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Sampling Guidance for Unknown Contaminants in Drinking Water

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Section 1.0 Introduction

Homeland Security Presidential Directive 9 (HSPD 9), in pertinent part, directed the U.S. Environmental Protection Agency (EPA) and others to "build upon and expand current monitoring and surveillance programs" to:

1. *Develop robust, comprehensive, and fully coordinated surveillance and monitoring systems for water quality that provide early detection and awareness of disease, pest or poisonous agents.*

2. *Develop nationwide laboratory networks for water quality that integrate existing federal and state laboratory resources, are interconnected, and utilize standardized diagnostic protocols and procedures.*

In response to the first task under HSPD 9, EPA proposed and initiated development of a Contaminant Warning System. Sampling and sample screening are crucial components of the Contaminant Warning System, which are addressed in this document.

The *Sampling Guidance for Unknown Contaminants in Drinking Water* provides comprehensive guidance that 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. The guidance is intended to support sampling for routine and baseline monitoring to determine background concentrations of naturally occurring pathogens, sampling in response to a triggered event, and sampling in support of remediation or decontamination efforts. The primary intended audience of this guidance document is drinking water utilities, but it may also be a useful reference for emergency response personnel. Given the complexity of a drinking water response, the response may quickly surpass the abilities of most utilities. Utilities are likely to call upon emergency responders. This guidance document can be used to supplement a drinking water utility's emergency response plan by providing detailed recommended sampling procedures for use by utility personnel in response to a potential contamination event. The sample collection procedures described may also be used to support other monitoring activities for specific contaminants or classes of contaminants, as appropriate.

The specific sampling procedures described may be modified to meet the analytical objectives or scope (i.e., target analytes) of the sample collection event. For example, a subset of the sampling procedures could be used to collect samples targeting one or several contaminants while the entire suite of sampling procedures could be used in situations where the presence or nature of the suspected contaminant(s) was unknown. This document also provides guidelines for the development and training of effective and responsive sampling teams. Recommendations for establishing appropriate communication and support networks, information management systems, site characterization procedures, field screening and testing procedures, and personnel safety and protection are included to support the integrated monitoring and surveillance activities of water utilities.

If there is evidence or information suggesting a harmful contamination, then there is a possible threat to the life or safety of the utility personnel. The utility should request a trained Hazardous Materials (HazMat) emergency response team. Ideally, the utility emergency response plan should include pre-established lines of communication with the HazMat emergency response team. However, in most situations, calling 9-1-1 will also work.

This guidance document presents a model to guide emergency response actions in the event of a contamination incident. Capabilities of utilities are expected to vary. The suggestions in this document are not mandated. Many small and medium sized utilities will not have the resources to implement most of the measures discussed in this guidance. However, small utilities can take initial steps to prepare for a contamination incident. These include:

- Contact local HazMat response units, familiarize them with the layout and procedures of the utility, and become aware of the utility's response capabilities
- Research the capabilities of the local laboratories within driving distance of the utility

- Become aware of the resources offered for emergencies by the Centers for Disease Control and Prevention (CDC) Laboratory Response Network (LRN), Regional Laboratory Response Network, and the EPA's Water Laboratory Alliance (WLA)
- Conduct a tabletop exercise to determine how the utility would respond to a variety of contamination scenarios with the resources at hand. Invite representatives from the local HazMat response unit to these exercise discussions. Ask for their recommendations, and establish lines of communication for use during a response.

1.1 Document Organization

The remaining sections of this document describe the following aspects of collecting drinking water samples to be analyzed for targeted or unknown contaminants:

- **Section 2.0: Overview of Sampling Approach.** This section presents an overview of activities that should be completed or in place before sample collection activities begin.
- **Section 3.0: Utility Roles and Responsibilities.** This section presents an overview of the roles and responsibilities that drinking water utilities should have in place to establish appropriate sampling capabilities and procedures.
- **Section 4.0: Safety and Personal Protective Equipment.** This section provides general guidelines on the use of personal protective equipment for sampling teams.
- **Section 5.0: Preparation for Sample Collection Activities.** This section presents an overview of the quality assurance/quality control samples that should be used for sample collection.
- **Section 6.0: Sample Collection Documentation.** This section describes sample collection documentation that should be completed before and during the sampling procedure.
- **Section 7.0: Sample Collection Procedures.** This section describes recommended sample collection procedures.
- **Section 8.0: Sample Packaging and Shipment.** This section describes recommended packaging and shipping procedures for sample containers.
- **Section 9.0: Consequence Management.** This section provides information on the current resources that are available for a utility that will aid them in writing a consequence management plan.

Section 2.0 Overview of Recommended Sampling Approach

This document is provided as a guidance, to outline an ideal level of preparedness. Responses to specific events by utilities with lesser capabilities are expected to vary greatly. The recommended sampling approach assumes that the utility has:

- Defined sampling capabilities for biological, toxin, chemical, and radiochemical analytes
- Developed on-site sample screening capabilities
- Established sampling team requirements, such as personnel, training, etc.
- Established a laboratory support network and chain of communication for the sampling teams
- Established an information management system

Figure 2-1 provides a conceptual flow chart of the requirements for biological (including toxins), chemical, and radiochemical sampling.

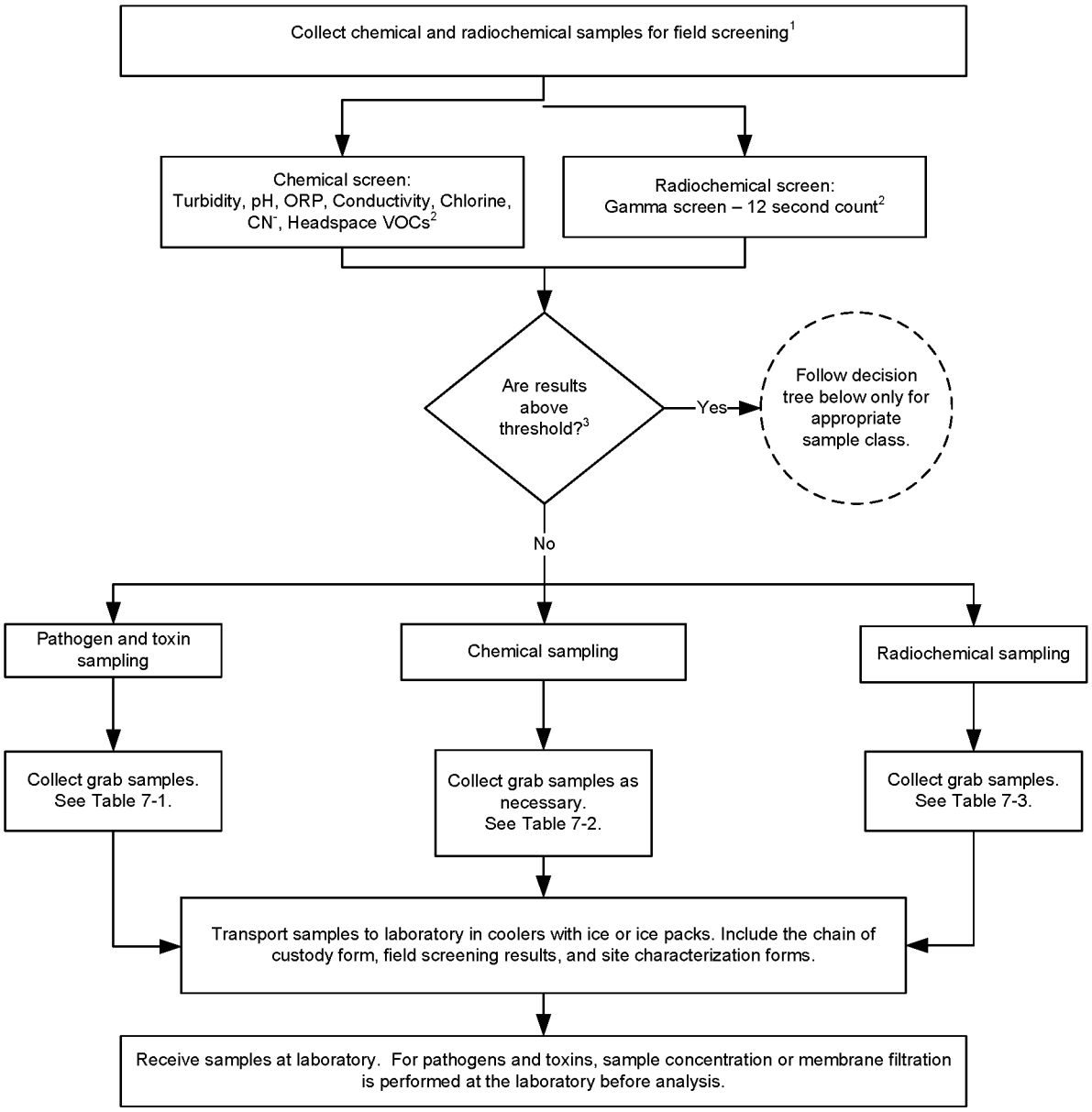
After a potential contamination incident has been identified, a site characterization should be conducted to obtain samples and other evidence to help determine the level of threat. Site characterization activities include the site investigation, field safety screening, rapid field testing of the water, and sample collection. The investigation site is the focus of site characterization activities and is the location where it is suspected that the contaminant was introduced into the system. In addition to the investigation site, other sampling sites might be identified around the system if it is suspected that the contaminant might have spread.

All sampling equipment and sample containers should be sterile for collection of samples to be used for biological parameters. Pre-cleaned and certified containers should be used for chemical parameters. Sampling kits should be prepared before an incident occurs. Preservatives may be applied in the laboratory or preferably in the field.

The objective of sampling from the site of a suspected water contamination event is to preserve a sample of the water at a particular time and location, such that it can be analyzed if deemed necessary. To do this effectively, an initial sample plan should be developed prior to sample collection activities. The two most common types of environmental samples are grab samples and composite samples. In general, it is recommended that only grab samples be collected from distribution systems; however, in some situations it may be necessary to composite samples over time or position. A grab sample is a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once and at one particular point in the sample medium. A composite sample is composed of more than one specific aliquot collected at various sample locations and/or different points in time.

Many of these field activities can be practiced during routine or baseline sampling. Baseline sampling is a constructive exercise for utilities to undertake in order to understand the range of contaminants that exist in the drinking water under normal operations.

Figure 2-1. Recommended Sampling Process for Analyses of Unknown Contaminants in Drinking Water



[1]EPA recommends Technology Testing and Evaluation Program evaluations to be consulted prior to purchasing screening equipment.
[2]The screening techniques mentioned are provided as common examples and do not constitute an exhaustive list.
[3]Threshold values refer to those set during baseline monitoring or known background levels.

Section 3.0 Utility Roles and Responsibilities

Drinking water utilities are strongly encouraged to establish appropriate and standardized sampling capabilities and procedures. Ideally, each utility will have "in-house" sampling teams that will be capable of collecting and providing samples to the appropriate analytical laboratory for baseline contaminant monitoring and in response to a triggered event. The following sections provide guidelines to assist utilities in the preparedness planning, implementation and integration of these critical response elements.

3.1 Defining Sampling Requirements: Capabilities and Capacity

In preparation for baseline contaminant monitoring and response to a trigger, the utility should evaluate the utility's sampling capabilities to ensure that all required sample collection activities can be performed. The utility manager should evaluate sampling capacity to ensure that adequately trained personnel and sufficient sampling equipment are available. Ideally, a utility should respond only with its own personnel to a suspected contamination. If there is evidence or information suggesting a harmful contamination, discovery of HazMat receptacles, or a possible threat to the life of the utility personnel, the utility should request a trained HazMat emergency response team. Ideally, the utility emergency response plan should include pre-established lines of communication with the HazMat emergency response team. However, in most situations, calling 9-1-1 will also work.

3.1.1 Sampling for Baseline Monitoring

Once standardized sampling capabilities and procedures are in place, the utility should focus on establishing a utility-specific profile or baseline levels of both priority contaminants and standard chemical parameters (chlorine, pH, oxidation-reduction potential, etc.). This baseline profile is critical to distinguish background or naturally occurring levels of each contaminant from higher levels that may be observed following a contamination incident. For many priority contaminants, the baseline is expected to be zero or below the detection limit of the corresponding analytical methods. To address spatial and temporal variables within the treatment and distribution systems, baseline monitoring should involve the collection and analysis of multiple types and numbers of samples.

Baseline monitoring should use the same sample collection and analysis procedures that would be used in a triggered event. This way the utility will have an idea of what the analytical results for drinking water are under normal conditions. This will eliminate unnecessary suspicion during a triggered event for low level detects that are seen regularly. Baseline monitoring can also serve as practice for the sampling teams and the utility's network of laboratories, so triggered events will go more smoothly.

Baseline monitoring may be either a very extensive activity, or a simple evaluation of data that the utility normally collects. Naturally, the more extensive the baseline monitoring, the more confidence the utility will have when evaluating data during a response event. EPA drinking water methods using mass spectrometry are routinely used in the regulatory data produced for utilities (e.g., Methods 200.8, 524.2 and 525.2). These mass spectrometry methods can detect contaminants in drinking water that are not on the calibration list. These contaminants are referred to as "non-target analytes." Non-target analytes are not usually reported for most EPA drinking water methods. It would be beneficial for a utility to be aware of non-target analytes that are usually present in drinking water samples, but not calibrated for or reported using the method. This could prevent a false alarm during a response event.

3.2 Sampling in Response to a Contamination Warning System Trigger

Adaptation of routine sampling and analysis procedures is important if there is a potential hazard present. The level of personal protective equipment (PPE) and field screening may need to be increased and all sampling and analysis may become evidence in a future case. These issues are discussed in Sections 4 and 5. In addition, sampling teams responding to a potential contamination event should be trained and equipped to characterize the site, perform on-site hazard screening using available field-test kits, collect samples, and prepare samples for transport. These functions are similar to those normally provided by a

HazMat response team, and utility managers are encouraged to coordinate with local HazMat resources to provide training and support in the event of a contamination event. Utilities located near state and federal agencies that have HazMat response capability may also benefit from establishing relationships with these agencies to coordinate response support. For example, any utility located near one of the EPA's National Response Team offices may want to establish relationships with the regional office. More information can be found about the EPA National Response Teams at http://www.epa.gov/superfund/programs/er/nrs/nrsrrt.htm. Additionally, states may also have response teams that are part of the state's department of health. If the site is characterized as having levels of contamination that are above a low hazard level, a HazMat response team should be available to continue the site characterization activities.

3.3 *Sampling Team Preparation*

Sampling teams should be familiar with the utility's operation, including the treatment plant and distribution system, and the utility manager should ensure that sampling teams are continually updated on any changes in facility design or distribution. Sampling teams should be familiar with the utility's Emergency Response Plan (ERP), Vulnerability Assessment (VA), and any other contingency plans that may assist the team in developing an effective sampling strategy. Utilities should make all response documents and plans available to all parties that could participate in an emergency response. Sampling teams should be familiar with the sampling techniques and associated activities presented in this document and should use these during all sampling activities. Each drinking water utility should determine the extent of site characterization capabilities that will be performed by either the sampling team or by an external organization. A drinking water utility may choose to develop capabilities for performing site characterization and core field testing in cases where a low hazard exists, but should make arrangements with HazMat responders to provide support during the characterization of a potentially hazardous site. It is critical that the utility plans for in-house site characterization activities and makes arrangements with those agencies that would be called upon in the event that a situation exceeds the utility's resources and capabilities.

All utilities should conduct field drills, ideally with local HazMat or other local emergency response resources, to become efficient in carrying out their ERPs.

3.4 Defining Analytical Support Requirements: Capabilities and Capacity

It is critical that utilities evaluate their internal analytical capabilities and incident response capacity. Some priority contaminants (select biological agents, some chemical agents, and radiochemicals) should be analyzed by qualified laboratories using specialized and or restricted analytical methods. It is important that utilities participate in analytical support networks. They are encouraged to look into the resources offered by the EPA Regional Laboratory Response Plans, the CDC's Laboratory Response Network (LRN), and EPA's Water Laboratory Alliance. Internal and external analytical support networks should be in place and operational prior to initiating any baseline sampling and analysis activities and in preparation for a triggered event.

Usually the closest LRN laboratory will be the state's department of health laboratory. For more information, CDC can be contacted at 800-CDC-INFO, 888-232-6348(TTY), or cdcinfo@cdc.gov. More information is also available at: http://www.bt.cdc.gov/lrn/.

Each EPA Region contains an EPA regional laboratory, which may also be able to provide support.

3.4.1 Establishing Analytical Support Networks

Establishing a support network of laboratory analytical capabilities and capacity will ensure that samples can be processed properly and expeditiously. To assist in locating laboratories capable of providing the necessary support, the EPA Environmental Laboratory Compendium includes a database of nationwide environmental laboratories available to water utilities and to federal and state agencies, which can be reached through a link in the references section. The database contains each laboratory's specific

capabilities for biological and chemical analyses as well as bioterrorism, chemical warfare, and radiochemical agents. This database was developed as a tool to quickly identify laboratories with capabilities to support incident-specific response and recovery efforts and to assist water utilities and federal and state agencies in responding to contamination threats, terrorist attacks or natural disasters.

Once an appropriate analytical laboratory support network has been identified, it is imperative to establish a chain of communication between and among the utility and the supporting laboratories. This will enable logistical support and coordination between the utility's sampling activities and analytical requirements and provide a framework for data reporting and information management.

Support laboratories should be consulted regarding specific sample collection, sample preservation, and sample shipping requirements. In some cases, support laboratories will train sampling teams in specialized sample collection procedures (e.g., ultrafiltration). The support laboratory may also provide the utility with or assist with the preparation of sample kits to ensure that the samples are properly prepared and preserved for the required analyses, particularly for sampling unknown or tentatively identified contaminants. It is important to follow specific laboratory requirements since this may impact the quality of the analytical results. Some laboratories may request specific quality control (QC) samples such as field duplicates, field blanks, trip blanks, and field matrix spikes and may require specific chain of custody, notification, and shipping procedures.

A laboratory may request that the sampling team collect backup samples in case there is a problem with the set of samples that are delivered to the laboratory, or if there is a need for additional samples for confirmation or analysis by another entity (e.g., a specialty laboratory or law enforcement agency). Backup samples should be properly stored, secured, and tracked such that the integrity of the samples is maintained.

If during a triggered sampling event the decision is made to analyze the samples immediately, the laboratory should be contacted as soon as possible so they can prepare for arrival of the samples. Laboratories may be responsible for the rapid analysis of samples collected in response to a contamination threat; thus, they should be engaged during site characterization activities if possible. Furthermore, the laboratory will need information from site characterization to support the development of the analytical approach for a specific contamination threat. In some cases, the laboratory may provide support staff to assist with sample collection and field analyses, as long as this staff is trained in sampling, field screening, and in the safety standard operating procedures (SOPs).

3.5 On-site Sample Screening Capabilities (Field Kits and Procedures)

Prior to initiating any sampling activities, each utility should evaluate their on-site sample screening capabilities. Sample screening procedures should be well defined and specific protocols should be in force for use by appropriately trained personnel prior to sample screening. More specific detail on sample screening procedures is located in Section 5.2 of this document. EPA's *Response Protocol Toolbox (RPTB), Module 3: Site Characterization and Sampling Guide* (USEPA, 2003) should also be referenced for guidance related to on-site sample screening parameters.

3.5.1 Baseline Monitoring/Routine Monitoring: On-site Screening

During baseline monitoring, sample screening will provide laboratories with information regarding conditions in the environment and the water quality at the time of the sampling event. Screening activities may include the use of instrumentation or equipment to measure water quality parameters (i.e., pH, conductivity, chlorine residual, hardness, and temperature) that may indicate the presence of harmful contaminants or substances or conditions that may interfere with analyses.

3.5.2 Triggered Monitoring: On-site Screening

During a triggered event, water quality parameters should be measured after a site characterization has been performed, EPA RPTB, Module 3, and after it has been determined that it is safe to enter the site.

The information provided by field test results can be valuable in making decisions early in the response to a contamination threat, particularly during the transition from the "possible" to the "credible" stage. Results from the on-site screening can also be used to refine the sampling plan.

Assuming that the threat has not been dismissed as "not credible" upon completion of the on-site investigation, samples should be collected as a precaution such that they are available for analysis if necessary. Negative field test results are not a good reason to forgo sampling at this stage, since field testing is limited in scope and there is a potential for false negative results. The decision to send samples to a laboratory for analysis should be based on the outcome of the entire threat evaluation, including site assessment, evidence evaluation, and sample screening. Specifically, if a threat is determined to be "credible," samples should be immediately delivered to the laboratory for analysis.

Section 4.0 Safety and Personal Protective Equipment

Disclaimer: EPA is including this section on safety and personal protective equipment (PPE) for general informational purposes. For up-to-date information and more specific details about safety and PPE requirements and recommendations, please refer to the Occupational Safety and Health Act and implementing regulations, directives, and guidance (see osha.gov).

Utilities are not expected to handle a contamination incident on their own when hazardous materials are believed to be present in high concentrations. However, they are expected to coordinate closely with local HazMat response teams. ***The information in this section is provided to introduce utilities to HazMat safety considerations. It does not necessarily represent expected or required capabilities on the part of the utility.*** Many utilities do not have personnel trained in hazardous waste operations and emergency response (HAZWOPER; 29 CFR 1910.120). Utilities without HAZWOPER-trained personnel should focus on collaboration with local HazMat response units. Some material in this section (e.g., Level A and B PPE, confined space entry, etc.) should not be attempted by personnel who are not trained to 29 CFR 1910.120 requirements. HazMat response units will receive a level of training that far exceeds the material covered in this section. As previously stated, the information in this section is provided to introduce utilities to HazMat safety considerations.

Proper safety practices are essential to minimize the risks to the site teams and should be established prior to an incident. Training for all team members should conform to appropriate regulations, such as Occupational Safety and Health Administration's (OSHA) *Hazardous waste operations and emergency response* regulations, 29 CFR 1910.120. PPE for a low level contamination should consist at a minimum of safety gloves, safety glasses with side shields, covering of extremities, and safety shoes. Additional levels such as clothing protection and respiratory protection may also be necessary but require additional training. All PPE should be treated as contaminated until the sample results are known.

The level of personal protection necessary to perform site characterization and/or activities will depend on the assessment of site hazards that might pose a risk to the site characterization team. The results of the field safety screening and initial site evaluation will be used to assess the site hazards, and are intended to confirm the absence (or presence) of certain acute hazards prior to site entry.

The sampling team should follow good safety practices, including:

- Do not eat, drink or smoke at the site.
- Do not smell or taste the water sample.
- Avoid contact with the sample or water flow.
- Minimize volatilization or aerosolization of contaminants into the air.
- Minimize contact time with expected contamination by proper and efficient assessment and sampling.
- Conduct response at sites with obvious signs of hazards using properly trained personnel and equipment, such as HazMat teams, EPA (or other federal) on-scene coordinators (OSCs), or other hazardous material response support.

This section provides some general guidelines in the use of PPE that are typically followed by HazMat Response Teams, and are recommended for sampling environmental material in response to an unusual or suspicious contamination event. This section also provides summary information regarding the types of hazards that should be considered.

4.1 Personal Protective Equipment

The level of PPE used should be determined by the level of potential risk associated with the respective incident as assessed by the utility management. Most utilities have only the basic level of PPE available for use by their staff, and are therefore expected to coordinate sampling procedures with local HazMat units, who would arrive in response to an incident with high levels of PPE. Specific guidance for selection of PPE is provided in Appendix B to 29 CFR 1910.120. Factors that should be considered

during selection include: contaminant identification, routes of exposure (i.e., inhalation, skin absorption, ingestion, and injection), performance of equipment in protecting against exposure, activity duration, and stress induced by work requirements. Because the use of PPE can also cause hazards to workers (e.g., heat stress, impaired vision and mobility), care should be taken to provide a level of protection that is sufficient to prevent exposure yet is not too high so as to create other unnecessary hazards.

The following information about PPE is quoted directly from Appendix B to 29 CFR 1910.120:

> *Part A*. Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)
>
> I. *Level A*—To be selected when the greatest level of skin, respiratory, and eye protection is required.
>
> The following constitute Level A equipment; it may be used as appropriate;
>
> 1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).
>
> 2. Totally-encapsulating chemical-protective suit.
>
> 3. Coveralls.[1]
>
> 4. Long underwear.[1]
>
> 5. Gloves, outer, chemical-resistant.
>
> 6. Gloves, inner, chemical-resistant.
>
> 7. Boots, chemical-resistant, steel toe and shank.
>
> 8. Hard hat (under suit).[1]
>
> 9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).
>
> ---
>
> [1] Optional, as applicable.
>
> II. *Level B*—The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.
>
> The following constitute Level B equipment; it may be used as appropriate.
>
> 1. Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
>
> 2. Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).
>
> 3. Coveralls.[1]
>
> 4. Gloves, outer, chemical-resistant.
>
> 5. Gloves, inner, chemical-resistant.
>
> 6. Boots, outer, chemical-resistant steel toe and shank.
>
> 7. Boot-covers, outer, chemical-resistant (disposable).[1]
>
> 8. Hard hat.[1]
>
> 9. [Reserved]

10. Face shield.[1]

[1] Optional, as applicable.

III. *Level C*—The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

The following constitute Level C equipment; it may be used as appropriate.

1. Full-face or half-mask, air purifying respirators (NIOSH approved).

2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).

3. Coveralls.[1]

4. Gloves, outer, chemical-resistant.

5. Gloves, inner, chemical-resistant.

6. Boots (outer), chemical-resistant steel toe and shank.[1]

7. Boot-covers, outer, chemical-resistant (disposable).[1]

8. Hard hat.[1]

9. Escape mask.[1]

10. Face shield.[1]

[1] Optional, as applicable.

IV. *Level D*—A work uniform affording minimal protection: used for nuisance contamination only.

The following constitute Level D equipment; it may be used as appropriate:

1. Coveralls.

2. Gloves.[1]

3. Boots/shoes, chemical-resistant steel toe and shank.

4. Boots, outer, chemical-resistant (disposable).[1]

5. Safety glasses or chemical splash goggles.[1]

6. Hard hat.[1]

7. Escape mask.[1]

8. Face shield.[1]

[1] Optional, as applicable.

4.2 Health and Safety Plans

Health and Safety Plans (HASPs) and the required level of PPE that should be used to collect samples during an emergency response will vary depending on the site, the response event, and the responsible organization. The purpose of these plans is to ensure maximum protection to workers, the environment, and surrounding communities, in a way that is consistent with requirements needed to perform operational activities.

When collecting samples that potentially contain unknown biological or chemical hazards, responders should follow the HASP that is specific to their organization or to the event. HASPs should include, at a minimum, instructions and guidelines regarding:

- Names, positions and contact information of key personnel and health and safety personnel
- Site or event-specific risk analysis
- Training requirements for specific events
- PPE on site and usage requirements
- Medical surveillance requirements (maintain confidential documents properly and securely)
- Contact information and location of the nearest medical facility; directions (and map) to the facility
- Site or event control
- Emergency response plan
- Entry procedures
- Spill containment
- Decontamination procedures

In the case of emergency response, these plans also should ensure protection of potential evidence, criminal or forensic (see discussion in Section 5.4).

4.3 Confined Space Entry

Many utility infrastructures contain areas that qualify as confined spaces. On their Web site, http://www.osha.gov/SLTC/confinedspaces/index.html, OSHA defines a confined space as having "…limited or restricted means for entry or exit, and it is not designed for continuous employee occupancy. Confined spaces include, but are not limited to underground vaults, tanks, storage bins, manholes, pits, silos, process vessels, and pipelines. OSHA uses the term 'permit-required confined space' (permit space) to describe a confined space that has one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress."

One of the greatest risks associated with confined spaces is that the entrant will be working in an area that does not have a sustainable atmosphere for life. This could be due to very poor ventilation, displacement of oxygen by another gas, or a poisonous/corrosive atmosphere. "Permit-required confined spaces" (29 CFR 1910.146) outlines entry requirements. Training regulations for persons entering confined spaces are contained in 29 CFR 1910.146(g). Confined space training is commercially offered as a 12-hour training course.

The training ensures that personnel entering confined spaces are aware of the ventilation and air monitoring requirements necessary for entering confined spaces.

4.4 Personal Safety Considerations

The following general guidelines should be considered and followed by first responders and sample collectors in the aftermath of an event that may involve biological or chemical agents:

- Stop and assess the situation.
- Contact the appropriate trained personnel.
- Remove all non-essential personnel from exposure but do not allow them to leave the site.
- Wear appropriate PPE.
- Approach the site upwind of the suspected source or contamination area.
- Handle contaminated materials with minimum manipulation.
- Maintain decontamination and contamination free zones properly.
- Contain all contaminated PPE and sampling equipment for disposal or decontamination.

This guidance is general, and site-specific procedures should be followed on a case-by-case basis.

4.5 General Safety Guidance

The following general guidelines should be considered and followed prior to sample collection (Note: this pertains to sampling in response to an incident, not routine sampling):

- It is recommended that at least two personnel are involved in sample collection. The primary sampler has control of the sampling activity and is responsible for physical sample collection, filling the containers, and cleaning the outside of the containers. The second sample collector or technician is responsible for labeling, packaging, record keeping and communication with the personnel outside of the contaminated area. If site geography or the contamination warrants, a third person with the sole task of record keeping should accompany the sampling team. This third party will carry any cameras and will stay in frequent radio communication with others outside of the contaminated area.
- Be aware of potential safety hazards associated with ignitable or explosive environments. Equipment that could potentially be a source of ignition (i.e., cell phones, cameras, radios, etc.) should not be used in these areas.
- Review any available information regarding the site or contamination event to determine if any additional equipment or PPE is needed. It is better to be prepared than to risk exposure to the sampling team.
- Note the full extent of the contamination area including whether the contamination is general or concentrated in areas. If possible, note the migration or potential routes of the contamination.
- Assemble more sampling kits than are expected to be needed. Sampling kits are composed of a sealable bag with the required container(s), documentation forms, storage and transport containers, decontamination materials, and sample collection equipment.
- Complete the sample container labels as much as possible prior to sample collection. A label should be attached to every container and outermost containment bag/container to assist in easy collection. This pre-sampling organization is significantly easier and less time consuming to do while in the comfort of an office, staging location, or vehicle than while sampling in PPE in the field.
- At a minimum, wear safety glasses and two pairs (layers) of nitrile gloves over regular safety equipment. Only the outer gloves need to be changed between each sample as long as the inner gloves remain clear of all contamination. Proper safety practices should always be observed. Potable water should be carried to remove contaminated materials from skin or eyes.

- Leave the sampling kits at the perimeter of the contaminated area, on the clean side of the contaminated area, preferably in the decontamination area. Sample containers should be treated as requiring custody to eliminate the potential for inadvertent or criminal external contamination, and should not be left unsupervised. Radio contact should be maintained with someone outside of the contaminated area. This contact provides safety and can assist in identifying the hazard(s) by relaying information to additional members of the assessment team.
- A sampler or technician should be available to record a log of everything the sampling team does, note the time and record other details that might assist in interpreting the analytical data generated by the laboratory or screening facility. Take at least one picture of the area at the entry to the contaminated area and several pictures of the impacted area. Take pictures of the areas to be sampled. If possible, lay a ruler or tape measure by the sampling points to allow the viewers of the pictures to know the scale of the photograph.
- All PPE should be decontaminated or at least contained after use. All decontamination materials and disposable sampling equipment should be contained until the nature of the contaminant is known.
- Leave the sampling site as undisturbed as possible, as it may prove to be of evidentiary value, and return to the decontamination area to gather supplies and/or additional personnel.

Section 5.0 Preparation for Sample Collection Activities

This section contains information regarding sampling supplies, field test kits, field sampling quality assurance/quality control, forensic protection and interagency cooperation.

5.1 Sample Collection Kits

Sample collection kits should contain all sample bottles, materials, supplies, and forms necessary to perform sample collection activities from a hose bib, faucet, or other sample taps. Other equipment may be needed when collecting samples from fire hydrants, valves, distribution storage tanks or aquifers. Table 5-1 lists the basic recommended components for a sampling kit as indicated by the EPA's RPTB: Module 3, Site Characterization and Sampling Guide. The following list of suggested equipment for the Field Collection Kit is presented as an example. Some utilities may decide it is appropriate to substitute or include additional items.

Table 5-1. Field Collection Kit – Example

Note: When sampling for unknowns, collecting unpreserved samples should be the first priority.

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	2 times the number of bottles	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	Tables 7-1, 7-2, and 7-3	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/labware	N/A	Beakers, graduated cylinders, spatula, etc.
Collapsible cooler	1 or more	For sample storage
Rigid shipping container	1 or more	For shipping by overnight service if needed.
1 quart zippered freezer bags	1 pack/100	For double bagging ice and sample containers
Paper towels	2 rolls	Wiping wet containers and containing spills
BIOLOGICAL SAMPLING SUPPLIES		
Tubing and clamp	1	For sample tap flushing, etc.
Stopwatch & graduated cylinder	1	For measuring flow rate
Ultrafiltration or membrane filtration apparatus	1	For concentrating biological (pathogen and toxin) samples

Item	Quantity	Notes
REAGENTS (may need to be kept separate from the rest of the kit)		
Laboratory grade water	5 liters	For sample dilution in the field
Sodium thiosulfate crystals	100 grams	For water sample disinfectant reduction
Ascorbic acid	100 grams	For water sample disinfectant reduction
Sodium sulfite crystals	100 grams	For water sample disinfectant reduction
Potassium dihydrogen citrate	100 grams	For carbamate preservation
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
Sulfuric acid (H_2SO_4)	25 mL	In dropper bottle for preservation of samples for pesticide preservation
pH paper in ranges from 0 to 4 and 10 to 14	50 strips	For checking the 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 per size (S, M, L, XL)	Nitrile or polyethylene, powder-free
Disposable shoe covers	2 pairs	One pair 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.
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

5.2 Field Test Kits (On-site/Field Pre-screening)

The generic types of screening and detection devices and kits listed in Table 5-2 could be included in a field test kit. The core field test kit should include the equipment necessary to conduct the recommended minimum level of field safety screening and rapid water testing. Additional technologies that might be used to perform *expanded field testing* are listed in the second section of the table. The target parameter for screening and rapid water testing may be a specific contaminant, a contaminant class, or a general indicator of potential contamination. The class indicates whether the technology is suitable for field safety screening, rapid water testing or both. The methodology describes the general principle of detection for the technology.

Due to the wide range of available field testing equipment, specific devices and vendors are not listed here; however, there are sites that do provide a detailed listing of commercially available detection technologies, such as http://www.epa.gov/safewater/security/guide/index.html, http://www.ojp.usdoj.gov/nij/pubs-sum/190747.htm, and http://www.ojp.usdoj.gov/nij/pubs-sum/184449.htm. Detailed verification reports for detectors that have undergone independent testing

through the Environmental Technology Verification (ETV) program are available at http://www.epa.gov/etv/verifiedtechnologies.html.

Additionally, EPA recommends Technology Testing and Evaluation Program (TTEP) evaluations to be consulted prior to purchasing screening equipment. TTEP is a non-biased EPA group that evaluates testing equipment.

Table 5-2. Core and Expanded Field Test Kits

CORE FIELD TEST KIT			
Target Parameter	**Class**	**Methodology**	**Comments**
Radioactivity (alpha, beta, and gamma)	Primarily a Safety Screen	G-M probe and meter	May be expanded to water testing with a special probe.
Cyanide	Water Testing	Colorimetric or ion selective electrode	Test water for cyanide ion, not combined forms.
Chlorine residual	Water Testing	Colorimetric	Absence of residual may indicate a problem.
pH/conductivity	Water Testing	Ion selective electrode	Abnormal pH or conductivity may indicate a problem.
EXPANDED FIELD TEST KIT			
Target Parameter	**Class**	**Methodology**	**Comments**
General hazards	Safety Screen	HAZCAT (explosives, oxidants, etc.)	Should be performed by trained HazMat responder.
Volatile chemicals	Safety Screen	"Sniffer"-type devices	Detects chemicals in air.
Chemical weapons (VX, sarin, etc.)	Safety Screen and/or , Water Testing	Enzymatic / colorimetric	Many kits may also detect certain pesticides. Some are sensitive enough to use in water.
Water quality parameters	Water Testing	Variable (e.g., ion probes, colorimetric)	Kits available for a variety of common parameters.
Pesticides (OP and carbamates)	Water Testing	Immunoassays	Semi-quantitative screening method, few steps required.
VOCs and SVOCs	Water Testing	Portable GC/MS	Expensive, but expands field capability for chemicals.
Toxins (ricin, botulinum, etc.)	Water Testing	Immunoassays	Semi-quantitative screening method, few steps required.
Pathogens (*Bacillus anthracis, Francisella tularensis*, etc.)	Water Testing	Immunoassays and PCR	Pre-concentration will increase sensitivity.
Toxicity	Water Testing	Inhibition of biological activity.	Need to establish a baseline.

This list has been taken from the EPA Response Protocol Toolbox Module 3 document. It is not meant to be an exhaustive list.

5.2.1 Core Field Test Kits

The core field test equipment should include a radiation detector capable of detecting alpha, beta, and gamma radiation for field safety screening. It is used to quickly determine if ionizing radiation is present. If detected levels of radioactivity are significantly higher than normal background levels, the site would be characterized as a radiochemical hazard. A radiation detector is essential to determine whether or not the site has been contaminated with radioactive material. Typically the components that form the detector are sold separately and include a probe (e.g., a pancake Geiger-Mueller [G-M] probe) and a rate meter. Radiation detectors are an established technology, widely used by responders, simple to operate, relatively inexpensive (<$1,000), and available from a variety of vendors.

Water is an effective shield to both alpha and beta radiation, and weak forms of radiation may not penetrate water at all. Thus, a negative result from a typical pancake G-M probe (designed to detect radiation in air) does not provide assurance that the water is free of radioactive contamination. There are devices, such as sodium iodide probes, that are designed to detect radiation (gamma) in water. In the most cases, the presence of gamma radiation in a sample also suggests the possibility of alpha or beta-emitters, and the absence of a gamma-emitter usually rules it out. Water shields alpha and beta radioactivity.

Cyanide detectors should be included in the core field kit to quickly rule out, or tentatively identify, cyanide as a potential contaminant in the water. Most commercially available cyanide test kits are based on either colorimetric or ion selective electrode technologies. Several commercially available cyanide detectors were verified by EPA's ETV program in 2003, and the verification reports can be found at http://www.epa.gov/etv/.

Chlorine, pH, and conductivity detectors should be included in the core field test kit as general indicators of water quality, and deviations from established baseline values may indicate a potential problem.

Chlorine residual measurements (both free and total) should be of particular interest in distributed drinking water since the absence of a residual disinfectant is undesirable under any circumstance. Chlorine residual test kits incorporate established technologies that are widely used in the drinking water treatment industry. Chlorine residual test kits are typically based on colorimetric techniques.

Most pH instruments are based on ion-selective electrodes, and are regularly used at every utility. Some pH instruments can also measure conductivity.

Conductivity is another useful indicator of water quality changes (assuming that a baseline for conductivity has been established).

5.2.2 Expanded Field Test Kits

The equipment listed under the expanded field test kit section is intended to provide an indication of the other types of detection technology that are currently available and which might be considered for inclusion in a field test kit. These additional detection technologies can provide additional information for characterizing hazards at a particular site or increasing the range of contaminants that can be tentatively identified during rapid field testing of the water. Expanded field testing might include volatile chemicals, chemical weapons, additional water quality parameters, pathogens, toxins, and general toxicity. The technologies may be relatively simple and inexpensive, as is the case for many immunoassay test kits, or complex and expensive, as is the case for mobile gas chromatography/mass spectrometry (GC/MS) instruments. Volatile organic compound (VOC) "sniffer" devices may warrant special consideration as they are commonly used in environmental monitoring, are relatively easy to use, and can provide a rapid indication of potential volatile hazards. Many of the technologies available for pathogens and toxins are not sensitive enough for use with drinking water.

False positive or false negative results from field testing can result in inappropriate decisions with potentially significant consequences. Some utilities may choose to perform their own evaluation of a field testing technology to characterize the performance of the detector so that it can be used with confidence during a site characterization activity.

As with sample collection kits, field test kits should be maintained so that the equipment and chemical reagents are in proper working order when the kits are needed. This generally includes proper calibration of instruments, ensuring that all reagents are fresh, checking batteries, and conducting any other maintenance or operational checks recommended by the equipment manufacturer. Furthermore, it is critical to provide staff training in the actual use of any field technology that will be used to support site characterization activities in response to contamination threats. This can be accomplished through field exercises or incorporation of the field testing technology into routine monitoring activities. The latter will also provide an opportunity to develop baseline information for the monitored parameters. Such baseline data are important for interpreting field testing results in the event of a threat.

5.2.3 Examples of Field Testing Equipment

Below is a list of the examples of field testing equipment used along with brief summaries of the procedures for use, strengths, and weaknesses for the equipment types.

Turbidity

Turbidity is the measurement of how many solid particles are suspended in a given volume of water. Most turbidimeters measure the ratio of scattered light to determine how turbid the water is, and usually cost about $800–900. A sample of water is put into a cell which is then placed in the instrument to determine turbidity. A daily calibration is usually required, with a more in depth calibration periodically (e.g., quarterly). After calibration, it is best to perform the turbidity measurement at the sampling site very soon after sampling. If this is not possible, it should be done within 24 hours.

pH, Oxidation Reduction Potential, and Conductivity

Many commercial screening instruments are available that can measure pH, oxidation reduction potential (ORP), and conductivity of water samples using multiple electrodes contained in one instrument. These instruments cost about $700. Measurements are taken by filling small cells with sample, and then submerging the instruments electrodes into the sample cell. Conductivity and pH checks usually should be performed at the beginning of each day before taking the multi-parameter probe into the field. ORP electrodes rarely give false readings unless there are problems with the reference electrode. For this reason, and because calibration solutions for ORP are highly reactive and potentially hazardous, most multi-parameter probes have an electronic ORP calibration.

Cyanide and Chlorine

Cyanide and chlorine can both be detected in the field using colorimeters. These instruments usually cost about $1,000. There are separate procedures for cyanide and chlorine. The most common cyanide procedure utilizes isonicotinic acid and barbituric acid reagents that react with cyanide to form strongly absorbing compounds. The measurement is performed by mixing the water sample with specific reagents, and then placing the sample in a cell which is inserted into the colorimeter. Note that this "field" procedure reports only free cyanide and not total cyanide. Chlorine is also measured by mixing the sample with a reagent, and then placing the sample in the colorimeter.

The colorimeter should be calibrated periodically, and the instrument should be recalibrated before expiration of calibration period.

Sample Headspace VOC Measurement

A photoionization detector (PID) that can detect volatile organic compounds (VOCs) down to part per billion levels should be used to measure VOCs volatilizing from a drinking water sample or liberated from the sample by shaking or agitation. These instruments usually cost about $7,000. The PID is a nonspecific total organic vapor detector. It does not give the concentration of any single, specific chemical in the headspace. The PID measures VOCs in the range 1 to 9999 ppb. There are two calibration checks to be performed, a fresh air calibration, and a span gas calibration. Generally, the fresh air calibration or "instrument zeroing" should be done each time the instrument is turned on. Calibration of the PID with span gas is generally performed once a month. After calibration is performed the measurement of VOC concentration in a sample container headspace can be performed.

M272 Water Testing Kit for Chemical Warfare Agents

M272 kits were originally developed by the U.S. Army, but currently many commercial vendors manufacture identical kits. These kits cost about $650 each, and can analyze only about 20 samples. The testing is somewhat time-consuming, so these kits are often used only as a backup analysis if chemical warfare agents are suspected. M272 kits screen water samples for chemical warfare agents (Lewisite,

nerve agents, sulfur mustard, and cyanide) using a series of color changing chemical reactions. The test kit will also respond to less toxic substances with similar chemical properties as chemical warfare agents. Some of the substances are relatively common, so it is important to remember that a positive result on the M272 does not always mean that a chemical warfare agent is present. The lower detection limit of the tests are 20 mg/L for cyanide, 2 mg/L for mustard, 2 mg/L as arsenic for Lewisite, and 0.02 mg/L for G and V nerve agents. The test is qualitative and does not distinguish between different compounds within a class. The procedure varies depending on which test is performed.

Field Site Atmosphere Safety Screening: VOC, Oxygen, Combustibles, and Toxic Gases

Several brands of multi-gas meters are commercially available. The most common type of multi-gas meter contains detectors for volatile organic compounds (VOCs), oxygen (O_2), combustibles, and toxic gases (carbon monoxide [CO] and hydrogen sulfide [H_2S]). These instruments cost about $4,000. Their main purpose for sampling activities is to monitor the atmosphere in the vicinity of a drinking water sampling location. The instrument requires periodic calibrations or calibration checks. There are three calibration checks to be performed; fresh air calibration, multi-sensor calibration, and PID VOC calibration. Generally, the fresh air calibration or "instrument zeroing" should be done each time the instrument is turned on. Calibrations of the multi-gas sensors and the PID are generally performed once a month. After calibrations have been performed, readings can be made with the multi-gas monitor. The instrument readouts are updated about every second.

Field Site Safety Radiation Measurement and Water Sample Testing

A kit containing multiple radioactivity detectors for alpha, beta, and gamma radiation is much more sensitive than a standard G-M detector, but also costs significantly more (about $2,300). The multiple detectors will not identify the actual isotope (radioactive material element and mass) or source of radiation being detected by the instrument. However it, will tell the user whether alpha, beta, or gamma radiation is the primary emission. These detectors will respond to naturally occurring, background radiation. The background level varies by location. Radiation detection instruments should be maintained with a periodic (usually annual) factory calibration procedure, and frequent QC checks (usually with every use) with radiation check sources are also important.

Some pancake-type detectors can detect alpha, beta, or gamma radiation, whereas the Gamma Scintillation detector and Gamma Survey Detector are used only for gamma radiation. A scanning survey determines the levels of contamination in an area, whereas a point survey determines the level of contamination of a certain object (such as a bottle of water) in an area or before being shipped off site. Never contact the surface of the detector with the contaminated area, as to prevent the transfer of radiation to the detector. After each instrument is calibrated and checked, measurements can be made.

Rapid Toxicity via Chemiluminescence

Chemiluminescence water test kits, specifically arsenic tests and rapid toxicity tests via a chemiluminescence technique, referred to as "Chemiluminescence Toxicity (CT)" are good overall indicators of whether toxic chemicals are present in drinking water. The results of the chemiluminescence technique can be significantly influenced by factors such as turbidity, rust, and even normal, small, day-to-day variation in processing at the water treatment plant. Accordingly, establishing the instrumental response baseline before leaving to respond to an incident may result in data important in interpreting the test results.

The CT test should be performed last, for it can be time consuming. The luminometer for the CT test should be formally calibrated before each use. CT reagents used for calibration and for measuring samples, can be temperature sensitive. If diluted reagents (described in the instrument manual) are not refrigerated, they should be remade every 72 hours. Reagents will remain stable for 1 year if refrigerated. After calibration, measurements can be made.

5.3 Quality Assurance/Quality Control

The sampler should employ a quality assurance/quality control (QA/QC) program. The following general protocols for quality control should not be considered to be exhaustive. The program should include the collection of equipment blanks, field blanks, and field replicates, when available and as appropriate for the intended analyses. Field QA/QC requirements should be specified in sampling or site plans and analytical support laboratories should be included in the discussion as analytical QA/QC requirements will greatly impact field sampling. This program should also include the routine calibration of all field instrumentation used for rapid on-site testing. The frequency of performing these QA/QC samples is dependent on the data quality needs and objectives.

The purpose of any QA/QC protocol is to ensure that 1) the laboratory receives samples that accurately represent the conditions existing at the sample site, 2) appropriate method-specific controls are provided to the analytical laboratory, and 3) the results of the analyses are traceable to the specific sample location or event. The following QC procedures should be included, as appropriate:

- Decontamination of Sampling Equipment: The field sampling plan should address the extent of decontamination and specify the procedures to prevent sample contamination. Sampling may be performed using separate laboratory cleaned equipment for each sample location.
- Sample Container Cleanliness Requirements: Specify the level of QC for sample containers. Pre-cleaned containers meeting EPA method-specific cleanliness protocols are available from many suppliers. If pre-cleaned containers are used, the serial number and QA batch number of each container should be recorded in the Field Log Book/Notes or Field Form. If sample containers are re-used, they should be decontaminated, and field blank samples should be submitted to the laboratory to verify container cleanliness.
- Field Duplicates and Split Samples: Field duplicates are two separate samples taken from the same source and are used to determine data repeatability based on field conditions. Field duplicate samples are assigned different sample numbers, specified in the Field Log Book/Notes or on the Field Form, distinguished from the regular field samples on the chain of custody (COC) form, and often submitted blind to the laboratory to provide objectivity. The comparability of the results provides information on the repeatability of the field extraction and analytical procedures. Split samples are two or more representative portions taken from one sample and submitted to different laboratories for identical analyses to obtain information on inter-laboratory repeatability.
- Equipment Decontamination Blank: These samples provide information on the levels of cross-contamination resulting from field or laboratory sample preparation actions. The equipment blank is reagent water that is free of the analytes of interest, transported to the site, opened in the field, and poured over or through the sample collection device, collected in a sample container, and returned to the laboratory and analyzed. Equipment blanks are collected for each type of equipment used in sampling during the day. Equipment blanks are assigned sample numbers and are not distinguished from regular field samples on the COC form.
- Field Blanks: Field blanks check the cleanliness of sample containers, environmental contamination, purity of reagents, or solvents used in the field. A sample container is filled with laboratory grade reagent water, preserved, and submitted for analysis for the same parameters as the regular field sample.
- Trip Blanks: A trip blank is used when collecting VOC samples. A blank may consist of two 40-mL VOC vials filled at the laboratory with laboratory grade reagent water, transported to the sampling site, and returned to the laboratory without being opened. This blank serves as a check on sample contamination during sample transport and shipping.
- Matrix Spike/Matrix Spike Duplicates (MS/MSD): Some analytical methods require that the laboratory spike a portion of the matrix at a frequency dependent on the heterogeneity of the sample matrix, with a predetermined quantity of analytes prior to sample extraction/digestion and analysis.

For MSD, a second portion of the matrix is spiked. A spiked sample is processed and analyzed in the same manner as the sample. The results of the spike compared with the non-spike sample indicate the ability of the test procedures to repeat recovery of the analyte from the matrix and also provides a measure of the performance of the analytical method. Additional containers may be specified to provide enough material for this procedure. The sample containers are assigned the same sample number as the regular field sample and are designated MS/MSD on the COC form.

5.4 Forensic Protection and Interagency Cooperation

When collecting samples following a contamination event, sampling activities should be conducted with the cooperation of any and all agencies investigating the incident. Such cooperation will help ensure that the necessary steps are taken to preserve a potential crime scene and that proper evidence is collected and protected. Special care should be taken to avoid moving any evidence until adequate documentation is conducted and the appropriate officials are notified. The following general protocols for maintaining crime scene integrity are provided as guidance only, and should not be considered to be exhaustive. The agency or agencies responsible for site investigation should be consulted for information regarding evidence requirements.

- Collection of environmental samples is time sensitive due to the public health and sample preservation implications. Thus, collection of samples may precede collection of physical evidence, and care should be taken not to disturb the crime scene while performing these activities.
- Physical evidence should be collected in cooperation with the appropriate law enforcement agency. Specially trained teams from the law enforcement community (e.g., the HazMat Unit) are best suited (and may be required) for the collection of physical evidence from a contaminated crime scene.
- Samples collected during a criminal investigation will be monitored by the local, state, or federal authorities and may be confiscated. All actions taken within a criminal investigation should be documented. Copies of all documentation should be maintained by all agencies present.
- Special care should be taken to avoid moving or disturbing any potential physical evidence or spreading the contaminant. Substantial physical evidence of a contamination event might include discarded PPE, equipment (such as pumps and hoses), and containers with residual material.
- Samples may be considered evidence, and thus could be subject to security measures. These measures may include keeping samples under the control of designated personnel at all times. When these samples are not in the possession of designated personnel, the samples should be secured (e.g., locked in a secure area) and accessible only by designated personnel. In the field, samples may need to be locked in a vehicle.
- It may be necessary to collect duplicate samples for law enforcement and to take photographs of the samples at the site of collection as an additional form of sample documentation.
- The samplers should, when possible, take pictures of the sample location and the sample container(s) at the location where the sample was collected. If appropriate, Global Positioning System (GPS) coordinates should be obtained for sample locations. Law enforcement should be consulted for proper handling during and after taking photographs/videos to ensure integrity of the evidence. Information concerning the times and locations of photographs taken or video recorded should be noted in a site logbook. A COC form should be maintained for all film development to ensure proper handling and tracking.

  Note: Photographs or video taken in areas of high security, as well as notations and information collected regarding the area, may need to be discussed with the law enforcing agency prior to entry. Videos and pictures may not be possible in areas of high security; as a result, drawings and written descriptions may become critical documentation.
- Sample COC documentation should be initiated immediately after sample collection.

- Since analytical results may be considered to be evidence, it is important to use a qualified laboratory for analytical support and to gain written authorization to release documentation.
- Before exiting the site, samplers should practice the following:
  - Verify that the perimeter has been properly secured before leaving the site. Verify that hatches, locks, etc., are properly secured.
  - Remove all samples, equipment, and materials from the site. Remove all PPE at site perimeter and place disposable PPE and other trash into a heavy-duty plastic trash bag.
  - Verify that all samples are in a transport container and properly seal the container.
  - Ensure that all documentation has been completed.
  - Comply with any other site control measures required by participating agencies.

Section 6.0 Sample Collection Documentation

Thorough documentation of sample collection and identification is important to ensure the validity of samples and corresponding analytical results. This documentation is used to ensure that samples are representative, protected from tampering, have been collected in accordance with any applicable collection requirements, and have not been exposed to compromising conditions. Sample collection documentation should include:

- Sample identification and label
- Records of sample collection operations and procedures
- COC form

6.1 Sample Identification Numbers

Each sample consists of all the material collected from a given location at one time and of one matrix. A sample identification number that is unique for each sample should be created by the sample collector, the receiving laboratory, or a program or project manager. Sample identification numbers often consist of elements describing the sample type, matrix, location, and date and time of collection. This number is unique to each sample. It is generally included in the sample documentation, and used to identify the sample in field reports and log books, COC forms, and sample containers and labels. The number can also be used on corresponding analytical data reports or evaluations.

6.2 Sample Container Labels

Each sample container should have a label that clearly provides information identifying and describing the sample. Ideally, sample container labels should provide the following information:

- Site name
- Sample identification number
- Date and time the sample was collected
- Sampling location (e.g., site name or address)
- Container size
- Container type
- Type of sample (grab or composite)
- Analysis (Emergency response personnel may not know what analyses will be assigned to a sample. This line may not always be filled out.)
- Preservatives added, if applicable
- Dechlorination method, if applicable
- Name or initials of sample collector(s)
- Hazard warning labels (The decision to use hazard warning labels should depend on the level of risk associated with the respective incident as assessed by the utility management, and should be used at their discretion.)

All of the information on the sample label should be identical to the information on the COC form. The sample collector should be able to recollect where and when the samples were taken in case additional sampling or analysis is necessary.

To facilitate sample collection activities and ensure proper labeling, sample containers should be pre-labeled as much as is practical prior to sample collection. Sample labels should be completed with a waterproof pen and securely affixed to each sample container to identify each sample clearly. If a waterproof pen is not used, it is recommended that the sampler cover the label(s) with clear packaging tape after writing the sampling information onto the label. An example sample label is provided in Figure 6-1.

Figure 6-1. Example Sample Container Label

Site Name: _____
Sample ID Number: _____
Date: _____ Time: _____
Location: _____
Container Size: _____
Container Type: _____
Sample Type (e.g., grab, composite):
_____
Analysis: _____
Preservative: _____
Dechlorination: _____
Collected by (initials): _____

6.3 Standard Operating Procedures (SOP)

All field activities should be performed in accordance with SOPs. Utilities should prepare SOPs for the entire sampling process.

6.4 Records of Sample Collection Operations

Field report forms should include any details that might assist in the interpretation of the data/results from laboratory analyses and in the overall assessment of the contamination situation. Notes on changes to flows, coloration, field data, field conditions or unexplained flora/fauna can assist in understanding the analytical data. The "Generic Sampling Checklist" (Appendix C) provides a guideline to ensure that all information is captured during a sampling event. This includes site location, conditions, field screening that was performed, and relevant observations.

The field reporting forms (Sample Event Report Form and Field Testing Report Form) should prominently show the sample identification number, date and time of collection, sample location, and sample collector name(s). An example of a Sampling Event Report Form is provided in Appendix D, and a Field Testing Report Form is provided in Appendix E. These reports should also contain a description of the sample and any information the samplers witnessed or know about the sample, including:

- Level of PPE used
- Weather conditions
- Agencies involved in the sampling effort
- Sample amount including units
- Number of people exposed
- Symptoms of those exposed to the sample
- General conditions of exposed flora and fauna (if available)
- Field screening methods, instruments used and their results
- Name and signatures of sample collectors and others present during collection
- Contact information of samplers or agency coordinators or managers

The information contained in the field reports can be used to help the laboratory determine an appropriate screening or analytical strategy. If certain types of sample screening have been performed in the field, laboratory pre-screening may not be necessary and the results may expedite sample analysis in the laboratory. Information regarding any symptoms or environmental effects caused by the contamination

also will greatly aid sample recipients in regards to sample handling precautions and the level of PPE needed.

Photographs are important field documentation at any site where there are forensic concerns. All site photography should begin with a wide overall view and then progress to more detailed photos. Entry and exit photos should always be included. Always try to provide wide angle, medium, and close-up photographs of the relevant areas of the site. Whenever possible, include a device to measure scale in the photographs. This is best done with a ruler or tape measure displayed visibly in the photograph. Photograph logs should be maintained during the sampling event. An example of a photograph log is provided in Appendix F.

6.5 Custody Seals

Custody seals are attached to each sample over the cap to ensure the sample has not been opened or tampered with after collection. Alternately, the shipping container can be custody sealed by placing a seal over the closed opening making it impossible to open the container without ripping the seal. Two custody seals should be used on each container to maintain the integrity of the sample custody process. Custody seals contain the signature of the person responsible for packing the container and the date sealed. The tape should be sturdy to resist incidental contact but able to break when the cap/lid is removed.

6.6 Chain of Custody Form

The COC form should include any available information regarding the potential hazards associated with the sample, handling procedures required for the samples, sample identification number, sample concentration, if known, sampling location, sample date and time, sample matrix, names and signatures of the samplers, and signatures of all individuals who had custody of the samples. A COC form should remain with the samples from collection to laboratory receipt. If samples are split into two or more shipping containers, copies of the COC form should be placed with each container and directly indicate the contents.

A COC form creates an accurate written record that can be used to trace the creation, possession, and handling of the sample from the moment it is collected through analysis. A COC form is used and required, without exception, for the tracking and recording of on-site or off-site sample collection, transport and analysis. An example COC form is provided in Appendix G. A COC form accompanies each sample or group of samples as custody of the sample(s) is transferred from one custodian to another. One copy of the form is retained by the original sample collector, and the original is obtained by the receiving laboratory. If multiple laboratories are receiving a sample, individual COC forms should be submitted; each COC form represents the contents of the sample shipment. Each laboratory or facility representative who accepts an incoming sample shipment signs and dates the COC form. It is typically the laboratory or facility's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis. Sample custodians are typically responsible for initiating, maintaining, and completing COC tracking. A sample custodian is the person responsible for the custody of a sample or samples at a particular time, until custody is transferred to another person (and so documented), who then becomes the new custodian. A sample is under a person's custody if:

- It is in that person's possession,
- It is in that person's view, after being in that person's physical possession,
- It was in that person's physical possession and then he/she locked it up to prevent tampering, or
- It was in that person's physical possession and then he/she placed it in a designated and identified secure area.

Handling of COC forms during sample transportation depends on the method of transport. If the laboratory is within driving distance, the sample containers can be couriered to the laboratory. In this case, then the courier should sign off on the COC. It is important to note that common commercial carriers will not usually accept responsibility for handling and completing COC forms. This often necessitates packing the COC form in the shipping container (enclosed with other documentation in a

plastic zipper-type bag). As long as COC forms are sealed inside the shipping or transport container and the container's custody seals are intact, commercial carriers are not required to sign the COC form. Using a computer and the Web, the tracking information generated by a common carrier can be obtained if complete COC tracking is required. This documentation is attached to the COC form to show that the sample container was in the possession of the carrier during the missing COC time. This time period should be noted as "common carrier" on the COC form between the final custodian at the sample site location and laboratory receipt.

Although COC forms vary in style, format, and detail, the forms should contain the same minimal information required to identify the sample. Procedures for filling out other styles of COC forms will be very similar. It is best for the samplers to fill out the COC form provided by the party receiving the samples. The COC form provided in Appendix G assumes that the samplers do not know what analyses to request for the sample. Sample screening can influence the strategy used for sample analysis.

The following information should be provided and the following steps should be followed to complete COC forms:

- General incident information (sample owners, contact information, site name)
- Sample specific information for each sample that will be traveling in the same cooler/transport container (i.e., sample identification number, sample type [matrix], grab or composite, number and type of sample containers, and date and time sample was collected)
- Sign, date, and enter the time under "Relinquished by" entry. Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (e.g., Federal Express, UPS).
- If a common carrier is used, a copy of the airbill is to be kept for recording purposes by both the sender and recipient.
- Place the original signed copy of the COC form in a plastic zipper-type bag or other appropriate waterproof sample shipping package. Retain a copy with the field records.
- Complete carrier-required shipping papers.
- If possible, fax or scan and email a copy of the COC form and field report to the party receiving the samples.

Section 7.0 Sample Collection Procedures

Samples containing suspected biological, chemical, and radiochemical contaminants are generally collected by grab sampling. Grab samples for biological analyses (suspected and unknown contaminants) should be collected when water samples are expected to contain sufficiently high levels of a contaminant(s) for analysis and/or the presence of particulates (turbidity) precludes field concentration of the sample. If the contaminant or contaminant class is unknown, it may be necessary to provide the analytical laboratory with a complete set of samples for biological, chemical, and radiochemical analyses (see Tables 7-1 to 7-3). This requires anywhere from 125 mL to more than 100 liters of sample for the biological analyses and almost 20 liters of sample for the chemical and radiochemical analyses. Because biological contaminants present in water systems are likely to be dilute, large volumes of sample are often needed. In these cases, samplers should either collect large volumes of water for concentration in the laboratory or be prepared to concentrate large sample volumes on site.

7.1 Equipment for Biological (Pathogen and Toxin) Sampling

The following materials should be used to collect grab samples (125 mL – 10 L) from water that may contain high levels of biological contaminants and/or particulates (e.g., wastewater, brackish water, etc.).

- Sterile plastic bottles (125-mL, 1-L) with lids or sterile cubitainers (10-L)
- Sampling pole (aluminum pole with clamp to hold sampling bottle)
- Gallon-sized, self-sealing bags
- Cooler
- Chlorine test kit (Fischer Scientific 15-398-398 or equivalent)
- Disinfectant reducing agent (sodium thiosulfate solution, 10% w/v, sterile)
- pH meter or pH indicator paper (see Table 5-1)
- Turbidity meter
- Thermometer
- Pump and pump tubing

7.2 Equipment for Chemical and Radiochemical Sampling

The following materials should be used to collect grab samples (125 mL – 10 L) from water that may contain high levels of chemical or radiochemical commandants and/or particulates (e.g. wastewater, brackish water, etc.):

- Certified clean sample containers
- Graduated cylinder
- Stop watch
- Paper towels
- Storage bags for contaminated garbage/PPE
- Transporting container with ice and proper labels
- Sealing tape
- PPE (including clean, disposable nitrile gloves)
- Individually wrapped disposable bleach wipes
- Potable water (to flush any materials from skin, eyes or other surfaces that have come into contact with contaminated water)
- Tools to open taps or other sample locations
- Sampling pole (i.e., a pole attached to a sample container)
- Extra bottles for dipping
- Depth sampling devices
- pH meter or pH indicator paper (see Table 5-1)

7.3 Example of Sampling Procedures

The following are examples of common utility sampling locations, and some of the basic nuances to sampling these locations.

Sampling from Accessible Water Taps: Remove the aerator, if present; aeration would remove VOCs from the sample. Maintain a steady flow of water until the water temperature is constant, and then hold the sample container under the discharge at an angle so that the sample flows down the inside wall of the sample container. This also minimizes aeration. Fill the container(s) to the fill line (if present) or to the top of the container lip.

Sampling from Fire Hydrants: Remove the small cap from the low-pressure side of the hydrant, adjust the flow down to a manageable level for sample collection, and collect the sample as if from a tap.

Sampling from Water Towers: Allow the water to run for at least 20 to 30 minutes to clear the plumbing leading to the sample port before sampling. If there is no sampling port, then a pump should be used. Lower the pump into the water reservoir to depth(s) prescribed by the routine sampling plan or by the person in charge of the investigation.

Sampling from Underground Tanks or Reservoirs: If there is a sampling port, allow the water to run for at least 20 to 30 minutes, and then collect the sample. If there is no sampling port, use a decontaminated submersible pump and set the flow on the pump to about 500 mL/min; then collect the water samples for analysis.

7.4 General Sample Collection Guidance

When collecting samples, it is important to take many aspects of the collection process into consideration. The following sections provide additional guidance that may be helpful to the collection of samples:

- Drinking water samples to be analyzed for radiochemicals, volatile organics, metals, nitrogen, and cyanides require pH adjustment or other chemical preservation. Preservation should be performed immediately upon collection of the sample for each analysis. Sample containers with appropriate preservatives may be obtained from the analytical laboratory or other supplier. When it is necessary to perform a sample pH adjustment, the acid or base will first be added to a separate and equal volume of water collected from the same sample location. This separate sample will be tested with either pH paper or a pH meter to determine how much acid or base needs to be added. The separate sample volume can now be disposed of. Then the same amount of acid or base will be added to the investigative sample that will be sent to the laboratory. This sample will not be tested for pH, so there is no risk that the pH testing imparts contamination to the sample.
- The sample locations should be clean of all debris and attachments such as hoses or clamps, which should be removed to allow for proper collection.
- Proper PPE (e.g., outer gloves) should be worn and changed prior to each sample collection point to reduce potential carry-over contamination.
- The sampler should have all required sample containers and preservatives at the sample location prior to sampling.

7.5 Grab Sampling Procedures for Biological, Chemical, and Radiochemical Contaminants

The following guidance should be considered whenever sampling for biological, chemical, and/or radiochemical contaminants is performed:

- Determine the exact sampling point (including depth if necessary) and obtain proper sampling equipment. Depth collection requires discrete sampling equipment, such as a peristaltic pump or an

adjustable-rate, positive displacement submersible pump, that can be used to suction water from a desired depth.

Note: A peristaltic pump cannot be used if samples need to be drawn from depths greater than 25–30 vertical feet.

- When sampling from a tap, remove the aerator or screen from the tap.
- Purge the sample point prior to collection if practical. The amount of purge water necessary varies depending on the sample location (immediate valved location vs. potential static location). The purged water should be collected in containers, labeled, and stored until the analytical data is assessed.
- Adjust the flow from the tap to about a ¼ inch diameter flow (i.e., the stream width should resemble the width of a pencil). Fill the containers directly from the tap.
- If the sample is being collected from a non-tap location such as an open pit or stream, a clean 1-L glass container should be used to dip the sample and fill the sample containers. If a sample is to be collected at a specified depth, a "weighted bottle sampler" can be used to submerge a bottle to the correct depth and open it to sample at the desired location with the pull of a trigger.
- If applicable, preservation is added to each sample container without touching the sample or container to reduce cross contamination. Do not mix sample preservatives, as these chemicals are not compatible and may rapidly increase temperature, spontaneously produce toxic fumes, and/or cause additional hazards, and/or compromise sample integrity and analytical objectives.
- Open the sample container, being careful not to contaminate the inside of the cap, the inside of the bottle, or the bottle threads.
- Fill the sample containers to ¼ inch from the top and cap the bottles unless otherwise indicated (e.g., volatiles and carbamate pesticide samples).
- Wipe off the entire exterior of the container.
- Record the sample identification number, date and time of sample collection, sample location, and any other pertinent information on the sample label with a permanent marker and complete appropriate sample documentation form(s).
- Ensure that the appropriate sample label(s) is permanently or securely affixed to each sample container. It is often easier to fill out the labels and attach them to the containers before mobilizing to the field. Do not populate the date and time until sampling has occurred, as the date and time should be entered on the container label in the field. After labeling is complete, the label should be covered with clear tape so that the fresh ink will not wash off or smear.
- Complete all sample documentation and shipping forms (see Section 6.0) and pack the sample containers for shipment (Section 8.0).
- Handle all PPE and waste as contaminated waste and place into a garbage bag or other secure storage until the analytical data are assessed and proper disposal procedures are determined.

7.5.1 Volatile and Carbamate Pesticide Samples

The following additional guidance should be considered when collecting volatile and carbamate pesticide samples:

- Sample collection vials for volatiles should contain ascorbic acid (0.25–0.5 g) prior to the addition of the sample to act as a disinfectant reducing agent. Sample collection vials for carbamate pesticides should contain sodium thiosulfate (~12.5 mg) prior to the addition of the sample to act as a disinfectant reducing agent.

- Sample vials should be completely filled so that the sample forms a convex meniscus at the top prior to pH adjustments. Hydrochloric acid is then added to the volatile sample vials (typically 5–7 drops) to adjust the final volume to a pH less than 2. Potassium dihydrogen citrate is added to the carbamate pesticide sample vials to adjust the final pH to 3.8.
- When it is necessary to perform a sample pH adjustment, the amount of acid or base to be added to each sample container should be determined on a separate and equal volume of water collected from the same sample location prior to collecting the investigative sample (see first bullet of 7.4 for more detail).
- Ensure the vial contains no head space.

7.5.2 Other Chemical Contaminant Samples

After a sample has been collected, preserved, capped, and inverted for mixing, the sample should be checked to determine if pH adjustment is required. This is performed by pouring a small amount of sample into the vial or bottle and measuring the sample pH using the appropriate range (0–4, 6–10) pH indicator (Table 5.1). If pH adjustment of the sample is appropriate (see Section 7.6) adjust by drop wise addition of acid or base (as appropriate) to the sample, mix, and repeat pH measurement. Appropriate sample pH adjustments (amount of acid or base additive) should be determined on a separate and equal volume of water collected from the same sample location prior to collecting and adjusting the pH of the sample.

7.6 Biological (Pathogen and Toxin), Chemical, and Radiochemical Sample Container and Preservative Guidelines

Tables 7.1 through 7.3, listed below, summarize typical specifications contained in the analytical methods for collecting samples for each of the various contaminants described in this guidance. Listed methods are taken from the RPTB, Module 4. When sampling for unknowns, the priority is to collect unpreserved samples first.

Table 7-1. Biological (Pathogens and Toxins) Collection Guidelines

Contaminant Class/Type	Container Volume and Type	Sample Concentration Volume	Disinfection Reducing Agent	Preservative	Holding Time	Analytical Technique (or Instrumentation)
Biological Fecal coliforms, *E. coli*	125 mL to 250 mL, Plastic	None	Sodium thiosulfate (0.05% final)	$\leq 4^{\circ}C \pm 2^{\circ}C$, do not freeze	24 – 30 hours	Culture Methods (multiple-tube fermentation/ membrane filtration)
Biological (pathogens and toxins)	10 to 100 L, Plastic	250 to 500 mL (ultrafiltration)	Sodium thiosulfate (0.05% final)	Sample concentrate $\leq 10^{\circ}C$, do not freeze	TBD	PCR and immunoassay
Bacterial Pathogens	1 to 2 L, Plastic	2-4 mL (membrane filtration)	Sodium thiosulfate (0.05% final)	Sample concentrate $\leq 10^{\circ}C$, do not freeze	TBD	PCR and immunoassay

Table 7-2. Chemical Collection Guidelines

Contaminant Class/Type	Container Volume and Type	No. of Containers	Disinfection Reducing Agent	Preservative	Holding Time	Analytical Technique
Volatiles (Methods 502.2, 8021B, 524.2, 8260B)	40 mL, Glass w/ Teflon faced septa	5	Ascorbic acid (0.25–0.5 g)	1:1 HCL to pH ≤2 stored <4°C	14 days	P&T - GC/MS P&T - GC/PID/ELCD
Carbamate Pesticides (Methods 531.1, 531.2)	40 mL, Glass w/ Teflon faced septa	4	Sodium thiosulfate (12.5 mg)	Potassium dihydrogen citrate; adjust sample pH to ~3.8 stored ≤4°C	28 days	HPLC-fluorescence
Unknown organics (volatile)	40 mL, Glass w/ Teflon faced septa	5	None	None - mark samples not preserved stored ≤4°C	7 days	P&T - GC/MS
Metals/ Elements (Methods 200.7, 200.8, 200.9)	125 mL, Plastic (i.e., HPDE)	2	None	Trace metal grade nitric acid to pH ≤2	6 months	ICP-MS ICP-AES AA
Organometallic compounds	125 mL, Plastic (i.e., HPDE)	2	None	Nitric acid to pH ≤2	30 days	AA - cold vapor manual AA - cold vapor automated
Toxicity	125 mL, Glass	2	Consult manufacturer's instructions	Consult manufacturer's instructions	Consult manufacturer's instructions	Rapid toxicity assay (several vendors)
Cyanide (Methods 335.2, 335.3, 335.4)	1 L, Plastic	2	Ascorbic acid (0.06 g)	Sodium hydroxide to pH ≥ 12 stored ≤4°C	14 days	Titrimetric Spectrophotometric
Quaternary nitrogen compounds (Method 549.2)	1 L, Amber PVC or silanized glass	4	Sodium Thiosulfate (100 mg)	Sulfuric acid to pH ≤ 2 stored ≤4°C	14 Days	SPE HPLC – UV
Semi-volatiles (Methods 525.2, 8270D/3535A)	1 L, Amber w/ Teflon-lined screw caps	4	Sodium sulfite (40 – 50 mg)	6M HCl to pH ≤2 stored ≤4°C	7 days to extraction, 28 days to analysis	SPE GC/MS
Unknown organics (general)	1 L, Amber glass	4	None	None - mark samples not preserved stored ≤4°C	7 days to extraction, 28 days to analysis	Prep: SPE, SPME, micro LLE, direct aqueous injection, headspace Analysis: GC/MS, GC, HPLC, LC-MS

Contaminant Class/Type	Container Volume and Type	No. of Containers	Disinfection Reducing Agent	Preservative	Holding Time	Analytical Technique
Unknown inorganics	1 L, Plastic	2	None	None - mark samples not preserved	28 days	ICP-MS
Water quality: Chemistry	1 L, Plastic or Glass	1	None	None - mark samples not preserved	Immediate to 14 days	Conductivity, pH, alkalinity, hardness, turbidity

Preservation is recommended at the time of collection for metals; however, samples should be preserved in the laboratory within 2 weeks of collection.

When mass spectrometry methods are used during a response event, the utility should request that the laboratory report all tentatively identified compounds. This may result in the initial identification of the contaminant, even if it is not calibrated.

Table 7-3. Radiochemical Collection Guidelines

Contaminant Class/Type	Container Volume and Type	Number of Containers	Disinfection Reducing Agent	Preservative	Holding Time	Analytical Technique (or Instrumentation)
Radiochemical	1, 5-L cubitainer or 4, 1-L plastic containers	2	None	Trace metal grade nitric acid to pH $\leq$2	6 months	Gross alpha, gross beta, gamma isotopes, specific radionuclides

The analytical method and any applicable state requirements are both factors in determining the preservation method to use for samples intended for radiochemical analyses. Preservatives for radiochemicals can be added at the analytical laboratory within 5 days of collection, but the analysis cannot begin until 16 hours after acidification. This practice is not encouraged, as it delays the analysis time by as much as 16 hours. If the laboratory agrees to add the preservative, then no preservative is needed for the sample.

7.7 Biological Sample Concentration Procedures

For some sampling methods, it is necessary to concentrate the sample before testing. The following are two methods for concentrating samples so that a contaminant may be detected.

7.7.1 Ultrafiltration Procedure

The difficulty of confirming the presence/absence of a biological contaminant in a water source is that a biological warfare agent can be very dilute in a large amount of water and yet still be dangerous. A large sample volume is required to thoroughly analyze the sample for biological agents. Large volumes of water are concentrated prior to analysis using an ultrafiltration device that concentrates viruses, bacteria, toxins, and protozoa. Ultrafiltration devices will concentrate more than 10 to 100 liters of water and result in a 250-mL concentrated sample. Ultrafiltration is typically performed by a laboratory in the LRN. Certification and training is generally needed to complete these procedures, and additional guidance for this process can be obtained from the CDC or a local LRN laboratory.

7.7.2 Membrane Filtration

The use of membrane filtration for the concentration and subsequent analysis of bacterial contaminants for baseline and triggered monitoring may provide an alternate sampling approach for targeted monitoring of these agents. Slight modifications of conventional membrane filtration-culture techniques have been used to recover bacteria from the membrane for subsequent analysis by polymerase chain reaction (PCR)-

based and/or immunoassay techniques. This procedure may be used in situations where the identity of the contaminant is suspected to be of bacterial origin and/or the concentration of the bacterial contaminant is suspected to be relatively low.

The following procedure describes the recommended process for filtration of a drinking water sample and the subsequent recovery of bacterial contaminants from the membrane filter:

- Drinking water (1–2 L) is collected using the sample collection procedures in Section 7.5 in a suitable container. Reduce the disinfectant using sodium thiosulfate.
- The sample is filtered using a commercially available, sterile, disposable filtration assembly containing a 47 or 90 mm diameter, 0.45 micron pore size, mixed cellulose ester membrane filter.
- Following sample filtration, the membrane filter is removed from the filtration assembly and placed in a sterile, disposable polystyrene centrifuge tube (15 mL or 50 mL) containing 2–4 mL of a phosphate buffer saline (PBS), usually containing surfactant (0.05 %).
- The tube containing the sample filter is capped and subjected to vigorous mixing using a vortex mixer to wash bacteria from the filter.
- The filter is removed and discarded, and the filter eluate, containing bacteria (or protozoa), is processed for analysis by PCR or immunoassay.
- The concentrated sample (2–4 mL) represents a 250- to 1,000-fold concentration of the original drinking water sample.

Section 8.0 Sample Packaging and Shipment

This section describes recommended procedures for properly packaging and shipping environmental or drinking water samples collected from a sampling site. These procedures should be performed after all samples have been collected and placed in the proper containers, and if necessary, sealed in containment bags. Biohazards should be communicated through labeling and biohazards signs. Where biologically active substances and wastes are used, handled or stored, sampling personnel should use the universal biohazard symbol. The decision to use hazard warning labels should depend on the level of risk associated with the respective incident as assessed by the utility management and should be used at their discretion (e.g., how likely is this incident to be a false alarm; are there any warnings indicating that biological contaminants are present?).

The following information provides guidelines for proper packaging, labeling and shipping of sample containers. Additional information and applicability can be obtained from common carriers' Hazardous Material Center hotlines.

8.1 Packaging – Low Hazard Samples

Samples defined as "Low Hazard" should be packaged and shipped as follows:

- Samples requiring cooling preservation should be placed in a cooler/overpack with ice immediately to ensure the sample temperature does not exceed preservation requirements until analysis is performed. *Note*: Shipping containers should be sealed shut.
- Each sample bottle should be securely wrapped with bubble-wrap.
- A picnic type cooler or overpack can be used as a shipping container. Only hard plastic, impact resistant coolers in good condition should be used. In preparation for shipping samples, if present, the drain plug should be taped shut from the inside and outside, and a large, new, clean plastic bag should be used as a liner for the cooler.
- Sample containers should be placed upright and can be sealed in individual plastic water-tight sealable bags in the lined cooler in such a way that they do not touch and will not touch during shipment. Place bubble-wrap, or other suitable material that will retain its integrity if it gets wet, between each sample bag to take up any void space and to prevent the containers from touching. Place a temperature blank, if needed, in close proximity to the samples.
- As required, chemically preserved samples should be shipped to the laboratory on ice and chilled to 4°C. Some methods require chilling only to 6°C. The most common temperature to preserve biological samples is 10°C, but this may vary slightly by method. Place ice inside a double layer of water-tight sealable bags. Place the bagged ice around, among, and on top of the sample bottles to assure samples will arrive at the laboratory or screening facility at 4°C or less. The liner bag should then be secured with a twist-tie or knot.
- The paperwork (e.g., original copy of COC form) going to the laboratory should be placed inside a plastic bag. The bag should be sealed and taped to the inside of the cooler lid. The last block of the COC form should indicate the overnight carrier and the associated air bill number. A copy of the COC form should be retained with the project document files. The air bill should be filled out before the samples are handed over to the carrier.
- The cooler should be closed and taped shut with strapping tape (filament-type) by running the tape around both ends of the cooler at least two times.
- At least two signed custody seals should be placed on the cooler, one on the front and one on the side, to maintain the integrity of the sample custody process.
- A copy of the COC form and the air bill should be faxed or scanned and emailed to the receiving laboratory to assist in tracking of potentially misrouted coolers.

8.2 Shipping – Low Hazard Samples

When the cooler is handed over to an overnight carrier, a standard air bill is necessary for environmental samples. The air bill is affixed to the top of the cooler and should contain both the shipped-from and ship-to address. The shipper's copy of the air bill should be retained with project document files as evidence. The laboratory or receiving facility will document the common carrier information upon receipt. However, if the laboratory is within driving distance, the coolers can be sent via courier to the laboratory, and the courier would sign off on the COC form.

8.3 Hazardous Sample Packaging and Shipment

Hazardous samples require additional packaging and shipping guidance due to their possible adverse health effects. The following precautions should be followed when shipping these samples. The following subsections 8.3.1 through 8.3.4 are purely informational for utility personnel. These activities should be performed by a HazMat unit.

8.3.1 Packaging for Biological Samples

Packing requirements and procedures for biological samples have been developed by the CDC to facilitate safe shipment of the samples to LRN laboratories. In summary, "triple" (primary receptacle, water tight secondary packaging, and durable outer packaging) packaging is required for a biological agent of human disease or materials that are known or suspected of containing them. This packaging requires the "Infectious Substance" label on the outside of the package.

8.3.2 Packaging for Chemical Samples

If the sample has a known hazardous component, it should be packaged and shipped in accordance with any applicable regulations (e.g., 49 CFR 173.24 and 173.24a). The type of container, correct labeling, proper naming of the hazardous material, proper labeling and transportation type are required.

Samples containing high levels of contamination should be shipped as Environmental Hazardous, Class 9 or by the proper shipping name of the contaminant. The package may consist of one or more receptacles, absorbent materials and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging. Trained hazardous materials responders should make the selection of the most appropriate packaging for the specific hazard. Transporters should be contacted prior to an event to ensure authorized transportation can be made if required. Transporters typically have a license to transport Hazardous Materials.

8.3.3 Packaging for Radiochemical Samples

In the case of a triggered sampling event, radioactive materials should be packaged in accordance with any applicable regulations (e.g., as a class 7 material regulated by 49 CFR 173.401–173.476). The type of packaging is typically dependent on the nature of the radioactive hazard (specific radionuclide and amount of radioactivity), and the selection of the most appropriate packaging for the specific radioactive hazard should be made by trained hazardous materials responders.

8.3.4 Shipping

The decision to use hazard warning labels should depend on the level of risk associated with the respective incident, and whether any evidence suggests the presence of these hazard classes, as assessed by the utility management, and should be used at their discretion. All containers and outside containers should contain labeling corresponding to the particular hazard class as follows:

- Class 1 Explosives
- Class 2 Flammable and Nonflammable Gas
- Class 3 Flammable Liquid
- Class 4 Solids

- Class 5 Oxidizers and Organic Peroxides
- Class 6 Poison
- Class 7 Radioactive
- Class 8 Corrosives
- Class 9 Miscellaneous

Labeling requirements for sample and shipping containers for U.S. Department of Transportation (DOT) Hazardous Materials are described in 49 CFR 172.400. Most HazMat teams licensed to transport hazardous materials have additional requirements for labeling packages. These may include such things as:

- Shipper's address
- Recipient's address
- Proper shipping name as designated by DOT
- The sample description

Most small businesses use a commercial transporter to ship hazardous waste. These transporters can give advice on specific requirements for placarding, labeling, marking, and packaging; however, the sample owner remains responsible for compliance. For guidance on DOT regulations (49 CFR Parts 172 and 173), call the DOT hazardous materials information line at (202) 366-4488.

Section 9.0 Consequence Management

The Public Health Security and Bioterrorism Preparedness and Response Act of 2002, commonly known as the Bioterrorism Act, P.L. 107-188, amended the Safe Drinking Water Act of 1974 (SDWA, P.L. 93-523), which was amended in 1996 (P.L. 104-182) and which is codified at 42 U.S.C. Sec. 300f et seq., by adding, among other requirements, requirements for community water systems serving populations greater than 3,300 to conduct a vulnerability assessment (VA) and either prepare or revise an Emergency Response Plan (ERP) that incorporates the results of its VA. The ERP must include "plans, procedures, and identification of equipment that can be implemented or utilized in the event of a terrorist or other intentional attack" on the community water system (42 U.S.C. 300i-2(b); SDWA 81433(b)). The ERP also must include "actions, procedures, and identification of equipment which can obviate or significantly lessen the impact of terrorist attacks or other intentional actions on the public health and the safety and supply of drinking water provided to communities and individuals" (42 U.S.C. 300i-2(b); SDWA 81433(b)). For more information on the requirements for an ERP or VA, please see the following EPA guidance documents:

- Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (USEPA, 2004)
- Large Water System Emergency Response Plan Outline: Guidance to Assist Community Water Systems in Complying with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (USEPA, 2003)

The Water Security Initiative–Contamination Warning System (WS-CWS) is a response to HSPD 9, which directed EPA to demonstrate an effective system for timely detection and appropriate response to drinking water contamination incidents that would have broad application to the nation's drinking water utilities. The Consequence Management Plan (CMP) is a key element of the WS-CWS, and describes the actions that the given utility should take upon notification of a "possible" contamination incident, as determined through investigation of an alarm generated by one of the WS-CWS monitoring and surveillance components: online water quality monitoring, sampling and analysis, enhanced security monitoring, consumer complaint surveillance, and public health surveillance.

EPA has worked with a pilot utility to develop a pilot CMP that can be used as a resource for other utilities that are in the process of creating or revising their own consequence management protocols. The final CMP created by a utility should provide a decision-making framework that governs when, how, what, and who will be involved in making decisions in response to contamination threat warnings to minimize the response timeline and implement operational or public health response actions appropriately. The CMP should also include SOPs that address field sampling and analysis protocols for rapidly characterizing the nature of a contamination incident.

Utilities may want to request a copy of the pilot CMP and its appendices drafted for the pilot study taking place at the Greater Cincinnati Water Works (GCWW). It may provide an example of how the guidance in this document can be integrated into other utilities' CMPs. The RPTB should also be referenced as it served as a technical reference for the Contaminant Warning System consequence management protocol.

Consequence management refers to the process and procedures for implementing response actions that are initiated upon detection of a "possible" contamination event and continues through restoration and remediation of the system. An initial trigger indicating possible contamination could come from single or multiple monitoring and surveillance information streams. Indication of possible contamination will prompt the water utility to conduct follow-up actions such as site characterization, triggered sampling and analysis for unknown contaminants, notifications, and precautionary actions, to reduce consequences should the event be later determined credible or confirmed. As information from the initial response actions and/or additional detection information is collected from or coordinated with the water utility, additional response actions should be considered and implemented as the event is assessed for credibility. This process of continuous information collection followed by assessment and action should be

performed by the water utility and their local offices of state and federal governments. The CMP can provide the decision logic guidance designed to: mitigate the consequences, provide internal and external notifications, coordinate additional resources for response and analysis, and help manage all related emergency response requirements associated with the specifics of the incident.

Section 10.0 References

DOT. *Additional general requirements for non-bulk packagings and packages.* 49 CFR 173.24a. Revised as of October 1, 2005. http://edocket.access.gpo.gov/cfr_2007/octqtr/49cfr173.24a.htm.

DOT. *Class 7 (Radioactive) Materials*. 49 CFR 173.401-173.476. Revised as of October 1, 2005. http://www.access.gpo.gov/nara/cfr/waisidx_05/49cfr173_05.html

DOT. *Class 9 – Definitions*. 49 CFR 173.140. Revised as of October 1, 2005. http://edocket.access.gpo.gov/cfr_2005/octqtr/49cfr173.140.htm

DOT. *General labeling requirements*. 49 CFR 172.400. Revised as of October 1, 2005. http://edocket.access.gpo.gov/cfr_2005/octqtr/49cfr172.400.htm

DOT. *General requirements for packagings and packages*. 49 CFR 173.24. Revised as of October 1, 2005. http://edocket.access.gpo.gov/cfr_2005/octqtr/49cfr173.24.htm

DOT. *Purpose and use of hazardous materials table*. 49 CFR 172.101. Revised as of October 1, 2005. http://edocket.access.gpo.gov/cfr_2005/octqtr/49cfr172.101.htm

OSHA. *Hazardous waste operations and emergency response*. 29 CFR 1910.120. Revised as of July 1, 2006. http://edocket.access.gpo.gov/cfr_2006/julqtr/29cfr1910.120.htm

OSHA, *Safety and Health Topics: Confined spaces.* Content Reviewed November 3, 2008, http://www.osha.gov/SLTC/confinedspaces/index.html

OSHA, *Permit-required confined spaces*, 29 CFR 1910.146, Revised as of July 1, 2006, http://edocket.access.gpo.gov/cfr_2006/julqtr/29cfr1910.146.htm

OSHA. *Hazardous waste operations and emergency response*. 29 CFR 1926.65. Revised as of July 1, 2006. http://edocket.access.gpo.gov/cfr_2006/julqtr/29cfr1926.65.htm

U.S. Congress. *Public Health Security and Bioterrorism Preparedness and Response Act of 2002*. PL 107-188. June 2002. http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_cong_public_laws&docid=f:publ188.107.pdf

U.S. Congress. *Safe Drinking Water Act* as ammended. 42 U.S.C. Chapter 6A, Subchapter XII, §300f et seq. In Effect as of January 2003. http://www.access.gpo.gov/uscode/title42/chapter6a_subchapterxii_.html

USEPA. *Emergency Response Plan Guidance for Small and Medium Community Water Systems to Comply with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002*, April 2004. http://www.epa.gov/safewater/watersecurity/pubs/small_medium_ERP_guidance040704.pdf

USEPA, *Environmental Laboratory Compendium*, On-Line Database. https://cfint.rtpnc.epa.gov/cetl/lblogin.cfm?action=None&CFID=22136&CFTOKEN=67039796&jsessionid=2830cf8a51b12f16256fTR

USEPA. *Large Water System Emergency Response Plan Outline: Guidance to Assist Community Water Systems in Complying with the Public Health Security and Bioterrorism Preparedness and Response Act of 2002*, July 2003. http://www.epa.gov/safewater/watersecurity/pubs/erp-long-outline.pdf

USEPA. *Response Protocol Toolbox: Planning for and Responding to Drinking Water Contamination Threats and Incidents, Module 3: Site Characterization and Sampling Guide*, December 2003. Interim Final. http://cfpub.epa.gov/safewater/watersecurity/home.cfm?program_id=8#response_toolbox

USEPA, *Response Protocol Toolbox: Planning for and Responding to Drinking Water Contamination Threats and Incidents, Module 4: Analytical Guide*, December 2003. Interim Final. http://cfpub.epa.gov/safewater/watersecurity/home.cfm?program_id=8#response_toolbox

Appendix A – Acronyms and Other Abbreviations

% w/v	Percent weight over volume
AA	Atomic absorption
ACS	American Chemical Society
CDC	Centers for Disease Control and Prevention
CN^-	Cyanide
CO	Carbon monoxide
COC	Chain of custody
CFR	Code of Federal Regulations
CMI	Consult manufacturer's instructions
CT	Chemiluminescence toxicity
DRA	Disinfectant reducing agent
DOT	U.S. Department of Transportation
ELCD	Electrolytic conductivity detector
EPA	Environmental Protection Agency
ERP	Emergency response plan
ETV	Environmental Technology Verification
g	Gram
GC	Gas chromatograph
GC/MS	Gas chromatography/mass spectrometry or gas chromatograph/mass spectrometer
G-M	Geiger-Mueller
GPS	Global positioning system
H_2S	Hydrogen sulfide
HASP	Health and safety plan
HAZCAT	Hazardous characterization
HazMat	Hazardous materials
HAZWOPER	Hazardous Waste Operations and Emergency Response

HCl	Hydrochloric acid
HDPE	High density polyethylene
HMT	Hazardous materials table
HNO_3	Nitric acid
HPLC	High performance liquid chromatography
HSPD 9	Homeland Security Presidential Directive 9
H_2SO_4	Sulfuric acid
ICP-AES	Inductively coupled plasma atomic emission spectroscopy
ICP-MS	Inductively coupled plasma mass spectrometry
L	Liter
LC-MS	Liquid chromatography-mass spectrometry
LLE	Liquid-liquid extraction
LRN	Laboratory Response Network
M	Molar
mg	Milligrams
mg/L	Milligrams per liter
mL	Milliliters
mm	Millimeters
MS/MSD	Matrix spike/matrix spike duplicate
N/A	Not applicable
NaOH	Sodium hydroxide
O_2	Oxygen
OP	Organophosphate
ORP	Oxygen reduction potential
OSC	On-scene coordinator (EPA or other federal agency)
OSHA	Occupational Safety and Health Administration
P	Preservative

P&T	Purge and trap
PCR	Polymerase chain reaction
PBS	Phosphate buffer saline
PID	Photoionization detector
P.L.	Public Law
ppb	Parts per billion
PPE	Personal protective equipment
PVC	Polyvinyl chloride
QA	Quality assurance
QC	Quality control
RPTB	Response Protocol Toolbox
SDWA	Safe Drinking Water Act
SCBA	Self contained breathing apparatus
SOP	Standard operating procedure
SPE	Solid-phase extraction
SPME	Solid-phase microextraction
SVOC	Semi-volatile organic compound
TBD	To be determined
TTEP	Technology Testing Evaluation Program
UN/NA	United Nations/North American Hazardous Materials Code
U.S.C.	United States Code
UV	Ultraviolet
VA	Vulnerability assessment
VOC	Volatile organic compound

Appendix B – Glossary

Composite Sample - a sample composed of several specific aliquot collected at various sample locations and/or different points in time, which are then combined to form one composite sample.

"Confirmed" - in the context of the *threat evaluation* process, a water contamination incident is "confirmed" if the information collected over the course of the threat evaluation provides definitive evidence that the water has been contaminated.

Contamination Site - the location where a contaminant is known or suspected to have been introduced into a drinking water system. For example, a distribution system storage tank where a security breach has occurred may be designated as a suspected contamination site. The contamination site will likely be designated as an *investigation site* for the purpose of *site characterization*.

Core Field Testing - analysis performed at the investigation site for radiation, cyanide, residual chlorine, and pH. Core field testing is performed as part of *site characterization* and is composed of two elements, *field safety screen* and *rapid field testing*.

"Credible" - in the context of the *threat evaluation* process, a water contamination threat is characterized as "credible" if information collected during the threat evaluation process corroborates information from the *threat warning*.

Emergency Response Plan - a document that describes the actions that a drinking water utility would take in response to various emergencies, disasters, and other unexpected incidents.

Expanded Field Testing - analysis of water at the site of a suspected contamination incident for parameters beyond those covered under core field testing (e.g., VOCs, chemical weapons, toxins, etc).

Field Safety Screening - screening performed to detect any environmental hazards (e.g., in the air or on surfaces) that might pose a threat to the *site characterization* team. Monitoring for radioactivity as the team approaches the site is an example of field safety screening.

Grab Sample - a single sample collected at a particular time and place that represents the composition of the water, air, or soil only at that time and location.

Infectious Substance - a material known to contain, or reasonably expected to contain, a pathogen.

Investigation Site - the location where site characterization activities are performed. If a suspected *contamination site* has been identified, it will likely be designated as a primary investigation site. Additional or secondary investigation sites may also be identified due to the potential spread of a contaminant.

Pathogen - an infectious microbial organism that is capable of causing disease.

Personal protective equipment (PPE) - equipment and supplies designed to protect employees from serious injuries or diseases resulting from contact with chemical, radiochemical, biological, or other hazards. PPE includes face shields, safety glasses, goggles, laboratory coats, gloves, and respirators. Additional requirements can be determined after a site specific review for potential contaminants or other safety requirements.

"Possible" - in the context of the *threat evaluation* process, a water contamination threat is characterized as "possible" if the circumstances of the *threat warning* appear to have provided an opportunity for contamination.

Quality Assurance - an integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Control - the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the client; operational techniques and activities that are used to fulfill requirements for quality.

Rapid Field Testing - analysis of water during *site characterization* using rapid field water testing technology in an attempt to tentatively identify contaminants or unusual water quality.

Responder - Person or Persons who initially act upon an emergency scene. First responders are typically internal trained personnel, police or fire fighters. These people are generally trained in OSHA First Response.

Site Characterization - the process of collecting information from an *investigation site* to support the evaluation of a drinking water contamination threat. Site characterization activities include the site investigation, *field safety screening*, *rapid field testing* of the water, and sample collection.

Site Perimeter - the boundary of the protective action zone at the site of a suspected contamination incident.

Transporter - person or company who assumes custody of samples between packing and receipt by a certified laboratory. This person or company should sign all documentation or provide written documentation of delivery to ensure that samples have not been tampered with.

Note: A cooler can be custody sealed at the sampling site to provide evidence that it has not been opened and the samples tampered with if a commercial carrier is used.

Ultrafiltration - a filtration process for water that uses a selective membrane to preferentially separate and retain particles that are larger than the membrane's molecular weight cut-off, typically greater than 30,000 Daltons.

Appendix C – Example of a Generic Sampling Checklist

Note: this checklist is from the RPTB: Module 3 and has been changed to fit the purposes of this document.

GENERAL INFORMATION

Date: _____ **Time arrived at investigation site:** _____

Name of Site Characterization Team Leader: _____

Phone No.: _____ **Fax No.:** _____

LOCATION OF INVESTIGATION SITE

Site Name: _____

Type of facility:

- ☐ Distribution main
- ☐ Elevated storage tank
- ☐ Finished water reservoir
- ☐ Treatment plant
- ☐ Ground storage tank
- ☐ Hydrant
- ☐ Pump station
- ☐ Other
- ☐ Sampling Tap
- ☐ Service connection
- ☐ Source water

_____

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"):

☐ Biological agents ☐ HAZCAT ☐ Radiation
☐ Chemical weapons ☐ None ☐ Volatile chemicals
☐ Other_____

Report results of field safety screening in "Field Testing Report 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.

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

☐ Biological agents ☐ HAZCAT ☐ Radiation
☐ Chemical weapons ☐ None ☐ Volatile chemicals
☐ Other_____

Report results of field safety screening in "Field Testing Report 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 or stressed vegetation
- ☐ Unexplained liquids
- ☐ Unexplained dead animals
- ☐ Unexplained clouds or vapors
- ☐ Other _____

Describe signs of hazard: _____

_____

_____

_____

Unexplained or Unusual Odors:

- ☐ Bitter almond
- ☐ Irritating
- ☐ None
- ☐ New mown hay
- ☐ Pungent
- ☐ Skunky
- ☐ Sulfur
- ☐ Sweet/Fruity
- ☐ Other _____

Describe unusual odor: _____

_____

_____

Unusual Vehicles Found at the Site:

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

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

_____

_____

_____

_____

Signs of Tampering:

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

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

- ☐ Yes
- ☐ No

Describe signs of tampering: _____

_____

_____

_____

Unusual Equipment:

- ☐ Discarded PPE (e.g., gloves, masks)
- ☐ Hardware (e.g., valves, pipe)
- ☐ Lab equipment (e.g., beakers, tubing)
- ☐ None
- ☐ Pumping equipment
- ☐ Tools (e.g., wrenches, bolt cutters)
- ☐ Other _____

Describe equipment: _____

_____

_____

_____

Unusual Containers:

Type of container:

- ☐ Bottle/Jar
- ☐ Box/Bin
- ☐ Bulk container
- ☐ Drum/Barrel
- ☐ None
- ☐ Plastic bag
- ☐ Pressurized cylinder
- ☐ Test Tube
- ☐ Other _____

Condition of container:

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

Size of container: _____

Describe labeling on container: _____

_____

Describe visible contents of container: _____

_____

Rapid Field Testing of the Water

- ☐ Cyanide
- ☐ General toxicity
- ☐ None
- ☐ Chlorine Residual
- ☐ Pesticides
- ☐ pH / conductivity
- ☐ Radiation
- ☐ Other _____
- ☐ Residual disinfectant
- ☐ Toxins
- ☐ VOCs and SVOCs

Report results of rapid field testing of the water on the "Field Testing Report 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:

- ☐ Biological hazard
- ☐ Chemical hazard
- ☐ Low hazard
- ☐ Radioactive hazard

If the site is characterized as a biological, chemical, or radioactive 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 water samples.
- ☐ **Do** use the general PPE included in the emergency water sampling kit.
- ☐ **Avoid** all contact with the water, 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 or disinfection reducing agents 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.
- ☐ Complete "Sampling Event Report Form".
- ☐ Complete "Chain of Custody Form".
- ☐ 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 and inform them that the team is leaving the site.

SIGNOFF

Site Characterization Team Leader:

Print name _____

Signature _____ Date/Time: _____

Appendix D – Example of a Sampling Event Report Form

Sampling Event Report Form				
Collection Information	Date:		Site Name:	
Sample Owner and/or Collector:	Signature:			
Level of PPE Used:	Weather Conditions:			
Additional Agencies Involved:	Agency Contact Information:			
Signature of Agency Representative(s):				
Site and Sample Description				
Sample ID	**Sample Location**	**Time**	**Sample Amount (volume or weight)**	**Sample Type (Matrix)**
Matrix: DW = Drinking Water, RW = Reservoir Water, UW=Untreated Water, SD = Sediment, SL = Sludge, SO = Soil, SM = Misc. Solid Material				
Incident Details				
Describe the number of people exposed and the types of symptoms they are experiencing:				
General conditions of exposed flora and fauna (if available):				
Describe the event and reason for sample collection:				

Appendix E – Example of a Field Testing Report Form

Field Testing Report Form								
Date of Testing:		Site Name:			Field Tester:		Contact Information:	
Sample ID	Parameter	Units	Screen	Meter/Kit ID	Testing Location	Time	Results	Reference Value
Comments/Additional Information:								

Appendix F – Example of a Photograph Log

<table>
<tr><th colspan="5">Example Photograph Log</th></tr>
<tr><td colspan="4">Sample Identification Number and Location:</td><td>Photographer</td></tr>
<tr><td rowspan="3">Camera:</td><td>Video</td><td rowspan="3">If Nondigital:</td><td colspan="2">Film Type</td></tr>
<tr><td>Digital</td><td colspan="2">Film Roll Number</td></tr>
<tr><td>Nondigital</td><td colspan="2"></td></tr>
<tr><td colspan="2">Photo #</td><td colspan="2">Date and Time</td><td>Location/Description</td></tr>
<tr><td colspan="5"></td></tr>
</table>

Appendix G – Example of a Chain of Custody Form

Chain of Custody Form							
Site Name:			Sample Owner/Collector:				
Contact Information:			Signature				
Sample ID	Collection Date/Time (24 h)	Sample Location	Sample Type (Matrix)	Grab/ Composite	Preservative(s)	No./Type of Bottles	Comments
Matrix: DW = Drinking Water, RW = Reservoir Water, UW=Untreated Water, SD = Sediment, SL = Sludge, SO = Soil, SM = Misc. Solid Material							
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 by:	Date/Time				
Method of Sample Transport							
Shipper:	Phone No.:	Tracking No.:					

Attach additional pages as required.