Bioenvironmental Engineering Site Assessment I

Unit 5: Potable Water

Unit Description: During this unit, you will be stationed at a bare base being established in southwestern Chad. Your primary mission will be to ensure the potability of the base's water supply. When you're finished with your assignments, you'll be able to explain the procedures for performing a base sanitary survey, a water vulnerability assessment, and an aircraft watering point survey. You will also be able to describe actions required to disinfect new water mains, breaks, or repairs.

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Lesson 1: Base Sanitary Survey

Lesson Description

In an effort to produce more effective counterterrorism forces in the region, a bare base is being established in southwestern Chad to train African troops. You are tasked with ensuring the quantity and quality of potable water for the new base.

Upon completion of this lesson, you will be able to state procedures for performing a base sanitary survey.

Lesson Overview (Page 1 of 11)

An initial sanitary survey is needed to assess the quantity and quality of the drinking water supplied to the base.

As you learn about the base sanitary survey being conducted at Chari Air Base, you will:

- Describe the purpose of the base sanitary survey in the site assessment process.
- Recall procedures for performing a base sanitary survey

Audio Script

Narrator: Upon arrival in Chad, you work with Civil Engineering to determine the best location for tent city and establish a drinking water system using water from the nearby Chari River. When CE completes construction of the water distribution system, you will need to conduct an initial sanitary survey**.**

Chari Air Base Scenario (Page 2 of 11)

You check in with TSgt Henson from Civil Engineering (CE) to determine whether the team has completed construction of the water distribution system for Chari Air Base.

Audio Script

BE Tech: Hey, everybody's eager to get some running water going on base. How's it coming?

CE Tech: We've laid pipes from the river to tent city, and the water treatment and distribution systems are all set up**.**

BE Tech: Great! I'll get started on the base sanitary survey. We want to make sure the system can produce and distribute plenty of drinking water. In this heat, we're going to need it.

Purpose of the Base Sanitary Survey (Page 3 of 11)

A sanitary survey is an onsite review of the integrity, operation, and maintenance of a drinking water source, treatment, storage, and distribution system.

The reasons for conducting this survey are to:

- Ensure water quality is safe and reliable from a health risk perspective.
- Determine if the system has the capability to produce and distribute an adequate supply of water to meet peak demand.
- Identify deficiencies in the system so they can be corrected.
- Comply with regulatory requirements to conduct sanitary surveys.

For overseas installations such as Chari Air Base, the base sanitary survey will need to be performed according to stipulations in the Final Governing Standards (FGS) for that country. If FGS do not exist for a location, complete a sanitary survey every 3 years for systems using surface water, and every 5 years for systems using groundwater, or as warranted, including review of required water quality analyses.

In garrison settings, after the initial sanitary survey, it will need to be performed every three years for a **community water system** and every five years for a **non-community water system.**

Community Water System (CWS)

A CWS is a public water system that provides water for human consumption to at least 15 service connections used by year-round residents, or one that regularly serves at least 25 year-round residents.

Non-Community Water System (NCWS)

An NCWS is a public water system that provides water for human consumption, but does not serve the same people year-round (e.g., recreational areas).

Appraisal (Page 4 of 11)

Build a list of the purposes of the base sanitary survey.

Word Bank	List
To comply with regulatory requirements	________________________________
To comply a written record for future assessors	________________________________
To determine if the system supply can meet demand	________________________________
To ensure water quality is safe and reliable from a health risk, perspective	________________________________
To review reports from previous sanitary surveys	
To identify deficiencies so they can be corrected	

Sanitary Survey Basics (Page 5 of 11)

Everything that affects the potable water system should be evaluated for compliance with regulatory requirements, including the following elements:

- Source water.
- Water treatment.
- Distribution system.
- Potable water storage.
- Pump and pump facility.
- Monitoring, reporting, and data.
- Operations and management.

The three phases of a sanitary survey are planning, conducting, and reporting. These phases are also referred to as the pre-survey, on-site survey, and the post-survey phases.

Planning / Pre-Survey Phase (Page 6 of 11)

Everything that affects the potable water system should be evaluated for compliance with Before scheduling the base sanitary survey for the Chari Air Base, you carefully review information you have gathered about the water system during the Occupational and Environmental Health Site Assessment (OEHSA) activities you have performed so far. You review:

- Data gathered during predeployment and baseline activities.
- Plans and engineering studies generated during site identification and sectoring.
- Results from sampling you performed during site reconnaissance.
- The Conceptual Site Model (CSM).

While reviewing all the available information, you create a list of items to check in the field and questions to ask about the system.

In **subsequent sanitary surveys,** information you gather now will be used in the next pre-survey planning phase.

Subsequent Sanitary Survey Planning

When planning for base sanitary surveys that are not conducted as part of an initial assessment, you should review previous survey information, paying particular attention to past sanitary survey reports and correspondence. Take note of any previously identified problems and their solutions and, once in the field, you should verify any action or inaction regarding these problems.

In addition to past reports and correspondence, you should review:

- Water system plans.
- Water sampling results.
- Operating and maintenance reports.
- Engineering studies.

The pre-survey review also helps you plan the format of the survey and estimate how much time it may take.

Conducting / On-Site Survey Phase (Page 7 of 11)

You conduct the on-site portion of the survey and interview those in charge of managing the water system, as well as the operators and other people involved with the technical aspects of the system.

Audio Script

CE Tech: We have a gaseous chlorine process here. We don't have a leak detection system in place, but we've ordered one. It should arrive within the week. We've looked at the distribution system map and we don't have enough backflow prevention devices either. We've ordered six of them so we can address backflow issues across the installation.

Graphic: Graphic of the three parts of the sanitary survey, with the second step, "Conducting/On-Site Survey Phase" highlighted.

Conducting / On-Site Survey Phase (Page 8 of 11)

You also review all the major water system components, including treatment and disinfection, pump and lift stations, storage, and the distribution system. When conducting this visual inspection, you look for **cross-connections,** which allow for the possibility of **backflow**. There are two types of backflow:

- **Back siphonage.**
- **Back pressure.**

As the survey progresses, you discuss the deficiencies you observe with water system personnel while on-site.

Cross-connections

Cross-connections refer to any connection between a potable water system and a source containing non-potable water, or a link through which the quality of processed water could be degraded.

Backflow

Backflow is the unwanted reverse flow of water, gases, or other substances into a potable water supply system.

Back Siphonage

Back siphonage is a form of backflow which occurs due to a reduction in system pressure which causes an unwanted reversal in pressure in the water system.

Back Pressure

Back pressure is another form of backflow. It occurs when liquid is forced (by pump, elevation of piping, or pressure) into the potable water system.

Reporting / Post- Survey Phase (Page 9 of 11)

After conducting the survey, you prepare a **final written report**. The report is used to notify water system owners and operators of the system's deficiencies and to encourage them to take corrective actions where deficiencies are noted. You provide the report to CE water personnel and brief the observations to the chain of command.

The report provides a written record for future assessors, as well as information useful during emergency situations. It also provides a reference for technical assistance and training.

Final Written Report

At a minimum, the report should include the following information:

- The date the survey was conducted and by whom.
- A schematic drawing of the system and, where appropriate, photographs of key system components.
- The findings of the survey.
- The recommended improvements to identified problems.

Clarify any differences between the findings discussed at the conclusion of the on-site survey and what is included in the final report with the water system operator and management prior to the information becoming a part of the official documentation.

The written final report must have a substantial and descriptive explanation when a system is determined to have a significant problem that could affect human health. When conducting the survey inside the U.S., the report should be submitted in accordance with state requirements. Additionally, at a minimum, the report should be marked "FOR OFFICIAL USE ONLY (FOUO)".

See the Appendix for a Base Sanitary Survey Final Report Template.

Appraisal (Page 10 of 11)

Match the actions with the correct phase of the process for completing a base sanitary survey by marking the appropriate block in the table.

Action	Pre-Survey	On-Site Survey	Post-Survey
Interview those in charge of managing the water system, as well as the operators and other people involved in technical aspects.			
Notify water system owners and operators of the system's deficiencies and encourage them to take corrective actions.			
Review all available information about the system and create a list of items to check in the field and questions to ask.			

Lesson Summary (Page 11 of 11)

In this lesson, you learned the reasons for the base sanitary survey are to:

- Ensure water quality is safe and reliable from a health risk perspective.
- Determine if the system has the capability to produce and distribute an adequate supply of water to meet peak demand.
- Identify deficiencies in the system so they can be corrected.
- Comply with regulatory requirements to conduct sanitary surveys.

You also learned the three phases of a base sanitary survey. In the Planning/Pre-Survey Phase you will use information gathered during the OEHSA process and/or prior survey information to prepare for the next phase of the sanitary survey. While conducting the sanitary survey you will interview operators and other people involved with managing the water system, and you will check the condition of all major water system components. You will write the Final Report for your survey in the Reporting/Post-Survey phase.

In this lesson, you:

- Described the purpose of the base sanitary survey in the site assessment process.
- Recalled procedures for performing a base sanitary survey.

Audio Script

Narrator: You've completed the initial sanitary survey for Chari Air Base. As recommended by CE and included in your final report, the leak detection system has been installed and backflow prevention devices have been added. Now that the system is capable of providing an adequate supply of drinking water to the base, it has been brought online.

Lesson 2: Potable Water Vulnerability Assessments

Lesson Description

Ensuring the continued safety of the potable water system for Chari Air Base is paramount. Upon completion of this lesson, you will be able to explain the steps for performing water vulnerability assessments for potable water source.

Lesson Overview (Page 1 of 11)

After the quantity and quality of the water system is verified through a sanitary survey, a water vulnerability assessment (WVA) should be conducted to ensure the water's continued safety.

As you learn about the WVA being conducted at Chari Air Base, you will:

- Describe the purpose of the water vulnerability assessment in the site assessment process.
- Describe why and when a water vulnerability assessment is conducted.
- Recall procedures for performing a water vulnerability assessment.

Audio Script

Narrator: Now that the potable water system is in place and you know it is capable of producing enough drinking water to meet demand, you need to ensure that it will remain safe. It is important to evaluate each component of the system to determine which points may be vulnerable to damage and/or contamination, whether by a natural disaster, accidental means, or sabotage.

Purpose of Water Vulnerability Assessments (Page 2 of 11)

You may be tempted to believe that the base's water supply is safe because it's within the fence line, locks and barriers are in place, and the water goes through treatment processes to protect against potential contaminants. However, trusting these security measures too completely may give you a false sense of security. It is important to remain vigilant in the protection of the water supply.

A key **BE responsibility** is to conduct and maintain a comprehensive **Water Vulnerability Assessment (WVA)** of the installation water system. The purpose of conducting the WVA is to identify vulnerabilities in the water distribution system that could be subject to damage and/or contamination, whether intentional or unintentional.

The completed WVA will use a risk assessment process to assist commanders, Force Protection Officers (FPOs), and other functional risk managers in prioritizing corrective actions and allocating limited resources to best protect personnel and mission-essential operations.

BE Responsibility

Bioenvironmental Engineering (BE) performs the WVA with support from CE to identify all viable threats to the base potable water system and propose recommendations to address those threats. When the WVA is performed by a contractor, BE will oversee the process.

Water Vulnerability Assessment (WVA)

The WVA is:

- An assessment of the vulnerability of a water distribution system to damage and/or contamination, whether by an intentional act of sabotage or an unintentional act such as a natural disaster.
- An evaluation of the impact of water supply disruption on the mission.
- A proposal of corrective actions to eliminate or minimize vulnerable components of the water treatment, storage, supply, and distribution system.

Appraisal (Page 3 of 11)

Which of the following *best* describes the purpose of a Water Vulnerability Assessment (WVA)?

A To identify areas in the water distribution system that could be subject to damage and/or contamination.

B To determine if the system has the capability to produce and distribute an adequate supply of water.

C To ensure the potability of the water that is supplied to military aircraft for passengers and crews.

D To comply with regulatory requirements and ensure potable water quality meets drinking water standards.

Why and When to conduct a WVA (Page 4 of 11)

Tab: Why?

The WVA is conducted to reduce water-related risks to personnel and mission-essential operations.

Vulnerability assessments and emergency response plans are required for all Air Force drinking water systems serving over 25 people. WVAs are performed IAW the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 and the 2003 HQ USAF/SGO policy document, Air Force Policy on Potable Water Vulnerability Assessments and Emergency Response Plans.

Tab: When?

Per AFI 10-246, whenever a new water system is put into place, a baseline WVA must be performed initially and then reviewed and updated every year thereafter. You must also review any proposed modifications to the installation’s water system.

For deployed locations, a baseline WVA must be accomplished within one week of initial arrival of BE personnel. Additionally, in deployed locations, the WVA should be updated during each rotation and when significant mission changes occur.

An update should include:

- Follow-up on the status of previous findings to determine corrective action status and update of the existing report with any changes in vulnerabilities, risk, or corrective action recommendations.
- Assessment of program criteria (e.g., O&M, WCRP updates, etc.) with annual or less frequent requirements (as identified in the Protocol).
- Completion of a full physical inspection of the water system/assets (using applicable physical assessment checklists).

To generate the updated WVA report, begin with the previous report and then update the descriptive information, add new observations in place of old observations, and re-generate the document as a new report.

Appraisal (Page 5 of 11)

Which two of the following are circumstances for which you would complete a Water Vulnerability Assessment (WVA)?

A A new water system has been established.

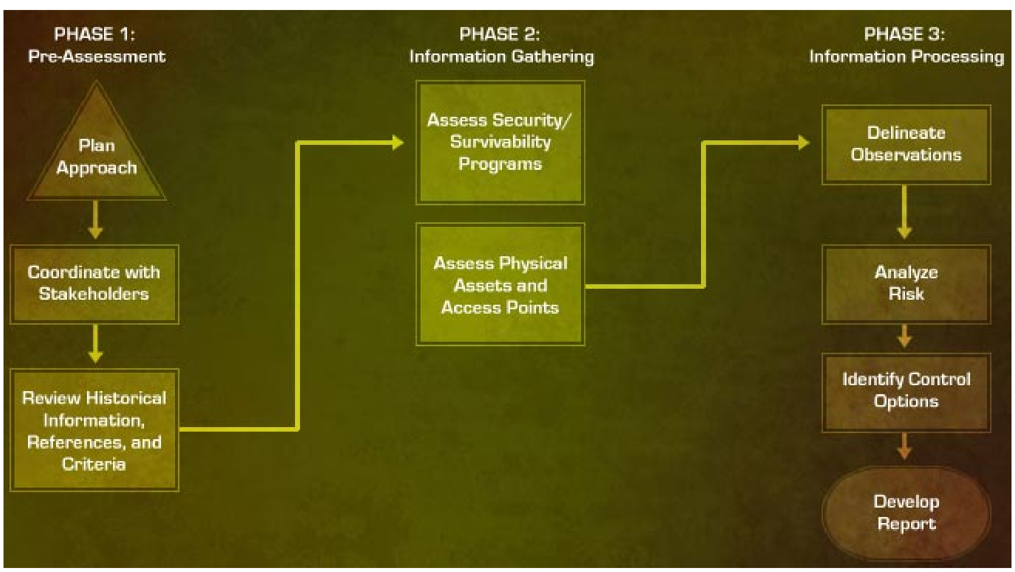
B The water system is unable to meet demand.

C The drinking water system serves 15-20 people.

D The drinking water system has been modified.

The WVA Process (Page 6 of 11)

You begin the **WVA process** at Chari Air Base, working in three phases. Phase 1 is Pre-Assessment, Phase 2 is Information Gathering, and Phase 3 is Information Processing.



WVA Process

The WVA technical process is designed to guide assessors through a methodical investigative and analytical process that integrates with and supports the AF Vulnerability Assessment Program. The WVA is performed when identifying and analyzing health threats and risks during the Health Risk Assessment (HRA) process.

WVA Phase 1: Pre-Assessment (Page 7 of 11)

You begin preparing for the WVA by planning your approach, coordinating with key stakeholders, and reviewing historical information, references, and antiterrorism (AT) criteria. The three steps of Phase 1, Pre-Assessment, are described below.

Plan Approach

Before conducting the assessment, you take time to plan your approach. During this step, you make decisions regarding the specific assessment activities to be performed and the level of effort required, which are dictated by the size and complexity of the water system.

The overall WVA technical approach is essentially the same for deployment and garrison-level locations regardless of the prevailing threat level or force protection condition (FPCON). All installations require the same conscientious effort to protect the assets of the base against damage and/or contamination.

Coordinate with Stakeholders

During the pre-planning stage, you identify **subject matter experts (SMEs)** and **WVA stakeholders** and arrange a time to interview them.

Representative from **primary stakeholder agencies** will typically be interviewed during the WVA and are invited to WVA in-briefings and/or out-briefings (when held).

Subject Matter Experts (SMEs)

SMEs are those personnel who can best answer relevant questions and provide necessary information concerning their particular functional area.

WVA Stakeholders

WVA stakeholders are those responsible for programs associated with the security and survivability of potable water supplies.

Primary Stakeholder Agencies

Primary Agency	Functional Area
CE Utilities (CEOIU)	Water Security (Owner / Operator); Water System O&M; Fire Flow Testing
CE Operations (CEO/CEOI)	O&M Engineering Support/Oversight; WCRP OPR; Liaison for non-AF Water Suppliers
CE Engineering (CEC)	Water System Design Engineering; Construction Contracts OPR
CE Fire Protection (CEF)	Fire Protection Program
Force Protection Officer (FPO)	Base AT Plan OPR; CVAMP Administrator
Critical Infrastructure Program (CIP) Manager	Base CIP Administrator

Review Historical Information, References, and Criteria

Reviewing key **historical information** provides you with an understanding of the water source(s), infrastructure, key processes, and previous or potential problem areas.

As you work through this step, you should also make sure you are familiar with the appropriate **WVA references** and have the most current versions available. Of course, you always try to stay abreast of any new references that may be applicable.

Review the most current WVA criteria checklists, which identify basic administrative and physical control requirements and best management practices. You also research applicable **local regulations or policies.**

Historical Information

As a minimum, you should review water system drawings and the most recent WVA and Sanitary Survey reports prior to field activities. Familiarization with other historical information concerning the water system and a review of the Threat Assessment report is also highly suggested.

WVA References

Some of the primary references you will use are:

- AFI 10-246, *Food and Water Protection Program.*
- AFI 48-144, *Safe Drinking Water Surveillance Program.*
- *Water Vulnerability Assessment Technical Guide.*
- DTRA, *Security Classification Guide for Vulnerability Assessments.*

Local Regulations or Policies

You need to review MAJCOM, primacy agency, and installation regulations or policies for criteria that may apply locally. For overseas locations, you need to review the Final Governing Standards (FGS), where available, or the Overseas Environmental Baseline Guidance Document (OEBGD), where FGS are not available.

WVA Phase 2: Information Gathering (Page 8 of 11)

During this part of the WVA process, you perform **field activities** and gather information in order to characterize vulnerability, risk, and control options. Below, after the explanation of field activities, is further information about the two steps in Phase 2, Information Gathering.

Field Activities

Field activities encompass a review of programs designed to support water security and survivability, and a physical assessment of water assets and access points.

Assess Security / Survivability Programs

An understanding of the system and related operations will enable you to properly plan and accomplish an effective physical assessment. Therefore, program reviews should be conducted prior to inspecting water assets and access points.

Your review of functional program areas designed to ensure water security and survivability includes:

- Water system design and integrity.
- Operations and maintenance (O&M).
- Electronic monitoring and control systems.
- Contingency response and monitoring.
- Contracting.

During this step, you also conduct the SME interviews that you arranged during the pre-planning stage.

Assess Physical Assets and Access Points

At this point in the process, you conduct a physical assessment of water assets and access points to identify vulnerabilities and to assess whether control measures adequately reduce risk. Any water assets or access points located outside the controlled perimeter or that are otherwise accessible to the public are of primary concern.

You use a physical assessment checklist to evaluate **major assets and access points.**

Major Assets and Access Points

Examples of Major Assets	Examples of Access Points
Groundwater wells	Exposed pipeline sections
Surface water source and intakes	Standpipes, fire hydrants, and other major filling points
Cisterns or catch basins	Other water main access points (e.g., BPDs, flushing and air release valves, and water main meters)
Transmissions, distribution, and fire pumps	Water trucks/tankers
Treatment units/facilities	Tactical distribution containers
Tanks, bladders, and other bulk storage reservoirs	Unit-level stored bottle water supplies
Supplemental support systems	Treatment chemical storage areas
Main isolation valves	Swimming pools
Centrally-stored bottled water supplies	

WVA Phase 2: Information Gathering (Page 9 of 11)

During this part of the process, you analyze WVA information, prepare the WVA report, and generate results in a format that **Core Vulnerability Assessment Management Program (CVAMP)** administrators can input into CVAMP. Below, after the explanation of Core Vulnerability Assessment Management Program (CVAMP), is a description of the four steps in Phase 3, Information Processing.

Core Vulnerability Assessment Management Program (CVAMP)

CVAMP is a secure web-based vulnerability database management program accessible via SIPRNet by authorized base administrators and other designated personnel. CVAMP enables AT observations to be identified, prioritized, tracked, and reported by DoD installations, Major/Unified Commands, and the Joint Staff (J3 Deputy Directorate for Antiterrorism/Homeland Defense). At the installation level, the CVAMP administrator is usually the ATO.

Delineate Observations

Once the program reviews and the physical assessment are completed, you begin delineating **observations** by identifying deficiencies indicated on the criteria checklists used during Phase 2 of the WVA.

For each observation you identify, you complete an **observation table**, which provides suggested inputs for CVAMP and enables the Antiterrorism Working Group (ATWG) to mitigate risks. Each table represents a single observation and is designed to provide only those inputs that correspond to the functional expertise of water vulnerability assessors.

Observations

An observation describes a situation in which criteria established to assess water security or survivability are deficient for the particular program or asset/access point being assessed. Observations are generally identified through the use of checklists that include detailed water-specific criteria. A criterion that is not met is considered a "deficiency," and one or more deficiencies result in an observation.

Observations are designated as one of three categories: Vulnerability, Concern, or Neutral. A vulnerability is a situation or circumstance that, if left unchanged, may result in the loss of life or damage to mission-essential resources. A concern is an existing condition that is exploitable and can indirectly lead to the death of DoD personnel and/or damage to resources. A neutral observation covers an existing condition that is neither exploitable nor can be reasonably assessed as leading to the death of DoD personnel and/or damage to resources, but is being identified to suggest considerations of modification and/or continuance.

Vulnerabilities are always classified and concerns are classified when they are associated with a specific US military site in the same portion of a report or presentation. If a concern is not designated as classified, it is designated as For Official Use Only (FOUO).

Example of an Observation Table

Observation	Discussion (Deficiencies)	Recommendations (Control Options)
Designation: Vulnerability Classification: S Description: Base water system is vulnerable to mass contamination incident due to unprotected off-base fire hydrant on transmission main entering the installation. AT Benchmark Code: IE-PLN-14 DoD AT Standards: 13, 14, 19; AFI 10-246; HQ AFCESA ETL 04-5 Repeat Observation? Yes	Classification: S One (1) hydrant on the base-dedicated portion of the purveyor's transmission line outside the base (along XXX road, North of the base): 1. Roadway is fully accessible to the public, and there are no physical barriers to restrict hydrant connections w/bulk liquid trucks or containers. 2. No established means to detect unauthorized activities or personnel at this relatively secluded access point; no established RAM (e.g., security checks), or additional security measures for elevated FPCONs.	Classification: Recommendation/ Mitigation Type

CVAMP DESCRIPTOR INPUTS				
Installation Access Controls	Symbolic Value	Population Centers	Mitigate Vulnerability With	Security Equipment/ Construction
Uncontrolled/Open Activity/Off Installation	Historical Targeting/ Importance	301 Personnel and Over		

Analyze Risk

During this step, you apply a systematic approach to estimate the risk posed by each observation. You then prioritize those risks so limited resources can be used to best protect people and permit mission-essential operations to continue without interruption. Although risks may never be completely eliminated, they can be controlled to acceptable levels.

You perform the risk analysis by following a **three-step process** for each observation.

Three-step Process for Each Observation

1. Estimate probability and severity of a worst-case water quality degradation and/or disruption incident as a result of the deficiencies cited using Risk Weighting Criteria.
2. Estimate the risk level using the ORM Risk Estimate Matrix.
3. Prioritize observations by initially sorting them in descending order based on risk level, and then by sorting those observations with similar risk levels in descending order based on severity category.

Identify Control Options

In this step, you make physical or administrative control recommendations to reduce the risk to an acceptable level. Recommendations may include the installation or implementation of new controls, or improvements in the way existing controls are maintained, operated, or managed.

Often, observations require **multiple recommendations.** The ATWG may determine to implement all or some of the recommended controls, or they may implement other options. Conversely, they may decide to accept the risk without any additional controls.

Multiple Recommendations

For example, you find a storage tank with insufficient physical security, and you recommend:

- Cutting the ladder.
- Adding fencing, padlocks, and lighting.
- Implementing owner/operator security inspections.

Develop Report

In the final step, you create the **WVA report** by consolidating all the critical information stakeholders need when making risk-reduction decisions. You classify the WVA report in accordance with the appropriate Security Classification Guide (SCG). Typically, the report is given an overall classification of Secret or Confidential and proper precautions should be taken to protect the report as such.

Include the following sections in the report:

1. **Introduction**
2. **Overview of the Potable Water System**
3. **Observations**
4. **Appendices**

WVA Report

In addition to identifying observations, estimating risk, and identifying control options, the WVA report identifies regulatory requirements and areas of non-compliance, and establishes continuity for future assessments.

Section 1.0: Introduction

The introduction is unclassified and identifies the dates of the WVA, who accomplished the assessment, and the following subsections that contain standardized information concerning the WVA which is useful to stakeholders:

- Background.
- Scope.
- Program drivers.
- Risk reduction approach.

Section 2.0: Overview of the Potable Water System

The overview provides information specific to the installation and potable water system. It includes the following subsections:

- System classification and service population.
- System owner/operator resources and responsibilities.
- System description.

Section 3.0: Observations

This section incorporates the observation tables presented in descending order by risk. The observation tables are preceded by a single page of unclassified information describing how the observations were identified, delineated, and classified, as well as other helpful information for users.

Section 4.0: Appendices

You include the following appendices in the report:

- References, Terms, and Acronyms.
- Risk Analysis.
- Water Security Program Elements.
- Representative Photographs.
- Water Vulnerability Reduction Support Materials.

Appraisal (Page 10 of 11)

Match the missing steps of the Water Vulnerability Process to their correct phase locations.

Missing Steps
Analyze Risk
Assess Security/Survivability Programs
Coordinate with Stakeholders
Develop Report

	Phase Locations
________________________	Phase 1: Pre-Assessment, step 2 (after Plan Approach).
________________________	Phase 2: Information Gathering, step 1, (before Assess Physical Assets and Access Points).
________________________	Phase 3: Information Processing, step 2 (after Delineate Observations).
________________________	Phase 3: Information Processing, step 4, (after Identify control Options).

Lesson Summary (Page 11 of 11)

You have learned that the WVA is necessary to ensure the continued safety of a drinking water system. The three phases of a WVA are Pre-Assessment, Information Gathering, and Information Processing. Each phase includes multiple steps which BE performs prior to completion of the WVA report.

In this lesson, you:

- Described the purpose of the water vulnerability assessment in the site assessment process.
- Described why and when a water vulnerability assessment is conducted.
- Recalled procedures for performing a water vulnerability assessment.

Audio Script

Narrator: You have completed the water vulnerability assessment for Chari Air Base by following the technical process. You conducted pre-assessment planning, coordinating, and reviewing, as well as information gathering and processing activities. By recommending measures to enhance security, you helped to avert potential threats associated with the weaknesses you found in the water system.

Lesson 3: Aircraft Watering Point Survey

Lesson Description

In this lesson, you will learn about performing an aircraft water point survey for the bare base in Chad. Upon completion of this lesson, you will be able to state procedures for performing and aircraft watering point survey.

Lesson Overview (Page 1 of 10)

Aircraft watering point surveys are conducted to ensure that personnel aboard military aircraft have potable water.

As you learn about aircraft watering point surveys, you will:

- Describe the purpose of aircraft watering point surveys.
- Recall procedures for performing an aircraft watering point survey.

Audio Script

Narrator: After the completion of the base sanitary survey, Civil Engineering (CE) constructed an aircraft watering point system. Now you must complete a sanitary survey of that system to ensure that it will supply potable water to the aircraft.

Purpose of Aircraft Watering Point Surveys (Page 2 of 10)

An aircraft watering point includes the facilities and equipment used to transfer water from the potable water distribution system to the aircraft. This may include water trucks, hoses, hydrants, buckets, faucets not permanently connected to the distribution system, and other items necessary to deliver potable water to the aircraft. It does not include the aircraft's internal water storage and dispensing system.

In order to ensure a potable water supply for passengers and crews aboard military aircraft, a sanitary survey of the aircraft watering point must be conducted at least once a year.

Appraisal (Page 3 of 10)

Which of the following is the purpose of an aircraft watering point survey?

A To identify areas in the water distribution system that could be subject to contamination.

B To determine if the system can produce and distribute enough water to meet demand.

C To ensure a potable water supply for passengers and crews aboard military aircraft.

D To ensure that treated water quality meets all drinking water standards and requirements.

Scenario Challenge Point (Page 4 of 10)

The water for the aircraft is supplied by the installation's potable water system that you helped establish upon arrival in Chad. Is this an approved source for the aircraft watering point?

A Yes

B No

Determining the Water Source (Page 4a of 10)

Potable water provided to military aircraft should be supplied by an approved source.

Approved sources include the following:

- A military installation potable water system managed IAW AFI 48-144.
- Public water supplies approved by a primacy agency, such as the state.
- International airport potable water supplies in countries known to have drinking water standards and sanitation requirements consistent with EPA and FDA interstate carrier drinking water regulations.
- Bottled water obtained from a supplier approved by the U.S. Army Veterinary Command or veterinary services personnel assigned to operational commands. BE may approve suppliers when no information on suppliers is available.

If an approved source is not available, **alternative sources** should be batch disinfected IAW BE recommendations.

Alternative Sources

When alternative sources are used, the systems that were serviced with the water of questionable quality should be purged, disinfected, and replenished with water from an approved source at the earliest opportunity.

Planning the Survey (Page 5 of 10)

You begin the sanitary survey of the aircraft watering point the same way you'd begin any sanitary survey – with the pre-survey phase. You review all the available data and create a list of items to consider about the system.

Some key questions you include on your list are:

- What is the specific source of water being supplied to the aircraft?
- How is the water transported from the source to the aircraft?
- Are there any possible cross-connections in the transmission of water from the source to the aircraft?
- Are there maintenance and cleaning records for the watering point, watering containers, tanks and trucks, etc.?
- How are water transport devices cleaned/sterilized?

Conducting the Survey (Page 6 of 10)

Next, you conduct the survey on-site, considering the following items:

- **Transport procedures.**
- **System maintenance.**
- **Plumbing.**
- **Non-potable outlets.**
- **Sanitation procedures.**
- **Routine handling.**
- **Test data.**

Transport Procedures

You review the procedures used to protect the water from contamination during transport from the aircraft watering point to the aircraft. At Chari Air Base, trucks are used to transport water to the aircraft, and you find that the procedures in place are acceptable.

System Maintenance

You review the maintenance and servicing programs of the aircraft watering points, water containers, trucks, and tanks. You ensure that hydrants, faucets, hoses, and servicing vehicles used to transport the water are used only for potable water, are signed appropriately, and are maintained to prevent contamination.

Plumbing

You inspect the piping system to ensure that there are no cross-connections that could contaminate the distribution system or aircraft watering point.

Non-potable Outlets

You ensure that nearby outlets providing non-potable water have fittings to readily distinguish them from those used for potable water. Each non-potable water outlet is posted with permanent signs warning that the water is unfit for drinking.

Sanitation Procedures

You review the sanitation procedures used for handling and storing bulk ice and equipment used to cool aircraft drinking water, beverages, or food because these procedures have not been evaluated by public health (PH) personnel.

Routine Handling

You observe the routine handling of potable water containers used on the aircraft to ensure that proper procedures are followed and handling does not introduce contaminants.

Test Data

When you conduct routine aircraft watering point surveys in the future, you will review all data from bacteriological testing conducted at the site since the last survey.

Reporting the Survey (Page 7 of 10)

You complete the survey by preparing a final written report IAW AFI 48-144 and providing a copy of the report to the Chief of Services, the organization that services the aircraft, and the Chief of Aerospace Medicine.

Monitoring the Aircraft Watering Point System (Page 8 of 10)

At a minimum, you must collect a bacteriological sample from the aircraft watering point every month. The frequency of monitoring will depend on the results of the sanitary survey. When trucks or tanks are used to transport water to aircraft, analyze a sample from one truck or tank at least once a month, and sample all trucks or tanks at least once each quarter.

When containers are used to transport water to aircraft, the service connections on the distribution system that provide water to the watering point should be designated as a routine monthly bacteriological sampling point.

Appraisal (Page 9 of 10)

Which item will NOT be considered when conducting an aircraft watering point survey?

Choices	**Answer**
Transport Procedures	________________________________
Non-potable Outlets	
Test Data	
Plumbing	
Non-community Water Systems	
Sanitation Procedures	
System Maintenance	

Lesson Summary (Page 10 of 10)

You have learned about the planning, conducting, and reporting stages of an aircraft watering point survey.

In this lesson, you:

- Described the purpose of aircraft watering point surveys.
- Recalled procedures for performing an aircraft watering point survey.

Audio Script

Narrator: You have completed the aircraft watering point survey and ensured that the water supply is potable for the passengers and crews of the aircraft.

Lesson 4: Disinfection of New Water Mains, Breaks, or Repairs

Lesson Description

One of your responsibilities at Chari Air Base is to help ensure the continued potability of the drinking water. Upon completion of this lesson, you will be able to describe actions required to disinfect new water mains, breaks, or repairs.

Lesson Overview (Page 1 of 9)

When a new water main is installed, or when a water main breaks and requires repair, you will be called upon to participate in disinfection procedures to ensure the water's potability. It is important for you to understand how water is disinfected to make it suitable for drinking.

When you respond to water main breaks you will:

- Recall principles of drinking water treatment.
- Recall BE responsibilities in water system repair.
- Recall disinfection requirements and procedures for breaks and repairs.
- Outline disinfection procedures for a given scenario.

Audio Script

Narrator: Drinking water is essential for all personnel, so it's important for you to understand disinfection processes that make the water potable for human consumption.

Principles of Drinking Water Disinfection (Page 2 of 9)

For water to be made potable, it must be treated to inactivate, destroy, and/or remove harmful bacteria, viruses, protozoa, and other microorganisms. The amount of treatment required depends on the initial quality of the water.

There are several treatment methods available, including the use of heat and radiation, but the most widely used method is **chemical treatment.**

The most common chemical treatment is **chlorination,** which helps prevent the water from becoming contaminated through the distribution system from the point of production to the point of use. Disinfection is normally accomplished by the addition of chlorine gas or a chlorine compound.

Chemical Treatment

The chemicals used for treating water include:

- Chlorine and chlorine compounds.
- Bromine.
- Iodine.

- Ozone (alone or in combination with other chemicals).
- Potassium permanganate.
- Oxygen.

Chlorination

The use of chlorine is desirable because no other widely available disinfectant has its combination of effectiveness, residual disinfection ability, and adaptability for potable water treatment. Chlorine is available at a reasonable cost in forms easy to apply in accurate doses. An easily detectable residual can be maintained in water, which provides extended and dependable protection.

Chlorine's disinfecting ability is due to chemical reactions with enzymes of the organisms involved. The efficiency of these reactions is affected by water temperature, pH, contact time, and type and concentrations of impurities, organisms, and chlorine compounds.

A major disadvantage of chlorine is that it reacts with certain organic compounds to form harmful trihalomethanes (such as chloroform) that are strictly limited by drinking water standards.

Calcium Hypochlorite ($CaCl_2O_2$)

Calcium hypochlorite ($CaCl_2O_2$), is a dry granular powder or tablet that contains about 65–70% available chlorine, and 3–5% lime. $CaCl_2O_2$ is preferred over other hypochlorite.

Advantages of Calcium Hypochlorite:

- Relatively stable compound
- Readily available through a variety of trade names
- Easy to handle

Disadvantages of Calcium Hypochlorite:

- Tendency to lose strength by absorbing moisture

Sodium Hypochlorite (NaOCl)

Sodium hypochlorite (NaOCl) is a clear to light yellow commercial liquid with about 5–15% available chlorine. Household bleach is NaOCl with about 5% available chlorine.

Advantages of Sodium Hypochlorite:

- Readily available

Disadvantages of Sodium Hypochlorite:

- Lower percentages of available chlorine than calcium hypochlorite
- Loses disinfection strength over time
- Alkaline and corrosive

Chlorine Gas (Cl_2)

Chlorine gas (Cl_2) is a pale yellow-green gas that is pure chlorine.

Advantages of Chlorine Gas:

- Effective
- Relatively inexpensive

Disadvantages of Chlorine Gas:

- Potential nefarious use by adversary
- Very irritating and toxic
- Taste and odor problems with high concentrations

BE Responsibilities (Page 3 of 9)

When new water mains are installed or a water main breaks and requires repair, you will work closely with CE to address disinfection requirements and procedures. BE responsibilities are shown below.

Tab: New Water Mains

- Conduct engineering reviews of scheduled repairs and modifications to assess and avert potential health hazards and to determine and conduct sampling, analysis, and monitoring (SAM) as necessary.
- Support the cross-connection and backflow prevention program by classifying health threats of potential and actual drinking water cross-connections.
- Isolate the distribution system so that contaminants may not enter other parts of the system.
- Ensure proper flushing and disinfection of the affected distribution system.

Tab: Water Main Breaks or Repairs

- Follow the base's water contingency response plan.
- Isolate the distribution system so contaminants that may enter at the location of the break do not spread to other parts of the system.
- Review plans and drawings to assess and avert potential health hazards.
- Ensure proper flushing and disinfection of the affected distribution system.
- Run bacteriological sampling analysis.
- If sampling indicates a potential public health threat or non-compliance with applicable regulations and standards, immediately implement **public notification procedures.**

Public Notification Procedures

Notifying the public of potential health threats may include sending basewide e-mail, going door-to-door, distributing flyers, and providing information to the base newspaper. First, you must notify the Medical Treatment Facility Commander, who will notify other Commanders of the situation to protect individuals in the affected areas. All public notifications must be channeled through the Public Affairs office.

Appraisal (Page 4 of 9)

Following are several questions regarding water disinfection principles and BE responsibilities related to new water mains, breaks, and repairs. Select the correct answers for each question.

Which two of the following are BE responsibilities related to *new* water mains?

A Classify health threats of potential and actual drinking water cross-connections.

B Implement public notification procedures if sampling indicates a potential public health threat.

C Ensure proper flushing and disinfection of the affected distribution system.

D Follow the base's contingency response plan.

Which two of the following are advantages of chlorination as a disinfection method?

A Formation of trihalomethanes

B Availability at a reasonable cost

C Ability to absorb moisture

D Residual disinfection ability

Which two of the following are BE responsibilities related to water main breaks and repairs?

A Review plans and drawings to assess and avert potential health hazards.

B Ensure proper flushing and disinfection of the affected distribution system.

C Classify health threats of potential and actual drinking water cross-connections.

D Conduct engineering reviews of scheduled modifications.

Which two of the following are disadvantages of using chlorine gas for disinfection?

A Toxic and irritating.

B Alkaline and corrosive.

C Loses strength by absorbing moisture.

D Taste and odor problems at high concentrations.

Chari Air Base Scenario (Page 5 of 9)

CE Utilities is calling you about a break in one of the water mains.

Audio Script

CE Utilities Tech: Hey, looks like we have a broken water main. Could you send somebody out here?

BE Tech: Sure, where's the break?

CE Utilities Tech: Behind the dining hall.

BE Tech: OK, we'll be right there.

Chari Air Base Scenario (Page 6 of 9)

You consult the map of the water system and locate the water main that CE told you about. The main is connected to a loop that supplies water to the laundry facilities and the dining hall.

The CE team has closed off this loop from the rest of the base, so the break does not affect the showers, latrines, or medical facilities.

Because only the laundry facilities and dining hall are affected by the break, emergency procedures are not necessary for the entire base. You decide it would be best to suspend water use for the laundry and dining hall until repairs are completed and disinfection has occurred. Bottled water should be used, as necessary.

You follow proper notification procedures to communicate the required actions.

Scenario Challenge Point (Page 7 of 9)

You arrive at the water main break and talk with CE about their team's progress.

Audio Script

BE Tech: How are things going?

CE Utilities Tech: We're starting repairs now. We'll follow our disinfection procedures during the repairs, and then let you know when we're ready for you to take your samples.

BE Tech: Ok, thanks.

Which two of the following are disinfection procedures performed when a water main is repaired?

A Flushing

B Aeration

C Flocculation

D Super-chlorination

Disinfection Requirements and Procedures (Page 7a of 9)

New water mains or mains that have been repaired or cut into, except those that have remained full of water under pressure during repairs, require disinfection.

IAW AFI 48-144, follow primacy regulations for emergency disinfection of water mains, water storage tanks, and water treatment facilities. If no primacy regulations exist, BE and CE will follow industry standards for disinfection (e.g., American Water Works Association (AWWA) standards).

Typically, BE and CE follow these disinfection procedures:

1. **Hypochlorite application.**
2. **Flushing.**
3. **Super-chlorination.**
4. **Sampling.**

Hypochlorite Application

When conducting repairs to underground piping, CE will first apply liberal quantities of hypochlorite to the trench to keep the danger of contamination to a minimum. The interior of all new components such as pipes or valves are also swabbed with a 5% hypochlorite solution before being installed.

Flushing

After repair, CE will flush the affected section of the system to remove dirt and debris until all discolored water is eliminated.

Super-chlorination

Typically during the super-chlorination process, CE adds a chlorine concentration of 50 ppm to the affected section of the system. After a 24-hour period has passed following super-chlorination, a chlorine residual of at least 25 ppm should remain in the affected area to ensure that proper disinfection is occurring.

If the break occurs in an essential water main, the procedure may be changed to add 300 ppm for a period of 15 minutes, per AWWA C651-05.

Sampling

Next, CE will flush the lines again with clean water until the residual chlorine level returns to normal.

You will collect bacteriological samples as well as pH and chlorine samples downstream of the repair, or, if you don't know the direction of flow, take samples on each side of the repair. The goals of the sampling are to ensure chlorine levels are back to normal (based on typical levels in the system) and to document the effectiveness of the disinfection before the water is put into use again. The samples must indicate that the chlorine level is acceptable and no coliform bacteria are present.

In some situations, where fire protection or sanitation concerns dictate, service may be restored immediately provided that a precautionary boil water notice is issued until you have confirmed drinking water safety based on bacteriological analysis results.

Scenario Challenge Point (Page 8 of 9)

After CE has finished repairing the water main break, you collect bacteriological, pH, and chlorine samples. What two criteria must be met before water can be restored to the dining hall?

A No coliform bacteria are present.

B Minimal coliform bacteria are present.

C Residual chlorine level of 25 ppm remains.

D Residual chlorine level is back to normal.

Lesson Summary (Page 9 of 9)

You have learned how drinking water is disinfected and what your responsibilities are regarding disinfection of new water mains, breaks, and repairs.

In this lesson, you:

- Recalled principles of drinking water disinfection.
- Recalled BE responsibilities in water system repair.
- Recalled disinfection requirements and procedures for breaks and repairs.
- Outlined disinfection procedures for a given scenario.

Audio Script

Narrator: When sampling indicates that the water is free of coliform bacteria and the residual chlorine levels are back to normal, the water is restored to the dining hall.

You have completed the disinfection procedures and ensured the potability of water on Chari Air Base.

Resources

- AFI 10-246, Food Water and Protections Program
- AFI 48-144, Safe Drinking Water Surveillance Program
- DoD 4715.056, Overseas Environmental Guidance Document
- ANSI/AWWA C651-05, *Disinfecting Water Mains*, 1 Jun 05.
- Country-specific Final Governing Standards
- DTRA, *Security Classification Guide for Vulnerability Assessments*
- HQ USAF/SGO Memorandum, *Air Force Policy on Potable Water Vulnerability Assessments and Emergency Response Plan*
- USAFSAM WVA Checklists
- U.S. EPA, Ground Water Rule, 71 FR 65573
- U.S. EPA, Interim Enhanced Surface Water Treatment Rule, 63 FR 69477
- USAFSAM Water Vulnerability Assessment Technical Guide
- Technical Bulletin Medical 577, *Sanitary Control and Surveillance of Field Water Supplies*
- EPA: Ground Water and Drinking Water
- VETCOME: Approved Sources

Answer Key: Appraisals / Scenario Challenge Points

Lesson 1: Base Sanitary Survey

Page 4 of 11

Build a list of the purposes of the base sanitary survey.

Word Bank	List
To comply with regulatory requirements	**To comply with regulatory requirements**
To comply a written record for future assessors	**To determine if the system supply can meet demand**
To determine if the system supply can meet demand	**To ensure water quality is safe and reliable from a health risk, perspective**
To ensure water quality is safe and reliable from a health risk, perspective	**To identify deficiencies so they can be corrected**
To review reports from previous sanitary surveys	
To identify deficiencies so they can be corrected	

Rationale: The purposes of a base sanitary survey are to comply with regulatory requirements to conduct sanitary surveys, to determine if the system supply can meet the peak demand, to ensure water quality is safe and reliable from a health risk perspective, and to identify deficiencies so they can be corrected. Reviewing reports and providing a record are parts of the process, but not reasons for conducting the survey.

Page 10 of 11

Match the actions with the correct phase of the process for completing a base sanitary survey by marking the appropriate block in the table.

Action	Pre-Survey	On-Site Survey	Post-Survey
Interview those in charge of managing the water system, as well as the operators and other people involved in technical aspects.		x	
Notify water system owners and operators of the system's deficiencies and encourage them to take corrective actions.			x
Review all available information about the system and create a list of items to check in the field and questions to ask.	x		

Rationale: You review information and create a checklist before beginning the survey, conduct interviews while you're on-site, and notify owners and operators of deficiencies in the final report prepared in the post-survey phase.

Lesson 2: Potable Water Vulnerability Assessments

Page 3 of 11

Which of the following *best* describes the purpose of a Water Vulnerability Assessment (WVA)?

A **To identify areas in the water distribution system that could be subject to damage and/or contamination.**

Rationale: The purpose for conducting a WVA is to identify areas in the water distribution system that could be subject to damage and/or contamination. The base sanitary survey is performed to determine the water system's capabilities and to comply with regulations to ensure that potable water quality meets drinking water standards. The aircraft watering point survey is performed to ensure the potability of the water supplied to military aircraft for passengers and crews.

Page 5 of 11

Which two of the following are circumstances for which you would complete a Water Vulnerability Assessment (WVA)?

A **A new water system has been established.**

D **The drinking water system has been modified.**

Rationale: A WVA should be conducted when a new water system is put into place. It should be reviewed and updated on an annual basis thereafter or once per rotation in a deployed environment. A WVA should also be conducted if modifications are made to the water system.

Page 10 of 11

Match the missing steps of the Water Vulnerability Process to their correct phase locations.

Missing Steps	Phase Locations
Coordinate with Stakeholders	Phase 1: Pre-Assessment, step 2 (after Plan Approach).
Assess Security/Survivability Programs	Phase 2: Information Gathering, step 1, (before Assess Physical Assets and Access Points).
Analyze Risk	Phase 3: Information Processing, step 2 (after Delineate Observations).
Develop Report	Phase 3: Information Processing, step 4, (after Identify control Options).

Lesson 3: Aircraft Watering Point Survey

Page 3 of 10

Which of the following is the purpose of an aircraft watering point survey?

C To ensure a potable water supply for passengers and crews aboard military aircraft.

Rationale: The purpose for conducting an aircraft watering point survey is to ensure a potable water supply for passengers and crews aboard military aircraft. Identifying areas that could be subject to contamination is the purpose of a Water Vulnerability Assessment (WVA). Determining the capabilities of a water system and ensuring compliance with standards are purposes of a base sanitary survey.

Page 4 of 10

The water for the aircraft is supplied by the installation's potable water system that you helped establish upon arrival in Chad. Is this an approved source for the aircraft watering point?

A Yes

Rationale: The purpose A military installation potable water system managed in accordance with AFI 48-144 is an approved source of potable water for military aircraft.

Page 9 of 10

Which item will NOT be considered when conducting an aircraft watering point survey?

Non-community Water Systems

Rationale: Non-community water systems have no effect on aircraft watering point surveys.

Lesson 4: Disinfection of New Water Mains, Breaks, or Repairs

Page 4 of 9

Following are several questions regarding water disinfection principles and BE responsibilities related to new water mains, breaks, and repairs.

Which two of the following are BE responsibilities related to *new* water mains?

A **Classify health threats of potential and actual drinking water cross-connections.**

C **Ensure proper flushing and disinfection of the affected distribution system.**

Which two of the following are advantages of chlorination as a disinfection method?

B **Availability at a reasonable cost**

D **Residual disinfection ability**

Which two of the following are BE responsibilities related to water main breaks and repairs?

A **Review plans and drawings to assess and avert potential health hazards.**

B **Ensure proper flushing and disinfection of the affected distribution system.**

Which two of the following are disadvantages of using chlorine gas for disinfection?

A **Toxic and irritating.**

D **Taste and odor problems at high concentrations.**

Page 7 of 9

Which two of the following are disinfection procedures performed when a water main is repaired?

A Flushing

D Super-chlorination

Rationale: Whenever a water main has been repaired or cut into, disinfection procedures involve applying hypochlorite, flushing the lines, super-chlorinating the water, and collecting Bacteriological samples.

Page 8 of 9

After CE has finished repairing the water main break, you collect bacteriological, pH, and chlorine samples. What two criteria must be met before water can be restored to the dining hall?

A No coliform bacteria are present.

D Residual chlorine level is back to normal.

Rationale: Before water can be restored to the dining hall, it must contain no coliform bacteria and the residual chlorine level must be within normal parameters.

Course Glossary

Acronyms

AAR
After Action Report

ACADA
Automatic Chemical Agent Detection Alarm

AFI
Air Force Instruction

AFMIC
Armed Forces Medical Intelligence Center

AFMS
Air Force Medical Service

AFMSA
Air Force Medical Support Agency

AFOSH
Air Force Occupational and Environmental Safety, Fire Prevention and Health

AFRRAD
Air Force Radiation and Radioactive Recycling and Disposal

ALARA
As Low As Reasonably Achievable

AMC
Aerospace Medicine Council

amu
Atomic Mass Unit

AO
Area of Operations

AOC
Area of Concern

AOR
Area of Responsibility

BE
Bioenvironmental Engineering Flight

CBRN
Chemical, Biological, Radiological, Nuclear

CE
Civil Engineering

COA
Course of Action

COC
Contaminant of Concern or Constituent of Concern

CONUS
Continental United States

CSM
Conceptual Site Model

CV
Coefficient of Variability

DIA
Defense Intelligence Agency

DF
Duty Factor

DOD
Department of Defense

DOE
Department of Energy

DOS
Department of State

DOT
Department of Transportation

D_{pel}
Estimated Hazard Distance

DRI
Direct Reading Instruments

EHF
Extremely High Frequency (Occurs between 30 and 300 GHz)

EMR
Electromagnetic Radiation

EPA
Environmental Protection Agency

EPD
Electronic Personal Dosimeters

FPWG
Force Protection Working Group

G_{abs}
Absolute Gain

HF
High Frequency (Occurs between 3 and 30 MHz)

HRA
Health Risk Assessment

HRE
Health Risk Estimate

HRM
Health Risk Management

IATA
International Air Transport Association

IPE
Individual Protection Equipment

LCL
Lower Confidence Limits

LET
Linear Energy Transfer

LF
Low Frequency (Occurs between 30 and 300 kHz)

MAJCOM
Major Command

MEDIC CD
Medical Environmental Disease Intelligence and Countermeasure CD

MIO
Medical Intelligence Officer

MF
Medium Frequency (Occurs between 300 and 3,000 kHz (3MHz))

MOPP
Mission Oriented Protection Posture

MPE
Maximum Permissible Exposure

MSP
Mission Support Plan

NFB
Near-Field Boundary

NGIC
National Ground Intelligence Center

NHZ
Nominal Hazard Zone

NIOSH
National Institute for Occupational Safety and Health

NOHD
Nominal Ocular Hazard Distance

NRC
Nuclear Regulatory Commission

OCONUS
Outside the Continental United States

OEH
Occupational and Environmental Health

OEHSA
Occupational and Environmental Health Site Assessment

OEL
Occupational Exposure Limits

OEL-C
Occupational Exposure Limits-Ceiling

OEL-STEL
Occupational Exposure Limits-Short Term Exposure Limit

OEL-TWA
Occupational Exposure Limits-Time Weighted Average

OH
Occupational Health

ORM
Operational Risk Management

OSHA
Occupational Safety and Health Administration

OSI
Office of Special Investigation

P_{avg}
Average Power

PEL
Permissible Exposure Limit

PH
Public Health

P_p
Peak Power

PPBS
Planning, Programming and Budgeting System

PPE
Personal Protective Equipment

PPM
Parts per million

PRF
Pulse Repetition Frequency

PW
Pulse Width

RFR
Radio Frequency Radiation

RSO
Radiation Safety Officer

S
Main-Beam Power Density

SAR
Specific Absorption Rate

S_{avg}
Power Density Average

SEG
Similar Exposure Group

SHF
Super High Frequency (Occurs between 3 and 30 GHz)

SLM
Sound Level Meter

S_{max}
Maximum Power Density

SPL
Sound Pressure Level

TLD
Thermoluminescent Dosimeters

TWG
Threat Working Group

UHF
Ultra High Frequency (Occurs between 300 and 3,000 MHz)

USACHPPM
United States Army Center for Health Promotion and Preventive Medicine

UTC
Unit Type Code

VA
Vulnerability Assessments

VHF
Very High Frequency (Occurs between 30 and 300 MHz)

VLF
Very Low Frequency (Occurs between 3 and 30 kHz)

Definitions

Absolute Gain (G_{abs})
The ratio of the power that would be required at the input of an ideal isotropic radiator to the power actually supplied to the given antenna, to produce the same radiant intensity in the far-field region.

Action Level
An airborne exposure level that dictates active air monitoring, medical monitoring, and employee training. The Action Level is one-half the Occupational Exposure Limit for time-weighted average (OEL-TWA) exposures, except where 29 CFR 1910 Subpart Z designates a different concentration or where the statistical variability of sample results indicates that a lower fraction of the OEL should be used as the Action Level.

Activity
The number of disintegrations or transformations of radioactive material per unit of time (usually expressed in seconds).

Antenna
The point on an RFR emitter where RFR energy radiates into free space.

Asbestos
A natural material that is made of tiny threads or fibers. The fibers can enter the lungs as a person breathes. Asbestos can cause many diseases, including cancer. Asbestos was used to insulate houses from heat and cold. It has also been used in car brakes and for other purposes. Some old houses still have asbestos in their walls or ceilings.

Asbestosis
A lung disease caused by breathing asbestos fibers over a period of time. The fibers eventually scar the lungs and make breathing difficult. Symptoms are similar to asthma.

Atomic Mass Unit (amu)
Approximately equal to the mass of a proton or a neutron and is used to describe the mass of an atom.

Becquerel (Bq)
The international standard for the unit of measurement for activity.

Breathing Zone
The location where exposure is measured in air sampling. The breathing zone is located forward of the shoulders within 9 inches of the nose and mouth. Breathing zone measurements are taken beneath a welder's helmet or face piece but outside of any respiratory protective devices.

Bremsstrahlung
An interaction that causes a form of x-ray production in which high-speed beta particles penetrate the electron cloud and interact with the nucleus.

Carcinogens
Hazardous materials that stimulate the formation of cancer.

Ceiling Limit (OEL-C)
The limit for an employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, the OEL-C will be evaluated during the worst-case 15-minute exposure period.

Chrysotile
The most common asbestos type. Chrysotile asbestos fibrils may appear crinkled, like permed or damaged hair, under plane-polarized light.

Coefficient of Variation (CV)
For an air sampling method, the CV is the standard deviation of the sampling and analytical error divided by the mean of the sample results. The CV is used to calculate the confidence limits for sampling. OSHA uses the term sampling and analytical error (SAE) to account for the total variation or error in the method.

Compton Scatter
A gamma/x-ray interaction which takes place between a photon and an outer electron where the photon has more energy than the electron can accept, so it imparts only a portion of its energy to the electron.

Conceptual Site Model (CSM)
Articulates the health threats and exposure pathways and begins when data or information is gathered during Predeployment and Baseline Activities.

Confidence Limits
The upper confidence limit (UCL) and lower confidence limit (LCL) are the boundaries for a single sample or a series of samples that have a specified probability (usually 95 percent) of including the true value of the level of exposure.

Controlled Environments
An area where personnel are aware of the potential for RFR exposures associated with their employment or duties.

Counts per minute (cpm)
The amount of radiation detected by an instrument each minute.

Diffuse Reflection
Situations where a laser beam is bounced off a dull or uneven surface that breaks the beam apart.

Disintegration per minute (dpm)
The number of atoms that decay or transform in a given amount of material per minute.

Disintegration per second (dps)
The number of atoms that decay or transform in a given amount of material per second.

Dose
The quantity of radiation absorbed.

Dose Rate
The quantity of radiation absorbed per unit of time.

Duty Factor (DF)
A unit-less number which only applies to pulsed wave systems that describes the ratio of time an RFR emitter is on to the total operating time.

Electromagnetic Radiation (EMR)
Waves of energy that can travel through space and matter.

Electromagnetic Spectrum
The entire frequency range of electromagnetic waves, or wave radiation.

Energy
The ability to do work.

Estimated Hazard Distance (D_{pel})
The distance from the antenna to the point where the power density equals the permissible exposure limit (PEL).

Excitation
Occurs when there is an addition of energy to an atomic system, changing the atom from a "ground" state to an excited state.

Exposure
Exposure occurs when an employee is subjected to a hazardous material through any of these routes: inhalation, ingestion, skin contact, or skin absorption. Airborne exposures are specified as the duration and concentration of hazardous materials measured in the breathing zone of an individual worker without regard for personal protective equipment used by the worker.

Exposure Assessment
An exposure assessment is a process of estimating or calculating potential exposure of a health threat for an individual or population at risk. The assessment includes professional judgment, calculations based on estimates or models, actual measurements, collection and analysis of samples, and statistical evaluation.

Exposure Pathway
Includes a threat and the opportunity for the population to come into contact with the threat.

f
Algebraic express that means, "a function of."

Fission
The splitting of the nucleus of an atom into nuclei of lighter atoms, accompanied by the release of energy.

Frequency
A value of how often a wavelength cycle occurs in a second.

Gain
The antenna's ability to concentrate its energy in a certain direction.

Hazardous materials
Materials that pose a hazard and require a Material Safety Data Sheet as defined in FED-STD 313, Federal Standard, Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Governmental Activities.

Health Risk
The health risk equals threat "combined with" vulnerability (health risk = (threat) + (vulnerability)). A health risk is an identified health threat and the vulnerability of the population at risk of coming into contact (i.e., completion of an exposure pathway) with the health threat.

Health Risk Assessment (HRA)
Health risk assessment is the process of identifying and analyzing or evaluating (exposure and toxicity assessments) OEH threats in populations or at locations over time (HRA = f [(health risk) "+" (HRE) "+" (COA)]). The HRA "product" is the validated health threat, qualified by the HRE, and the COA which includes overall mission impact, recommended control options, associated uncertainties, risk mitigation estimate(s), and a cost-benefit analysis if applicable.

Health Risk Communication
Health risk communication is the process of effectively communicating potential health effects, outcomes, and control measures to all stakeholders (i.e., commanders, supervisors, AF personnel, military, families, and the public). It provides detailed information about the HRA and should occur throughout the HRA process.

Health Risk Estimate (HRE)
Health Risk Estimate is the probability and severity of loss from exposure to the health threat. The HRE is a function of probability and severity when either or both increase the Health Risk Estimate increases. The HRE is also referred to as a health risk level.

Health Risk Management (HRM)
Health risk management is a decision-making process to evaluate and select COAs, minimize OEH risks, and maximize benefits for operations and missions. HRM is the health component of the ORM process and health risk management recommendations and decisions are integrated into the commander's ORM decision-making.

Health Threat
A health threat is a potential or actual condition that can cause short or long-term injury, illness, or death to personnel. A health threat can be occupational or environmental in origin; internal or external to the installation; or continuous, intermittent, or transient; and includes enemy capability and intent.

Ionization
Occurs when beta particles interact with nearby atoms causing an electron to be removed, creating an ion pair.

Ionizing Radiation
Radiation which has enough energy to change the atomic structure of matter.

Isotope
Elements with the same number of protons, but a different number of neutrons.

Kinetic Energy
Energy of motion.

Laser
Light amplification by stimulated emission of radiation.

Linear Energy Transfer (LET)
Energy lost by particles along the path through which they are traveling.

Mass
Description of how much matter there is present in an object.

Maximum Permissible Exposure (MPE)
The level of laser radiation to which a person may be exposed without hazardous effects or adverse biological changes in the eyes or skin.

Mesothelioma
Cancer that generally occurs in the chest, abdominal region, and areas surrounding the heart. It is typically associated with exposure to asbestos.

n
Algebraic express that means, "Number of samples."

Nominal Hazard Zone (NHZ)
The area within a laser workplace in which the exposure from direct beam, specular reflection, and diffuse reflection could exceed the Maximum Permissible Exposure (MPE).

Nominal Ocular Hazard Distance (NOHD)
The distance along the laser beam beyond which the exposure is not expected to exceed the appropriate Maximum Permissible Exposure (MPE).

Non-aqueous Phase Liquids (NAPLs)
Non-aqueous phase liquids are liquids that are sparingly soluble in water. Because they do not mix with water, they form a separate phase. For example, oil is an NAPL because it does not mix with water, and oil and water in a glass will separate into two separate phases. NAPLs can be lighter than water (LNAPL) or denser than water (DNAPL). Hydrocarbons, such as oil and gasoline, and chlorinated solvents, such as trichloroethylene, are examples of NAPLs.

Non-ionizing Radiation
Radiation which does not have enough energy to change the atomic structure of matter.

Nuclear Stability
Describes the certain combinations of neutrons and protons within a nucleus of an atom which are required for that atom to be considered stable.

Occupational and Environmental Health Site Assessment (OEHSA)
The key operational health tool for producing data or information used for health risk assessments (HRA) and to satisfy Occupational and Environmental Health (OEH) surveillance requirements.

Occupational Exposure Limit (OEL)
The limit for the airborne concentrations of a specified substance for a specified time. Employees will not be exposed to concentrations greater than the OEL. The term OEL includes all OEL-TWAs, OEL-STELs, OEL-Cs, and acceptable ceiling concentrations, that apply to a specific substance. For each hazardous material, the OELs are the most stringent limits found in the latest edition of the TLV Booklet published annually by the American Conference of Government Industrial Hygienists, in 29 CFR 1910 Subpart Z, and in AFOSH Standards for specific substances. OELs apply to occupational exposures for each individual worker for a single 8-hour work shift except where 29 CFR 1910 Subpart Z allows 40-hour averages. Exposure during work shifts that exceed 8 hours must be adjusted before applying an OEL.

Operational Risk Management (ORM)
A systematic process of identifying hazards, assessing risk, analyzing risk control options and measures, making control decisions, implementing control decisions, accepting residual risks, and supervising/reviewing the activity for effectiveness.

Optical Cavity
The component that houses the laser.

Pair Production
Occurs when a photon disappears in the vicinity of a nucleus, and an electron and positron appear in its place.

Particulate Radiation
Fast-moving atomic or subatomic particles that may be charged positively or negatively or not at all.

Peak Power (P_p)
The maximum power density during the on time for a pulsed wave system.

Permissible Environment
Operational environment in which host country military and law enforcement agencies have control as well as the intent and capability to assist operations that a unit intends to conduct.

Permissible Exposure Limit (PEL)
The value to which an individual may be exposed without exhibiting damaging biological effects and is based on the emitter's frequency.

Photochemical Reaction
A chemical reaction which is induced by the absorption of energy in the form of visible, infrared, or ultraviolet radiation.

Photoelectric Effect
An "all or none" energy loss where gamma rays impart all of their energy into an electron.

Pleural Effusion:
When too much fluid collects between the lining of the lung and the lining of the inside wall of the chest.

Positron
Created when a proton changes into a neutron and a positron because there are too many protons in the n:p ratio.

Potential Energy
Energy of position.

Pulse Repetition Frequency (PRF)
The number of times the signal is on per unit of time.

Pulse Width (PW)
The length of time the signal is on for a pulsed wave system.

Quality Factor (Q)
A dimensionless quantity assigned to each type of radiation that allows doses to be normalized in relation to each other.

Radiation
Energy in the form of waves or moving subatomic particles emitted by an atom or other body as it changes from a higher energy state to a lower energy state.

Radiation Absorbed Dose (RAD)
The amount of radiation absorbed by the tissue.

Radioactive Decay
The spontaneous disintegration or transformation of an atom in an attempt by that atom to reach a stable state.

Radioactive Material (RAM)
Material which contains unstable (radioactive) atoms that give off radiation as they decay or transform.

Radioactivity
The spontaneous emission of matter or energy from the nucleus of an unstable atom.

Radioisotopes
Unstable isotopes that, in an attempt to become a stable atom, emit energy in the form of radiation.

Regulated Area
An area under the supervisor's control where entry and exit are restricted and controlled to prevent exposure to hazards. An area shall be established when a requirement in 29 CFR 1910 or 29 CFR 1926 exists, or when BE determines that employees entering the area might be exposed to a hazard unless access is controlled.

Short Term Exposure Limit (OEL- STEL)
A time-weighted exposure for a 15 minute (or shorter) period which shall not be exceeded during the work day. The definition of STEL is different in 29 CFR 1910.1000 (a) (5) (ii) and in the TLV Booklet. The definition must correspond to the reference being cited. As with other OELs, OEL-STELs are the most stringent limits found in the latest TLV Booklet, in 29 CFR 1910 Subpart Z, and in AFOSH Standards for specific substances.

Short-Term Public Emergency Exposure Guideline (SPEGL)
An acceptable peak concentration for unpredicted, single, short-term emergency exposures of the general public. These limits do not apply to occupational exposures.

Specific Absorption Rate (SAR)
An expression of how much RFR energy is imparted to each kilogram of biological body mass per second. SAR is expressed in units of watts per kilogram (W/kg).

Specular Reflection
Situations where a laser beam is reflected from shiny, mirror-like surfaces.

Spontaneous Fission
Spontaneous fission is a natural mode of decay in which nuclei disintegrate.

Stakeholders
Any individual who is affected by the content of the communication and/or will be making decisions based on the information provided.

Stratigraphy
The layering of rock or ice strata, from which information on succession, age relations, and origin can be deduced.

Threshold Limit Values—(TLVRs)
Exposure guidelines published annually by the American Conference of Governmental Industrial Hygienists (ACGIH) in Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. TLVRs are employed as OELs when they are more stringent than the OSHA PELs.

Time-Weighted Average (OEL-TWA)
Eight-hour average concentration for which the average is mathematically adjusted for the duration of exposure. The method for calculating OEL-TWAs is shown in 29 CFR 1910.1000 (d) and in the TLV Booklet.

Toxicology Assessment
Process of estimating the human toxicological impact of a specific material based on published and unpublished literature sources and taking into consideration: uptake, metabolism/biotransformation, transport and storage, and excretion including acute (short-term) and chronic (long-term) human health endpoints.

Transmission Line
Carries the RFR signal from the transmitter to the antenna.

Transmitter
The part of an RFR emitter that generates the RFR signal.

Uncontrolled Environments
An area where exposures may be incurred by people who have no knowledge or control of the hazard.

Wavelength
The distance from one peak of a wave to the next peak of a wave.

Appendix

- Base Sanitary Survey Final Report Template

POTABLE WATER SANITARY SURVEY

XX AFB, STATE/COUNTRY

Prepared by:

The United States Air Force School of Aerospace Medicine (USAFSAM)
Brooks City-Base, Texas

DATE

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1.0 INTRODUCTION

A comprehensive potable water sanitary survey was conducted at XXX Air Force Base (AFB) by functional experts from the AFIOH/RSEW. Fieldwork took place from DATE (e.g., 14–17 Nov 2007).

The purpose of a sanitary survey is to evaluate the capabilities of a water system's sources, treatment, storage, distribution network, operation and maintenance, and overall management to continually provide safe drinking water. Sanitary survey activities include the following:

- identify risks which may compromise the "multiple barrier" protection of a water system
- provide a comprehensive and accurate review of a system's components
- assess the operating conditions and adequacy of the water system

The sanitary survey is organized to evaluate the following eight major drinking water system components/elements: 1) source water, 2) water treatment, 3) water distribution system, 4) potable water storage, 5) water system pumps and pump facilities, 6) drinking water monitoring and reporting, 7) water contingency response program, and 8) water system management and operation. The sanitary survey assesses whether the drinking water system can effectively produce safe drinking water. A sanitary survey does not assess physical security deficiencies associated with water systems and supplies; this is addressed in an Antiterrorism (AT) Water Vulnerability Assessment (WVA).

Section 2.0 of this report provides background information concerning overarching program drivers. Section 3.0 provides a brief description of the water system. Section 4.0 provides the details of each sanitary survey observation including deficiencies, recommended corrective actions, references, and risk category. Appendix A provides sanitary survey criteria and reference sources for the eight sanitary survey evaluation elements. Appendix B provides the risk assessment criteria for assigning hazard categories. Appendix C provides a water distribution system layout map. Appendix D includes representative photographs to highlight deficiencies associated with sanitary survey observations. Appendix E provides supplemental support materials and other resources to aid the base in maintaining safe drinking water and Appendix F includes lists of references, terms, and acronyms.

2.0 BACKGROUND

The continuous availability of large quantities of potable water to support Air Force mission-critical systems and services is required during all operational modes. This section presents background information concerning the overarching programs that provide the basis for assessing potable water systems and protecting them from unintentional contamination and supply disruption.

The US Environmental Protection Agency (EPA) defines a sanitary survey as an onsite review of the water source, facilities, equipment, and the operation and maintenance (O&M) of a public water system to ensure compliance with federal, state, and host country regulations/requirements and to identify and address "deficiencies that may adversely impact the system's ability to provide a safe, reliable water supply." Within the US, its territories, and possessions, the Safe Drinking Water Act (SDWA) regulations require sanitary surveys at least once every three years for surface water sources and every five years for groundwater sources. AF Instruction (AFI) 48-144, *Safe Drinking Water Surveillance Program*, directs BE to perform or oversee sanitary surveys to meet primacy agency requirements. Deficiencies found during the sanitary survey requiring infrastructure repair, redesign, or construction will be forwarded to the Base Civil Engineer with recommendations for corrective action. Water programs on AF installations are governed by a wide body of documents including various 10-, 32-, and 48-series AFIs, DoD directives and guidance, including the Unified Facilities Criteria (UFC), the Higher Headquarters (HHQ) policy guidance, state and local regulations, the EPA sanitary survey guidance manual, and various water industry standards. Sanitary survey criteria may be in the form of requirements or best management practices and are derived from all of these sources.

3.0 DESCRIPTION OF THE POTABLE WATER SYSTEM

This section provides a description of the XXX AFB potable water system. This section is not intended to provide a detailed analysis of the water system or how it is operated and maintained, or to focus exclusively on deficiencies. The Sanitary Survey included, but was not limited to the following activities:

- Interviews of stakeholders with responsibilities for potable water operation, maintenance, and safety
- A review of programs established to ensure the operation and safety of water supplies
- A physical assessment of the water system infrastructure and critical processes.

3.1 SYSTEM CLASSIFICATION AND SERVICE POPULATION

The XX AFB public water system (PWS XX0000) is classified by the State of XX as a Consecutive Water System that serves a population of approximately 0,000.

3.2 PERSONNEL RESOURCES AND RESPONSIBILITIES

The 000 CES Water Utilities Work Center (CEOIU) includes 00 qualified military and 0 civilian personnel who operate and maintain the XX AFB PWS and the off-base 00-inch transmission main that supplies potable drinking water to the base. The main, which is owned by XX AFB, spans approximately 00 miles and connects to the City of XX Water Supply at the XX Airport. The unit is well equipped, trained, and staffed to repair most service breaks and conducts other required maintenance activities including the installation and testing of backflow prevention devices (BPDs), exercising of valves, etc.

3.3 WATER SYSTEM DESCRIPTION (Tailor and modify as appropriate)

The [Name of Base] distribution system is [well, adequately, insufficiently] designed with [multiple, dual, single] water sources and supply points. The system is [looped, spur/dead ends, or combination] and equipped with functional valves that are appropriately spaced, and there [are no, is one, are two] major system choke points. Storage reserves [exceed, do not meet] one day's average demand, and the water storage tanks are design and operated to allow frequent fresh water turnover. Overall integrity (condition and serviceability) of the base distribution system and a 00-mile, 00-inch transmission line owned and operated by XXX is considered [very good, adequate, insufficient].

The XXX AFB potable water system is completely self-contained and includes XX groundwater wells with collocated treatment processes, XX elevated storage tanks (ESTs), and the distribution system, all within the confines of the installation. Groundwater supplies are disinfected with (chlorine gas/sodium or calcium hypochlorite) at each well location. (Chlorine gas/sodium or calcium hypochlorite) is injected after pump discharge from the aquifer and before entering the base distribution system. Water operators monitor chlorine residuals daily at each well location. The XXX AFB water system includes XX water storage towers. XX towers are located on the west side of the base (Towers X, X, and X) and XX is located on the east side of the base (Tower X). Each tower is directly connected to the distribution system allowing the towers to "float" on the system. The water distribution system lines are constructed of asbestos cement, ductile iron, and polyvinyl chloride (PVC) and a small amount of stainless steel. The base water system is composed of two pressure zones divided along the flightline. See Appendix C for a map of the water system. Storage capacity (XXX,000 gallons) exceeds one day's average demand of approximately YYY,000 gallons. The overall integrity of the base distribution system is considered good/fair/poor by base stakeholders.

Potable drinking water is supplied to [Name of Base] via the 00-mile, 00-inch transmission line that connects with the [name of purveyor] water distribution system at the [insert name, if any] pump station. The base-dedicated main is completely buried and has [no, one, two] interconnecting service lines or access points between the [insert name, if any] pump station and [Name of Base]. The main enters the base distribution system at a single location on the [north, south, west, east] side of the base at Building XXX, which is [outside, inside] the installation perimeter and near the Main Gate. There are also XXX additional water sources that connect to the base distribution system at separate locations (see Figure C-1). These water sources, owned and operated by two other water utility purveyors, presently serve as standby emergency water sources, and the main valves are closed. Additional information on the three water sources is provided below.

XXX Water Treatment Plant (XXWTP) [Modify paragraph as appropriate to installation]

[Name of Base] obtains potable water from the XXWTP, which utilizes the [Name of River(s) or impoundment] as the source of raw water. The XXWTP has the ability to independently pump from each river or blend water from both sources. Treatment at the XXWTP includes [coagulation, flocculation, softening (lime and soda ash), pH adjustment (carbon dioxide), addition of anti-scaling compound (polyphosphate), chloramination (chlorine gas and ammonia), fluoridation, and gravity filtration (sand, gravel, and anthracite coal)]. Water to [Name of Base] is transmitted by a series of [type and number of pump(s)] located at the [insert location of pumps], which can provide up to [0,000] gallons per minute (GPM) to the installation through a 00-mile, 00-inch transmission line. The XXWTP also has the capability to bypass the [insert location of pumps] pumps and transmit water through the 00-inch transmission main with pressure provided by the [name of purveyor] distribution system.

XXX (referred to hereafter as XXX) [Modify paragraph as appropriate to installation]

In the event of supply disruption, [Name of Base] has the capacity to acquire potable water from a dedicated well situated directly off-base. The XXX-owned and operated pump, situated just [outside, inside] the confines of the installation, is designed to provide the base up to [000] GPM through a 0-inch transmission main. [Describe reliability and any recent upgrades]. The system was last used during [Insert month] of [Year]. The XXX well is in standby mode and can be brought on line within approximately [XX hours] for potable purposes (after chlorination, flushing, and acceptable results for bacteriological and arsenic tests), or within [XX hours] for non-potable purposes (e.g., firefighting).

The XXX well has a history of high [insert chemical(s)] levels and has exceeded the maximum contaminant level (MCL) [00] during past sampling. As part of this assessment, the [insert local/country health department or equivalent] was contacted to clarify the emergency use requirements of this water source. According to [Name of Base] the most recent sampling from the XXX well indicates a result of x.x mg/L, which is well [below, above] the [insert chemical(s)] MCL of [0.0] mg/L. Accordingly, based on these results, the [insert local/country health department or equivalent] would not restrict the use of this well and [Name of Base] can use as "emergency standby" when the primary water source is not available.

XXX (referred to hereafter as XXX) [Modify paragraph as appropriate to installation]

Another emergency water source connection is available from XXX. Water from XXX [is considered very high quality, meets primary drinking water standards]. The capacity of water that can be provided to the installation from this source is [not known, 000 GPM]. The 00-inch connection [is not believed to be, is sufficiently] large enough to supply enough water to meet base operational demands without water restrictions being imposed. The XXX water supply can be brought on line within [XX hours] for potable purposes (after chlorination, flushing, and acceptable results for bacteriological testing), or within [XX hours] for non-potable purposes (e.g., firefighting).

An inventory of [Name of Base] potable water system assets are provided in Table 3-1 for reference purposes. A map of the potable water system and major assets can be found in Appendix E.

TABLE 3-1. XX AFB Water System Assets

DESCRIPTION	LOCATION/ DESIGNATION	APPLICATION
Groundwater supply Well XX	Bldg 000	Active production well for main base
Groundwater supply Well XX	Bldg 000	Active production well for main base
Groundwater supply Well XX	Bldg 000	Active production well for main base
Groundwater supply Well XX	Bldg 000	Active production well for main base
[Vertical turbine or submerged turbine] well pumps	Bldg 000	Service pumps to transmit water from aquifer into distribution system
Elevated storage tank, steel, 000 K-gal, potable	Bldg 000	Installation water reserves and system pressurization
Elevated storage tank, steel, 000 K-gal, potable	Bldg 000	Installation water reserves and system pressurization
Elevated storage tank, steel, 000 K-gal, potable	Bldg 000	Installation water reserves and system pressurization
Elevated storage tank, steel, 000 K-gal, potable	Bldg 000	Installation water reserves and system pressurization
Distribution system service booster pumps	Bldg 000	System pressure booster pumps
Metering station	Bldg 000	Monitoring of incoming flow rates and chlorine; main isolation valves for incoming 00" transmission main
Airport booster pump station (owned and operated by the City of XX)	South of XX International Airport	XX WTP primary pump station for potable water transmitted to XX AFB via the base-dedicated 00" transmission line
Supply main, 00", cast iron and transite, approximately 00 miles long	Interconnects w/XX WTP supply at the airport pump station	XX WTP potable water supply access
Fire hydrants	Base-wide	Firefighting/flushing/flow testing
Valves/backflow prevention devices (BPDs)	Base-wide	Isolation to prevent and limit water losses/degradation
XX booster station	North end of base runway	Primary emergency supply pump; presently in standby mode
Emergency supply main, 0", cast iron, approximately 0 miles long	North of runway	Primary emergency supply main

4.0 SANITARY SURVEY OBSERVATIONS AND DEFICIENCIES

Sanitary survey observations are associated with the eight water system review elements. Observations are based on the application of control-based criteria. A criterion that is not met is generally considered a “deficiency,” and one or more deficiencies result in an observation. Criteria consist of requirements derived from OEBGD and FGS requirements and supporting DoD and AF directives. In the absence of specific requirements, best management practices derived from DoD and AF guidance documents, and water industry consensus standards, manuals, and guidance are applied. Additional or more restrictive criteria derived from MAJCOM or Primacy Agency directives or regulations may also apply locally.

Tables 4-1 through 4-X provides a summary of the sanitary observations along with deficiencies, recommendations, and criteria reference sources for each observation. Recommendations that are numbered address correspondingly numbered deficiencies associated with the same deficiency. Refer to Appendix A for the criteria used to assess the eight water system review elements.

Sanitary survey observations in the following tables are presented in descending order by relative risk, based upon the methodology that incorporates DoD Operational Risk Management (ORM). Refer to Appendix B for the risk assessment hazard estimation for each sanitary survey observation.

Table 4-1. SANITARY SURVEY OBSERVATION—
SOURCE WATER

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. Intake location does not comply with adequate protection from septic disposal field.	1. Minimum distance from septic disposal field must be 100 feet horizontal distance	FGS 3.3.1.3; AFI 32-1067; UFC 3-230-07 Section 5-4, Table 5-2.

Table 4-2. SANITARY SURVEY OBSERVATION—
WATER TREATMENT

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. Clear well contamination…	1.	

Table 4-3. SANITARY SURVEY OBSERVATION—
WATER DISTRIBUTION SYSTEM

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. Primary isolation valve corrosion…	1.	

Table 4-4. SANITARY SURVEY OBSERVATION— POTABLE WATER STORAGE

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. Altitude valve inoperability…	1.	

Table 4-5. SANITARY SURVEY OBSERVATION— WATER SYSTEM PUMPS AND PUMP FACILITIES

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. Secondary well pump inoperable …	1.	

Table 4-6. SANITARY SURVEY OBSERVATION— WATER MONITORING AND REPORTING

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. Insufficient well water quality data …	1.	

Table 4-7. SANITARY SURVEY OBSERVATION— WATER CONTINGENCY RESPONSE PROGRAM

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. …….	1.	

Table 4-8. SANITARY SURVEY OBSERVATION— WATER SYSTEM MANAGEMENT AND OPERATION

DEFICIENCIES	RECOMMENDATIONS	CRITERIA REFERENCES
1. ……..	1.	

APPENDIX A

SANITARY SURVEY CRITERIA AND REFERENCES

AFI 48-144, Safe Drinking Water Surveillance Program and the Overseas Environmental Baseline Guidance Document (OEBGD) defines a sanitary survey as an onsite review of the water source, facilities, equipment, operations and maintenance of a public water system to evaluate the adequacy of such elements for producing and distributing potable water. Within the US, its territories, and possessions, the SDWA regulations require sanitary surveys at least once every three years for surface water sources and every five years for groundwater sources. Overseas locations are governed by the OEBGD and FGS that require sanitary surveys every three years for surface water sources and every five years for groundwater sources. AF Instruction (AFI) 48-144, *Safe Drinking Water Surveillance Program*, directs BE to perform or oversee sanitary surveys to meet primacy agency requirements. Deficiencies found during the sanitary survey requiring infrastructure repair, redesign, or construction will be forwarded to the Base Civil Engineer with recommendations for corrective action. Water programs on AF installations are governed by a wide body of references including various 10-, 32- and 48-series AFIs, DoD directives and guidance including Unified Facilities Criteria (UFC), Higher Headquarters (HHQ) policy guidance, state and local regulations, EPA sanitary survey guidance manual and various water industry standards. Sanitary survey criteria may be in the form of requirements or best management practices, and are derived from all of these sources.

The sanitary survey report has been organized to address eight evaluation elements of a drinking water system that include: 1) source water, 2) water treatment, 3) water distribution system, 4) potable water storage, 5) water system pumps and pump facilities, 6) water monitoring and reporting, 7) water contingency response program, and 8) water system management and operation.

A.1 SOURCE WATER

Groundwater and surface waters must be maintained in a manner that prevents contamination of the source. The OEBGD requires bases to evaluate source waters for any contaminants of concern and determine susceptibility of any contamination. Accordingly, this evaluation should consider any wellhead protection program results. AFI 10-246 requires Civil Engineering to ensure a Source Water Assessment has been conducted for all wells and surface waters to determine safety and reliability of source waters.

In accordance with (IAW) Unified Facilities Criteria (UFC) UFC 3-230-02, wellheads should be inspected at least quarterly to check the integrity of the watertight structure, including the condition of the sanitary seal and evidence of cracks or other openings that could allow intrusion of surface water, vermin, debris, and other contaminants into the borehole. The integrity of well vent screens must also be assessed. Surface water runoff must drain away from the well site, and the well casing must extend 12 inches above the floor or 18 inches above the ground. Furthermore, Engineering Technical Letter (ETL) 04-5, wellhead protection for base wells (including monitoring wells) should address protection of the water source from accidental and deliberate contamination. Unsealed or unsecured openings, unscreened well vents, and other deficiencies should be corrected immediately.

IAW UFC 3-230-02 and AFI 32-1067, routine performance measurements are necessary to detect performance problems before they become critical. Potential problems can include receding water tables, decreasing replenishment rates in the extraction zone, or decreasing yield rates. Performance measurements should include static water levels, pumping water levels, drawdowns, and yield rates. Drawdown is the difference between static water level and pumping water level. Drawdown should be measured at least twice a month at or near the same time as possible. Yield rate calculations are also recommended at this frequency. The yield rate can be calculated by dividing the volume pumped by the run time. Decreasing yield rates over time are not uncommon. According to UFC 3-230-02, common reasons for decreasing well yield include a clogged well screen or clogged aquifer near the borehole. Methods for cleaning well screens are provided in UFC 3-230-02, Section 4.5.3.1. Instructions for performance tests, assessing results, and likely causes for performance problems are provided in UFC 3-230-02, beginning at Section 4.5.1.

IAW AFI 32-1067, AF Form 996, Well Data, (or equivalent) serves as a historical record concerning design parameters and maintenance activities for each well and must be kept up to date with information such as repairs, well redevelopment, inspections, and performance tests. AF Form 997, Daily Well Activity Record, (or equivalent) is used to record operational data of the well and pumping system such as static water levels, drawdown, and yield. This information allows performance trends to be ascertained. AF Form 998, Daily Pumping Station Activity Record, (or equivalent) is used to record daily operational information, including pumping times and volume pumped.

A.2 WATER TREATMENT

UFC 3-230-02, requires operators to be sufficiently trained and familiar with manufacturer instruction manuals for treatment systems to properly perform required inspections and preventive maintenance tasks, calibrations, tests, etc. General maintenance requirements for all treatment systems are also outlined in Section 11 of UFC 3-230-02. IAW AFI 32-1067, Standard Operating Procedures (SOPs) must be developed for essential tasks derived from manufacturer instruction manuals. SOPs should also incorporate relevant activities identified in UFC 3-230-02, and activities developed to address local conditions and needs (e.g., hard water, temperature extremes, and maintaining proper treatment chemical concentrations). AFI 32-1067 requires that recurring maintenance activities be including in the recurring work program (RWP), and that essential spare parts and supplies be kept readily available. IAW AFI 10-246, a backup treatment system or capability should be available, and treatment systems should be equipped with an effective means to alert operators to system failures and malfunctions. When emergency power generators are provided, AFI 32-1064, *Electrical Power Systems*, requires generators to be tested monthly under actual load during peak load periods to ensure proper automatic transfer switch operation, generator capacity, and overall system reliability. In most cases, the Electrical Shop provides generator maintenance, and tests are documented on AF Form 487, Emergency Generator Operating Log (Inspection Testing), or equivalent, which are usually maintained at the generator site.

A.3 WATER DISTRIBUTION SYSTEM

AFI 10-246 and AFI 32-1066 require an effective cross-connection and backflow prevention program to help protect the system against contamination. CE is required to appoint an engineer or appropriate supervisor as the Backflow Program Manager.

AFI 32-1066 requires a comprehensive cross-connection survey be conducted every five years. This involves a survey of all base facilities and water-using equipment and systems to locate BPDs, access their adequacy and determine any areas of cross-connection that require devices and assign a degree of hazard. If the survey is completed by an outside agency, BE is required to review the report and inventory for assignment of appropriate health hazard classifications. In addition, during construction design reviews, BE will recommend appropriate BPDs where equipment plumbed to potable water supplies is being installed. Annual inspections and testing of BPDs must be accomplished by Air Force and/or state-certified personnel and included in the RWP as required by AFI 32-1067.

Valves that are not periodically tested/exercised may eventually cease to function properly, and may not be available to isolate contaminated water, mitigate water losses, or enable the flow of emergency water supply during a contingency. AFI 10-246 directs the exercising of system valves (including tank and other process isolation valves) on an annual basis. UFC 3-230-02 specifies a semi-annual basis, but this is often unrealistic for all valves due to installation resource constraints. All system valves should at least be exercised annually. Consider exercising those valves deemed most critical on a semi-annual basis, e.g., primary and emergency supply line interconnections. The specific locations of valves must be identified and known to any potential responder, and they must be accessible at all times. According to AFI 32-1067, valve exercising maintenance activities must be including in the RWP.

Water mains susceptible to corrosion, scaling, and suspended solids deposition should be flushed at high velocity (at least six ft/sec) and at least annually or more frequently if needed, as directed by UFC 3-230-02, AFI 10-246, and AFCESA Engineering Technical Letter 04-5. Unidirectional, high-velocity flushing maintains optimal hydraulic capacity within mains, which is particularly important for fire flows, and removes biofilm and other matter that may harbor microbial organisms. The practice of opening hydrants in a manner that does not conform to a unidirectional flushing program is not effective for removing scale, biofilm, and deposits system-wide. Water mains with severe corrosion/tuberculation that adversely impacts flows may be rehabilitated by mechanical cleaning, or should otherwise be considered for replacement. Note: unidirectional, high-velocity flushing should not be confused with flushing activities performed as needed to address water quality problems, which often occur in dead ends and areas of low demand. According to UFC 3-230-02, a flushing (blowoff) valve or hydrant should be installed on dead ends. Recurring maintenance activities must be including in the RWP as required by AFI 32-1067.

A.4 POTABLE WATER STORAGE

Historically, storage tanks are one of the most neglected and problematic areas associated with AF water system infrastructure. Deficiencies are often traced to insufficient freshwater turnover and/or failure to implement required tank inspection and maintenance requirements. Industry best management practices (AWWA White Paper, *Finished Water Storage Facilities*) call for complete freshwater turnover in tanks at least every three days, and not longer than five days, to prevent complete dissipation of chlorine residual, water stagnation, and proliferation of pathogenic organisms. Recurring inspections of the exterior and interior of all storage reservoirs used for potable water are required by AFI 10-246, UFC 3-230-02, and UFC 3-600-02. Tanks should be inspected for corrosion and structural defects, leaks, unsealed openings, missing or deteriorated vent screens, appropriate water levels, deteriorating interior surface coating, indications of inadequate turnover (e.g., notable biofilm on interior surfaces and stagnant water), indications of contamination (e.g., surface sheen or coating, suspended material, unusual color or odor, excessive turbidity), and other potential problems. Inspections are required semiannually for potable water storage tanks per UFC 3-230-02, Table 47. In addition, UFC 3-230-02 directs that potable water storage tanks be drained, thoroughly inspected, and cleaned every three to five years. Deficiencies must be promptly addressed. IAW AFI 32-1067 recurring tank inspections and maintenance activities must be included in the RWP.

Tanks designed to pressurize or “float on” the system typically do not have the turnover problems associated with tanks equipped with altitude valves, which are designed primarily to serve only as emergency reservoirs and provide temporary pressure during emergencies (system pressure is normally provided by other means, e.g., booster pumps, geographic elevation, pressurization tanks, or other elevated tanks designed to provide gravity pressure).

Metal storage tanks, pipelines, and other structures are sometimes equipped with a cathodic protection system to deter corrosion. Inspections, calibration, and maintenance are generally provided by the Exterior Electric work center within CE (or equivalent). Servicing of cathodic protection systems is governed by AFI 32-1054, *Corrosion Control*, and UFC 3-570-06, *Operation and Maintenance: Cathodic Protection Systems*, and includes annual rectifier operational checks and calibrations. Recurring maintenance activities must be included in the RWP.

A.5 WATER SYSTEM PUMPS AND PUMP FACILITIES

Velocity pumps and positive-displacement pumps are the two categories of pumps commonly used in water supply operations. Velocity pumps, which include centrifugal and vertical turbine pumps, are used for most transmission and distribution system applications, including well pumps (vertical turbine and submersible), raw water pumps, and booster pumps designed to fill elevated reservoirs, maintain sufficient positive pressure throughout the system, and/or provide sufficient flows to meet peak flows for fire and general water demands.

One of the most serious operational problems associated with centrifugal pumps is cavitation, which occurs when cavities or bubbles of vapor form in the liquid and collapse against the impeller, making an excessive sound as if there were rocks in the pump. If left uncorrected, cavitation will seriously damage the pump. Any observations of excessive noise, vibration, heat, and odors are indicators that immediate maintenance is required.

IAW UFC 3-230-02 and AFI 32-1067, Standard Operating Procedures (SOPs) must be developed for essential tasks derived from manufacturer instruction manuals, and should be supplemented by relevant maintenance tasks outlined in UFC 3-230-02, Sections 6.5–6.8. Recurring maintenance should include, but are not limited to, weekly oil level checks, monthly grease lubrication, and complete pump inspection and overhaul annually for pumps that run in a continuous operation mode (e.g., daily). When emergency power generators are provided, AFI 32-1063 requires generators to be tested monthly under actual load during peak load periods to ensure proper automatic transfer switch operation, generator capacity, and overall system reliability. In most cases, the Exterior Electrical work center provides the maintenance, and tests are documented on AF Form 487 or equivalent, which are usually maintained at the generator site.

A.6 WATER MONITORING AND REPORTING

The OEBGD, FGS, and AFI 48-144 instructs BE (or equivalent) to ensure monthly bacteriological testing is being performed at representative points in the distribution system on AF-owned or operated public water systems, based on population served, and that chlorine residual and pH readings be recorded. Routine water monitoring includes monthly bacteriological, chlorine residual, fluoride, and pH tests by BE at select points in the system. BE also performs less frequent testing for contaminants to comply with OEBGD and FGS agency requirements.

AFI 48-144 requires BE, in coordination with CE, to create and annually update a drinking water Environmental Sampling, Analysis, and Monitoring (ESAM) Plan which must address the following elements:

- Identification of all drinking water sampling sites used to determine compliance with the OEBGD, FGS or SDWA.
- Annual and long-range sampling schedule.
- Quality Assurance and Quality Control (QA/QC) Plan for bacteriological, chemical, and radiological monitoring.
- Description and classification of each Public Water System and approval of the designation by the primacy.

- Identification of support laboratory for each contaminant and a confirmation annually that the laboratory holds the appropriate certification for the analyte(s).
- Locally developed procedures for conducting the drinking water surveillance program. These procedures should include a schedule for routine monitoring, monitoring of aircraft watering points (to include annual sanitary survey of aircraft watering point), increased monitoring for NBC agents during contingencies or heightened Force Protection Condition, and monitoring performed before placing new connection and repaired water mains or storage tanks into use.
- A current map of each water distribution system showing the locations of bacteriological, chemical, lead and copper, and radiological monitoring points.
- Procedures to take when MCLs are exceeded. Procedures should be reviewed and approved by the Base Environmental Protection Committee.

AFI 48-144 also directs the BE to prepare and distribute Consumer Confidence Reports (CCRs). AF-owned or operated PWS that are regulated as CWS are required to issue a CCR no later than 1 July, annually. According to AFI 48-144, overseas installations with drinking water systems that serve at least 15 service connections used by year-round residents, or regularly serve at least 25 year-round residents will provide a water quality report through appropriate means to inform base customers by 1 July, annually. The water quality reports can be modeled after the CCR, and will follow a MAJCOM Bioenvironmental Engineer-approved format.

AFI 48-144 directs BE to perform a sanitary survey of all watering points at least annually, addressing all sanitary survey elements referenced in Attachment 2 of the AFI. Potable water taps used for filling tanks, trucks, and other containers should not have any cross-connections with cleaning solutions, hoses used to fill or clean non-potable containers (e.g., lavatory waste trucks, mop buckets), etc.

Supervisory Control and Data Acquisition (SCADA) and other less-sophisticated forms of automation can be used to monitor and optimize operations, maximize efficiencies, and to anticipate, avert, and quickly mitigate and recover from contingency events (i.e., contamination and/or supply disruptions). SCADA consists of a centralized computer-based system and specialized software that can be used to remotely control (manually or automatically) and monitor various system functions and parameters and record measurements (data acquisition) for later review or processing. Typical SCADA control functions for a water system include remote control of well or booster pumps, treatment systems, and/or valves. Less sophisticated automation that may not include data acquisition or may not be computer-based can be employed to automatically turn well or booster pumps on or off, based on adjustable system pressure or tank level control switches, to inject treatment chemicals, and perform other treatment process functions. SCADA or less sophisticated automation for monitoring and control of water system functions are sometimes integrated with an installation’s overall Energy Monitoring and Control System (EMCS). The EMCS is typically operated by CE and is designed to reduce installation energy and manpower needs for various energy, utility, and environmental systems by providing centralized control, monitoring, and sometimes data acquisition for these systems, base-wide.

Automated systems that control critical processes should be equipped with backup power and sufficient redundancy. Regardless of the type of automation and functions, critical processes should never be totally reliant upon the automated system. CE should have the capability to manage critical system parameters and processes (i.e., flow, pressure, tank levels, treatment, etc.) by manual operation or other means (e.g., “overrides”) in the event that part or all of the automated system fails due to an incident, or is taken off line for maintenance, repairs, or upgrades.

A.7 WATER CONTINGENCY RESPONSE PROGRAM

A Water Contingency Response Plan (WCRP) is required by AFI 10-246 and HQ USAF/SGO policy document, *Air Force Policy on Potable Water Vulnerability Assessments and Emergency Response Plans* (6 Oct 03), for potable water systems serving more than 25 consumers. According to the HQ USAF/ILEV document, *USAF Water Contingency Response Plan (WCRP) Guide* (Oct 04), the WCRP must be updated annually and may be developed as a standalone plan and cross-referenced with the CE Contingency Response Plan (CRP) and/or the Comprehensive Emergency Management Plan (formally known as the Full-Spectrum Threat Response Plan), as an Annex or Appendix to these plans, or as WCRP elements incorporated into appropriate sections of these plans. Essential elements of the WCRP are outlined in Table 4.1 of the HQ USAF/ILEV *WCRP Guide* and include, but are not limited to the following:

- System-specific information including critical components and supplemental support systems, current water system drawings of distribution lines and valves, and SOPs for isolation, repair/replacement of key components, work-around, flushing, disinfection, and containing/treating/discharging contaminated water
- Roles and responsibilities
- Communication procedures
- Personnel safety
- Alternative potable and non-potable water sources and conservation (demand reduction) measures
- Replacement equipment and chemical supplies
- Infrastructure protection, including measures under increased FPCON
- Action plans including a general response action plan and scenario-specific action plans for credible intentional and unintentional contingency scenarios
- Water sampling and monitoring, (BE is assigned as the Office of Primary Responsibility [OPR] for this element; a cross-reference with the Medical Contingency Response Plan (MCRP), BE Annex may suffice

A.8 WATER SYSTEM MANAGEMENT AND OPERATION

AFI 32-1067 and UFC 3-230-02 require that new operators receive classroom training and extensive, supervised on-the-job training. Experienced personnel must also receive technical refresher courses and upgrade training.

AFI 32-1067 directs the water utilities work center to prepare daily and monthly operating logs. Operators at each installation must prepare AF Form 1461, Water Utility Operating Log (or equivalent).

AFI 32-1067 requires the Utilities work center to develop and maintain plant-specific O&M manuals for each treatment system. O&M manuals can include manufacturer's catalogs and instruction manuals for all equipment. System operating instruction should be developed that include operational and compliance monitoring procedures. Up-to-date water system maps must be available and should indicate locations of water sources (wells), water supply connections to purveyors, locations of treatment facilities, pumping stations, storage tanks, and water line sizes, and isolation valves.

CE is required to develop and maintain effective maintenance plans. AFI 32-1067 requires the implementation of a RWP to schedule and track all routine maintenance activities for the water system. Maintenance history records should also be available for each major piece of equipment. At a minimum, maintenance history records need to document when service was last performed and when it will be required again for each piece of equipment.

APPENDIX B

SANITARY SURVEY RISK RANKING

B.1 Risk Analysis

The risk analysis applies a systematic approach to prioritize observations uniformly and aid in making appropriate corrective action selections, so that limited resources are applied in a manner to best protect people and mission-essential operations. Although risks may never be completely eliminated, they can be controlled to acceptable levels.

The risk analysis methodology incorporates principles, concepts, and techniques derived from DoD Operational Risk Management (ORM). ORM risk estimate categories of extremely high, high, medium, and low provide a common frame of reference across DoD for relative risk ranking purposes. These designations are not associated with an absolute risk scale; there is no absolute scale for risk. Risk levels of extremely high or high, however, generally indicate conditions of unacceptable risk to personnel and/or the mission due to the probability and severity of water degradation and/or disruption event, and warrant corrective actions on a priority basis.

B.2 Risk Analysis Guidelines

The following guidelines were considered during the Risk Analysis process:

- Observation deficiencies may either allow an incident to occur, or exacerbate the severity of an incident if one were to occur. For example, the lack of an effective WCRP may not be the cause of an incident but may result in longer, more widespread, and more adverse impacts on the populace and mission if an incident were to occur.
- For sanitary survey related observations (i.e., system design and integrity, O&M, water contingency response, and water contingency monitoring), the cumulative incident probability and severity for all causative factors (i.e., threats) including non-intentional, accidental, and natural disasters were considered when assigning risk levels.

B.3 Risk Analysis Steps

The Risk Analysis is a three step process:

1) Estimate the probability and severity of a worst-case water quality degradation and/or supply disruption incident as a result of the deficiencies cited using Risk Weighting Criteria (Table B-1).

2) Determine the estimated risk level using the ORM Risk Estimate Matrix (Table B-2).

3) Prioritize observations by initially sorting them in descending order based on risk level (highest risk to lowest risk), then by sorting those observations with similar risk levels in descending order based on severity category (most severe to least severe) (Table B-3).

TABLE B-1. Risk Weighting Criteria

Probability[1] (*P*)	
WEIGHTING CATEGORY	CRITERIA
FREQUENTLY	1) Occurs often in the life of the asset/system 2) Expected to occur during a deployment period
LIKELY	1) Occurs several times in the life of the asset/system 2) Will often occur during a deployment period
OCCASIONAL	1) Will occur intermittently or sporadically in the life of the asset/system 2) May or may not occur during a deployment period
SELDOM	1) May occur in the life of the asset/system as an isolated incident 2) Not expected to occur during a deployment period, but possible
UNLIKELY	1) May occur in the life of the asset/system, but not likely 2) Highly unlikely to occur during a deployment period, but not impossible

Severity[2] (*S*)	
WEIGHTING CATEGORY	CRITERIA
CATASTROPHIC	1) Health/Safety: Deaths; Permanent debilitating effects, or non-permanent but extended debilitating effects to mission-critical personnel 2) Criticality: Loss of mission-critical systems/services for extended period, with no suitable options available
CRITICAL	1) Health/Safety: Temporary debilitating effects on many mission-critical personnel and/or widespread non-combatant population 2) Criticality: Loss of mission-critical systems/services, requiring alternatives that only partially sustain the mission. . For conus bases violation of EPA and/or State Primacy regulations. For oconus bases violations of OEBGD and/or FGS regulations.
MODERATE	1) Health/Safety: Temporary debilitating effects on some mission-critical personnel and/or non-combatants 2) Criticality: Temporary interruption of mission-critical system/services with little overall mission impact. For both CONUS and OCONUS violations of AFIs, Policy Letters/Guidance.
NEGLIGIBLE	1) Health/Safety: Aesthetic/palatability effects or no effects 2) Criticality: Partial/minor disturbance of systems/services with insignificant or no mission impact. For both CONUS and OCONUS violations of Best Management Practice (BMP) guidance

[1]*Probability* does not refer directly to an event (i.e., contamination, accident, or natural disaster), but refers to the likelihood of a water quality degradation and/or disruption incident associated with a threat event (of the indicated severity level) that could be expected as a result of deficiencies cited in the subject observation. For sanitary survey observations (i.e., system design and integrity, O&M, water contingency response, and water contingency monitoring), considers the cumulative incident probability for all causative factors (i.e., threats) including unintentional, accidental, and natural disasters.

[2]*Severity* refers to a credible worst case scenario that could be expected as a result of cited deficiencies. Severity considers estimated impacts on the health and safety of the populace, and/or mission-essential operations.

TABLE B-2. Risk Estimate Matrix

SEVERITY	PROBABILITY				
	Frequent	**Likely**	**Occasional**	**Seldom**	**Unlikely**
Catastrophic	Extremely High	Extremely High	High	High	Moderate
Critical	Extremely High	High	High	Moderate	Low
Moderate	High	Moderate	Moderate	Low	Low
Negligible	Moderate	Low	Low	Low	Low

Observations are listed in Table B-3 in order of decreasing relative risk. Observations are first organized in hierarchal order by estimated risk level (highest risk to lowest risk). Observations with similar risk levels are further sorted in descending order based on severity (most severe to least severe).

TABLE B-3. Estimated Risk Levels

OBSERVATION	INCIDENT PROBABILITY	INCIDENT SEVERITY	ESTIMATED RISK LEVEL
1. Water Source Redundancy (Design)	Seldom	Catastrophic	High
2. Water Contingency Response Plans	Occasional	Critical	High
3. Storage Tanks (O&M)	Occasional	Critical	High
4. Water Treatment (Design)	Seldom	Critical	Medium
5. Distribution System Backflow Prevention (O&M)	Seldom	Critical	Medium
6. Water Source (Integrity)	Seldom	Critical	Medium
7. Distribution System Valves (Integrity)	Occasional	Moderate	Medium
8. Water Monitoring and Reporting	Unlikely	Critical	Low
9. Pumps (O&M)	Unlikely	Critical	Low

APPENDIX C

WATER SYSTEM LAYOUT MAP

As required by the AFI 32-1067, Water Systems and the Overseas Environmental Baseline Guidance Document, Chapter 3, Drinking Water Criteria, Air Force installations shall maintain a map/drawing of the complete potable water system (G-1 tab). The water system layout map should depict the primary water assets of the installation that include locations of: 1) water sources (primary wells and/or surface water), 2) treatment facilities 3) service connection(s) to the base distribution system, 4) any post-treatment facilities (on-base), 5) water storage tanks, 6) isolation valves, 7) water system piping, and 9) buildings/facilities. The water system asset descriptions and details can be found in Section 3.0, Table 3-1.

[Insert Water System Layout Map (with system supply points and all other cited features clearly marked)]

Figure C-1. XXX AFB Potable Water Distribution System Layout Map

APPENDIX D

REPRESENTATIVE PHOTOGRAPHS

(Photos included in separate, electronic format)

APPENDIX E
SANITARY SURVEY SUPPORT MATERIAL

The following sanitary survey support materials are attached separately in electronic format:

1. *USAF Water Contingency Response Plan (WCRP) Guide* (HQ USAF/ILEV, Oct 04)
2. *Water Contingency Monitoring* (AFIOH, Nov 05)
3. *AWWA White Paper, Finished Water Storage Facilities* (AWWA, no date)
4. *AWWA White Paper, Water Age Effects on Water Distribution System Quality* (AWWA, no date)
5. *Unidirectional High-Velocity Flushing* (AFIOH, no date)

APPENDIX F

REFERENCES, TERMS, AND ACRONYMS

REFERENCES

DoD 4715.5, *Overseas Environmental Baseline Guidance Document* (OEBGD)

AFI 10-211, *Civil Engineer Contingency Response Planning*, Jul 98.

AFI 10-246, *Food and Water Protection Program,* Dec 04.

AFI 10-2501, *Air Force Emergency Management (EM) Program Planning and Operations*, Jan 07.

AFI 32-2001, *The Fire Protection Operations and Fire Prevention Program*, Apr 99.

AFI 41-106, *Medical Readiness Planning and Training*, Feb 03.

AFI 32-1067, *Water System, March 94*

AFI 32-7006, *Environmental Program in Foreign Countries*

AFI 32-1066, *Plumbing Systems, May 96*

AFI 32-1054, *Corrosion Control, March 00*

AFI 48-144, *Safe Drinking Water Surveillance Program,* Mar 03.

AFI 90-901, *Operational Risk Management*, Apr 00.

AFP 90-902, *Operational Risk Management (ORM) Guidelines and Tools*, Dec 00.

AFPD 10-24, *Air Force Critical Infrastructure Program (CIP)*, Apr 06.

AFIOH, IOH-RS-BR-TR-2003-0001, *Water Vulnerability and Risk Assessments for Potable Water Assets*, Oct 03.

AFIOH, Technical Information Paper, *Water Contingency Monitoring*, Nov 05.

American Water Works Association (AWWA), *Emergency Planning for Water Utilities*, Manual M19, 4th ed., Denver, 2001.

Department of Defense (DoD) 5200.1-R, *Information Security Program*, Jan 97.

DoDD 3020.40, *Defense Critical Infrastructure Program (DCIP)*, Aug 05.

DoD Unified Facilities Criteria (UFC) 3-230-02, *Operation and Maintenance: Water Supply Systems*, Jul 01.

DoD UFC 3-600-01, *Design: Fire Protection Engineering for Facilities*, Apr 03.

DoD UFC 3-600-02, *Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems*, Jan 01.

DoD UFC UFC 3-230-07A, *Water Supply: Sources and General Considerations,*

DoD UFC 3-230-08A, *Water Supply, Water Treatment, Jan 04*

DoD UFC 3-230-10A, Water Supply: Water Distribution, Jan 04

UFC 3-230-09A *Water Supply: Water Storage, Jan 04*

UFC 3-230-13A, *Water Supply: Pumping Stations, Jan 04*

HQ AF Civil Engineer Support Agency (AFCESA), Engineering Technical Letter (ETL) 04-5: *Design Recommendations for Potable Water System Security*, Aug 04.

Engineering Technical Letter 04-11, Recommendation for Incorporating Water System Emergency Response Plan (ETL 04-11)

HQ AF/ILEV, *USAF Water Contingency Response Plan (WCRP) Guide*, Oct 04.

Sandia National Laboratories, *Risk Assessment Methodology for Water Utilities*, 2nd ed., 2002.

AWWA Manual M46, Manual of Water Supply Practice: Reverse Osmosis and Nanofiltration, First Edition, 1999

EPA Guidance Manual for Conducting Sanitary Surveys of Public Water Systems

EPA Electronic Sanitary Survey (EPA ESS)

EPA Ultraviolet Disinfection (UV) Guidance Manual for the Final Long Term 2 Enhanced Surface Water Treatment Rule

EPA Finished Water Storage Facilities

TERMS

Critical Asset – Any facility, equipment, service or resource considered essential to Air Force operations in peace, crises, and war and warranting measures and precautions to ensure its continued efficient operation, protection from disruption, degradation or destruction, and timely restoration. Critical Assets may be DoD assets or other government or private assets, domestic or foreign, whose disruption or loss would render DoD Critical Assets ineffective or otherwise seriously disrupt DoD operations. The term “critical infrastructure” is a subcategory sometimes used to describe critical assets.

Critical Control Points (CCP) – Points in a system or process where deficiencies that contribute to vulnerability can occur, and where controls can be implemented to abate vulnerability. For the purposes of this report, CCPs refer to critical water assets, points of contaminant introduction (access points), points of disruption, and programs designed to avert, abate, and/or recover from an attack.

For Official Use Only (FOUO) – Information that has not been given a security classification pursuant to the criteria of an Executive Order, but which may be withheld from the public for one or more of the reasons cited in the Freedom of Information Act (FOIA) exemptions 2 through 9. FOUO is a designation typically used to mark sensitive, but unclassified information.

Non-potable Water – Water that does not meet applicable drinking water standards.

Non-potable Water Assets – Critical components of the non-potable water system (e.g., storage tanks, fire hydrants, booster pumps, pools, etc.). Although they may be considered less critical than potable assets, the loss of non-potable water can have significant impacts on mission-critical operations, including firefighting, decontamination, sanitation, construction, etc. Furthermore, non-potable water may be inadvertently ingested, and some contaminants may cause adverse effects through contact or inhalation.

Observation – The term “observation” is used to describe a situation or circumstance that presents an avoidable risk to DoD-affiliated personnel and assets, and is comprised of one or more control-related deficiencies for a particular program area or critical asset.

Operational Risk Management (ORM) – A decision-making process promoted throughout DoD that is used to systematically evaluate possible courses of action, identify risks and benefits, and determine the best course of action for any given situation. ORM goals include 1) enhance mission effectiveness, while preserving assets and safeguarding health and welfare, and 2) integrating ORM into mission processes, ensuring decisions are based upon assessment of risk integral to the activity and mission.

Potable Water – Water that has been examined and treated to meet all applicable water quality standards and declared by the responsible authorities to be fit for drinking.

Potable Water Assets – Critical components of the potable water system (e.g., storage tanks, treatment processes/facilities, wells, booster pumps, transmission and distribution mains).

Primacy – The agency of the local, state, or federal government that has primary enforcement responsibility in regards to the Safe Drinking Water Act (SDWA). Outside the US and its territories, the Major Command Surgeon (MAJCOM/SG) acts as the primacy agent and is responsible for establishing a program to be consistent with the direction given in SDWA regulations.

Public Health Security and Bioterrorism Response Act of 2002 (Public Law 107-188) – Amended the SDWA with section 1433, “Terrorist and Other Intentional Acts” directing one-time completion and certification of a comprehensive water system vulnerability assessment for public water systems serving populations greater than 3,300, but less than 50,000, by 30 June 2004. AF Policy expanded the requirements to all AF systems serving at least 25 people, with various deadlines for completion established through 30 Jun 09, based on the type of system.

Risk Assessment – Application of a risk analysis methodology to prioritize observations so that proper determinations can be made on how to best allocate limited resources to protect people and critical assets. For water-related observations, the risk assessment methodology considers probability of an incident, vulnerability (control deficiencies), and potential severity of an incident.

Safe Drinking Water Act (SDWA) – A Congressional Act that establishes standards for drinking water safety. Regulations adopted to enforce the SDWA are codified in 40 CFR Parts 141 to 143.

Sanitary Survey – An onsite review of the water source, facilities, equipment, operation, and maintenance of the water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation, and maintenance for producing and distributing safe drinking water reliably. Issues related to survivability (e.g., system design and integrity, O&M, contingency response) are relevant to both sanitary surveys and AT WVAs; however, the sanitary survey is concerned with vulnerability to threats that result in unintentional degradation of the water supply (quality and/or quantity) vs. intentional threats for the AT WVA.

Stakeholders – Various agencies who have a key stake in the overall safety and security of an installation's potable water assets (e.g., BE, SF, CE, CONS and other DoD or non-DoD counterparts).

Vulnerability – For the purposes of this guidance, a situation or circumstance that, if left unchanged, may directly result in the loss of life or debilitating effects on AF-affiliated personnel, or damage/destruction of mission-critical assets.

Water Contingency (or Emergency) Response Plan (WCRP) – The WCRP consists of, but is not limited to, plans, actions, procedures, and identification of equipment used to prevent, anticipate, mitigate the effects of, and quickly restore services after a contingency event that threatens the safety and reliability of the critical water assets.

Water Vulnerability Assessment – An assessment of the susceptibility of critical water assets to intentional contamination or disruption, and proposed corrective actions to eliminate or minimize vulnerability and the associated risks.

ACRONYMS

AF	United States Air Force
AFB	Air Force Base
AFCESA	AF Civil Engineer Support Agency
AFI	Air Force Instruction
AFIOH	Air Force Institute for Operational Health
AFM	AF
AFP	AF Policy
AFPD	AF Policy Directive
AMP	Asset Management Plan
AOR	Area of Responsibility
AWWA	American Water Works Association
BE	Bioenvironmental Engineering
BEE	Bioenvironmental Engineer
BPD	Backflow Prevention Device
CAAP	Critical Asset Assurance Program
CBRN	Chemical, Biological, Radiological, and Nuclear
CCP	Critical Control Point
CCR	Consumer Confidence Report
CE	Civil Engineer
CEC	Civil Engineering, Engineering Function
CEF	Civil Engineering Fire Department
CEO	Civil Engineering Operations
CES	Civil Engineering Squadron
CEOIU	CES Water Utilities Work Center
CEV	Civil Engineering Environmental Management
CEX	Civil Engineering Readiness
CIP	Critical Infrastructure Protection
CRP	Contingency Response Plan
CW	Chemical warfare
CWS	Community water system
DoD	Department of Defense
DoDD	DoD Directive
DoDI	DoD Instruction
DRP	Demand Reduction Plan
DTRA	Defense Threat Reduction Agency
ESAM	Environmental Sampling, Analysis, and Monitoring
EPA	Environmental Protection Agency
ERP	Emergency Response Plan (also referred to as CRP)
ETL	Engineering Technical Letter
FGS	Final Governing Standards
FOIA	Freedom of Information Act
FOUO	For Office Use Only
FPCON	Force Protection Condition
FSTR	Full Spectrum Threat Response
FY	Fiscal Year
GC/MS	Gas chromatograph/mass spectrometer
HHQ	Higher Headquarters
IAW	In Accordance With

IDS	Intrusion detection system
K-gal	Thousand gallons
M-gal	Million gallons
MGD	Million gallons per day
MAJCOM	Major Command
MCL	Maximum Contaminant Level
MCRP	Medical Contingency Response Plan
NBC	Nuclear, Biological, and Chemical
NPDWR	National Primary Drinking Water Regulations
O&M	Operations and Maintenance
OEBGD	Overseas Environmental Baseline Guidance Document
OPR	Office of Primary Responsibility
ORM	Operational Risk Management
PDD	Presidential Decision Directive
POU	Point of Use
PM	Preventive Maintenance
PRV	Pressure-reducing valve
psi	Pounds per square inch
PWS	Public Water System
QA/QC	Quality assurance/quality control
ROWPU	Reverse Osmosis Water Purification Unit
RWP	Recurring Work Program
SCADA	Supervisory Control and Data Automation
SDWA	Safe Drinking Water Act
SF	Security Forces
SME	Subject Matter Expert
SOP	Standard operating procedure
UFC	Unified Facilities Criteria
US	United States
VOC	Volatile organic compound
WCMP	Water Contingency Monitoring Plan
WCRP	Water Contingency Response Plan
WVA	Water Vulnerability Assessment