wastewater system.

The recommended analytical approach for unknown contaminants in wastewater presented in this module is comprehensive for selected priority contaminants and provides coverage for hundreds of additional contaminants. The following assumptions and principles were used in the development of this approach:

- Selection of target analytes was based on an assessment of contaminants likely to pose a threat to public health, public safety, utility employee health and safety, property, utility operations/infrastructure, and the environment.

- Existing laboratory infrastructure and analytical methods were utilized.

- Analytical procedures are tiered, with a progression from field safety screening and rapid field testing, through laboratory screening, to confirmatory analysis.

- Samples that cannot receive confirmatory analysis in the lab performing the initial testing are subsequently referred to laboratories that can perform a confirmatory analysis.

- The entire approach relies on the systematic elimination of potential contaminants, both to ensure the safety of sampling and laboratory personnel and to aid in identification of the unknown contaminant.

It is also important to realize that identification of unknown contaminants in wastewater samples is not an exact science. This is especially true given the difficult analytical matrix presented by wastewater. There is no guarantee that any combination of technology will always yield successful identification of unknown contaminants.

It should be emphasized that Module 4 is not intended to represent a prescriptive how-to laboratory manual. Rather, this model screening procedure is intended to be a recommended planning tool for laboratories to formulate a Laboratory Guide specific to their own needs and capabilities. The Laboratory Guide for the lab dealing with emergency samples is similar to the Emergency Response Plan prepared by the utility in that both can be based extensively on information presented in the EPA Wastewater Response Protocol Toolbox, but both should still be customized to local needs and resources.

Also, the *Water Laboratory Alliance – Response Plan* (WLA-RP) provides a structure to coordinate laboratory capability and capacity to prevent duplication of effort, maximize efficiencies and effectiveness, improve communication, and increase analytical support. Laboratories are encouraged to increase awareness of the WLA-RP through notification and discussion with the state drinking water programs and emergency management agencies.

Additionally, EPA has recently published additional guidance on sample collection entitled *Sampling Guidance for Unknown Contaminants in Drinking Water* (EPA 817-R-08-003, November 2008) (see www.epa.gov/watersecurity; search under Water Laboratory Alliance). The guidance integrates recommendations for pathogen, toxin, chemical, and radiochemical sample collection, preservation, and transport procedures to support multiple analytical approaches for the detection and identification of potential contaminants in drinking water.

5 Basic Screening for Organic and Inorganic Chemicals Using Standard Methods

The recommended chemical screen integrates a number of analytical techniques to cover a broad range of chemical classes. These techniques include not only wet chemistry and instrumental analysis, with which laboratories are typically familiar, but also hand-held equipment and commercially available test kits, such as those based on immunoassays.

The overall screening approach for unknown chemicals is broken into two parts, the basic screen (Section 5) and the expanded screen (Section 6). The basic screen utilizes established (standardized) analytical methods for the analysis of contaminants in wastewater. The WLA-RP also has a section on Basic Field/Safety Screening to assist laboratories in procedures for dealing with unidentified contaminants. Typically, these methods are produced as a standard by a recognized method development organization and contain steps to defensibly confirm the presence and/or quantity of specific contaminants. Table 4-1 lists several sources of standard methods.

Standardized methods may be selected from an appropriate method database, such as the Water Contaminant Information Tool

Table 4-1: Sources of Standardized Methods

Name	Description	Publisher	How to obtain
Water Contaminant Information Tool (WCIT)	Contains methods compiled from a number of sources. **May be consulted first.**	US EPA Office of Water	http://www.epa.gov/wcit
EPA SW-846 methods	Compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.	US EPA Office of Solid Waste	http://www.epa.gov/epaoswer/hazwaste/test/main.htm
40 CFR Parts 136 and 141	Promulgated list of defensible methods widely accepted in the analytical community for water and wastewater.	US EPA Office of Resource Conservation and Recovery and US EPA Office of Water	http://ecfr.gpoaccess.gov
National Environmental Method Index (NEMI)	On-line database containing chemical, microbiological, biological, toxicity, and physical methods for comparison.	US Geological Survey and US EPA	www.nemi.gov

(WCIT) (http://www.epa.gov/wcit/). The National Environmental Methods – Index (NEMI) contains methods compiled from many sources. These methods are reviewed and selected by the National Methods and Data Comparability Board (http://acwi.gov/methods/). Some of these methods are EPA wastewater methods, some are EPA SW-846 methods (Test Methods for Evaluating Solid Waste, Physical/Chemical Methods), and others were developed by USGS or DOE for their environmental monitoring programs.

Also, EPA's National Homeland Security Research Center's *Standardized Analytical Methods for Environmental Restoration Following Homeland Security Events* (SAM) (EPA 600-R-10-122, October 2010) (www.epa.gov/sam/) identifies analytical methods to be used by laboratories tasked with performing analyses of environmental samples following a homeland security event.

The basic screen is designed to capture many of the chemical contaminants of concern using a relatively small number of well-defined, standardized analytical techniques (Figure 4-3). The techniques chosen for basic screening analysis are summarized in Table 4-2.

If the methods in this table are performed, then the basic screen may cover a large percentage of the priority chemical contaminants. Furthermore, many other contaminants of concern, but of lower priority, may be screened

Table 4-2: Suggested Analytical Techniques for Performing the Basic Screen, Arranged by Chemical Class

Chemical (general class)	Analytical Technique	EPA Method (SW 846)	Clean Water Act Method 40 CFR Part 136	Analyte List
Volatiles (organic)	Purge-and-trap PID/ELCD Purge-and-trap GC/MS	8021B 8260B	601 602 624	A
Semivolatiles (organic, includes many pesticides)	Solid-phase extraction GC/MS	8270D 3535A	625	B
Trace metals (inorganic)	ICP-AES, ICP-MS, graphite furnace AA	6010 6020A 7010	200.7 200.8 200.9	C
Total mercury (inorganic, includes organomercury compounds)	Cold vapor AA	7471B	245.1 245.2	D
Cyanides	Wet chemistry	9012A	335.4	E
Radionuclides	Gross alpha, gross beta, gross gamma	7110B	900.0	F

for as well. To increase confidence in the results, only validated methods should be used for the basic screen (e.g., SW-846 or comparable methods). Table 4-3 below lists contaminants that may be detected by the basic screen standardized methods listed in Table 4-2.

Figure 4-3. Lab Personnel Using an Analytical Approach

Table 4-3: Analyte Lists Corresponding to Table 4-2

A	B	C	D	E	F
1,1,1,2-Tetrachloroethane	2,2',3,3',4,4',6-Heptachlorobiphenyl	Arsenic	Mercury	Free cyanide (see method)	Cesium-137
1,1,1-Trichloroethane	2,2',3,3',4,5',6,6'-Octachlorobiphenyl	Cadmium			Iridium-192
1,1,2,2-Tetrachloroethane	2,2',3',4,6-Pentachlorobiphenyl	Chromium			Cobalt-60
1,1,2-Trichloroethane	2,2',4,4',5,6'-Hexachlorobiphenyl	Cobalt			Strontium-90
1,1-Dichloroethane	2,2',4,4'-Tetrachlorobiphenyl	Copper			
1,1-Dichloroethene	2,3-Dichlorobiphenyl	Lead			
1,1-Dichloropropene	2,4,5-Trichlorobiphenyl	Mercury			
1,2,3-Trichlorobenzene	2,4-Dinitrotoluene				
1,2,3-Trichloropropane	2,6-Dinitrotoluene				
1,2,4-Trichlorobenzene	2-Chlorobiphenyl				
1,2,4-Trimethylbenzene	a-BHC				
1,2-Dibromo-3-chloropropane	Acenaphthylene				
1,2-Dibromoethane	a-Chlordane				
1,2-Dichlorobenzene	Alachlor				
1,2-Dichloroethane	Aldrin				
1,2-Dichloropropane	Anthracene				
1,3,5-Trimethylbenzene	Atrazine				
1,3-Dichlorobenzene	Azinphos methyl				
1,3-Dichloropropane	b-BHC				
1,4-Dichlorobenzene	Benz(a)anthracene				
2,2-Dichloropropane	Benzo(a)pyrene				
2-Chlorotoluene	Benzo(b)fluoranthene				
2-Nitropropane	Benzo(g,h,i)perylene				
4-Chlorotoluene	Benzo(k)fluoranthene				
Acrylonitrile	bis(2-Ethylhexyl)adipate				
Allyl chloride	bis(2-Ethylhexyl)phthalate				
Benzene	Bolstar				
Bromobenzene					
Bromochloromethane					

Table 4-3 (cont.): Analyte Lists Corresponding to Table 4-2

A	B
Bromodichloromethane	Butachlor
Bromoform	Butylbenzylphthalate
Bromomethane	Chlorobenzilate
Butyl chloride	Chloroneb
Carbon disulfide	Chlorothalonil
Carbon tetrachloride	Chlorpyrifos
Chloroacetonitrile	Chrysene
Chlorobenzene	cis-Permethrin
Chloroethane	Coumaphos
Chloroform	Cyanazine
Chloromethane	Dacthal
Cis-1,2-Dichloroethene	d-BHC
Cis-1,3-Dichloropropene	Demeton (mixed isomers)
Dibromochloromethane	Diazinon
Dibromomethane	Dibenz(a,h)anthracene
Dichlorodifluoromethane	Dichlorvos
Diethyl ether	Dieldrin
Ethyl methacrylate	Diethyl phthalate
Ethylbenzene	Dimethyl phthalate
Hexachlorobutadiene	Di-n-butyl phthalate
Hexachloroethane	Disulfoton
Isopropylbenzene	Endosulfan I
Methacrylonitrile	Endosulfan II
Methanol (solvent)	Endosulfan sulfate
Methyl acrylate	Endrin
Methyl methacrylate	Endrin aldehyde
Methyl tert-butyl ether	Ethoprop
Methylene chloride	Etridiazole
m-Xylene	Fensulfothion
Naphthalene	Fenthion
n-Butylbenzene	Fluorene
Nitrobenzene	g-BHC
n-Propylbenzene	g-Chlordane

Table 4-3 (cont.): Analyte Lists Corresponding to Table 4-2

A	B
o-Xylene	Heptachlor
Pentachloroethane	Heptachlor epoxide (Isomer B)
p-Isopropyltoluene	Hexachlorobenzene
Propionitrile	Hexachlorocyclopentadiene
p-Xylene	Indeno(1,2,3-cd)pyrene
sec-Butylbenzene	Lindane
Styrene	Merphos
tert-Butylbenzene	Methoxychlor
Tetrachloroethene	Methyl parathion
Tetrahydrofuran	Metolachlor
Toluene	Metribuzin
trans-1,2-Dichloroethene	Mevinphos
trans-1,3-Dichloropropene	Naled
trans-1,4-Dichloro-2-butene	p,p'-DDD
Trichloroethene	p,p'-DDE
Trichlorofluoromethane	p,p'-DDT
Vinyl chloride	Pentachlorophenol
	Phenanthrene
	Phorate
	Propachlor
	Pyrene
	Ronnel
	Simazine
	Stirophos
	Tokuthion
	trans-Nonachlor
	Trichloronate

6 Expanded Screening for Chemicals

The purpose of the expanded screen is to capture chemical contaminants not picked up by the basic screen. The expanded screen may also more rapidly detect some analytes covered by the basic screen. The expanded screen should be sufficiently broad to permit the analyst to screen for many possible contaminants.

In practice, the expanded screen can be used in addition to the basic screen, because the results of the basic screen may provide a springboard to guide the selection of techniques for the expanded screen. For example, many of the techniques in the basic screen rely on chromatography and/or mass spectrometry, so the data should be capable of being evaluated for the presence of not only target analytes, but also other compounds. Combining observations from multiple basic screening techniques may also be helpful.

Alternatively, some laboratories may choose to utilize only the expanded screen, comprised of potentially sensitive techniques, including those summarized in Table 4-4. In the latter case, preliminary results can be cautiously used to make response decisions, but should be followed up with confirmatory analysis because screening techniques, including some listed in Table 4-4, are not necessarily definitive. Some details regarding utilization of the expanded screening techniques are included below to help guide the reader in the selection of appropriate techniques relative to wastewater analysis.

Table 4-4: Expanded Screening for Contaminants (Arranged by Class of Contaminant)

Contaminant Type	Expanded Screening Technique
Organic	GC, GC/MS, HPLC, LC/MS, Immunoassay test kits
Inorganic	IC, AA, ICP, ICP-MS
Cyanides	Wet chemistry
Biotoxin	Immunoassay test kits, GC/MS, HPLC, and LC/MS
Radiological	Handheld equipment
Chemical Warfare Agents	GC/MS with direct injection, purge & trap, and SPE/SPME, test kits, handheld equipment

6.1 Expanded Screening for Organic Compounds - Sample Preparation Techniques

Organic analyses utilized in this approach are comprised of some combination of the following three steps: 1) extraction or recovery of the contaminant from the wastewater matrix; 2) separation of the compounds through gas chromatography or liquid chromatography; and/or 3) detection and identification of the analyte. Preparatory and extraction techniques for organic constituents should be broad enough to recover a variety of compound classes (e.g., a range of hydrophilic properties and molecular weights). A variety of techniques are used for detection of organic constituents.

Regardless of the detector system employed, there are a number of widely used sample preparation techniques. These include the following:

Large Volume Liquid/Liquid Extraction (LLE)

This technique (SW846-Method 3510C) is not advisable for aerosolizable samples because it requires the use of separatory funnels that may release aerosols when vented. The generation of these aerosols may represent a larger health hazard than other techniques, unless labs take precautions such as appropriate hoods.

Direct Aqueous Injection

Although a powerful analytical technique, the use of direct aqueous injection of wastewater samples into a GC may present technical difficulties in chromatographic separation and could reduce the lifetime of the GC column and the detector (Figure 4-4). While the high concentrations of contaminants that might be present during an emergency incident may cause the use of direct injection of wastewater samples to prove valuable, particularly for initial and rapid screening of analytes, the analytical system should be carefully monitored for loss of performance. For all but a few analytes, confirmatory analyses may be required.

Figure 4-4. Lab Personnel Using Syringe to Inject GC.

Micro Liquid-Liquid Extraction (micro-LLE)

Liquid micro extraction involves the use of small volumes of solvent (e.g., 2 ml) to extract analytes from a small volume (e.g., 40 ml) of water. For the high concentrations of contaminants that may be present during an emergency incident, the use of micro-LLE of aqueous samples with a suitable solvent, such as methylene chloride, could prove particularly valuable for initial and rapid screening of analytes. The extraction could be immediately followed by GC/MS analysis which can provide qualitative identification. However, micro-LLE may not provide adequate detection limits for lower concentrations which may occur at the tailing edge of a contaminant slug.

Continuous Liquid-Liquid Extraction (Cont LLE)

This technique, as described in SW846-Method 3520C, may be used for the isolation and concentration of water insoluble and slightly soluble organics. Its use can result in excellent detection limits, although analysis times can be long.

Solid-Phase Extraction (SPE)

Solid-phase extraction, sometimes referred to as liquid-solid extraction (SW846-Method 3535A), is one of the techniques for basic screening analysis. Like micro-LLE, SPE extracts many contaminants, but can achieve larger concentration factors compared with the former technique. C18 adsorbents are commonly used. Many other adsorbents can also be employed to extract contaminants not amenable to C18 adsorbents. Different elution solvents can be used. A safety advantage associated with SPE is that it produces few aerosols.

Solid-Phase Microextraction (SPME)

SPME involves the use of a fiber coated with sorbent material. The sorbent coated fiber is exposed to either the aqueous sample or the headspace from the sample, and the analytes then adsorb to the coating on the fiber. After exposure to the sample, the fiber is introduced into the detection system (i.e., GC or HPLC). For example, after exposure to the sample, the SPME fiber is inserted into the injector of a GC, and contaminants are released to the column by thermal desorption. As with micro-LLE, another quick screen, the detection limits achievable via the use of SPME may only be useful in the case of elevated contaminant concentrations. Like SPE, SPME should produce few aerosols.

Headspace Collection

The headspace above an aqueous sample may be injected into a GC (SW846-Method 3810). Commercially available equipment, interfaced with the GC, is designed to facilitate this analysis.

Flow Injection

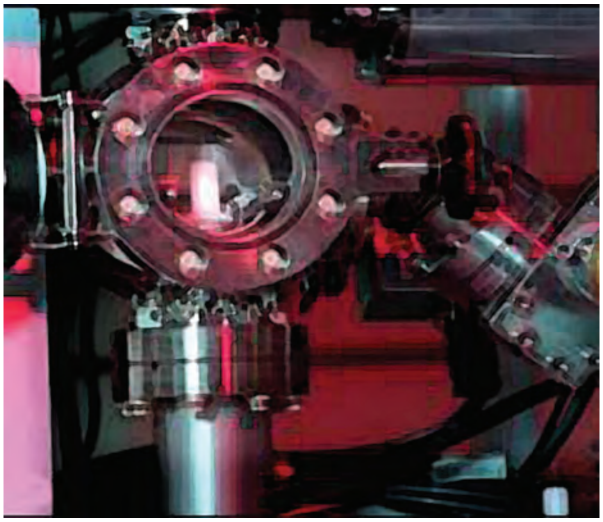
In flow injection, an aqueous sample or sample extract is injected directly into an LC/MS in such a manner that it bypasses the LC column. Thus the analytes are not chromatographically separated, but the technique can prove useful if high concentrations of a single analyte are present, or if sample preparation is employed that is selective for particular analytes.

6.2 Expanded Screening for Organic Compounds - Detection Methods

In addition to the sample preparation techniques described above, there are a number of detection methods available for organic chemical contaminants:

Gas Chromatography with Electron Impact Ionization Mass Spectrometry

The subsequent analysis of contaminants extracted from wastewater may be conducted by the use of GC/MS. When the mass spectrometry is performed using electron impact ionization, eluting peaks show distinctive fragmentation patterns, which may be used in identification, particularly through the use of a variety of computerized tools for library matching to ionization patterns of known compounds. Usually, the program performs a spectral search using a user-defined library (such as National Institute of Standards and Technology - NIST, EPA, Wiley, etc.) and will report the compound with the best spectral match as the tentatively identified compound with an estimated concentration.



It is desirable to examine the peaks for more than just the analytes for which the instrument is calibrated. The analyst may utilize a threshold for examining unidentified peaks that exceed 10% (height threshold) of the internal standard.

Multidetector GC in Screening Mode

A multidetector GC is utilized for specific analytes as an alternative, and sometimes complement, to a mass spectrometer. The intent of using multidetector GC in the analysis of unknowns is primarily as a screening tool. There are more than a dozen detectors available including electron capture, infrared, flame ionization, nitrogen-phosphorous specific, thermal conductivity, etc. Various GC detectors respond to contaminants in different ways, and the evaluation of all the data from the various detectors increases the selectivity, and sometimes the sensitivity, of the analysis. For example, flame ionization detectors respond to a wide variety of contaminants, but typically with low sensitivity. On the other hand, electron capture detectors are more sensitive and react more specifically to halogenated compounds. The detectors may be used in series with one GC, or in parallel through the use of multiple GCs.

High Performance Liquid Chromatography-Ultraviolet (UV) Detector

Analogous to multidetector GC, HPLC with UV detection can be used to determine if organic compounds not amenable to GC procedures (e.g., non-volatiles or thermally unstable compounds) are present in amounts greater than background. Calibration and quality control samples should be included to provide accurate analysis. Analytical confirmation may be necessary using established techniques such as GC/MS, although derivatization of the compounds may be necessary to make them amenable to GC/MS analysis.

High Performance Liquid Chromatography-Mass Spectrometry (LC/MS)

Many polar hydrophilic compounds cannot be easily extracted from an aqueous sample. Additionally, there are contaminants of large molecular weight (e.g., biotoxins) or thermally unstable compounds that are not amenable to GC analysis but can sometimes be analyzed by LC/MS. Direct aqueous injection HPLC allows analysis of a sample without extraction or concentration. SPME and SPE (and other extraction procedures) may be utilized for compounds that can be extracted. Identification of unknowns can be performed but there are no standardized mass spectral libraries, as in GC/MS. Analyst interpretation can help identify possible compound fragments and structure.

More than a decade after its commercialization, LC/MS is not commonly used for water analysis, although it has proved extremely useful for analysis of target analytes in other industries. Nonetheless, LC/MS can be an added tool in an expanded screen for unknown chemicals in specific cases, and may be useful for certain classes of pesticides, such as carbamates.

Tandem Mass Spectrometry (MS/MS)

Both GC and HPLC may be used in conjunction with tandem mass spectrometry, also known as MS/MS. Different MS/MS instruments operate under different principles to achieve similar results, but essentially can be considered to be like two mass spectrometers connected by a collision cell. The first mass spectrometer separates ionized molecules, which are broken apart in the collision cell, and the resulting fragments are separated in the second mass spectrometer. This produces a great deal of information that can be used to identify the original molecules, but does not necessarily produce searchable libraries. MS/MS is not as widely available as MS and requires a high degree of skill.

High Resolution Mass Spectrometry (HRMS)

GC or HPLC, combined with a high resolution mass spectrometer, may provide exact mass data of an eluting compound, allowing for calculation of elemental composition of both molecular and fragmentation ions. This information is useful in the identification of unknown organic compounds, especially when the result of mass spectral library research is not conclusive or when the standard of a tentatively identified compound is not available. Careful quality control procedures are required, and the technique is not always definitive, especially for unknown compounds, because many compounds produce fragments with the same exact masses.

Immunoassays

There are a number of immunoassay test kits available for organic chemicals, such as pesticides and biotoxins. These may be useful for screening a sample for specific unknowns in the field or in the laboratory. These kits may be used for speed or if instrumental methods are not available in the lab. However, use of these kits requires that the goals of the analysis be planned because some kits are slower than the instruments, especially if analytical confirmation time is considered. Also, appropriate training is necessary in the use of these tests. Laboratories should be aware of the kits' reliability and levels of detection before using them. It is important to note that most of these test kits are not recognized by any standard setting organization. Not all of these products have been studied in detail as to their efficacy for wastewater, which may contain interfering and/or cross reacting substances. These problems can lead to false positive and false negative results. In general, a positive or negative result from one of these test kits should be considered tentative and be confirmed through more rigorous laboratory analysis.

6.3 Expanded Screening for Inorganic Chemicals

The inorganic analyses include several analytical techniques: classical wet chemistry; instrumental techniques such as inductively coupled plasma mass spectrometry (ICP-MS), inductively coupled plasma atomic emission spectrometry (ICP-AES), and atomic absorption (AA) spectrometry for trace metals; and ion chromatography for anionic and cationic contaminants.

Like the determination of organic chemicals, there are a number of preparation steps that are required for the analysis of inorganic chemicals. These vary with the methodology being employed. To select a sample preparation approach, it may be useful to refer to relevant standardized methods. For instance, if the goal is to look for trace metals not listed in a particular method, it may be useful to refer to a method in which a wastewater sample of similar composition to the one in question is prepared for metal analysis. This is not an exact process, and some metals have certain characteristics that may cause them to not be amenable to a preparation technique applicable to another. For example, a digestion method for nickel may not be suitable for mercury analysis. Following preparation, the samples can be analyzed by a number of techniques, described below:

ICP-AES or ICP-MS in Semiquantitative Mode

Analogous to multi-detector GC and HPLC with UV detection, the ICP-AES and ICP-MS methods (CWA Methods 200.7 and 200.8) can also be expanded to provide a broad screening approach to identifying unknown trace metals. Under the semiquantitative mode, the ICP-MS instrument, operated in scanning mode, may be capable of providing semiquantitative results for more than 60 elements including major atomic cations, metals, semi-metals, rare earth elements and selected radionuclides (uranium and thorium). (Note: radioactive materials should be handled by a specialized laboratory).

Ion Chromatography

Ion chromatography forms the basis of several EPA methods to determine ions of regulatory interest (e.g., CWA Method 300.1). By the correct choice of operating conditions and ion chromatography columns, determination of many different types of ions have appeared in the literature.

Wet Chemistry

Wet chemistry forms the basis of many types of chemical test kits. The chemistry and detectors for test kits approved for compliance monitoring are traceable to EPA methods. Wet chemistry techniques, through the use of autoanalyzers, form the basis of many types of chemical analysis for environmental and clinical applications. Manufacturers of these devices often provide full detailed methodology for defensible application of wet chemistry to a variety of analytes. Titrimetric methods are also available to analyze background water quality parameters such as alkalinity.

Ion Selective Electrodes (ISE)

Ion selective electrodes (ISE, also known as electrochemical probes) can be utilized to analyze for some background wastewater quality parameters. A simple example of an ISE is the familiar pH probe for the hydrogen ion. Other ISEs are available for a variety of ions and may be considered (e.g., ammonia, calcium, chloride, fluoride, nitrate, potassium, silver, sodium, and sulfide). Some parameters that can be monitored by ISEs may be useful in characterizing the extent of contamination or verifying the credibility of a contamination threat as part of the rapid field testing of wastewater procedure during site characterization.

6.4 Expanded Screening for Cyanides

Free cyanide concentration, measured without distillation, is useful in detecting acutely toxic cyanide. Therefore, distillation is not used in the rapid field tests for cyanide or for safety screening upon the receipt of samples in the laboratory. Distillation is required for determination of total cyanide concentration and is the most conservative approach with respect to public health concerns. Distillation may be applicable for expanded cyanide screening.

6.5 Expanded Screening for Biotoxins

Some biotoxins have been monitored routinely for quite a while, particularly in conjunction with naturally occurring outbreaks of biotoxins in marine environments. There are hundreds of biotoxins from dozens of different plant and animal species. Analysis of some biotoxins may be supported by the CDC Laboratory Response Network (LRN) laboratories. The LRN may utilize immunoassays for screening for botulinum toxin, ricin, and some other biotoxins.

Immunoassay kits are commercially available for a number of biotoxins. It is important to note that most of these kits are not recognized by any standard setting organization, and potential interferences and/or cross reacting substances in wastewater are not well studied. Because these tests are susceptible to false positive and negative results, a positive or negative result should be considered tentative and should be confirmed through a more rigorous laboratory analysis. Confirmatory analyses usually involve GC/MS, LC, or LC/MS. Because biotoxins tend to be very water soluble, LC/MS may be particularly useful for biotoxin analysis, although specialized sample preparation techniques may be required. The skill of the analyst is critical for this technique to be used effectively.

6.6 Expanded Screening for Chemical Weapons

The term chemical weapons refers to the substances that appear on Schedule 1 of the Chemical Weapons Convention. The Schedule 1 agents are extremely hazardous to handle and most environmental chemistry laboratories do not have the facilities or the procedures in place to handle these agents. In addition, most of the agents are not available commercially to prepare analytical standards for quantification. The chemical weapons agents will need to be analyzed by special laboratories for confirmatory analysis.

In the unlikely event that an environmental chemistry laboratory receives a sample containing a chemical weapon, screening techniques can be used to detect the presence of the agents in wastewater. In addition, the laboratory should notify appropriate ICS personnel. The best analytical approach may be to utilize the preparatory procedures for organic chemical analysis described above (direct injection, micro-LLE, SPE, SPME) followed by GC/MS for identification. This approach may only be able to determine the presence, not concentration, of the agent because an analytical standard would not be available. The standard electron impact mass spectral libraries frequently contain mass spectra of these compounds and can be used for tentative identification. As an aid to increasing confidence in chemical warfare agents' GC/MS library matches, the NIST has developed the Automated Mass Spectral Deconvolution and Identification System (AMDIS) (http://chemdata.nist.gov/mass-spc/amdis/).

In the unlikely event that chemical weapons agents are present, the expanded screen for organic chemicals is procedurally designed to reduce risk to personnel handling the sample, namely through reduction of aerosols. As with any organic chemical, an additional way to reduce risk would be through sample dilution. The laboratory may first start with the most dilute sample (1/1,000) and if nothing is detected may proceed to analyze the next dilution (1/100), followed by the 1/10 dilution, and lastly the undiluted sample. If the laboratory proceeds through the undiluted sample and nothing is detected, it may be that the sample is a non-detect for the chemical weapon that would be captured by the screen. If chemical weapons agents are identified in the screen, proper notifications should be made to the Incident Commander or appropriate official within the ICS structure. Also notify law enforcement who may be able to gain access to laboratory resources that can confirm the presence of the chemical weapons agent. EPA is developing the capability and capacity at seven fixed laboratories and two mobile laboratories to analyze environmental samples potentially contaminated with chemical warfare agents and degradents. Other notifications may be required by applicable laws and regulations.

6.7 Basic and Expanded Screening for Radionuclides

Screening for radionuclides is somewhat different than screening for other chemical contaminants since radionuclides can be characterized by both the type of radiation they emit as well as their exact chemical identity. Accordingly, initial screening for radionuclides may involve measurement of gross radioactivity. However, any initial screening that indicates the presence of a radionuclide should be followed by analytical confirmation of the chemical identity. A schematic for radionuclide screening is shown in Figure 4-5. The results of field testing for radioactivity should be compared to background levels to determine whether the site may have been contaminated with radioactive material.

The analysis for gross alpha and beta radiation may be conducted as a screening method for alpha and beta particle activities in wastewater and used to determine if specific radiological analyses are needed. Preliminary analysis can

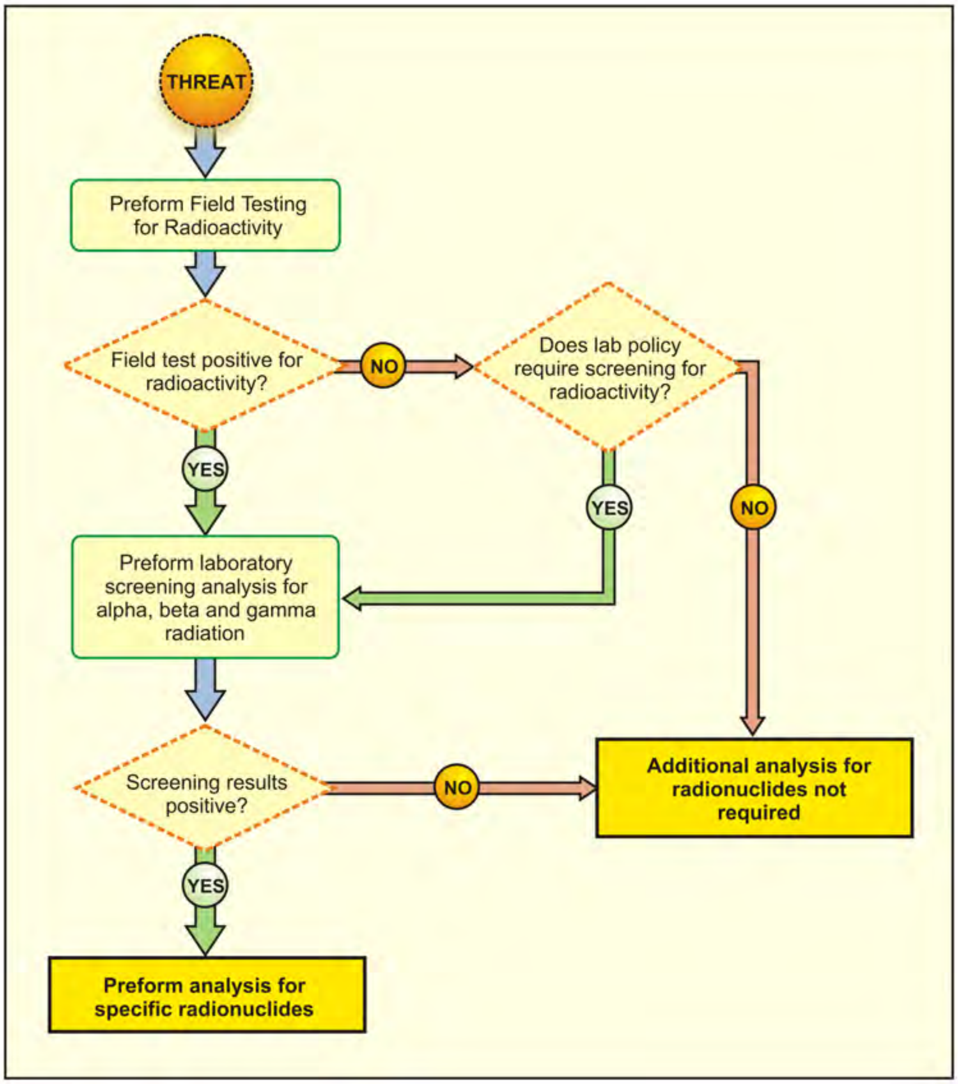


Figure 4-5: Protocol for Basic Radionuclide Screening

first be conducted in the field using appropriate field portable or hand-held devices, but may be verified in the laboratory. As part of their safety plan, laboratories may wish to screen samples upon arrival for gamma radiation using appropriate technologies such as hand held detectors.

If the presence of radioactive material is indicated by the initial screening, specific radioisotopes may be determined by radiochemical specific procedures, using techniques with which radiation labs are already familiar. These procedures often involve separation of the radionuclide from the sample by precipitation techniques, and subsequent determination by a gas flow proportional counting system or scintillation detector system for alpha and beta emitters and an appropriate gamma detector for gamma emitters. For example, strontium-89 and strontium-90 can be precipitated as carbonates from the sample. Additional precipitation steps allow separation from other radionuclides and interferences.

Due to the unique nature of radionuclide analysis, some laboratories have developed in-house procedures for radionuclide analysis that make use of their special skills and capabilities to enhance the speed of analysis, especially since some standardized methods are not rapid methods. For example, one standardized method for radioactive strontium in water recommends a two-week in-growth period for obtaining the yttrium isotope from the purified strontium. Modification of the method produces much faster results. Reduction in analysis time could be accomplished by measuring the total amount of an element's radionuclide, not the isotopic distribution. Also, for some isotopes, faster results may be obtained by simply reducing the volume of water processed.

It must be emphasized that radiochemical analysis should be performed only by licensed, specialty laboratories, and the need for such analysis should be indicated by the field screening equipment for alpha, beta, and gamma emitters, or other specifics of the incident, such as threats.

As described above, the basic screen is rather comprehensive because it requires identification of the specific radionuclide if indicated by the screens for gross alpha, beta, and gamma radiation. Therefore, the expanded screen is designed to capture radionuclides that do not fall into the energy range of the gross radionuclide screen for gross alpha and beta. Fortunately, these radionuclides have specific standardized methods designed for their analysis, and radionuclide labs may also have additional reliable methods at their disposal for their analysis.

Two other techniques that may be particularly useful for radionuclide analysis are gamma spectroscopy, which can directly identify the gamma emitting radionuclide, and inductively coupled plasma mass spectrometry (ICP-MS). Principal considerations in the use of both of these techniques include detection limits and availability of instrumentation.

7 Additional Recommendations for Chemical Screening of Wastewater Samples

Unlike drinking water analysis, wastewater analysis is complicated by the high solids content of samples. This is especially true for raw sewage as well as primary effluent and mixed liquor from the wastewater treatment process. Solids residue is much less of a factor in secondary or tertiary effluent from the treatment chain.

The following practical observations and suggestions may help to overcome the analytical challenges posed by the difficult wastewater matrix:

- The purge and trap extraction/concentration method can be utilized without modification to introduce volatile organic compounds into a GC or GC/MS. Because the sample itself does not come into contact with the sensitive components of the analytical system, there should be no fouling potential for the GC or GC/MS even when raw sewage, primary effluent, or mixed liquor samples are analyzed.

- Solid phase extraction can be used directly on secondary or tertiary effluent samples. The extract can then be analyzed by GC, GC/MS, or other appropriate techniques.

- When screening raw sewage, mixed liquor, and primary effluent samples, the samples can be filtered through a 0.45um membrane filter to remove residue. The filtrate can then be extracted by solid phase extraction and the extract analyzed by HPLC, GC, GC/MS, or other methods.

- The filter retentate from the step above can also be digested via Soxhlet extraction using SW-846 methods 3540C or 3541. If

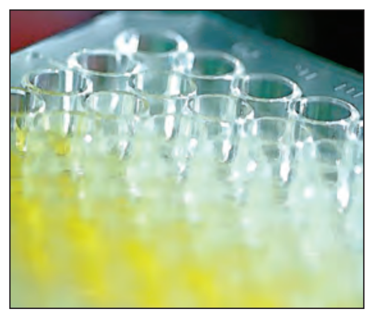
necessary, the extract can subsequently be purified using a gel-permeation clean-up method such as SW-846 method 3640A. The product of this preparatory step can then be analyzed using GC, GC/MS, or other techniques.

8 Screening for Microbiologicals Including Unknowns

Wastewater typically contains large numbers of viruses, bacteria, and protozoans. Additional microbes are seeded into wastewater during the secondary treatment process, and are encouraged to multiply to assist in the breakdown of organic matter and nutrients. Even finished effluent from wastewater treatment plants may contain significant numbers of microorganisms. The chlorination or UV light treatment that occurs at the end of the wastewater treatment process is intended to control pathogens and reduce microbial numbers, but does not produce sterile water. Furthermore, the likely routes of exposure of utility workers or the general public to microbes that may have been added to wastewater accidentally or intentionally is through inhalation of aerosols and perhaps limited dermal contact, as opposed to ingestion. Consequently, there is much less emphasis placed on screening for microbial contaminants in wastewater during a suspected contamination event compared to a drinking water contamination incident.

Possible exceptions may include microbes such as the anthrax bacterium, *Bacillus anthracis*, whose spores could pose an inhalation risk if they ended up in the wastewater system. Various parts of the wastewater collection and treatment systems generate aerosols that may potentially impact health via the inhalation route. Still another situation where the need may arise to analyze wastewater for the presence of microbial contaminants might be if the decision is made by officials to discharge to or bypass the wastewater treatment plant, following an intentional or unintentional biological contamination incident, allowing elevated numbers of potentially harmful microbial contaminants to enter natural waterways if such discharge or bypass is not otherwise prohibited by CWA Section 301(f), 40 CFR 122.41(m), or another law or regulation.

Analysis of wastewater for specific bacterial, viral, or protozoal contaminants is complicated by high background levels of microbes in wastewater. Additionally, efforts to concentrate wastewater samples for microbial analysis are complicated by the high solids content of wastewater.



For all of these reasons, an extensive screening procedure is not recommended at this time for microbes in wastewater following a contamination threat or incident. Should the need for detailed microbial analysis arise, an attempt may be made to screen wastewater samples using molecular techniques (e.g., Polmerase Chain Reaction - PCR) or traditional culture methods. In the event that

select biological agents (such as anthrax spores or the biotoxins ricin or botulinum toxin) are believed to be involved in a contamination incident, samples may be analyzed by the Centers for Disease Control and Prevention's laboratory since they are authorized to work with these microbes.

9 Forensic Implications of Sample Collection and Analysis

It is important to note that if a contamination event in wastewater is the result of an intentional or accidental release, there will likely be legal ramifications. Any samples collected and analysis conducted during the incident response may ultimately be used for evidentiary purposes. Therefore, sampling and analytical procedures should be accorded greater attention to detail.

10 Data Analysis and Reporting

The responsibility of the laboratory during an emergency does not end with sample analysis. At a minimum, the lab should report the results in a timely manner to the recipients designated by incident command. Additionally, the laboratory may be asked to assist in the analysis and interpretation of the data. The *Water Laboratory Alliance – Response Plan* has suggestions for the maintenance and reporting of data. The following are some general guidelines for the analysis and reporting of results:

- The laboratory and the client (e.g., the Utility Incident Commander or the overall Incident Commander) should agree on the format and content of the report before data are released by the lab. In general, the report should be thorough enough so that all information is available. However, if too much detailed information is reported, the laboratory may confuse the client.

- During a suspected contamination incident, it is important that all relevant information be managed through incident command. Therefore, analytical results should be reported only to those individuals designated by incident command, and it will be their responsibility to subsequently inform other stakeholders.

- In a crisis situation, the laboratory may be asked to provide tentative results (sometimes called a rolling report) prior to complete data review and confirmation. In this case the lab may need to provide appropriate caveats regarding the validity of the data at that stage of the analysis.

- The laboratory should remain available to assist in the analysis and interpretation of both preliminary and final results. The laboratory staff has a unique perspective regarding the reliability of the methods and interpretation of results.

11 Summary

The response to the threat of an intentional or accidental contamination event in wastewater often necessitates sample collection and analysis. The analytical response will begin at a fairly basic level with rapid testing of wastewater in the field during the site characterization process. Should the contamination threat be deemed 'Credible', definitive analyses will need to be conducted in one or more laboratories. An important challenge to labs analyzing such samples is the potential risk to personnel handling samples which may contain potentially hazardous substances. Another challenge is accurately detecting, identifying, and quantifying one or more contaminants from the array of thousands of chemical, microbes, and radionuclides that could accidentally or intentionally end up in a wastewater collection or treatment system.

Module 4 discusses safety procedures that should be employed to protect the analysts. It also recommends general approaches that could be used to begin the process of eliminating possible contaminants and target the agent that is actually present. In the case of many contaminants, a variety of both standardized and exploratory techniques may need to be utilized.

The Module emphasizes the need for utility, government, and commercial laboratories to prepare their own Laboratory Guides, follow emergency procedures contained in the *Water Laboratory Alliance – Response Plan*, and prepare site-specific analytical approaches based on the recommendations provided in the *Wastewater Response Protocol Toolbox*.

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EPA
United States
Environmental Protection
Agency

Wastewater Response Protocol Toolbox:

Planning For and Responding To Wastewater Contamination Threats and Incidents

December 2011

Module 5:
Public Health and Environmental Impact Response Guide

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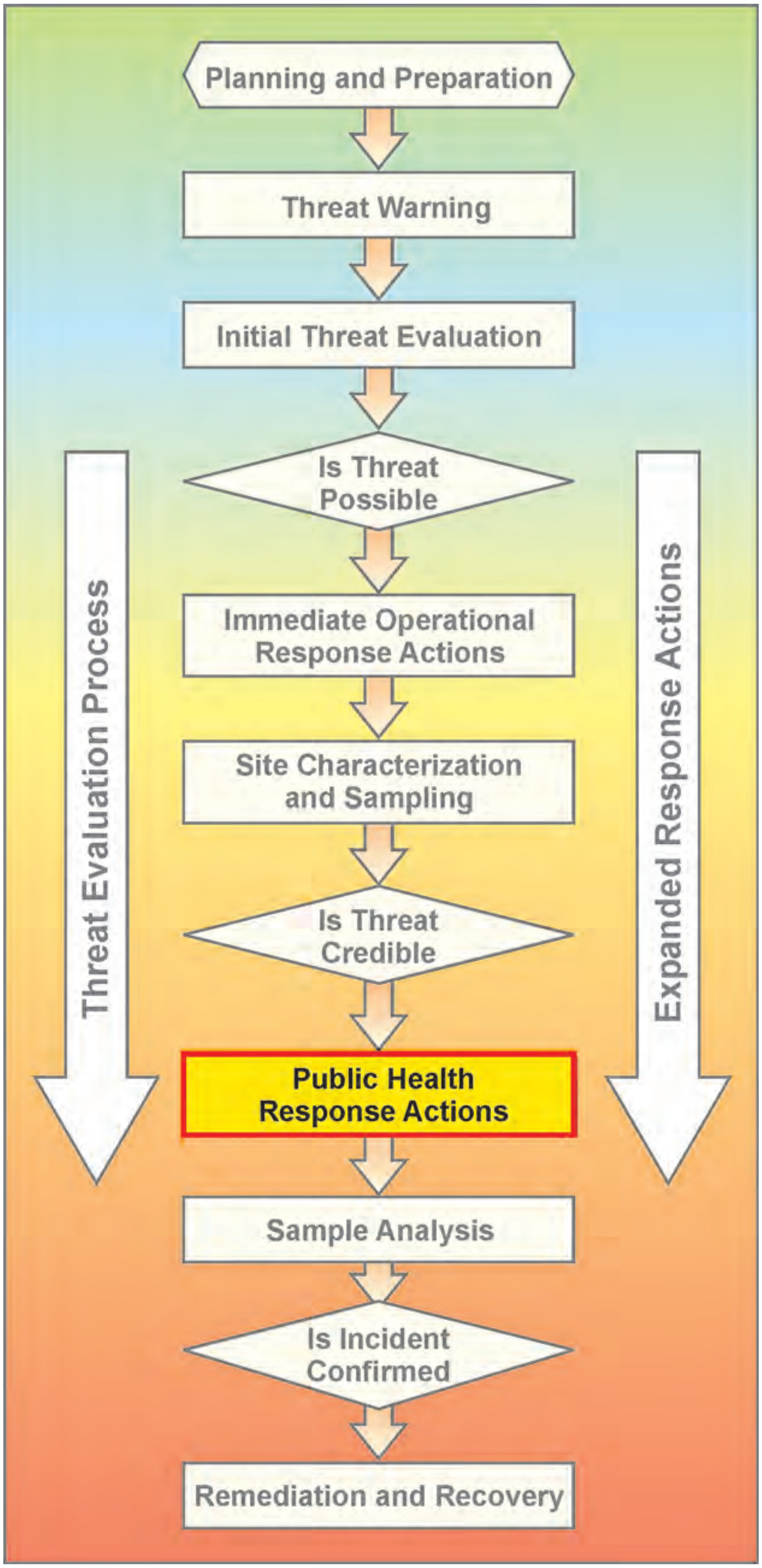
Planning and Preparation
Threat Warning
Initial Threat Evaluation
Is Threat Possible
Immediate Operational Response Actions
Site Characterization and Sampling
Is Threat Credible
Public Health Response Actions
Sample Analysis
Is Incident Confirmed
Remediation and Recovery
Threat Evaluation Process
Expanded Response Actions

1 Introduction

Module 5 provides guidance for the public health and environmental protection response to a wastewater contamination threat or incident. The response is one component of the overall threat management process which is described in Module 2, the Contamination Threat Management Guide. This response includes those actions taken by utilities, health entities, and regulatory agencies to decrease the public health and safety consequences, as well as negative effects on the environment, which may result from a contamination threat or incident. Public health and environmental responders in this context include the utility, local and state health and environmental departments, the EPA, and the Centers for Disease Control and Prevention because they may all be involved in choosing and implementing the public health/environmental response actions taken during a contamination incident.

The public health and environmental protection response consists of the five actions listed below:

Action taken before a threat occurs

- Plan the public health and environmental response

Actions taken after a threat occurs

- Determine the public health and environmental consequences resulting from this particular wastewater contamination incident
- Implement appropriate operational responses
- Implement public notification
- If necessary, make available short term alternate sanitary services

2 Plan the Public Health/ Environmental Response (Pre-threat Phase)

The public health/environmental response should be planned and coordinated between utilities, public health agencies, and environmental regulatory agencies before a threat occurs. Utilities document their planning when preparing their Emergency Response Plan (ERP). State and local health agencies typically develop a Public Health Response Plan that covers responses to all types of public health emergencies (including but not limited to water emergencies). Regulatory agencies have developed extensive environmental protection plans to be used in response to a variety of contingencies. In their planning, utilities, health agencies, and regulatory agencies should address several issues as they relate to a response in the event of a threatened or actual contamination event in a wastewater system.

First, during the planning phase, the roles and responsibilities of the agencies involved in public health and environmental impact response should be identified. At this point, the utility should define its intended role in future public health/environmental impact responses.

Secondly, an effort should be made to integrate public health and environmental protection agency planning into the utility's ERP. The utility should investigate how the public health response plans of local and State health departments, and the environmental protection plans of regulatory agencies, address wastewater contamination incidents. They should then integrate appropriate portions of these plans into the utility ERP.

The utility should also develop a communications strategy. Rapid and reliable communications are crucial to ensuring a prompt and coordinated public health and environmental response. Plans should be made, prior to an incident, that describe who should be notified, when and how they should be notified, and what types of information they should be given consistent with any applicable laws and regulations. A backup communication and notification system should be put into place in the event that phone networks are not functioning. Those notified may include emergency responders, government and non-governmental agencies, critical customers such as hospitals, and the public. Especially important is two-way communication between wastewater utilities and public health agencies. The Incident Commander (who may or may not be from the utility) should report contamination threats to the public health agency so that physicians and hospitals can be on alert to report potential signs and symptoms to the health department. Similarly, public health agencies should communicate with wastewater utilities regarding unusual symptoms being reported by the medical community that may have a connection to wastewater.

Finally, prior to a threat being received, the involved organizations should develop plans for operational and public health responses to be taken during a threat or incident. The operational steps should be designed to minimize the impact of a contamination event on public health and the environment. The plan should identify the agency or organization that is responsible for carrying out the action(s), as well as the circumstances under which certain actions are to be taken. The organizations should also assess the feasibility and potential effectiveness of these operational steps. At the same time these agencies should determine the potential impacts of specific response actions on the community.

It is during the planning phase that gaps in operating procedures, technical capabilities, and communications should be identified and addressed. As with all response plans, regularly exercising the public health/environmental impact plan is critical to effective implementation during an emergency.

Exercises should involve not only the utility but also health agencies, regulatory agencies, and public safety response agencies.

The remaining four actions, described below, should be taken following the utility becoming aware of an accidental or intentional contamination threat. These actions may be taken individually, or in combination, at any point throughout the threat management process. However some actions may be required to be taken at specified times.

3 Determine the Public Health Consequences and Environmental Impacts Resulting from the Contamination Event (Post-threat Phase)

Once the possible identity of the contaminant (or contaminants) has been determined, the utility and other responders should obtain information on the properties and potential health and safety consequences of the contaminant, as well as possible impacts on the environment and wastewater operations. This information will help inform response decisions. Some public health/public safety factors of concern include the acute and chronic health effects of human exposure to the contaminant, exposure routes of concern (e.g.,

inhalation or dermal contact), contaminant concentrations that are toxic or infective, and the flammability of vapors. Environmental factors of concern include the stability of the contaminant in water and the potential impact of the contaminant on living organisms in the receiving waters as well as on downstream users of the receiving waters (e.g., drinking water utilities). Operational concerns include the ability of wastewater treatment processes to remove or inactivate the contaminant, as well as the contaminant's potential to damage the biological treatment process in the wastewater plant.

A good source for information on properties, health effects, and environmental impacts of a variety of chemical, biological, and radiological contaminants of concern for drinking water and wastewater is EPA's Water Contaminant Information Tool (WCIT). For these contaminants, WCIT provides information about relevant topics such as chemical or pathogen properties, medical aspects, toxicity, as well as decontamination methods for wastewater infrastructure and the effect of wastewater treatment processes on contamination concentrations. Access to this

secure, web-accessible database is available to water utilities, regulators, health agencies, and others free of charge. However, prior registration is required. Additional information on WCIT is available at http://www.epa.gov/wcit.

Another factor relevant to determining the consequences of a contamination event is assessment of the actual spread of the contaminant in the wastewater system. This assessment can be accomplished using manual methods which are simply based on the utility's knowledge of flow patterns in the collection system. The assessment can also be conducted through the use of hydraulic models such as EPA's SewerNet.

SewerNet is an integrated, GIS-based simulation model for consequence assessment of sanitary and storm water collection systems affected by contamination events. It can be applied to any storm, sanitary, or combined sewer system. The model is capable of predicting the routing of contaminated storm water and/or sanitary flow through the sewer network, from points of collection to treatment facilities or direct discharge points. It can account for chemical transformations and losses that might occur during transport, such as volatilization or adsorption onto pipe walls, and can analyze the consequences of a variety of contamination scenarios. Additional information on SewerNet is available at the following website:
http://eh2o.saic.com/iwqss.

The Contaminant Characterization and Transport Worksheet (Appendix 13) is a form that could be used to help organize information that will lead to the identification of the contaminant. It can also facilitate decisions on appropriate operational responses and provide more accurate information for public notification.

4 Implement Appropriate Operational Responses (Post-threat Phase)

Certain operational responses, identified during the pre-threat phase planning process, may be implemented in response to a 'Possible' or 'Credible' contamination threat. The objectives of operational response actions should be to minimize exposure of the public and wastewater system employees to the contaminated wastewater, decrease the negative impact on the environment, lessen the potential impact on the wastewater infrastructure, and provide additional time to evaluate whether or not the threat is 'Credible' or 'Confirmed.' Some operational responses include the following and can be implemented if consistent with applicable laws and regulations:

- Isolate and store contaminated wastewater (e.g., in backup storage basins or tanks, if available).
- Slow the influent flow of wastewater into the treatment plant to permit more extensive treatment.

- Isolate redundant unit wastewater treatment processes, if available, to prevent the contaminant from damaging the entire treatment process.
- Increase disinfectant concentrations to reduce the passage of infectious pathogens through the treatment plant and into the environment

Because some of these actions could violate permit conditions or the Clean Water Act, these actions should only be taken after consultation with the regulatory agency. If the utility is considering a bypass, the utility should note that the conditions for a bypass are described in 40 CFR 122.41(m). If the permittee knows in advance of the need for a bypass, it shall submit prior notice at least ten days before the date of the bypass, if possible. In the case of an unanticipated bypass, the permittee shall submit on 24 hour notice if the following conditions are met: (A) bypass was unavoidable to prevent loss of life, personal injury, or severe property damage; (B) there were no feasible alternatives to the bypass, and (C) the permittee submitted notices as required under paragraph (m)(3) of this section. CWA Section 301(f) governs the discharge of any radiological, chemical, or biological warfare agent, any high-level radioactive waste, or any medical waste, into the navigable waters. The cost of restoring the contaminated plant versus the environmental and economic damage to the watershed must be carefully considered. In addition, downstream drinking water treatment plants should be notified since this could impact their ability to provide safe drinking water to the public.

The Public Health Response Action Worksheet in Appendix 14 can be utilized to organize information to aid in the evaluation of containment options, issuance of public notification, and provision of alternate sanitary services.

5 Implement the Public Notification Strategy (Post-threat Phase)

Public notification will be a key component of an effective response to a 'Credible' threat or 'Confirmed' incident. It may also be required by applicable laws and regulations. Public notification may be needed to reduce or mitigate exposure to a contaminant and prevent panic. In the case of a 'Credible' contamination threat, if time allows, the utility should consult with the wastewater primacy agency, and the public health agency, to determine whether or not the situation warrants public notification.

Once the decision has been made to notify the public, it is important to evaluate the type of information that should be delivered to the public. Any available information about the suspected contaminant will support the process of developing a notification message. If the identity of the contaminant is known with a sufficient degree of confidence as a result of the threat evaluation, then the public

notification may be crafted to deal with the specific risks to public health and safety posed by the contaminant. At a minimum generally, the public notification could include:

- Description of the contaminant
- How the contaminant was introduced into the wastewater system
- Geographical extent of the affected area
- Potential risks to which the public may be exposed (e.g., explosive fumes and/or toxic vapors)
- Protective actions the public should take (e.g., evacuation)
- Actions being taken by authorities to control the situation
- Reassurance that the public will be kept informed

In an extreme situation, it may become necessary to advise the public not to flush toilets (Do Not Flush order). This could occur, for example, if the drinking water supply had become contaminated with substances that present an inhalation risk if aerosolized or volatilized. In this situation, the public would probably also receive a Do Not Use order for the drinking water system. In the event that it becomes necessary to communicate with the public concerning a contamination event in the wastewater system, the communication will most likely occur through the media (TV, radio, newspapers). Methods such as email notices, reverse 911, and door-to-door notifications may also be used. To facilitate this communication, and maintain the credibility of the utility, as well as public health and regulatory agencies, it is important to maintain a communications plan, try to establish a working relationship with the local media prior to an event, and deal with the media in a forthright manner.

6 Make Available Short Term Alternate Sanitary Services (Post-threat Phase)

In the event that the wastewater collection system, or a portion of it, is temporarily not usable, the response will have to include provision of alternate sanitation options. A similar situation occurred in the past when portions of the wastewater collection system were destroyed by explosions in Akron, Ohio (1977) and Louisville, Kentucky (1981) as described in Module 1 of the Toolbox. Options for temporary sanitary facilities may include deployment and maintenance of portable toilets, home waste treatment devices, or packaged systems.

The wastewater utility and local authorities may or may not have the resources to provide alternate sanitation facilities. In the event that local resources are overwhelmed, state and federal agencies may need to provide assistance.

7 Summary

The public health and environmental response to an intentional or accidental wastewater contamination event includes the actions taken to control the public health/safety, property/infrastructure damage, and environmental consequences resulting from biological, chemical or radiological contaminants.

The utility should plan the response with other organizations prior to receipt of a threat. This includes identification of the roles and responsibilities of agencies involved in the response, development of a communication strategy, and evaluation of the feasibility of various operational responses.

Once the utility and other responders become aware of a contamination threat, they should determine the public health and environmental consequences resulting from the contamination, implement operational responses, notify the public, and if necessary, provide alternate sanitary services.

Much of the success of the public health and environmental response depends on adequate pre-planning and effective communications among all the response organizations involved.

8 Appendices

The following are examples of forms that may be used to facilitate the public health response:

- Contaminant Characterization and Transport Worksheet
- Public Health Response Action Worksheet

These forms can be found in the Appendices located at the end of the Toolbox.

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Wastewater Response Protocol Toolbox:
Planning For and Responding To Wastewater Contamination Threats and Incidents

December 2011

Module 6:
Remediation and Recovery Guide

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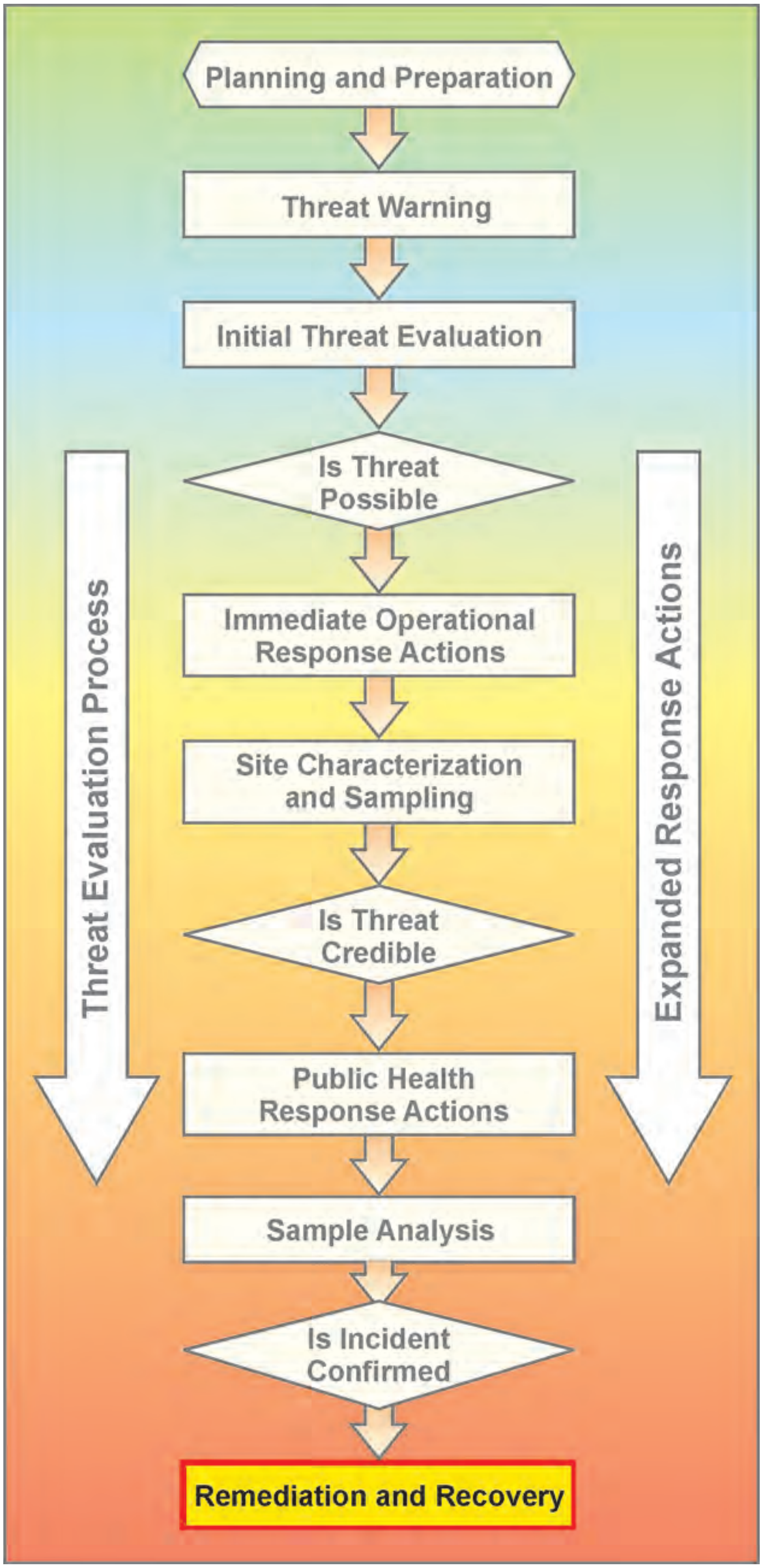
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1 Introduction

This module presents guidance on the remediation and recovery process that should be applied when a wastewater contamination incident has been confirmed. The target audience for this module includes:

- Individuals who will be involved in characterization, risk assessment, and remedial response activities following a confirmed contamination incident.
- Lead agency personnel and decision makers who will determine the need for long-term alternate sanitary services, select remedial technologies, determine when to return to normal operations, and communicate with the public.

These individuals will probably include utility personnel, regulators, public health officials, and technical assistance providers.

The purpose of the remediation and recovery process is to address extensive contamination at levels that pose immediate and/or long-term risks to human health and the environment. The overall objective is to reduce or eliminate the contaminant and return the wastewater system to service as quickly as possible while protecting public health and the environment and minimizing disruption to normal life. The remediation and recovery process is applicable for decontamination of the contaminated wastewater prior to safe disposal, as well as to remediation of the wastewater collection system, the treatment plant, and associated facilities such as lift stations. While rapid recovery of the system may be critical, it is important to follow a systematic process that is consistent with any applicable laws and regulations, and establishes remedial goals acceptable to all stakeholders, implements the remedial process in an effective and responsible manner, and demonstrates that the remedial action was successful. This module describes some elements of such a systematic process.

If it is determined that chemical, biological, or radiochemical contaminants have entered the public wastewater system it may be necessary to protect utility employees from exposure until the scope of the problem is defined and remediation has been completed. These actions may even need to take place prior to the completion of the characterization process. Some specific steps that might be taken to protect employees in the interim include:

- Prevent personnel from entering manholes
- Prevent personnel from entering wet wells of pump stations
- Suspend manual cleaning of bar screens and removal of grit
- Restrict access to trickling filters, aeration basins, and other treatment plant sites where aerosols might be generated
- Suspend manual handling of biosolids

2 Roles and Responsibilities During Remediation and Recovery

The remediation and recovery process should be implemented when a contamination incident has been confirmed. For a ‘Confirmed’ incident, an agency external to the utility may assume the responsibility for coordinating the response under the Incident Command System (ICS). Whether a local, state, or federal government exercises primary authority may depend on the nature and size of the incident and the resources needed for remediation and recovery. State and local governments have primary responsibility for consequence management, including remediation and recovery efforts. If the magnitude of the remediation and recovery efforts exceeds the capabilities and resources of state and local government, and if federal interests are involved, then the federal government may be required to provide assistance.

3 Steps in Remediation and Recovery Process

It should be noted that the remediation and recovery approach outlined in this module is modeled, in part, on the EPA Superfund remedial response program. There are nine steps in the remediation and recovery program. Each is described below.

3.1 Long-Term Alternate Sanitary Services

During the remedial process, long-term alternate sanitary services may need to be secured. The specific services required will depend on the extent of contamination but could include long-term alternate wastewater collection, treatment, and disposal. Long-term alternate services may be different from the short-term services described in Module 5. The need for long-term alternative services will depend on the nature and severity of the contamination event and the length of time required to return the system to normal operation. If utility and local authorities do not have the resources to provide long-term alternate sanitation, assistance may be required from mutual aid and assistance agreements with other wastewater utilities (such as WARNs), the state, or the federal government. Alternative services may include:

- Portable toilets
- Collection points for removal and disposal of ‘gray water’ (i.e., wash water that does not contain sanitary waste)
- Contracts with hauling companies to assist in transferring unaffected wastewater

3.2 System Characterization/Feasibility Study

After a contamination incident has been confirmed, additional information will be required to support remediation/recovery actions. This information and data can be obtained via a System Characterization/Feasibility Study. The study will provide a detailed assessment of the nature and extent of contamination and preliminarily screen candidate treatment options. Several planning documents may be helpful for the system characterization.

System Characterization/Feasibility Study Work Plan

The System Characterization/Feasibility Study Work Plan documents information collected and decisions made during the systematic planning process, and describes anticipated future tasks. It also serves as a tool for assigning responsibilities and setting the project's schedule and cost. Appendix 15 provides a suggested outline for the System Characterization/Feasibility Study Work Plan.

Quality Assurance Project Plan

This is a critical planning document for data collection for system characterization because it documents all project activities including Quality Assurance (QA) and Quality Control (QC) procedures. See Appendix 16 for a listing of the elements of a Quality Assurance Project Plan.

Health and Safety Plan (HASP)

The HASP includes information regarding personnel roles, lines of authority and communication, site security and control, and medical and emergency alert procedures. The HASP should be developed for the specifics of the incident so that staff is aware of the common routes of exposure at a site and is trained in the proper use of safety equipment and protective clothing and equipment. Safe areas should be designated for washing, drinking, and eating. A suggested format for a HASP is given in Appendix 17.

3.3 Risk Assessment

Upon confirmation of a contamination incident, the lead agency for consequence management will quickly assess the risk posed to on-site workers and the public. This rapid risk assessment will help guide response actions.

During the remedial response phase, additional risk assessments may be required to:

- Evaluate risk reduction achieved by the operational response actions being conducted at that time
- Aid in establishing preliminary remediation goals
- Assess potential risk reduction from implementation of long-term remedial actions

3.4 Detailed Analysis of Alternatives for Remediation

This step involves the evaluation of various remediation approaches available on the basis of their effectiveness and technical feasibility. In situations in which human health and environmental risks are reduced to acceptable levels through natural attenuation or degradation of the contaminant, no remedial actions may be required.

If remedial actions are required, they may include any of the following steps, or combination of steps:

- Containment of contaminated wastewater
- Treatment of contaminated wastewater
- Disposal of contaminated wastewater
- Rehabilitation of contaminated wastewater system components
- Restoration of the biological treatment process

Restoration of biological treatment may require importing and introducing organisms from other processes within the plant (if unaffected) or from other nearby treatment plants. Full recovery of the biological community could take weeks or months.

Possible technologies for cleanup of contaminated wastewater include, but are not limited to, the following, which can be used alone or in combination:

- Chlorination
- Air stripping
- Granular activated carbon filtration
- Ultraviolet irradiation
- Ozonation

For the management of radioactive materials entering POTWs that may impact wastewater/stormwater management, guidance is provided by the Interagency Steering Committee on Radiation Standards in the document *ISCORS Assessment of Radioactivity in Sewage Sludge: Recommendations on Management of Radioactive Materials in Sewage Sludge and Ash at Publicly Owned Treatment Works* (February 2005 - ISCORS Technical Report 2004-04; EPA 832-R-03-002B; DOE/EH-668) that is available on the ISCORS website under LIBRARY at http://www.iscors.org/pdf/FinalRecommendations.pdf.

Additionally, various contaminated components of the wastewater system may need to be rehabilitated. These include the infrastructure, such as system mains and pumps, as well as the equipment used to treat the wastewater at the plant. Possible technologies and alternatives that can be considered for the rehabilitation of contaminated system components include:

- Disinfection
- System flushing
- Pigging and swabbing of system piping
- Air scouring
- Sand blasting
- Relining pipes
- Condemning portions of the collection and/or treatment system (e.g., in response to gross contamination such as from a radiological agent)
- Utilization of the current treatment plant with a new collection system
- Utilization of the current wastewater collection system with a new treatment plant

Remediation can be performed in stages with emergency short-term remediation being conducted to reduce dangerous levels of a contaminant to a safer level. This can then be followed by long-term, more comprehensive cleanup steps to remove any remaining low levels of the contaminant(s). When assessing remediation alternatives, the utility will need to take into consideration any applicable laws and regulations.

To learn more about available federal funding for remediation/recovery from disasters see http://water.epa.gov/infrastructure/watersecurity.

3.5 Remediation Technology Selection

To select the remediation technology, a comparative analysis may be performed to identify the advantages and disadvantages of each technology. The criteria for technology selection include, among others:

- Protection of human health
- Protection of the environment
- Compliance with applicable laws and regulations (e.g., the Clean Water Act)
- Feasibility of implementation
- Cost

3.6 Remedial Design

After a final remedy is selected, remedial design is the next step. This is an engineering phase involving preparation of a series of documents, specifications, and drawings that detail the specific steps to be taken during the remedial action. The lead agency will be responsible for remedial design, assisted by the wastewater utility (if not already the lead agency) and other technical support staff. Remediation should be designed to prevent impacts on the remaining unaffected portions of the wastewater system.

3.7 Remedial Action

This is the actual implementation of the chosen remediation approach and includes both treatment of contaminated wastewater and rehabilitation of system components.

3.8 Post-Remediation Monitoring

After site actions are complete, monitoring of the system must be conducted to ensure that the remediation was effective.

3.9 Communication to Restore Public Confidence

During remediation activities, and prior to return of the system to normal operations, the utility and other agencies should conduct outreach to the community to restore public confidence in the wastewater system.

The degree to which remediation and recovery follows the nine step model presented above will depend on the nature and extent of the contamination. A small-scale incident might not involve all of the steps. For example, extensive system characterization may not be required if the contamination is contained through early operational responses and is confined to a well-defined area. Each remediation and recovery effort will be unique and will be dictated by details of the intentional or accidental contamination event.

4 Summary

Following confirmation of either an accidental or intentional contamination event in a wastewater system, steps must be taken to remove the contamination and bring the system back into full service. Depending on the nature and extent of contamination, the wastewater may have to be decontaminated prior to disposal. The wastewater infrastructure (e.g., collection mains, pumps, and treatment plant) may also have to be decontaminated. Module 6 of the Toolbox outlines a systematic approach, based on EPA's Superfund experience, for remediation and recovery of affected wastewater systems.

Efforts are ongoing within the federal government and research community to develop specific technical solutions to wastewater system decontamination needs. When developed, this information may be distributed through vehicles such as WCIT.

5 Appendices

The following are examples of forms that may be used to facilitate the remediation and recovery process:

- Suggested Outline for System Characterization/Feasibility Study Work Plan
- Elements for a Quality Assurance Project Plan
- Elements of a Health and Safety Plan

These forms can be found in the Appendices located at the end of the Toolbox.

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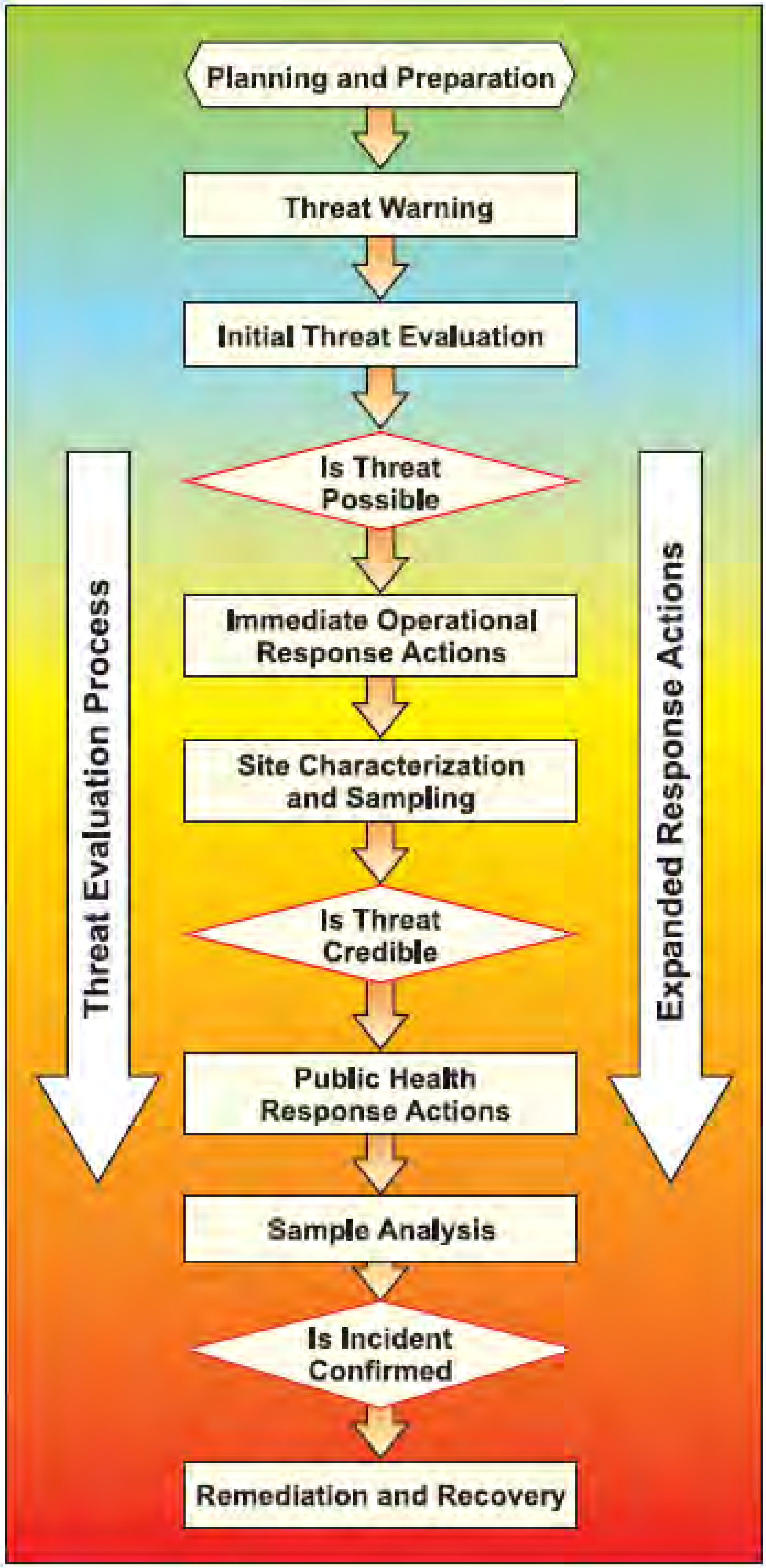
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1 Response Planning Matrix

Incident				**Response**	
Credibility	*Consequences*		*Other Considerations*	*Possible Actions*	*Anticipated Impacts on the public, infrastructure, property, and environment*
	# people affected	*Health Impact*			
Possible	10's	Minor			
		Moderate			
		Severe			
	100's	Minor			
		Moderate			
		Severe			
	1,000's	Minor			
		Moderate			
		Severe			
Credible	10's	Minor			
		Moderate			
		Severe			
	100's	Minor			
		Moderate			
		Severe			
	1,000's	Minor			
		Moderate			
		Severe			
Confirmed	10's	Minor			
		Moderate			
		Severe			
	100's	Minor			
		Moderate			
		Severe			
	1,000's	Minor			
		Moderate			
		Severe			

2 Threat Evaluation Worksheet

INSTRUCTIONS

The purpose of this worksheet is to help organize information about a contamination threat warning that would be used during the Threat Evaluation Process. The individual responsible for conducting the Threat Evaluation (e.g., the Utility Incident Commander) should complete this worksheet. The worksheet is generic to accommodate information from different types of threat warnings; thus, there will likely be information that is unavailable or not immediately available. Other forms in the Appendices are provided to augment the information in this worksheet.

Threat Warning Information

Date/Time threat warning discovered: ______________________________

Name of person who discovered threat warning: ______________________________

Type of threat warning:

☐ Security breach ☐ Witness account ☐ Phone threat
☐ Written threat ☐ Law enforcement ☐ Public health notification
☐ News media ☐ Public complaints
☐ Degradation of treatment organisms
☐ Unusual wastewater chemical characteristics
☐ Other: ______________________________

Identity of the contaminant: ☐ Known ☐ Suspected ☐ Unknown

If known or suspected, provide additional detail below

☐ Chemical ☐ Biological ☐ Radiological

Describe: ______________________________

Time of contamination: ☐ Known ☐ Estimated ☐ Unknown

If known or suspected, provide additional detail below

Date and time of contamination: ______________________________

Additional information: ______________________________

Mode of contamination: ☐ Known ☐ Suspected ☐ Unknown

If known or suspected, provide additional detail below

Method of addition: ☐ Single dose ☐ Over time ☐ Other ______________

Amount of material: ______________________________

Additional information: ______________________________

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Site of contamination: ☐ Known ☐ Suspected ☐ Unknown

If known or suspected, provide additional detail below

Number of sites: ____

Provide the following information for each site.

Site #1

Site Name: ____

Type of facility:

☐ Manhole ☐ Treatment plant ☐ Pump station
☐ Catch basin ☐ Collection main ☐ Building drain
☐ Other: ____

Address: ____

____

Additional site information: ____

____

Site #2

Site Name: ____

Type of facility:

☐ Manhole ☐ Treatment plant ☐ Pump station
☐ Catch basin ☐ Collection main ☐ Building drain
☐ Other: ____

Address: ____

____

Additional site information: ____

____

Site #3

Site Name: ____

Type of facility:

☐ Manhole ☐ Treatment plant ☐ Pump station
☐ Catch basin ☐ Collection main ☐ Building drain
☐ Other: ____

Address: ____

____

Additional site information: ____

____

Additional Information

Has there been a breach of security at the suspected site? ☐ Yes ☐ No

If "Yes," review the completed 'Security Incident Report'

Are there any witness accounts of the suspected incident? ☐ Yes ☐ No

If "Yes," review the completed 'Witness Account Report'

Was the threat made verbally over the phone? ☐ Yes ☐ No

If "Yes," review the completed 'Phone Threat Report'

Was a written threat received? ☐ Yes ☐ No

If "Yes," review the completed 'Security Incident Report'

Are there unusual wastewater chemical data or public complaints? ☐ Yes ☐ No

Are there unusual symptoms or disease in the population? ☐ Yes ☐ No

If "Yes," review the completed 'Public Health Report'

Is a 'Site Characterization Report' available? ☐ Yes ☐ No

If "Yes," review the completed 'Site Characterization Report' (Module 3)

Are results of sample analysis available? ☐ Yes ☐ No

If "Yes," review the analytical results report, including appropriate QA/QC data

Is a 'Contamination Identification Report' available? ☐ Yes ☐ No

If "Yes," review the completed 'Contaminant Characterization and Transport Worksheet' (Module 5)

Is there relevant information available from external resources? ☐ Yes ☐ No

Check all that apply

☐ Local law enforcement ☐ FBI ☐ Primacy agency

☐ Public health agency ☐ Hospitals/911 call centers ☐ US EPA/Water ISAC

☐ Media reports ☐ Homeland Security alerts ☐ Neighboring utilities

☐ WARNs ☐ Other: ________________

Point of contact: ____

____

Summary of key information from external sources (provide detail in attachments as necessary):

____

____

____

____

____

Appendices

Threat Evaluation

Has normal activity been investigated as the cause of the threat warning? ☐ Yes ☐ No

Normal activities to consider

☐ Utility staff inspections ☐ Routine wastewater sampling
☐ Construction or maintenance ☐ Contractor activity
☐ Operational changes ☐ Wastewater chemical changes with a known cause
☐ Other: ______________________________

Is the threat 'possible'? ☐ Yes ☐ No

Summarize the basis for this determination: ______________________________

____

____

Response to a 'possible' threat:

☐ None ☐ Site characterization ☐ Isolation/containment
☐ Increased monitoring/security ☐ Other: ______________________________

Is the threat 'credible'? ☐ Yes ☐ No

Summarize the basis for this determination: ______________________________

____

____

Response to a 'credible' threat:

☐ Sample analysis ☐ Site characterization ☐ Isolation/containment
☐ Partial EOC activation ☐ Public notification ☐ Law Enforcement Notification
☐ Other: ______________________________

Has a contamination incident been confirmed? ☐ Yes ☐ No

Summarize the basis for this determination: ______________________________

____

____

Response to a confirmed incident:

☐ Sample analysis ☐ Site characterization ☐ Isolation/containment
☐ Full EOC activation ☐ Public notification ☐ Provide alternate sanitary services
☐ Initiate remediation and recovery ☐ Law Enforcement Notification
☐ Other: ______________________________

How do other organizations characterize the threat?

Organization	Evaluation	Comment
☐ Local law enforcement	☐ Possible ☐ Credible ☐ Confirmed	
☐ FBI	☐ Possible ☐ Credible ☐ Confirmed	
☐ Public health agency	☐ Possible ☐ Credible ☐ Confirmed	
☐ Wastewater permitting agency	☐ Possible ☐ Credible ☐ Confirmed	
☐ Other	☐ Possible ☐ Credible ☐ Confirmed	
☐ Other	☐ Possible ☐ Credible ☐ Confirmed	

Signoff

Name of person responsible for threat evaluation:

Print name: ____

Signature: ____________________________________Date/Time: _________________

Appendices

3 Security Incident Report Form

INSTRUCTIONS

The purpose of this form is to help organize information about a security incident, typically a security breach, which may be related to a wastewater contamination threat. The individual who discovered the security incident, such as a security supervisor, the Utility Incident Commander, or another designated individual may complete this form. This form is intended to summarize information about a security breach that may be relevant to the threat evaluation process. This form should be completed for each location where a security incident was discovered.

Discovery of Security Incident

Date/Time security incident discovered: ______________________________

Name of person who discovered security incident: ______________________________

Mode of discovery:

☐ Alarm (building) ☐ Alarm (gate/fence) ☐ Alarm (access hatch)

☐ Video surveillance ☐ Utility staff discovery ☐ Citizen discovery

☐ Suspect confession ☐ Law enforcement discovery

☐ Other: ______________________________

Did anyone observe the security incident as it occurred? ☐ Yes ☐ No

If "Yes", complete the 'Witness Account Report'

Site Description

Site Name: ______________________________

Type of facility

☐ Manhole ☐ Treatment plant ☐ Pump station

☐ Catch basin ☐ Collection main ☐ Building drain

☐ Other: ______________________________

Address: ______________________________

____

Additional Site Information: ______________________________

____

Background Information

Have the following "normal activities" been investigated as potential causes of the security incident?

☐ Alarms with known and harmless causes ☐ Utility staff inspections

☐ Routine wastewater sampling ☐ Construction or maintenance

☐ Contractor activity ☐ Other: ______________________________

Was this site recently visited prior to the security incident? ☐ Yes ☐ No

If 'Yes,' provide additional detail below

Date and time of previous visit: ____________________

Name of individual who visited the site: ____________________

Additional information: ____________________

____

Has this location been the site of previous security incidents? ☐ Yes ☐ No

If 'Yes,' provide additional detail below

Date and time of most recent security incident: ____________________

Description of incident: ____________________

____

____

What were the results of the threat evaluation for this incident?

☐ 'Possible' ☐ 'Credible' ☐ 'Confirmed'

Have security incidents occurred at other locations recently? ☐ Yes ☐ No

If 'Yes,' complete additional 'Security Incident Reports' for each site

Name of 1st additional site: ____________________

Name of 2nd additional site: ____________________

Name of 3rd additional site: ____________________

Security Incident Details

Was there an alarm(s) associated with the security incident? ☐ Yes ☐ No

If 'Yes,' provide additional information below

Are there sequential alarms (e.g., alarm on a gate and a hatch)? ☐ Yes ☐ No

Date and time of alarm(s): ____________________

Describe alarm(s): ____________________

Is video surveillance available for the site of the security incident? Yes No

If 'Yes,' provide additional detail below

Date and time of video surveillance: ____________________

Describe surveillance: ____________________

____

____

Unusual equipment found at the site and time of discovery of the security incident:

- ☐ Discarded PPE (e.g., gloves and masks)
- ☐ Tools (e.g., wrenches, bolt cutters)
- ☐ Lab equipment (e.g., beakers, tubing)
- ☐ None
- ☐ Empty containers (e.g., bottles, drums)
- ☐ Hardware (e.g., valves, pipe)
- ☐ Pumps or hoses
- ☐ Other: ______________________________

Describe equipment: ____

____

____

Unusual vehicles found at the site and time of discovery of the security incident:

- ☐ Car/sedan
- ☐ Flatbed truck
- ☐ SUV
- ☐ Construction vehicle
- ☐ Pickup truck
- ☐ None
- ☐ Other: ____

Describe vehicles (including make/model/year/color/license plate #, logos, or markings):

____

____

Signs of tampering at the site and time of discovery of the security incident:

- ☐ Cut locks/fences
- ☐ Open/damaged access hatches
- ☐ Facility in disarray
- ☐ Open/damaged gates, doors, or windows
- ☐ Missing/damaged equipment
- ☐ None
- ☐ Other: ____

Are there signs of sequential intrusion (e.g., locks removed from a gate and hatch)?

☐ Yes ☐ No

Describe signs of tampering: ____

____

____

Signs of hazard at the site and time of discovery of the security incident:

- ☐ Unexplained or unusual odors
- ☐ Unexplained dead or stressed vegetation
- ☐ Unexplained clouds or vapors
- ☐ Unexplained dead animals
- ☐ Unexplained liquids
- ☐ None
- ☐ Other: ____

Describe signs of hazard: ____

____

____

Signoff

Name of person responsible for documenting the security incident:

Print name: ____

Signature: ______________________________________ Date/Time: ___________________

4 Witness Account Report Form

INSTRUCTIONS

The purpose of this form is to document the observations of a witness to activities that might be considered an incident warning. The individual interviewing the witness, or potentially the witness, should complete this form. This may be the Utility Incident Commander or an individual designated by incident command to perform the interview. If law enforcement is conducting the interview (which may often be the case), then this form may serve as a prompt for "utility relevant information" that should be pursued during the interview. This form is intended to consolidate the details of the witness account that may be relevant to the threat evaluation process. This form should be completed for each witness that is interviewed.

Basic Information

Date/Time of Interview: ______________________________

Name of person interviewing witness: ______________________________

Witness contact information: ______________________________

Full Name: ______________________________

Address: ______________________________

Daytime phone: ______________________________

Evening phone: ______________________________

E-mail address: ______________________________

Reason the witness was in the vicinity of the suspicious activity: ______________________________

____

____

Witness Account

Date/Time of activity: ______________________________

Location of activity:

Site name: ______________________________

Type of facility

☐ Manhole ☐ Treatment plant ☐ Pump station

☐ Catch basin ☐ Collection main ☐ Building drain

☐ Other: ______________________________

Address: ______________________________

____

Additional site information: ______________________________

Appendices

Type of activity

☐ Trespassing ☐ Vandalism ☐ Breaking and entering
☐ Theft ☐ Tampering ☐ Surveillance
☐ Other: ____

Additional description of the activity: ______________________________________

____

____

____

____

Description of suspects

Were suspects present at the site? ☐ Yes ☐ No

How many suspects were present? ______________________________________

Describe each suspect's appearance:

Suspect #	Sex	Race	Hair Color	Clothing	Voice
1					
2					
3					
4					
5					
6					

Were any of the suspects wearing uniforms? ☐ Yes ☐ No

If 'Yes,' describe the uniform(s): ______________________________________

____

Describe any other unusual characteristics of the suspects: ____________________

____

____

____

Did any of the suspects notice the witness? ☐ Yes ☐ No

If 'Yes,' how did they respond? ______________________________________

Appendices

Vehicles at the site

Were vehicles present at the site? ☐ Yes ☐ No

Did the vehicles appear to belong to the suspects? ☐ Yes ☐ No

How many vehicles were present? ____

Describe each vehicle:

Vehicle #	Type	Color	Make	Model	License Plate
1					
2					
3					
4					
5					
6					

Were there any logos or distinguishing marks on the vehicles? ☐ Yes ☐ No

If 'Yes,' describe: ____

____

Provide any additional detail about the vehicles and how they were used (if at all): ____________

____

____

____

Equipment at the site

Was any unusual equipment present at the site? ☐ Yes ☐ No

- ☐ Explosive or incendiary devices
- ☐ PPE (e.g., gloves, masks)
- ☐ Tools (e.g., wrenches, bolt cutters)
- ☐ Lab equipment (e.g., beakers, tubing)
- ☐ Firearms
- ☐ Containers (e.g., bottles, drums)
- ☐ Hardware (e.g., valves, pipe, hoses)
- ☐ Pumps and related equipment
- ☐ Other: ____

Describe equipment and how it was being used by the suspects (if at all): __________________

____

____

____

Unusual conditions at the site

Were there any unusual conditions at the site? ☐ Yes ☐ No

☐ Explosions or fires ☐ Fogs or vapors ☐ Unusual odors

☐ Dead/stressed vegetation ☐ Dead animals ☐ Unusual noises

☐ Other: ____

Describe the site conditions: ____

____

____

____

Additional observations

Describe any additional details from the witness account: ______________________

____

____

____

____

____

____

Signoff

Name of interviewer:

Print name: ____

Signature: ______________________________ Date/Time: ____________________

Name of witness:

Print name: ____

Signature: ______________________________ Date/Time: ____________________

5 Phone Threat Report Form

INSTRUCTIONS

This form is intended to be used by utility staff that regularly answer phone calls from the public (e.g., call center operators). The purpose of this form is to help these staff capture as much information as possible from a threatening phone call while the caller is on the line. It is important that the operator keep the caller on the line as long as possible in order to collect the information. Since this form will be used during the call, it is important that operators become familiar with the content of the form. The sections of the form are organized with the information that should be collected during the call at the beginning of the form (i.e., Basic Call Information and Details of Threat) and information that can be completed immediately following the call at the end of the form (i.e., the description of the caller). The information collected on this form will be critical to the threat evaluation process.

Basic Information

Name of person receiving the call: ______________________________

Date phone call received: ______________ Time phone call received: ________

Time phone call ended: ______________ Duration of call: ____________

Originating number: ______________ Originating name: ____________

If the number/name is not displayed on the caller ID, press *57 (or call trace) at the end of the call and inform law enforcement that the phone company may have trace information.

Is the connection clear? ☐ Yes ☐ No

Could the call be from a wireless phone? ☐ Yes ☐ No

Details of Threat

Has the wastewater system already been contaminated? ☐ Yes ☐ No

Date and time of contaminant introduction known? ☐ Yes ☐ No

Date and time if known: ______________________________

Location of contaminant introduction known? ☐ Yes ☐ No

Site name: ______________________________

Type of facility

☐ Manhole ☐ Treatment plant ☐ Pump station

☐ Catch basin ☐ Collection main ☐ Building drain

☐ Other: ______________________________

Address: ______________________________

____

Additional site information: ______________________________

____

Appendices

Name or type of contaminant known? ☐ Yes ☐ No

Type of contaminant

☐ Chemical ☐ Biological ☐ Radiological

Specific contaminant name/description: ______________________________

____

Mode of contaminant introduction known? ☐ Yes ☐ No

Method of addition: ☐ Single dose ☐ Over time ☐ Other ________

Amount of material: ______________________________

Additional information: ______________________________

Motive for contamination known? ☐ Yes ☐ No

☐ Retaliation/revenge ☐ Political cause ☐ Religious doctrine

☐ Other: ______________________________

Describe motivation: ______________________________

____

Caller Information

Basic information

Stated name: ______________________________

Affiliation: ______________________________

Phone number: ______________________________

Location/address: ______________________________

Caller's voice

Did the voice sound disguised or altered? ☐ Yes ☐ No

Did the call sound like a recording? ☐ Yes ☐ No

Did the voice sound ☐ Male ☐ Female ☐ Young ☐ Old

Did the voice sound familiar? ☐ Yes ☐ No

If 'Yes,' who did it sound like? ______________________________

Did the caller have an accent? ☐ Yes ☐ No

If 'Yes,' what did it sound like? ______________________________

Appendices

How did the caller sound or speak?

☐ Educated	☐ Well spoken	☐ Illiterate
☐ Irrational	☐ Obscene	☐ Incoherent
☐ Reading a script	☐ Other: ____________________	

What was the caller's tone of voice?

☐ Calm	☐ Angry	☐ Lisping	☐ Stuttering/broken
☐ Excited	☐ Nervous	☐ Sincere	☐ Insincere
☐ Slow	☐ Rapid	☐ Normal	☐ Slurred
☐ Soft	☐ Loud	☐ Nasal	☐ Clearing throat
☐ Laughing	☐ Crying	☐ Clear	☐ Deep breathing
☐ Deep	☐ High	☐ Raspy	☐ Cracking

☐ Other: ____________________

Were there background noises coming from the caller's end?

☐ Silence	Describe: ____________________
☐ Voices	Describe: ____________________
☐ Children	Describe: ____________________
☐ Animals	Describe: ____________________
☐ Factory sounds	Describe: ____________________
☐ Office sounds	Describe: ____________________
☐ Music	Describe: ____________________
☐ Traffic/street sounds	Describe: ____________________
☐ Airplanes	Describe: ____________________
☐ Trains	Describe: ____________________
☐ Ships or large boats	Describe: ____________________

☐ Other: ____________________

Signoff

Name of call recipient:

Print name: ____________________

Signature: ____________________ Date/Time: ____________________

Name of person completing form (if different from call recipient):

Print name: ____________________

Signature: ____________________ Date/Time: ____________________

6 Written Threat Report Form

INSTRUCTIONS

The purpose of this form is to summarize significant information from a written threat received by a wastewater utility. This form should be completed by the Utility Incident Commander or an individual designated by incident command to evaluate the written threat. The summary information provided in this form is intended to support the threat evaluation process; however, the completed form is not a substitute for the complete written threat, which may contain additional, significant details.

The written threat itself (e.g., the note, letter, e-mail message, etc.) may be considered evidence and thus should be minimally handled (or not handled at all) and placed into a clean plastic bag to preserve any forensic evidence.

Safety

A suspicious letter or package could pose a threat in and of itself, so caution should be exercised if such packages are received. The US Postal Service has issued guidance when dealing with suspicious packages which can be found here: http://about.usps.com/posters/pos84.pdf

Threat Notification

Name of person receiving the written threat: ______________________________

Person(s) to whom threat was addressed: ______________________________

Date threat received: ________________ Time threat received: __________

How was the written threat received?

☐ US Postal Service ☐ Delivery service ☐ Courier

☐ Fax ☐ E-mail ☐ Hand-delivered

☐ Other:

If mailed, is the return address listed? ☐ Yes ☐ No

____

____

If mailed, what is the date and location of the postmark? ______________________

If delivered, what was the service used (list any tracking numbers)?

____

____

If faxed, what is the number of the sending fax? ______________________

If e-mailed, what is the e-mail address of the sender? ______________________

____

If hand-delivered, who delivered the message? ______________________

Appendices

Details of Threat

Has the wastewater system already been contaminated? ☐ Yes ☐ No

Date and time of contaminant introduction known? ☐ Yes ☐ No

Date and time if known: ______________________________

Location of contaminant introduction known? ☐ Yes ☐ No

Site name: ______________________________

Type of facility

☐ Manhole ☐ Treatment plant ☐ Pump station

☐ Catch basin ☐ Collection main ☐ Building drain

☐ Other: ______________________________

Address: ______________________________

____

Additional site information: ______________________________

____

Name or type of contaminant known? ☐ Yes ☐ No

Type of contaminant

☐ Chemical ☐ Biological ☐ Radiological

Specific contaminant name/description: ______________________________

____

Mode of contaminant introduction known? ☐ Yes ☐ No

Method of addition: ☐ Single dose ☐ Over time ☐ other

Amount of material: ______________________________

Additional information: ______________________________

Motive for contamination known? ☐ Yes ☐ No

☐ Retaliation/revenge ☐ Political cause ☐ Religious doctrine

☐ Other: ______________________________

☐ Describe motivation: ______________________________

____

Note Characteristics

Perpetrator information:

Stated name: ______________________________

Affiliation: ______________________________

Phone number: ______________________________

Location/address: ______________________________

Condition of paper/envelope:

- ☐ Marked personal
- ☐ Marked confidential
- ☐ Properly addressed
- ☐ Neatly typed or written
- ☐ Clean
- ☐ Corrected or marked-up
- ☐ Crumpled or wadded up
- ☐ Soiled/stained
- ☐ Torn/tattered
- ☐ Other: ______________________________

How was the note prepared?

- ☐ Handwritten in print
- ☐ Handwritten in script
- ☐ Computer typed
- ☐ Machine typed
- ☐ Spliced (e.g., from other typed material)
- ☐ Other: ______________________________

Language:

- ☐ Clear English
- ☐ Poor English
- ☐ Another language: ______________________________
- ☐ Mixed languages: ______________________________

Writing style:

- ☐ Educated
- ☐ Proper grammar
- ☐ Logical
- ☐ Uneducated
- ☐ Poor grammar/spelling
- ☐ Incoherent
- ☐ Use of slang
- ☐ Obscene
- ☐ Other: ______________________________

Writing tone:

- ☐ Clear
- ☐ Direct
- ☐ Sincere
- ☐ Condescending
- ☐ Accusatory
- ☐ Angry
- ☐ Agitated
- ☐ Nervous
- ☐ Irrational
- ☐ Other: ______________________________

Signoff

Name of individual who received the threat:

Print name: ______________________________

Signature: ______________________ Date/Time: ______________

Name of person completing form (if different from written threat recipient):

Print name: ______________________________

Signature: ______________________ Date/Time: ______________

7 Public Health Information Report Form

INSTRUCTIONS

The purpose of this form is to summarize significant information about a public health episode that could be linked to contaminated wastewater. This form should be completed by the Utility Incident Commander or an individual designated by incident command. The information compiled in this form is intended to support the threat evaluation process.

In the case of a threat warning due to a report from public health, it is likely that the public health agency will assume incident command during the investigation. The wastewater utility will likely play a support role during the investigation, specifically to help determine whether or not wastewater might be the cause.

PUBLIC HEALTH NOTIFICATION

Date and Time of notification: ____________________ ____________________

Name of person who received the notification: ____________________

Contact information for individual providing the notification

Full Name: ____________________
Title: ____________________
Organization: ____________________
Address: ____________________
Day-time phone: ____________________

Evening phone: ____________________
Fax Number: ____________________
E-mail address: ____________________

Why is this person contacting the wastewater utility? ____________________

____

____

Has the state or local public health agency been notified? ☐ Yes ☐ No

If "No," the appropriate public health official should be immediately notified.

DESCRIPTION OF PUBLIC HEALTH EPISODE

Nature of public health episode:

☐ Unusual disease (mild) ☐ Unusual disease (severe) ☐ Death
☐ Other: ____________________

Symptoms:

☐ Diarrhea ☐ Vomiting/nausea ☐ Flu-like symptoms
☐ Fever ☐ Headache ☐ Breathing difficulty
☐ Other: ____________________

Describe symptoms: ____________________

Causative Agent: ☐ Known ☐ Suspected ☐ Unknown

Appendices

If known or suspected, provide additional detail below

☐ Chemical ☐ Biological ☐ Radiological

Describe ____

____

Estimate of time between exposure and onset of symptoms: ____________________

Exposed Individuals:

Location where exposure is thought to have occurred

☐ Residence ☐ Work ☐ School

☐ Other: ____

Additional notes on location of exposure: ______________________________

____

Collect addresses for specific locations where exposure is thought to have occurred.

Is the pattern of exposure clustered in a specific area? ☐ Yes ☐ No

Extent of area

☐ Single building ☐ Complex (several buildings) ☐ City block

☐ Neighborhood ☐ Cluster of neighborhoods ☐ Large section of city

☐ Other: ____

Additional notes on extent of area: ______________________________

____

Do the exposed individuals represent a disproportionate number of:

☐ Immune compromised ☐ Elderly ☐ Children

☐ Infants ☐ Pregnant women ☐ Women

☐ Other:

☐ None, no specific groups dominate the makeup of exposed individuals

EVALUATION OF LINK TO WASTEWATER

Were there any public complaints within the affected area? ☐ Yes ☐ No

Were there any unusual wastewater chemical data within the affected area? ☐ Yes ☐ No

Were there any process upsets or operational changes? ☐ Yes ☐ No

Was there any construction/maintenance within the affected area? ☐ Yes ☐ No

Were there any security incidents within the affected area? ☐ Yes ☐ No

SIGNOFF

Name of person completing form:

Print name ______________________________

Signature ______________________________ Date/Time: ____________

8 Site Characterization Plan Template

INSTRUCTIONS

This form is intended to support the development of a customized site characterization plan developed in response to a specific wastewater contamination threat. The Incident Commander and Site Characterization Team Leader should develop this plan jointly if possible. The completed form will be used to guide site characterization activities in the field. However, it may be necessary to revise the plan based on initial observations at the site. A form should be completed for each investigation site that will be characterized.

Threat Warning Information

Consult Module 2, "Threat Evaluation Worksheet" for details about the threat.

Investigation Site

Site Name: ____

Type of facility:

☐ Manhole ☐ Treatment plant ☐ Pump station

☐ Catch basin ☐ Collection main ☐ Building drain

☐ Other: ____

Address: ____

____

Additional Site Information: ____

____

Initial Hazard Assessment

Are there any indicators of an explosive hazard? ☐ Yes ☐ No

If "Yes," notify law enforcement and do not send a team to the site.

Initial hazard categorization

☐ Low hazard ☐ Chemical hazard

☐ Radiological hazard ☐ Biological hazard

If the initial hazard assessment indicates a chemical, radiological, or biological hazard, then only teams trained to deal with such hazards should be sent to the site.

Site Characterization Team

Name & Affiliation of Site Characterization Team Leader: ______________________________

____

Wastewater utility staff:

☐ Wastewater security specialist Name: ______________________________

☐ General security specialist Name: ______________________________

☐ Operations specialist Name: ______________________________

☐ Other Name: ______________________________

Appendices

Representatives from other agencies:

- ☐ Local law enforcement
- ☐ Fire department
- ☐ HazMat
- ☐ US EPA
- ☐ FBI
- ☐ Other

Communication Procedures

Mode of communication:

- ☐ Phone
- ☐ 2-way radio
- ☐ Digital
- ☐ Facsimile
- ☐ Other: ______________________________

Reporting events:

- ☐ Upon arrival at site
- ☐ During approach
- ☐ Site entry
- ☐ After site evaluation
- ☐ After field testing
- ☐ Site exit
- ☐ Other: ____

Field Screening Checklist for Worker Safety and Rapid Wastewater Testing

✓	Parameter[1]	Screen[2]	Meter/Kit ID[3]	Check Date[4]	Reference Value[5]
	Radiation	Both Safety and Wastewater			
	pH / conductivity	Wastewater			
	Cyanide	Wastewater			
	Combustible gases	Both Safety and Wastewater			
	Volatile chemicals	Both Safety and Wastewater			
	Metals	Wastewater			

[1]List the parameters that will be evaluated as part of field screening (examples are listed).
[2]Screening may be conducted for safety, rapid wastewater testing, or both.
[3]Report the unique identifier for the meter or kit used during screening.
[4]Report date of last calibration, expiration date, or date of last equipment check as appropriate.
[5]List any reference value that would trigger a particular action, such as exiting the site.

Sampling Checklist

✓	Analyte[1]	No. Samples	Sample Preservation[2]
	Standard VOCs		
	Semi-volatiles		
	Quaternary nitrogen compounds		
	Cyanide		
	Carbamate pesticides		
	Metals/elements		
	Organometallic compounds		
	Radionuclides		
	Non-target VOCs		
	Non-target organic compounds		
	Non-target inorganic compounds		
	Immunoassays		
	Pathogens – PCR		
	Water quality - chemistry		

[1] List the parameters that will be sampled during site characterization (examples are listed).
[2] List preservatives and indicate if they are to be added in the field.

Equipment Checklist

- ☐ Completed Site Characterization Plan
- ☐ Emergency Wastewater Sampling Kit (Table 3-1)
- ☐ Reagents (if stored separately)
- ☐ Laboratory grade water (5 gal)
- ☐ Special equipment for the specific site
- ☐ Additional Documentation
- ☐ Field Testing Kit
- ☐ Bags of ice or freezer packs
- ☐ Rinse water (20 liters)
- ☐ Disposable camera
- ☐ Other: ____

Sample Handling Instructions

Sample delivery:

- ☐ Return samples to wastewater utility
- ☐ Ship samples to specified location
- ☐ Deliver samples to specified recipient (e.g., laboratory, law enforcement, shipping co., etc.)

Name of recipient: ____

Phone: ______________________ Fax: ______________________

Delivery address: ____

____

Sample storage and security:

Describe any special precautions or instructions related to sample storage and security:

____

____

____

Signoff

Incident Commander (or designee responsible for developing Site Characterization Plan):

Print Name: ____

Signature: ______________________ Date/Time: ______________________

Site Characterization Team Leader:

Print Name: ____

Signature: ______________________ Date/Time: ______________________

9 Site Characterization Report Form

INSTRUCTIONS

Members of the Site Characterization Team can use this form to record their observations at the investigation site. It also serves as a checklist for notifying incident command at key points during the characterization. Additional checklists are included in this form for sample collection and exiting the site. The completed form can also be used as a component of the Site Characterization Report. A form should be completed for each investigation sited that is characterized.

General Information

Date: ______________________ Time arrived at investigation site: ______________________

Name of Site Characterization Team Leader: ______________________

Phone: ______________________ Fax: ______________________

Location of Investigation Site

Site Name: ______________________

Type of facility:

☐ Manhole ☐ Treatment plant ☐ Pump station

☐ Catch basin ☐ Collection main ☐ Building drain

☐ Other: ______________________

Address: ______________________

____

____

Weather conditions at site: ______________________

____

Additional Site Information: ______________________

____

Approach to Site

Time of approach to site: ______________________

Initial Field Safety Screening (as listed in the "Site Characterization Plan"):

☐ None ☐ Radiation ☐ Volatile chemicals

☐ HazCat ☐ Chemical Weapons ☐ Biological agents

☐ Other: ______________________

Report results of field safety screening in Appendix 10 "Field Testing Results Form."

If any field safety screening result is above the corresponding reference value, immediately notify incident command and do not proceed further into the site.

Appendices

Initial Observation and Assessment of Immediate Hazards

- ☐ Unauthorized individuals present at the site
- ☐ Fire or other obvious hazard
- ☐ Signs of a potential explosive hazard (e.g., devices with exposed wires)
- ☐ Signs of a potential chemical hazard (e.g., dead animals, unusual fogs, unusual odors)
- ☐ Unusual and unexplained equipment at the site
- ☐ Other signs of immediate hazard: ____

If there are any indicators of immediate hazard, immediately notify incident command and do not proceed further into the site.

Report initial observations and results to Incident Commander

Approval granted to proceed further into the site? ☐ Yes ☐ No

Site Investigation

Time of Entry to Site: ____

Repeat Field Safety Screening

☐ None	☐ Radiation	☐ Volatile chemicals
☐ HazCat	☐ Chemical weapons	☐ Biological agents

☐ Other: ____

Report results of field safety screening in Appendix 10 “Field Testing Results Form.”

If any field safety screening result is above the corresponding reference value, immediately notify incident command and do not proceed further into the site.

Signs of Hazard:

☐ None	☐ Unexplained dead animals
☐ Unexplained dead or stressed vegetation	☐ Unexplained clouds or vapors
☐ Unexplained liquids	☐ Other: ______________________

Describe signs of hazard: ____

____

____

____

Appendices

Unexplained or Unusual Odors:

☐ None ☐ Pungent ☐ Irritating

☐ Sulfur ☐ Skunky ☐ Bitter almond

☐ Petroleum ☐ Other: ______________________________

Describe unusual odor: ______________________________

____

____

Unusual Vehicles Found at the Site:

☐ Car/sedan ☐ SUV ☐ Pickup truck

☐ Flatbed truck ☐ Construction vehicle ☐ None

☐ Other: ______________________________

Describe vehicle(s) (include make/model/year/color, license plate #, and logos or markings):

____

____

Signs of Tampering:

☐ None ☐ Cut locks/fences

☐ Open/damaged gates, doors, or windows ☐ Open manholes

☐ Missing/damaged equipment ☐ Facility in disarray

☐ Other: ______________________________

Signs of sequential intrusion (e.g., locks removed from a gate and hatch)? ☐ Yes ☐ No

Describe signs of tampering: ______________________________

____

____

Unusual Equipment:

☐ None ☐ Discarded PPE (e.g., gloves, masks)

☐ Tools (e.g., wrenches, bolt cutters) ☐ Hardware (e.g., valves, pipes)

☐ Lab equipment (e.g., beakers, tubing) ☐ Pumping equipment

☐ Other: ______________________________

Describe equipment: ______________________________

____

____

Unusual Containers:

Type of container:

- ☐ None
- ☐ Drum/barrel
- ☐ Bottle/jar
- ☐ Plastic bag
- ☐ Box/bin
- ☐ Pressurized cylinder
- ☐ Test tube
- ☐ Bulk container
- ☐ Other: ______________________________

Condition of container:

- ☐ Opened
- ☐ New
- ☐ Damaged/leaking
- ☐ Unopened
- ☐ Old
- ☐ Intact/dry

Size of container: ______________________________

____

Describe labeling on container: ______________________________

____

Describe visible contents of container: ______________________________

____

Rapid Field Testing of Wastewater

- ☐ None
- ☐ Residual disinfectant
- ☐ pH/conductivity
- ☐ Cyanide
- ☐ Radiation
- ☐ VOCs and SVOCs
- ☐ Pesticides
- ☐ Biotoxins
- ☐ General toxicity
- ☐ Other: ______________________________

Report results of rapid field testing in Appendix 10 "Field Testing Results Form."

If any field test result is above the corresponding reference value, immediately notify incident command and wait for instruction regarding how to proceed.

Report findings of site investigation to Incident Commander.

Approval granted to proceed with sample collection? ☐ Yes ☐ No

Sampling

Time Sampling was Initiated/Completed: ______________________ /__________________________

Implement Sampling Procedures Appropriate for the Hazard Conditions at the Site:

☐ Low hazard
☐ Chemical hazard
☐ Radiological hazard
☐ Biological hazard

If the site is characterized as a chemical, radiological, or biological hazard, then special sampling and safety procedures should be followed.

Safety Checklist:

☐ **Do not** eat, drink, or smoke at the site.

☐ **Do not** taste or smell the wastewater samples.

☐ **Follow** all steps/procedures in HASP.

☐ **Do** use the general PPE included in the emergency wastewater sampling kit.

☐ **Avoid** all contact with the wastewater, and flush immediately with clean water in the case of contact.

☐ **Slowly fill** sample bottles to avoid volatilization and aerosolization.

☐ **Minimize** the time that personnel are on site and collecting samples.

General Sampling Guidelines:

☐ Properly label each sample bottle.

☐ Carefully flush sample taps prior to sample collection, if applicable.

☐ Collect samples according to method requirements (e.g., without headspace for VOCs).

☐ Add preservatives as specified.

☐ Carefully close sample containers and verify that they do not leak.

☐ Wipe the outside of sample containers with a mild bleach solution if there was any spillage.

☐ Place sample containers into a sealable plastic bag.

☐ Place samples into an appropriate, rigid shipping container.

☐ Pack container with frozen ice packs, as appropriate.

☐ Complete "Sample Documentation Form" (Appendix 11)

☐ Complete "Chain of Custody Form" (Appendix 12)

☐ Secure shipping container with custody tape.

☐ Comply with any other sample security provisions required by participating agencies.

Exiting the Site

Time of Site Exit: ____________________

Site Exit Checklist:

- ☐ Verify that hatches, locks, etc. are properly secured.
- ☐ Remove all samples, equipment, and materials from the site.
- ☐ Verify that all samples are in the cooler and properly seal the cooler.
- ☐ Remove all PPE at site perimeter.
- ☐ Place disposable PPE and other trash into a heavy-duty plastic trash bag.
- ☐ Verify that the perimeter has been properly secured before leaving the site.
- ☐ Ensure that all documentation has been completed before leaving the site perimeter.
- ☐ Comply with any site control measures required by participating agencies.
- ☐ Contact Incident Commander (IC) and inform the IC that the team is leaving the site

Signoff

Site Characterization Team Leader:

Print Name: ____________________

Signature: ____________________ Date/Time: ____________________

10 Field Testing Results Form

Date of Field Testing: Site Name: Field Tester: Phone:

Parameter	Units	Screen[1]	Meter/Kit ID[2]	Testing Location[3]	Testing Time[4]	Results[5]	Ref. Value[6]

[1]Screening may be conducted for safety, rapid wastewater testing, or both.
[2]Report the unique identifier for the meter or kit used during screening.
[3]Report the specific location where the field testing was conducted.
[4]Report the specific time at which the test was performed.
[5]Results of field testing should include replicate analysis where appropriate.
[6]Results should be compared with a reference value, if available, to determine whether or not the levels detected pose a hazard.

11 Sample Documentation Form

Collection Date: Site Name: Sampler: Phone:

Sample ID	No. Bottles	Sampling Time	Sampling Location	Sample Description	Analysis	Sample Additives[1]

[1] Report preservatives, dechlorinating agents, acid/base for pH adjustment, and any other sample additives.

12 Chain of Custody Form

Site Name:	Sampler:
Sampler Phone No.:	Signature:

Sample ID	Collection Date	No. Bottles	Analysis

Relinquished by:	Received by:	Date/time:
Relinquished by:	Received by:	Date/time:
Relinquished by:	Received by:	Date/time:
Relinquished by:	Received by:	Date/time:
Relinquished by:	Received by:	Date/time:

Dispatched by:	Date/time:	Received for Laboratory by:	Date/time:

Method of Sample Transport:		
Shipper:	Phone No.:	Tracking No.:

13 Contaminant Characterization and Transport Worksheet

INSTRUCTIONS

The purpose of this worksheet is to help organize information that will lead to the identification of the contaminant to facilitate decisions on appropriate operational responses and provide more accurate information for public communication/notification. Contaminant identification will most likely first be a presumptive identification followed by more lengthy procedures for verification. While validated analytical results are typically the most reliable means of contaminant identification, other information collected during the ***threat evaluation*** *and* ***site characterization*** *may provide valuable insight regarding the identity of the contaminant.*

Site Characterization/Threat Evaluation Summary

Describe the contaminant's odor, if applicable. (Note: For safety reasons, it is recommended that you not intentionally smell samples.)

What was the physical form of the contaminant?

- ☐ Solid
- ☐ Liquid
- ☐ Gas
- ☐ Slurry
- ☐ Powder
- ☐ Granules
- ☐ Other: ____________________

What color was the contaminant?____________________

Summarize additional information obtained during site characterization/threat warning that is relevant to contaminant identification. ____________________

____

____

Summarize the on-line monitoring data, public complaints, or witness accounts that are relevant to contaminant identification. ____________________

____

____

Describe any other characteristics of the contaminant not mentioned above. ____________________

____

____

Field Analysis Summary

Summarize the results of the field analysis for the following parameters:

Radiation: ____________________

Chlorine residual: ____________________

pH conductivity: ____________________

Cyanide: ____________________

Volatile chemicals: ____________________

Chemical weapons: ____________________

Biotoxins: ____________________

Pathogens____________________

Other: ____________________

Has death or disease in the population been reported? ☐ Yes ☐ No ☐ Unknown

Type/symptoms: ____________________

Is there information on unusual sales of pharmaceutical supplies? ____________________

Number of people affected: ____________________

Number of fatalities: ____________________

Location/area affected: ____________________

Was an epidemiological investigation conducted? ☐ Yes ☐ No ☐ Unknown

Results: ____________________

Was a clinical investigation conducted? ☐ Yes ☐ No ☐ Unknown

Results: ____________________

Is the contaminant acutely toxic and what are the acute effects? ☐Yes ☐No ☐ Unknown

Describe: ____________________

Laboratory Analysis Summary

Unusual analytical results: ____________________

Reporting units: ____________________

Analytical method: ____________________

Minimum reporting level: ____________________

Precision (relative standard deviation): ____________________

QA/QC (e.g., recovery of matrix spikes, standard checks, etc.): ____________________

Summarize additional information obtained during laboratory analysis that is relevant to contaminant identification. ____________________

____

____

Contaminant Characteristics

What is the class of the contaminant?

☐ Biological ☐ Chemical ☐ Radiological

☐ Unknown: ____________________

Appendices

Can any conclusions regarding the contaminant properties be made? (Place an 'X' in the appropriate column)

	Yes	No	Unknown	Comment/Additional Information
Is the contaminant susceptible to disinfection or chemical oxidation?				
Does the contaminant hydrolyze into less toxic products?				
Does the contaminant hydrolyze into more toxic products?				
Does the contaminant react at certain pH's?				
Is the contaminant water soluble?				
Does the contaminant have a discernable odor or color? (Note: For safety reasons you should not intentionally smell samples.)				
Is the contaminant volatile or semi-volatile?				
Does the contaminant impact the pH?				
Does the contaminant impact conductivity?				
Does the contaminant impact other wastewater chemical parameters?				
Does the contaminant react with certain disinfectants (i.e., chlorine, chloramines, etc.)?				
What is the contaminant's half-life?				

Contaminant Public Health Effect Information

What are the primary routes of exposure?

☐ Inhalation ☐ Dermal contact ☐ Ingestion ☐ Unknown

What are the acute health effects for the exposure routes identified? ______________________________

____

____

What is the contaminant's LD50/ID50 for these routes of exposure? ______________________________

____

____

Appendices

What is the length of time to first onset of symptoms after exposure?

____

____

What are the chronic health effects associated with exposure to the contaminant? ______________________

____

____

Does the contaminant have the potential for secondary transmission?

☐ Yes ☐ No ☐ Unknown

Describe: ____

Is an approach available to prevent undesirable health effects from the contaminant?

☐ Yes ☐ No ☐ Unknown

Describe: ____

Are there treatments available for individuals exposed to the contaminant?

☐ Yes ☐ No ☐ Unknown

Describe: ____

Are health standards for the contaminant available?

☐ Yes ☐ No ☐ Unknown

Describe: ____

By which exposure routes?

☐ Dermal ☐ Inhalation ☐ Ocular ☐ Ingestion

List the levels for each exposure route.

____

____

Access to Contaminant Information (Effects and Properties)

In-house Information

Contact/ phone no.: ____

Internal database: ____

Public Health Officials

Contact/phone no.:____

Website/database: ____

Appendices

Resources

- ☐ US EPA Water contaminant information tool (WCIT), at http://www.epa.gov/wcit.
- ☐ US EPA Water Health and Economic Analysis Tool (WHEAT), at http://water.epa.gov/infrastructure/watersecurity/techtools/wheat.cfm
- ☐ US EPA's List of Drinking Water Contaminants & MCLs: http://www.epa.gov/safewater/mcl.html#mcls.
- ☐ Agency for Toxic Substances and Disease Registry (ATSDR): www.atsdr.cdc.gov.
- ☐ CDC Emergency Preparedness and Response: www.bt.cdc.gov.
- ☐ Recognizing Waterborne Disease and the Health Effects of Water Pollution: A Physician On-line Reference Guide: www.waterhealthconnection.org.
- ☐ Physician Preparedness for Acts of Water Terrorism: www.waterhealthconnection.org/bt/index.asp.
- ☐ Registry of Toxic Effects of Chemical Substances (RTECS): www.cdc.gov/niosh/rtecs.html.
- ☐ Risk Assessment Information System (RAIS), which contains information taken from US EPA's Integrated Risk Information System (IRIS), the *Health Effects Assessment Summary Tables* (HEAST-rad HEAST-nonrad), US EPA Peer Reviewed Toxicity Values (PRTVs) Database, and other information sources: http://www.epa.gov/risk_assessment/.
- ☐ United States Army *Medical Research Institute of Infectious Diseases (USAMRIID) Medical Management of Biological Casualties Handbook*: http://www.usamriid.army.mil/education/bluebook.html.
- ☐ WHO: www.who.int/search/en/.
- ☐ WHO's *Public Health Response to Biological and Chemical Weapons (2004)*: www.who.int/csr/delibepidemics/biochemguide/en/index.html.

Contaminant Transport

Summarize what is known regarding the location of contaminant introduction:

____

____

____

How much material was used: ________________________(lbs, tons, gals, etc.)

How was it added? ☐ Single dose ☐ Over time ☐ Unknown

Time period of suspected contaminant introduction: ________________________

Elapsed time: ____________________________________

Method of estimating the spread:

☐ Manual calculations ☐ Hydraulic model ☐ Water flow analysis

☐ GIS ☐ Field analysis ☐ Areas of public complaints

☐ Areas of people with health-related symptoms

☐ Other: ____

Estimate the contaminated area: ______________________________________

Estimate the population affected:______________________________________

Identify any customers with special needs that are within the affected area.

☐ Critical Care Facilities

- ☐ Hospitals ☐ Clinics
- ☐ Nursing Homes ☐ Dialysis Centers
- ☐ Other: ____

☐ Schools

☐ Day Care Facilities

☐ Businesses

- ☐ Food and Beverage Manufacturers ☐ Commercial Ice Manufacturers
- ☐ Restaurants ☐ Agricultural Operations
- ☐ Power Generation Facilities
- ☐ Other : ____

Signoff

Name of person completing form: ______________________________________

Print name: ____

Signature: ________________________ Date/Time: ____________________

Appendices

14 Public Health Response Action Worksheet

INSTRUCTIONS

The purpose of this form is to help organize information to aid in the evaluation of containment and public notification options. The objectives of public health response actions (operational and public notification) are to prevent or limit public exposure to potentially contaminated wastewater by either restricting further transport of the contaminant through the wastewater system or restricting use of the system through public notification. This worksheet assumes that the "Contaminant Characterization and Transport Worksheet" in Appendix 13 has been completed to the extent possible.

Assessment of Public Health Impact

Identity of the contaminant: ☐ Suspected ☐ Known ☐ Unknown

Describe: ____

Contaminant properties (if known):

Route of exposure:

☐ Dermal ☐ Inhalation ☐ Ingestion ☐ Other: ______________

Toxic or infectious dose (LD_{50}/ID_{50}) by these routes of exposure: ______________

Symptoms of exposure to high dose: ______________________________

Symptoms of exposure to low dose: ______________________________

Other: ____

Evaluation of Containment Options

Describe the location and extent of the contaminated area: ______________________

____

____

Containment options:

☐ Valve closures ☐ Reverse flow conditions ☐ By-pass

☐ Isolate zone(s)

☐ Other: ____

Critical equipment within contaminated area:

☐ System equipment ☐ Zones ☐ Pump stations

☐ Other: ____

Customers with special needs within contaminated area:

☐ Critical Care Facilities

- ☐ Hospitals ☐ Clinics
- ☐ Nursing Homes ☐ Dialysis Centers
- ☐ Other: ____

☐ Schools

☐ Day Care Facilities

☐ Businesses

- ☐ Food and Beverage Manufacturers ☐ Commercial Ice Manufacturers
- ☐ Restaurants ☐ Agricultural Operations
- ☐ Power Generation Facilities
- ☐ Other: ____

Effectiveness of containment options:

☐ Complete contaminant isolation ☐ Reduction in spread of contaminant

☐ Unknown

☐ Other: ______________________________

Is containment expected to provide adequate public health protection?

☐ Yes ☐ No ☐ Unknown

Timeline for implementation of containment options:

Containment procedures to begin: ______________________________

Containment procedures to end: ______________________________

Evaluation of Public Notification Options

Is public notification necessary and/or required by any applicable laws or regulations? ☐ Yes ☐ No

Collaboration Agencies (identified in Public Health Response Plan and Utility's ERP)

☐ Public health agencies ☐ Police departments ☐ Fire departments
☐ Hospitals/clinics ☐ Laboratories ☐ Wastewater permitting agency
☐ Regional Poison Control Center
☐ Other: ______________________________

Type of notification (follow steps shown):

- Is the contaminant known? ☐ Yes ☐ No
- Is there a risk of explosion? ☐ Yes ☐ No

If "Yes," consider an evacuation notice.

- Is there a risk of dermal or inhalation exposure? ☐ Yes ☐ No ☐ Unknown

If "Yes" or "Unknown," consider an evacuation notice.

Content of Public Notification

☐ Has the contamination event been confirmed? ☐ Yes ☐ No

☐ Is the contaminant known? ☐ Yes ☐ No

☐ If "Yes," identity of the contaminant: ______________________________

☐ Characteristics of the contaminant: ______________________________

☐ Restrictions on use: ______________________________

☐ Inhalation exposure ☐ Dermal exposure

☐ Exposure symptoms: ______________________________

☐ Medical treatments: ______________________________

☐ Transmission mode (if biological): ______________________________

☐ Duration of restriction: ____

☐ Alternate sanitary services: ____

☐ Additional instructions to consumers: ____

☐ Other information about the incident: ____

☐ Other: ____

Notification to customers with special needs:

☐ Critical Care Facilities

- ☐ Hospitals
- ☐ Clinics
- ☐ Nursing Homes
- ☐ Dialysis Centers
- ☐ Other: ____

☐ Schools

☐ Day Care Facilities

☐ Businesses

- ☐ Food and Beverage Manufacturers
- ☐ Commercial Ice Manufacturers
- ☐ Restaurants
- ☐ Agricultural Operations
- ☐ Power Generation Facilities
- ☐ Other: ____

Are there subpopulations that will be affected at a greater rate than general population?

☐ Yes ☐ No ☐ Unknown

Describe: ____

Notification to consecutive system:

☐ Yes ☐ No ☐ Not Applicable

Method of dissemination (check all that apply):

☐ Broadcast media (radio and television)

☐ Government access channels

☐ Web site

☐ Listserve email

☐ Newspaper

☐ Letters by mail

☐ Newsletters (wastewater utility/partner)

☐ Phone banks

☐ Broadcast phone messages

☐ Broadcast faxes

☐ Posting in conspicuous locations

☐ Mass distribution through partners

☐ Hand delivery

☐ Door-to-door canvassing

☐ Town hall meetings

☐ Conference calls

☐ Auto dialer system

☐ Reverse 911

☐ Other ____

Notification/restriction timeline: ____

Notification/restriction to begin: ____

Notification/restriction to end: ____

Alternate Sanitation Services

Are alternate sanitation services needed? ☐ Yes ☐ No

Where can customers obtain the alternate sanitary services (e.g., locations for portable toilets)?

____

____

Which customers with special needs should be notified of the alternate sanitary services?

☐ Critical Care Facilities

- ☐ Hospitals
- ☐ Clinics
- ☐ Nursing Homes
- ☐ Dialysis Centers
- ☐ Other: ____

☐ Schools

☐ Day Care Facilities

☐ Businesses

- ☐ Food and Beverage Manufacturers
- ☐ Commercial Ice Manufacturers
- ☐ Restaurants
- ☐ Agricultural Operations
- ☐ Power Generation Facilities
- ☐ Other: ____

Signoff

Name of person completing form: ____

Print name: ____

Signature: ______________________ Date/Time: ______________________

Appendices

15 Suggested Outline for System Characterization/Feasibility Study Work Plan

I. Executive Summary

II. Introduction

III. System Description and Environmental Setting

IV. Initial Evaluation and Results of Site Characterization

- A. Contaminants present, volume of wastewater and media affected
- B. Potential pathways of contaminant migration/preliminary assessment of public health and environmental impacts
- C. Preliminary identification of candidate response objectives and remedial response action alternatives

V. Work Plan Rationale

- A. Data quality objectives
- B. Work plan approach

VI. Tasks

- A. Project Planning
- B. Community Relations/Public Communication
- C. Field Investigations
- D. Sample Analysis/Validation
- E. Data Evaluation
- F. Risk Assessment
- G. Evaluation of Remedial Alternatives
- H. Treatability Studies
- I. Reports

VII. Costs and Key Assumptions

VIII. Schedule

IX. Project Management

- A. Staffing
- B. Coordination

X. References

XI. Appendices

16 Elements for a Quality Assurance Project Plan

I. Project Management

A. Title and Approval Sheet

B. Table of Contents

C. Distribution List

D. Project/Task Organization

E. Problem Definition and Background

F. Project/Task Description

G. Quality Objectives and Criteria

H. Special Training/Certifications

I. Documentation and Records

II. Data Generation and Acquisition

A. Sampling Process Design (Experimental Design)

B. Sampling Methods

C. Sample Handling and Custody

D. Analytical Methods

E. Quality Control

F. Instrument/Equipment Testing

G. Inspection and Maintenance

H. Instrument/Equipment Calibration and Frequency

I. Inspection/Acceptance of Supplies and Consumables

J. Non-direct Measurements

K. Data Management

III. Assessment and Oversight

A. Assessments and Response Actions

B. Reports to Management

IV. Data Validation and Usability

A. Data Review, Verification, and Validation

B. Verification and Validation Methods

C. Reconciliation with User Requirements

17 Elements of a Health and Safety Plan

I. The name of a site health and safety officer and the names of key personnel and alternates responsible for site safety and health

II. Health and safety risk analysis for existing site conditions, and for each site task and operation

III. Employee training assignments

IV. Description of personal protective equipment to be used by employees for each of the site tasks and operations being conducted

V. Medical surveillance requirements

VI. Description of the frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used

VII. Site control measures

VIII. Decontamination procedures

IX. Standard operating procedures for the site

X. Contingency plan that meets the requirements of 29 CFR 1910.120(l)(1) and (I)(2)

XI. Entry procedures for confined spaces